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An Empirical Study Of The Factors Contributing To Microcomputer Usage

Francis Neville Pavri

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AN EMPIRICAL STUDY OF THE FACTORS CONTRIBUTING TO MICROCOMPUTER USAGE

by

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of the requirements for the degree of
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ABSTRACT

Information technology - computers, communication networks and the like - has assumed a role of growing importance in both private and public sector organizations during the 1980's. This technology is no longer the private preserve of small groups of computer specialists; rather, the office automation and end user computing movements are placing information technology into the hands of workers at all levels, and in all areas. The emergence of the business microcomputer has played a central role in this trend.

The rapid growth of microcomputers in the workplace, however, has not been without problems. In some offices, even where having a microcomputer is viewed as a status symbol, the systems themselves are hardly used.

Because information technology, and in particular the microcomputer, has come to play such an important role in modern organizations, it is crucial that we develop a better understanding of the various factors that affect managers' decisions whether to adopt this technology. The purpose of this research is to develop and test a model of the relationships between a variety of external variables, and the managers' usage of computers.

Fishbein's 'theory of reasoned action,' a widely accepted model of human behaviour, lies at the core of this study. Fishbein's model posits that one's intention to act a certain way (e.g., begin to use a microcomputer) is derived from two general classes of factors: attitudes, and subjective norms. Furthermore, intention leads to action (barring the presence of external variables, e.g., unavailability of a microcomputer).

Data was collected from a cross-sectional survey of 519 managers, drawn from managers of 54 corporations in Ontario. The results provided support for 11 of the 16 propositions in the model. Using LISREL as the data analysis technique, it was found that positive attitudes towards computer usage, and subjective norms that supported usage led to higher levels of usage. In turn, attitudes were affected by computer anxiety, computer skills, the quality of the system and management support. Subjective norms were affected by management support, and usage by upper level managers and peer managers in the organization.

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CHAPTER 1 - INTRODUCTION

Since the start of this decade, computers have captured managers' imaginations as a spearhead of growth and profits. The emergence of the microcomputer has contributed much to this trend. The microcomputer has been hailed as a revolution that will profoundly change the nature of professional work (Strassman, 1985; Curley and Pyburn, 1982). Managers have increasingly utilized microcomputer-based applications as viable alternatives to mini and mainframe systems. Many of the information processing functions that had been performed on larger computers by information systems staff are now being performed on microcomputers by managers. In addition, many management decision-making tasks are now being accomplished with the assistance of microcomputers. Strassman (1985) forecasts that over the next fifteen years, there will be more than 200 million workstations in offices world-wide.

There are three underlying reasons for this growing presence of the computer in organizations.

1. There has been a vast improvement in the capabilities and cost of office workstations and microcomputers. The rapid advances in microcomputer technology have consistently pushed the cost/performance ratio of microcomputers along a 30-40% annual reduction curve. (Benjamin, et. al., 1984)

2. The power and simplicity of the new software tools has increased dramatically.

3. The availability and capability of networks, which connect workstations to each other and to mainframe systems has also increased (Grindlay, 1986).

However, this rapid growth in the use of microcomputers in the workplace has not been without problems. Many people have found the computers to be difficult to use and are therefore using them very reluctantly, if at all. Often, computers are only used to adorn the managers' desks as status symbols - they are seldom if ever powered on, much less, used. Young (1984) estimates that as many as one third of microcomputers in organizations end up abandoned by users. A trend noted by Aarsteinsen (1986) is that more and more managers are delegating work on the computer to their subordinates and that fewer executives are going for training on how to use these systems. The optimistic scenario, proposed by Rockart (1979) and Rockart and Treacy (1982), of an increasing number of executives doing their own computing has not yet materialized.

In his research, Brod (1984) found that too much emphasis had been on the productivity and technical aspects of introducing computers to the workplace without sufficient concern for the human side of the issue. Strassman (1985) raised a similar issue; "once an economically feasible and technologically efficient electronic system is installed in the workplace, there still remains the question: will people use it?"

Olson (1982) suggested that two scenarios might occur with the introduction of microcomputers in organizations. There is the positive scenario, wherein microcomputers provide more effective management and control of office workers and the ability to increase managerial span of control. Microcomputers would also give individuals increased numbers of work options and increased opportunities for skill acquisition and career enhancement.

However, if implemented poorly, a negative scenario may result. The computers make the office like the factories of the industrial revolution, increasing the division of labour and making jobs more routine and repetitive, resulting in increased stress on the job.

Olson also suggested that the manner in which this new technology is implemented partially dictates the changes that will occur. The positive scenario can be accomplished if management is prepared for the changes and understands how the technology will affect the people that will have to live with it. Keen and Woodman (1984) agree with this perspective. They argue that without appropriate management policies, microcomputers can bring as many problems as they can solve.

However, many organizations, in planning for the implementation of computerized systems, are more concerned

with the productivity that the systems can bring than its effects on people. The ability to achieve greater productivity through the introduction of microcomputers depends, in part, on the speed with which users adapt to the new system. Long learning cycles negate the productivity increase that the system is designed to achieve. Management often forces the system on employees without taking into account the nature and content of the complex interactions between people and computers. Often, the result is implementation failure (Ginzberg, 1981).

Many companies believe that technology must be accepted as a necessary requirement to maximize the wealth and comfort of the organization and its people. Therefore, they assume that people will adapt. Frequently, however, people do not, and problems occur (Bostrom and Heinen, 1977). Lucas (1977) believes, "the major reason most information systems have failed is that we have ignored organizational behaviour problems in their design and operation."

In the present business environment, where microcomputer purchases are growing rapidly, there are too many instances where system usage is far from optimal. Although people have microcomputers, many are not using them fully. Uttal (1982) found that "those who feel comfortable with a microcomputer are rare; most executives are still technophobic. Nobody knows how to make a manager more

productive with electronics." Djurdjevic (1986) suggests that many corporate executives are still intimidated by computers. Consequently, they hire young computer "whizzes" to run the system rather than making an effort to master the new technology themselves. In doing this they may miss the subtle but important information that the data may present, information which may not be obvious after the data are compressed and filtered by their subordinates. They therefore deprive the company of their judgment and experience. This point is emphasized by the president of a bank who says, "If I have a staff member do it, I don't get the same feel for the business" (Bralove, 1983b).

Donald Sanders (1981) believes that the basic challenge to organizations and society, in the next few years is to "forsee and manage the flood of technologically induced changes that will face organizations and individuals and to do this within a democratic framework for the benefit of society."

This "flooding of technology" is occurring in many organizations. Companies acquire large numbers of microcomputers for all their managers, in the hope that they will use them to improve their productivity. However, the actual levels of usage by different people are very different.

A case of technology flooding occurred at the University of Western Ontario School of Business. All faculty members and some secretaries and staff were given personal computers through a grant from IBM. Clear differences in usage patterns were observed. These can be classified into three categories.

1. Those who use the computers extensively. They try new ways of doing things and solve problems through asking others, using manuals or by sheer trial and error.
2. Those who want to use the computers and have tried but find the frustrations of doing so quite daunting. They therefore use the system only occasionally, when they need to or have to, frequently preferring the older tried and tested ways of doing things.
3. Those who choose not to use the computers at all.

RESEARCH QUESTIONS

The focus of this research is on the underlying reasons for these patterns of usage. The important question that is addressed is:

What are the factors that contribute to differences in microcomputer usage by managers in organizational settings?

The goal of this research is to explore the relationships between certain external variables and individuals' attitudes towards microcomputers, and also to examine how these attitudes can affect usage.

Key questions guiding the research include:

1. What are the major determinants that contribute to managers use of microcomputers?
2. What motivational variables (beliefs and attitudes), if any, mediate between these determinants and actual use of microcomputers by managers?

Conceptual Framework

As discussed above, the research is intended to examine certain attitudinal factors that are hypothesized to contribute to microcomputer usage. Fishbein's Theory of Reasoned Action, which has been widely used in psychological and marketing research, will provide the underlying model for this research. This model is based on the assumption that all behaviour is based on beliefs about the consequences of the behaviour, which in turn causes certain attitudes to be formed, leading to an intention to perform the behaviour and ultimately the occurrence of the behaviour. (See Figure 1 on page 8)

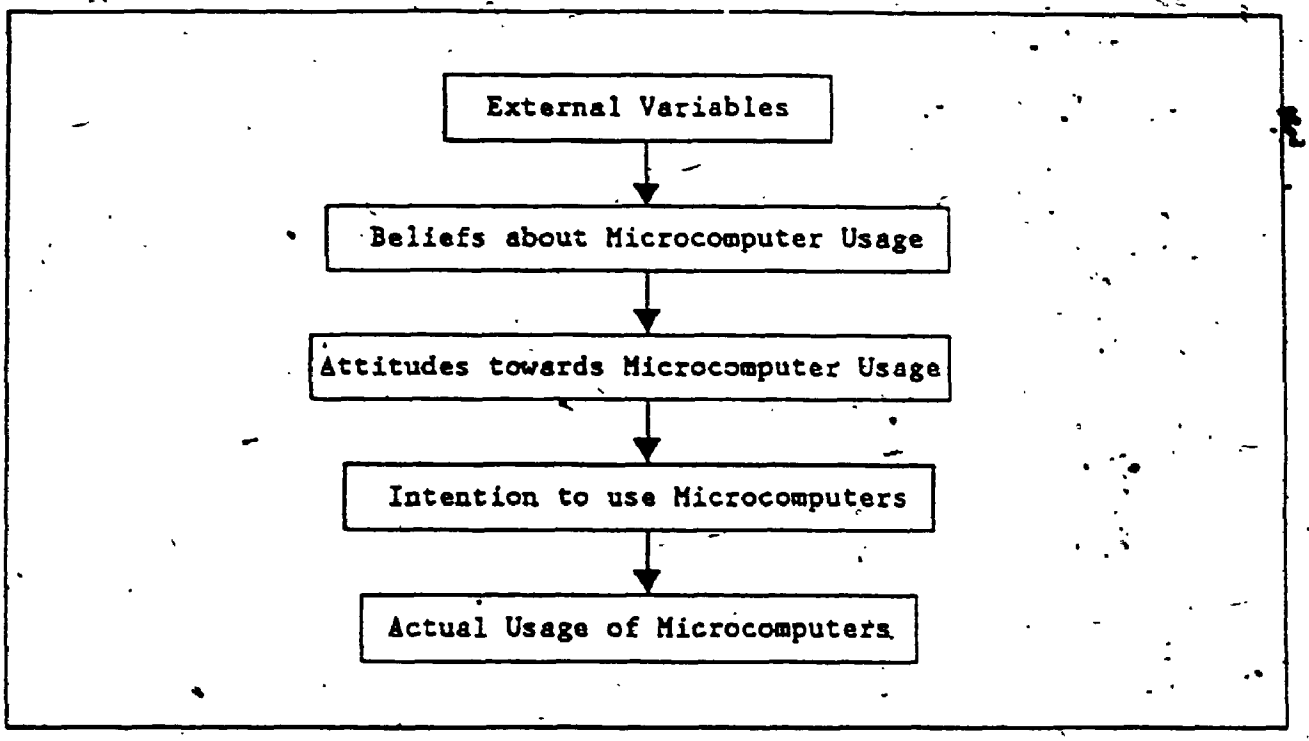


Figure 1. Conceptual Model of Microcomputer Usage

IMPORTANCE OF THE RESEARCH

The importance of this research is its contribution to the theory of implementation of computer based systems. Fishbein's model originated in the psychology discipline and has also been used very successfully in other disciplines to predict behaviour from attitudes. If the model is found to apply to the MIS discipline, it opens open up a line of behavioural research in MIS dealing with attitudes towards systems. Most of the current research on behavioural issues in MIS does not have a strong theoretical base, and therefore results in inconsistent findings (Schewe, 1976;

Lucas, 1978). Borrowing a well developed theory from another discipline will strengthen the base for MIS research in this area of attitudes and behaviours towards computers, and possibly open up other avenues of research as well. This is especially important now, as more and more technology is encroaching on the lives of individuals and the exact implications on people's attitudes and behaviours are not as yet fully understood.

This area of research is also important to practitioners. Organizations are becoming more cautious about microcomputer acquisitions. Top managers are starting to realize that effective microcomputer policies are required to enable organizations to better control microcomputer use, and obtain the benefits from their investments. There is a great deal of concern as to how these new machines can be used more effectively. This study proposes to add to our understanding of what makes managers decide to use microcomputers in their jobs. A better understanding of why certain managers use these machines, while others do not, is a first step towards understanding how to motivate managers to use them more effectively.

OVERVIEW

This introductory chapter has outlined the purpose of the study, the basic research question and the intended

contribution to MIS theory and practice. The remaining chapters will describe the study and its results. Chapter 2 includes the outline of several existing models of the usage of computers and their associated problems. This is followed by a description of Fishbein's Theory of Reasoned Action, which overcomes some of these limitations, and a discussion of how it can be used to study the usage of microcomputers. In Chapter 3, a model of microcomputer usage is proposed together with some propositions generated from the model. In Chapter 4, the research methodology is described. Data collection techniques are presented and the constructs used in the model and their operationalizations are described. Chapter 5 presents the data analysis. First, the descriptive statistics and the statistical techniques used are discussed. The research model is evaluated and tests of the propositions are given. The chapter ends with a summary of qualitative data gathered during the research. Finally, Chapter 6 concludes the thesis with an assessment of the research, implications for practice and some strengths and weakness of the study. Some directions for future research are also presented.

CHAPTER 2 - ATTITUDE AND BEHAVIOURAL RESEARCH IN MIS

A long standing objective of Management Information System research has been to improve our understanding of the factors that influence successful development of computer-based systems in organizations. There has been much controversy regarding the criteria of MIS success but three factors have emerged as being important: system usage (Lucas, 1978; Schewe, 1976; Robey, 1979; King and Rodrigues, 1978), user satisfaction (Bailey and Pearson, 1983; Ives, Olson and Baroudi, 1983), and performance (Lucas, 1975a; Ein-dor, Segev and Stenfield, 1983; King and Rodrigues, 1978).

In turn these three variables are affected by three broad classes of independent variables (Ives, Hamilton and Davis, 1980):

- characteristics of the individuals using the system (Zmud, 1979; Howard, 1986; Lucas, 1978),
- characteristics of the organization in which the system exists (Mahmood and Becker, 1986; Olson, 1981; Nolan, 1977; Ginzberg, 1981), and
- characteristics of the system itself and the technological environment. (Bikson and Gutek, 1983; Fuerst and Cheney, 1982; Lucas, 1978; Maish,1979).

To a large extent, MIS implementation research has tried to understand how the independent variables can be used to better explain and predict why some systems are successful

while others are not. However, it must be noted that it is not these individual, organizational or systems characteristics alone that cause system success or otherwise. There are certain intervening motivational variables that play an important role in determining success. For example, while researchers have shown that the quality of the system, its accuracy and ease of use result in greater usage (Lucas, 1978; Bikson and Gutek, 1983), it is not the quality per se that has contributed to greater usage. Rather, that the quality of the system has caused users to have positive attitudes towards the use of the system and they are, therefore motivated to use it. (See Figure 2)

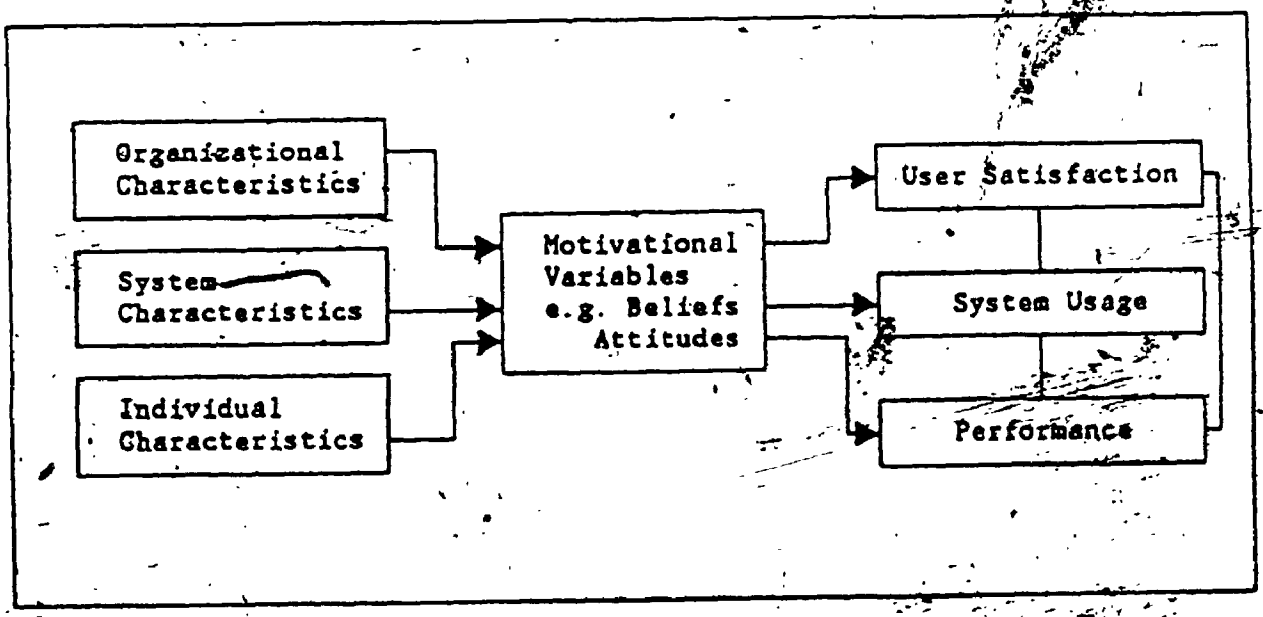


Figure 2. Model of Implementation Research

The focus of this research is system usage, specifically the attitudinal and behavioural factors that contribute to use. Although the relationships between usage and satisfaction and performance are still unclear and much research needs to be done to explore these linkages, the study of usage itself has merits. Ein-dor and Segev (1982) propose that:

> there are a number of criteria for success - profitability, application to major problems of the organization, quality of decisions or performance, user satisfaction, and widespread use. These criteria are clearly mutually dependent; profitability is correlated with performance, application to major problems and actual use. We claim that a manager will use some of the criteria, and that use is highly correlated with them. Thus we choose use as a prime criterion of MIS success.

STUDIES ON ATTITUDES IN MIS RESEARCH

User attitudes have been widely researched both in OR/MS and MIS.. They have been treated as independent variables influencing system use. Some studies found no relationship between attitudes and use (Schewe, 1976). However, common sense, in addition to, numerous studies, suggests that user attitudes do influence a system's usage.

The most extensive program of research on MIS user attitudes has been that of Lucas (1973, 1974, 1975a, 1975b, 1978). His descriptive model (1978) identified five main determinants of voluntary use of a computerized system: user attitudes and perceptions, technical quality of the system,

situational and personal factors, decision style and management support. To test the model he conducted nine empirical studies. In findings relating to attitudes, he found that favourable user attitudes and perceptions of information systems and the information services staff led to high levels of use of an information system. This was the most significant finding from all the studies. Several specific perceptions were consistently related to use. These included the suitability of number of reports received, on-line system rating, output quality, management support, involvement in setting goals, and compensation based on goals.

While Lucas' research had a broader focus, Schewe (1976) was specifically interested in attitudes and how they explained system usage. His research focussed on beliefs and attitudes in predicting usage. He investigated the effects of five sets of variables on user attitudes and system usage for two kinds of users, interactive and batch. The five sets of variables included:

1. MIS Capability. This reflected the quality and usefulness of the computerized system. Dimensions included were depth of information provided, access time, response time, completeness, reliability, accuracy and currency of the output.

2. User Education. This consisted of measures which assessed the amount and quality of the education and training support provided. This construct also reflected the competence of the trainers and their compatibility with the users.

3. Atmosphere. This construct included a set of variables which reflected the organizational climate within which users operate. For example, ideas included were top management commitment and support, the degree to which the company used advanced technologies to solve problems the company's acceptance and adaptation to change, the level of enthusiasm in the company, and the company's encouragement of creativity.

4. MIS Refinements. This was used to capture the extent of both mental and physical efforts required to use the computerized system, and to understand the outputs provided.

5. Demographics. Other exogenous variables included measures of age, sex, level of education, years in the job and in the company, etc.

The major hypotheses that Schewe tested were that (1) there is a relationship between beliefs and attitudes, and that

attitudes predict behaviour and (2) there is a difference in these relationships between batch and interactive users.

He found that beliefs about MIS capability, user education, and atmosphere were the key constructs influencing user attitudes, and that these variables were important whether users were operating in batch or interactive mode. MIS refinements were not significant in either case.

Schewe's hypothesis that attitudes influence behaviour, on the other hand, was not supported. Neither group's behaviour toward the information system appeared to be influenced by their feelings of satisfaction with use of the system.

Schultz and Slevin (1975) investigated the relationships between intended use and attitudes. As part of this research they developed an easy-to-administer instrument to measure user attitudes. The scale consisted of seven attitude factors. These factors covered a broad range of areas - performance, interpersonal relationships, changes caused by the introduction of the system, effects on goals, management support, relationships between client/researcher and urgency. Each factor was operationalized with between 3 and 13 questions.

The relationships between these attitude factors and five dependent variables were tested. The most important

correlate was intended use. The performance and urgency dimensions of the attitude construct were very highly correlated with intended use. Goals and support were also correlated but to a lesser degree. These correlations suggest that intended use has two broad determinants, one personal in nature - how will the system affect the user's personal performance? - and the other, organizational - will the user be supported by the organization in using the OR/MS system?

Maish (1979) conducted a study to determine which of a group of factors was associated with favourable information system user behaviour. The factors studied included the users' perceptions of the quality of the system and the system staff, their perceptions of the organization, and their rank, length of service, and prior training in the use of the system. He found that positive user behaviour, defined as non-routine or extraordinary use of the system, was correlated significantly with seven attitudinal variables: (1) feelings about the information system staff, (2) feelings of good management support, (3) feeling of preparededness to use the system due to adequate training, (4) feeling that there is adequate access to the information system, (5) feeling that the system provides the information wanted, (6) feeling that it is easy to correct data or instructions on the on-line system and (7) feeling that the online formats are flexible.

In addition to finding factors associated with user behaviour, the study also identified factors associated with user feelings about the system. Positive feelings about the system were correlated with (1) positive feelings about the system staff, (2) positive feelings about batch output quality, (3) positive feelings about on-line system quality, (4) the impression that users were involved in the design of changes or of new systems, (5) the impression that user problems were well provided for and (6) less than five years service with the company.

An important study on user attitudes was conducted by Howard (1986). This study was significant in two respects. First, it was the first study to deal with microcomputer usage. Second, it added a variable, computer anxiety, which had not been previously investigated.

The study concentrated only on the determinants of attitudes towards the usefulness of microcomputers, specifically, how attitudes towards microcomputer usage can be affected by anxiety about computers. It did not, however, show how these attitudes would affect actual computer usage.

Howard's research used attitude of managers using microcomputers as the dependent variable. The attitude construct encompassed six factors:

1. computers provide quicker access to information;

2. takes too long to learn and use computers;

3. computers suffer from a lack of capability to perform tasks for real business situations;

4. using microcomputers is not consistent with normal managerial tasks;

5. computers are more trouble and expense than they are worth;

6. there is a problem with proliferation of computers leading to incompatibilities of hardware, software and data.

Howard also emphasized the fact that his measure of attitude described a particular manager's attitude toward personally using a microcomputer in management tasks, not attitude towards microcomputers in general. He found that these attitudes towards usage are strongly affected by the managers' anxiety about using them.

Robey (1979) studied the use of a computer based system by salesmen to record, update, and maintain information pertaining to their customer accounts. What was different in this study (as emphasized by the investigator) was that the usage measure was objectively obtained, since the earlier studies had only self reported subjective measures. Therefore, in his study, usage was operationalized by (1) the number of customers maintained by each salesmen, and (2) the number of times these records were updated. Both the measures were obtained from computer records. For the attitude measure, Robey used the Schultz and Slevin

instrument. The strongest association obtained was between the attitudes towards performance and the two usage measures.

Neidleman (1979), in a study of computer usage by small and medium sized firms, found that the respondents' perceived need for a computer system was strongly correlated with their belief that computers were necessary to compete effectively. Furthermore, the vast majority did not feel that many jobs would be lost if their organizations acquired a computer system.

Similarly, Nilles et al (1976) found that perceptions played a significant role in the success of telecommunication systems. They demonstrated that prior attitudes to cable television, radio and touchtone telephones affected subsequent use of these systems. They hypothesized that attitudes towards telecommunication technologies in the home, including electronic banking, video conferencing and work on terminals, would significantly impact the way in which these technologies were used.

Swanson (1974) developed a construct called "MIS appreciation" using 16 perceptual measures. The nature of the items was evaluative and can therefore be considered attitudes. MIS appreciation was strongly related to the

usage construct as measured by an indicator called inquiry involvement.

Schultz, Ginzberg and Lucas (1983) tried to integrate all the previous research into what they call a "third generation" model of implementation. In their model they tried to put together the evidence available from earlier studies on implementation into a scheme for classifying implementation situations that could be generalized across different settings. Attempts to test this model in totality are still in progress. The central variable was user acceptance, which was defined as a predisposition of users to personally use a specific system or its outputs. It is not known how this variable was operationalized but it bears a close similarity to attitudes towards using a particular system.

DISCUSSION

The above studies show that attitudes and perceptions are important variables in determining the success of MIS implementations, as measured by system usage. All the studies which investigated the attitude-use relationship, with the exception of Schewe's (1976) study, showed a strong correlation between attitudes towards computer systems and their subsequent use of the system. The consistency of results in most of the studies should make interpretation of

the relationships between attitudes and usage relatively straightforward. However, comparisons of the studies and interpretation of results are very difficult. There are four underlying reasons for for this:

1. Varying concepts and definitions.

There seem to be as many definitions of the attitude concept as there are studies. For example, Lucas interpreted attitudes as consisting of two dimensions, attitude toward the computer and attitude toward system staff. He differentiated between perceptions (which included such items as perceived quality of output, perceived quality of management support and perceived training received) and attitudes.

Schewe's study is much clearer about the differences between beliefs and attitudes. Schewe measured beliefs by requiring respondents to agree or disagree with statements about MIS characteristics (e.g. depth of information, accuracy, completeness, access time etc.) Attitudes, on the other hand, were captured by the respondent's evaluation of the outcomes associated with MIS use. The dimensions included information usefulness, decision making effectiveness, impact on managerial effectiveness, and management control of costs.

Schultz and Slevin made no distinction between attitudes and beliefs or perceptions. As stated by Robey (1979), who used the same instrument, "more emphasis will be placed on the object of those attitudes than on whether the measurement is of a belief, and affective response, or a perception."

Maish used the word "feelings" instead of attitudes. He did not define what was really meant by feelings, but what was implied was a combination of attitudes and perceptions. The feelings he used included not only those those towards the system in general, but also feelings towards the staff, the organization, and quality of the system.

Thus, a major problem in these studies was the lack of agreement in defining attitude. Some researchers used the terms feelings, perceptions, attitudes and beliefs synonymously. Others differentiated between these terms. The object of the attitudes was also varied. Some of the studies used attitudes towards the computer another used used attitudes towards use of computer, and others used attitudes towards computer staff, quality etc. This lack of consistency and definition of terms has make interpretation of the results quite difficult.

2. Lack of specificity in the attitude measure.

In addition to the varying definitions of attitude, there appears to be a lack of specificity in the attitude measure. It is not exactly clear in the studies what attitudes were being measured. It is implicitly accepted that attitude is a multi-dimensional construct, but there is no agreement among the studies as to what these dimensions should be. The result is that each of the studies looked at various dimensions, some of which were common and others were unique.

Lucas used two dimensions, attitude towards computer potential and attitudes towards system staff. These dimensions were quite different from the ten proposed by Schewe, whose components consisted of decision making effectiveness, managerial capabilities, personal prestige, management control, etc. The Maish scales tried to improve on Lucas' by adding new dimensions.

Schultz and Slevin had yet other components. Their dimensions of attitude consisted of the seven factors, as discussed earlier, which bore some similarities to the other instruments but were, on the whole, quite different.

Howard's view of attitudes towards usefulness of microcomputers was quite different from the seven factors

proposed by Schultz and Slevin and had only some agreement with that of Schewe.

Zmud (1979), in a review of the literature on attitudes and MIS success, found that the attitudes used in the various research studies had four broad dimensions:

1. perceptions of the capabilities of and need for a management information system;
2. perceptions of the organizational environment for an MIS;
3. perceptions of the IS staff and the need for interaction with the staff;
4. perceptions of organizational change.

This lack of specificity in defining the various dimensions of attitude can account for the differences in the results obtained in the various research studies.

These problems enumerated above were summarized by Swanson (1982):

> The usage-relevant components of user attitudes are as yet not well understood. Identification of these usage-relevant components is much needed to advance further research in this field.

3. Varying measurement methods.

Because of this lack of agreement on definition of terms, measurements of the construct have also been very different. Each of the studies mentioned above had its own way of

measuring attitude toward MIS. There were few attempts to compare measuring methods or attempts to validate the scales used.

For example, Lucas used only a single question to measure each of the attitude factors. This is also true of Schewe's scale of attitude, where the ten attitude components were measured with ten questions. Schultz and Slevin and Howard tried to overcome this by having multiple questions for each factor and examining their reliabilities. Although their reliabilities were tested, there is still a question about the construct validity of the instruments. For example, a six factor, twenty-four item scale was developed by Howard using executive MBA students. The most important factor was "improved access to information," which explained 36 percent of the variance. However, when using this scale on a group of practicing managers, the number of significant factors was reduced to three and the original main factor (improved access to information) appeared only weakly. The explanation given for this discrepancy was that the original population, with which the instrument was developed, was more exposed to microcomputers, and was therefore more aware of their capabilities. This lack of generalizability of the scale suggests that its construct validity is questionable.

4. Different Measures of Behaviour.

Like the attitude construct, the behaviour measure, system usage, had different meanings and measures. Most of Lucas' studies defined this as general usage of a computerized system (either batch or interactive). However, Schultz and Slevin and Robey defined it as the usage of a specific system, in one case the use of a forecasting system and in the other a computerized customer account system. It can be expected that attitudes towards general usage would be quite different from the attitude towards specific system usage.

Maish used a different measure completely. He felt that measures of routine usage could lead respondents to produce only "safe answers," and therefore his measures of usage were related only to non-routine or extraordinary usage, (e.g. requesting optional features of the system, making extra use of terminals, requesting system changes and assisting the system designers). Interpreting usage in this way included a large element of initiative.

Summary

The major reason for the differences in definition and measurement employed by the various researchers noted above is that the studies were done without reliance on any underlying theory. No theory or even definition of the

attitude construct was given and no theoretical explanation of the structure was stated. Only the Schewe study hypothesized the structure of the attitude construct based on Fishbein's model (1970). The others were merely based on observations of the researchers and factors proposed by earlier researchers.

As Goodhue (1986) has written:

> MIS research on user attitudes lacks a strong research tradition of generally accepted propositions from which we can build new theory. MIS could strengthen its research tradition by borrowing and expanding theory from relevant reference disciplines which would provide both models and precisely defined theoretical constructs. Too often we create new theory "from the whole cloth." The results are inconclusive and mixed.

He suggests that Fishbein's theory of Reasoned Action might provide a basis for studying attitudes in MIS.

FISHBEIN'S THEORY OF REASONED ACTION

Fishbein has written extensively on attitudes and their relationship to behaviour (Fishbein, 1970; Fishbein, 1971; Fishbein, 1980; Fishbein and Ajzen, 1975; Ajzen and Fishbein, 1980). His theory of reasoned action has been applied successfully to the prediction of behaviour in numerous situations, including why people buy certain consumer products or behave in certain ways in social

situations. (Burnkrant and Page, 1982, Wilson, et. al., 1975, Ryan and Bonfield, 1975)

The theory predicts that people usually act in accordance with their intentions. A person's intention is a function of two basic factors, one personal, and the other reflecting social influence. The personal factor is the individual's positive or negative evaluation of performing the behaviour; this factor is termed the attitude toward the behaviour. The second determinant of intention is the person's perception of the social pressures put on him or her to perform or not to perform the behaviour in question. Since it deals with perceived prescription, this factor is termed subjective norms. Generally speaking, people will intend to perform a behaviour when they evaluate it positively and when they believe that important others think they should perform it.

Extending the theory further, Fishbein asserts that attitudes are in turn explained by beliefs. Generally speaking, a person who believes that performing a given behaviour will lead to mostly positive outcomes will hold a favourable attitude toward performing the behaviour, while a person who believes that performing the behaviour will not improve outcomes will hold unfavourable attitudes. Similarly, subjective norms are a function of beliefs, the belief that specific individuals or groups think he should or should not perform the behaviour. If the person believes

that most of these referents think he should perform the behaviour, the perceived social pressure to perform it will increase and his motivation to comply will increase. The assignment of relative weights to the two determinants of intention may be incorporated in the model to increase the explanatory value of the theory. The resulting general model is expressed by the following equation.

$$B = BI = w1(A_B) + w2(SN)$$

where

B = overt behaviour
BI = behavioural intention
A_B = attitude toward performing the behaviour
SN = the subjective norm
w1 and w2 = empirically determined weights

Attitudes

As discussed earlier, there are a wide variety of meanings attached to terms like attitude, belief, opinion, evaluation, feeling, and perception, and very often they are assumed by many researchers to mean, more or less, the the same thing. As Lemon, (1973) states; "attitude is one of the most ubiquitous of all terms used in social science and the one with no generally accepted definition." This is especially true in the MIS literature, where the definition of attitude has seldom been clearly stated.

Historically, two major orientations have emerged in the study of attitudes. The first, often referred to the tripartite view, specifies three underlying components of

attitude. The second, which is the unidimensional perspective, treats attitude as a single construct.

Tripartite Perspective of Attitude

Under the tripartite view, attitude is seen as being made up of three underlying components: cognition (the knowledge or idea), affect (the emotion that charges the idea) and (3) conation (the action taken) (Lutz, 1976). Cognition refers to all beliefs which an individual holds with respect to the behaviour in question (e.g., computers provide faster access to information, using computers takes up too much time). Affect pertains to positive or negative emotional reactions to the attitude (e.g., I feel that computers will be very useful in my work). Conation emcompasses intended and actual behaviours with respect to the object of the attitude (e.g. I will most likely use a computer in my job). According to the tripartite conceptualization, all three components are integral parts of any attitude; every attitude consists of greater or lesser degrees of each component. Furthermore, the three components are expected to exhibit a basic consistency in terms of the extent of favourability or unfavourability toward the behaviour. In other words, if an individual believes that computers will provide positive benefits (cognition), then he will be expected to like using computers (affect) and will most likely use them (conation). The difficulty with this tripartite perspective is that most

of the measurement approaches fail to measure all three components of attitude. Most procedures rely on a series of belief-type questions which are combined to yield an overall measure of attitudinal affect. The cognitive and conative components of attitude have been largely ignored in these empirical investigations of attitude.

Unidimensional Perspective of Attitude

Under the unidimensional perspective, the same components appear but their conceptual status is altered significantly (Triandis, 1971). Under this view the cognitive and conative components are "pulled out" of attitude; cognition is labeled beliefs and conation is labeled intentions and behaviours. Thus, the unidimensional perspective views attitude as consisting of only one component, affect. The belief and behavioural dimensions are not seen as being components of attitude, but rather as the antecedents and consequences of attitude. While the tripartite view incorporates the notion of consistency among the components, the unidimensionalist view posits a causal flow through the components to account for this consistency. Beliefs are seen as the immediate causal antecedents of attitude, while intentions are the immediate causal consequences, with actual behavioural consequences being one step removed from attitude.

In this unidimensional perspective attitude, beliefs and conation are defined as follows:

ATTITUDE is defined as a predisposition towards a certain object, event or behaviour. It -- is a feeling of favourableness or unfavourableness toward the object (or event or behaviour) in question. It is conceptualized as the amount of affect for or against the object. Thurstone (1928) has a similar definition. He views attitude as the sum total of a man's inclinations and feelings, prejudice or bias, preconceived notions, ideas, fears, threats and convictions about any specified topic. Attitudes, therefore, reflect a predisposition to respond in a consistently favourable or unfavourable manner to a given object or behaviour. It is a non-cognitive, classically conditioned emotional response (Triandis, 1971).

BELIEFS , on the other hand, refer to a person's favourable or unfavourable evaluation of an object. They are the cognitive component. A belief incorporates the information a person has about the object. It links an object to some attribute. For example, the belief that microcomputers are intimidating links the object "microcomputers" to the attribute "intimidating". Another belief may be that "having computer skills" (the object) will lead to "better jobs" (the attribute). Thus, the object of belief may be a person, a group, a behaviour or an event and the associated

attribute may be any characteristic, outcome, quality or event.

People may differ in the strength of their beliefs when relating the object to the attribute in question. In other words, they may differ in terms of the perceived likelihood that the object has, or is associated with, the attribute in question. Thus, belief is measured by a procedure which places the subject along a dimension of subjective probability involving an object and some related attribute.

CONATION refers to an individual's intention to perform various behaviours, and to the performance of those behaviours. Intention can be viewed as a special case of beliefs in which the object is always the person himself and the attribute is always a behaviour. As with belief, the strength of an intention is indicated by the person's assessment of the subjective probability that he will perform the behaviour in question. The measure of intention thus places the subject along a subjective-probability dimension involving a relation between himself and some action.

In summary, under this unidimensional perspective, the concept, attitude, is where one is measuring an individual on an affective dimension. Belief is where the measure

places the individual on a dimension of subjective probability relating an object to an attribute. When the probability dimension links the person to a behaviour, one is measuring behavioural intention.

Fishbein's Perspective

Fishbein's theory of reasoned action takes a slightly different position from the unidimensional perspective. He believes that although the distinction between beliefs and attitudes can be justified in theory, such a division is not readily apparent at the empirical level. He cites:

> I do not feel that a distinction between affect and evaluation is warranted or useful. First, it seems to me that the decision to call a given measure evaluation is purely arbitrary. Second, it is usually impossible to distinguish empirically between these two concepts. Third, and perhaps most important, I simply do not believe that there are noncognitive attitudinal responses (be they called attitude, affect or evaluation) (Fishbein, 1980).

He asserts that since, theoretically, attitudes are a function of beliefs then,

> if it were possible to tap and accurately measure all a person's salient behavioural beliefs and outcome evaluations, the indirect measure of attitude based on these beliefs and outcome evaluation should be perfectly correlated with a direct valid measure of attitude. The direct measure and indirect measures should be interchangeable. Since there is always some error in measurement, it is conceivable that, the indirect measure could sometimes be more reliable than a direct measure of the same attitude.

Burnkrant and Page (1982) tested this proposition and found this to be largely true. Their assertion is that " any measures of attitude toward behaviour, whether based on beliefs or direct ratings of affect, may be regarded as alternative measures of the same unidimensional construct."

Beliefs are the fundamental building blocks in Fishbein's conceptual structure. On the basis of direct observation or information received from outside sources or by way of various inference processes, a person learns or forms a number of beliefs about an object. That is, he associates the object with various attributes. In this way he forms beliefs about other people, objects, events or his behaviour. The totality of a person's beliefs serves as the informational base that ultimately determines his attitudes, intentions and behaviours.

An information processing approach is also viewed as underlying the formation of attitudes. Specifically a person's attitude towards an object is based on his salient beliefs about that object. An individual's attitude towards computers, for example, is a function of his beliefs about what computers are and what they can do. If these beliefs associate the object with primarily favourable attributes, his attitude will tend to be positive. Conversely, a negative attitude will result if the person associates computers with primarily unfavourable attributes. It can

therefore be seen that a person's attitude toward some object or behaviour is determined by his beliefs that the object has certain attributes or that the behaviour has certain qualities, and his evaluations of those attributes or qualities.

As discussed earlier, attitudes - whether affective or cognitive in nature - are determined by a person's beliefs about the attitude object. Most people hold both positive and negative beliefs about an object, and attitude is viewed as corresponding to the total affect associated with their beliefs. In terms of the relationship between beliefs and attitudes, Fishbein's conceptual model thus suggests that a person's attitude toward some object is related to the set of his beliefs about the object, but not necessarily to any single specific belief. In a similar fashion, attitude towards an object is related to the person's intentions to perform a variety of behaviours with respect to that object. Again however, the relation is between attitude and the set of intentions as a whole, and attitude towards an object will usually not be related to any specific intention with respect to the object.

To give a concrete example, a person may hold many beliefs about usage of microcomputers, such as "you need to be good at mathematics to use computers," "it will give better access to information," "it will save a lot of time at

work," "it will give me more time for more creative work," but "it will make communicating with people more impersonal," etc. These beliefs may lead the person to hold a moderately favourable attitude toward usage of microcomputers. This attitude will lead to a set of intentions which, in their totality, are also moderately favourable. Thus the person may use microcomputers for access to databases and for word processing but not to write his own programs or use electronic mail.

In summary, the attitude towards performing a particular behaviour under a given set of circumstances can be expressed as

$$A = \sum b_i e_i$$

where

A = attitude toward performing the behaviour
b_i = belief that performing B leads to consequence i
e_i = the person's evaluation of consequence i
n = number of beliefs

Subjective Norms.

Other beliefs relevant to behavioural intention are of a normative nature, beliefs that certain referents think the individual should or should not perform the behaviour in question. If the person believes that most of these

referents think he should perform the behaviour, and his motivation to comply with these referents is high, then he will tend to perform the behaviour in question. Conversely, if he believes that most referents are opposed to his performing the behaviour, his tendency will be to not perform. These pressures, termed subjective norms by Fishbein, are another major determinant of a person's intention to perform a certain behaviour. For example, in an organization where a large number of an individual's peers are using computers extensively in performing their tasks, there would be pressure on the person to do likewise, if he feels strongly that complying with these norms is important to him. These pressures can come not only from peer reference groups but also from top management.

A subjective norm toward performing a particular behaviour under a given set of circumstances can be expressed as

$$SN = \sum NB_j MC_j$$

where

- SN = subjective norm
- NB_j = Normative belief (the person's belief that reference group or individual j thinks he or she should or should not perform the behaviour)
- MC_j = motivation to comply with the influence of referent j
- n = number of relevant reference groups or individuals

Another consideration which will increase the predictive power, and therefore usefulness of the model for practical purposes, is the relative importance of the attitudinal and

normative factors. For example, if it can be shown that microcomputer usage is largely determined by subjective norms, then in order to change an individual's behaviour, more effort should be directed to changing the norms than to changing the attitudes.

Attitudes towards the Object and attitudes towards the Behaviour

When studying attitudes, it is important to distinguish between attitudes toward the object and attitudes towards the behaviour. Fishbein notes:

> I think this distinction between attitude toward an object and attitude toward a behaviour is a very important one, and one that has often been ignored. Even though I may think some product has all kinds of good characteristics, qualities and attributes, I may not believe buying or using that product will lead to valued outcomes. This is, even though I may have a positive attitude toward "Brand X" I may not have a positive attitude toward "buying Brand X," and according to behavioural decision theory, it is this latter attitude that should be related to buying behaviour. (Fishbein, 1971)

For example, Klein (1983) quotes many instances of managers who have a very positive attitude towards computers. They recognize the value of microcomputers for others and support and encourage their subordinates' use of the computers. Inspite of this, however, they are very uncomfortable with the idea of personally using microcomputers. Therefore, the important criterion, in the study of attitudes, is the person's beliefs and attitudes toward <u>his</u> or <u>her own</u>

performance of the behaviour that are directly relevant to the formation of intentions and behaviour, and not the attitude to the object.

Many research studies, in various disciplines, support Fishbein's theory. In social research, Fishbein has accurately predicted the intention of women to have children (Fishbein, 1979), and voting intentions and behaviour (Ajzen and Fishbein, 1980). In organizational research, the Fishbein model was successfully used to predict turnover and reenlistment of National Guard volunteers. These predictions were found to be more accurate than the results obtained using organizational commitment and job satisfaction as predictors (Krateberg and Hulin, 1979). In marketing, Ryan and Bonfield (1975) cite many instances of the use of Fishbein's model to predict purchase intention and purchase behaviour of cars, fruit drinks and toothpaste.

Although there are no specific cased of the application of the Fishbein model in MIS research, there are instances where its applicability is implicit. For example, Salerno (1985) says that many individuals are apparently resisting the advent of computers because they fail to see any benefits being offered by the new technology. According to the model, computers offer no benefits (belief) and this led to resistance to usage (behaviour).

Both Bralove (1983a) and Benson (1983) cite cases of managers refusing to use computers because they viewed the usage as "executive typing," and were concerned about their image, because they viewed using a computer as essentially a clerical function. Relating this to Fishbein's model, computers are for clerks (belief) led to minimal computer usage (behaviour).

Benson (1983) also cited instances of managers resisting computer usage because they felt that top management tended to be ignorant of, or indifferent to computers. This top management indifference (subjective norms) has resulted in resistance to computer usage (behaviour). Yet in another case a CEO, after seeing what his micro could do for him, instituted a small network among his VP's. This network eventually grew into a network of 800 terminals throughout the company. In this instance, the CEO's use of the computer is the subjective norm, which led to the extensive use of computers throughout the organization (the behaviour).

Role of External Variables

The Fishbein model asserts that external variables influence behavioural intention and therefore behaviour only indirectly, by influencing the individuals' beliefs, evaluations, normative beliefs and motivation to comply with

these norms. External variables include any variables not explicitly represented in the model, as well as demographic and personality characteristics, characteristics of referents in the organization, system characteristics, organizational characteristics and task characteristics.

For example, a person may not be motivated to use microcomputers, despite good training or management support. These external variables by themselves have no direct influence on behaviour usage. Instead, in the case of training, the exposure to the systems during the training causes the person to develop positive attitudes toward the usage which leads to more usage. In the case of management support, the fact that management is providing the support causes the individual to believe that management is serious about the implementation, and wants wide usage to be the norm in the organization. The individual is motivated to comply with this norm and therefore uses the computer. These external variables, support and training, form another level of explanation in the prediction of usage behaviour.

Summary

There are many characteristics of the Fishbein model which make it attractive as a theoretical foundation for the present research. These include:

1. The model integrates a number of previously disjoint theories covering the relationships between beliefs, attitudes, intention and behaviour (Fishbein, 1975).
2. The Fishbein model is very explicit regarding the definition and operationalization of the variables used in the model. This is what seems to be lacking in much MIS research on attitudes.
3. The model has been widely used in a number of research studies spanning various disciplines. (Brinberg and Durand, 1983; Burnkrant and Page, 1982; Hom et. al., 1979)
4. A substantial body of empirical literature has accumulated, some of which provide support for the model (Ryan and Bonfield, 1975, 1980; Wilson, 1975), others which are aimed at understanding the model's limitations, testing key assumptions, or adding refinements, (Warshaw, 1980; Bagozzi, 1981, 1984)
5. There are no competing models in MIS which attempt to achieve the same objectives as Fishbein's model.

OTHER CORRELATES OF ATTITUDES AND USAGE

Attitudes and perceptions are one group of variables that pertain to the characteristics of users. This next section discusses some other variables that have an impact on attitudes and usage. They include computer anxiety, cognitive style, locus of control and demographics. The

description of these variables is followed by a discussion of relationships between usage and variables pertaining to the organization in which the system exists. These variables include management support, policies and training. The section concludes with a review of variables pertaining to the characteristics of the system, e.g., the quality of the system.

Computer anxiety

The concept of fear of computers is discussed extensively in the the popular press (Aarsteinsen, 1986; Bralove 1983a; James, 1982; Next, 1981). The common theme is that in spite of the potential of microcomputer based management tools for productivity improvement, many people have been surprisingly resistant to their adoption and use. There are reports that the incidence of computer anxiety in the workforce is as high as 20% to 30% (Next, 1981; James, 1982). However, research studies which investigate this phenomena are few. Raub (1981) surveyed attitudes of college students toward computers and found that fear or anxiety about computers led to negative attitudes toward their use. Howard (1986) is the only researcher to investigate the concept of computer anxiety among managers. He found this anxiety at least partially accounted for their resistance to use microcomputer based management tools. It is useful to further investigate this concept in order to understand its

relationships to computer attitudes, and usage of computers. Bearing in mind the newness of the phenomenon, some detail will be given to explain the underlying reasons for computer anxiety.

Howard defines computer anxiety as the tendency of a particular person to experience a level of uneasiness over his impending use of a computer, that is disproportionate to the actual threat presented by the computer. This anxiety may be viewed as having three basic roots: psychological, educational and operational.

PSYCHOLOGICAL ROOTS. Psychologically based resistance can be caused by managers' preference for face-to-face and verbal contact rather than through an inhuman machine. For example, computer conferencing has not met with the success for which the originators had hoped because many managers still prefer the social contacts they experience at meetings.

The danger of bruising managerial egos is another source of psychologically based resistance. Many executives feel that sitting at a computer is not an appropriate image for them. They feel they should "manage" and not do what they consider to be clerical work (Bralove, 1983a). A similar ego problem arises because most technologically competent computer people are still relatively young. As Bralove reports,

"many managers find asking a computer analyst half their age for help a daunting prospect." Strassman (1985) and Aarsteinsen (1986) in their research discovered that tradition oriented managers have resisted the acquisition of typing skills as a threat to their status, especially when they found out how poorly they were doing when compared to their younger subordinates.

Another psychologically based fear is the loss of control that is sometimes associated with the use of computers. Computers tend to impose their own structure. Managers and professionals have their own way of filing, doling out assignments and reading mail. The computer restricts that freedom. It imposes its own standard for dealing with tasks that managers used to freely control. In many marketing situations, for example, managers had the freedom to make deals with clients to win a sale. The introduction of a computer tended to reduce that ability since most computerized systems demand certain fixed procedures for dealing with situations. This constraint and the resulting loss of control creates a psychologically uncomfortable feeling in many managers, causing them to resist using microcomputer based management tools.

Another source of fear and resistance is the increased accessibility of executives that results from wide use of computers in their offices, and from increasing use of

portable computers. Undue pressure is exerted on managers whose superiors, with the capability of electronic mail, can short circuit the normal chain of command and gain knowledge about them and their situation without their knowledge. (Bralove, 1983b) This produces a sense of helplessness and insecurity regarding their positions. Portable computers are also resisted because of their tendency to limit a manager's freedom and control. Executives with portable machines can be reached anytime, anywhere, and it is, therefore impossible to escape the pressure of the workplace by simply leaving the office. Loss of control through any of the above ways may cause managers to have negative attitudes towards using computers in their management tasks.

EDUCATIONAL ROOTS. Lack of knowledge about computers also causes fear. A common fear among managers is that computers might soon replace them. This fear is caused by terms like 'artificial intelligence' and 'expert systems,' which frequently appear in the popular press. Managers fear that just as routine, clerical tasks were threatened by computers ten years ago, so may their management positions soon be threatened. The fear of being replaced by a machine is largely attributable to a lack of knowledge about the capabilities of computers. Managers who are truly knowledgeable about computers appreciate their limitations and realize that they are not effective substitutes for

human experience and judgment, especially in such rich and diverse tasks as management.

Lack of understanding of computer jargon is another source of intimidation and fear. The language of computing is unfamiliar to most managers. Bralove (1983a) notes that as many as 90% of America's managers are computer illiterate. They resist and have negative attitudes towards the use of computers because they simply don't understand the jargon and feel insecure and small, especially when their juniors seem to have no problems with it.

Related to this intimidation by computer jargon is the fear held by many manager's that they are already so far behind that catching up will be impossible. This fear is reinforced by the feelings of inadequacy they have when they see that most college, high school and even grade school students are now being taught how to use computers and can write programs. This situation is exacerbated by the fear of many executives that pushing the wrong button of a computer will either damage the machine or destroy important data in its memory. This sense of apprehension is aggravated by the incomprehensibility and inhumanness of computers.

OPERATIONAL ROOTS. Novice computer users face many operational problems, the most important of which is the inability to type. Many managers are daunted by the fact

that they have to learn such 'lowly' tasks, and feel that the amount of time it would take to learn this skill is not warranted, considering the other more important jobs they have. Managers avoid personal use of computers to avoid the embarrassment connected with their inability to operate the machine and perform simple tasks on the system, like inserting diskettes, or even finding the off/on switch. They therefore avoid or postpone using their systems or use them only for tasks that cannot be performed any other way.

One of the factors affecting a person's anxiety about computers was his/her perception of the impact of computers on society. Lee (1970) performed a nationwide study to investigate the public's views towards computers and discovered two distinct factors. He labelled the first factor "the Beneficial Tool of Man Perspective," described as a positively slanted set of beliefs that computers are beneficial to science, industry and mankind. The second factor, "the Awesome Thinking Machine Perspective," portrayed computers as an autonomous machine that can perform the functions of human thought - functions previously thought to be unique to man. This factor represented a downgrading of humans. It can be explained in terms of alienation and intolerance of ambiguity. The variable alienation ties in with the psychological roots of computer anxiety, where people find anything that is remotely technical daunting because of their fear of the

unknown. Intolerance of ambiguity is strongly connected with the locus of control variable; people who dislike ambiguity feel that computers are taking over their lives and dictating the way they should work and behave.

Howard (1986) showed a strong relationship between beliefs about the impact of computers and anxiety. He found that people who had a positive view about computers and their potential impact on society were less anxious about using them.

Cognitive Style

Cognitive style can be described as the strategy or group of strategies that an individual typically adopts in approaching a wide variety of problem situations (Shouksmith, 1970). It is measured by a scale which ranges from analytic to heuristic. The concept of cognitive style and its potential influence on individual preferences has been found to be very appealing. Mason and Mitroff (1973) suggest that this construct should be examined to understand the cognitive processes underlying computer and information usage.

There are a number of research studies on cognitive styles and their impact on computer usage. Lucas (1978) found that individuals with differing decision styles have differing

levels of use of information systems, perform different analyses of data, and take different actions based on the information. The results of four of the nine studies (reported earlier) offer support for the relationship between the way an individual thinks and approaches his or her job and the use of an information system or model. Witkin et al. (1971) found that high analytic types tended to perceive information systems as useful in decision making, because such people have an ability to impose structure on a disorganized set of facts. Barkin (1974) found that analytic types tended to select a greater amount of information than heuristics types. Lusk and Kersnick (1979) discovered that, in a highly structured environment, analytic types performed much better than heuristics types. Lucas (1981) found that analytic decision makers were characterized by their tendency to look at details, while heuristic types tended to take an overall view. All of these studies imply that the structure, quantity of information and details preferred by analytics would attract them to computers.

However, in spite of its appeal, and the number of research efforts it has attracted, the cognitive style concept has proven to be elusive, as evidenced by conflicting results (Taylor and Benbasat, 1980). The usefulness of many of the conclusions has been criticized and the whole research

stream has recently been called to question (Huber, 1983; Robey, 1983).

Locus of Control

Locus of control was found by Howard (1986) to be correlated with attitudes towards usage of computers. Locus of control is broadly defined as the frame of mind in which people view their relationship with the world around them. People can be classified as either internal types or external types. Internal type people consider the forces that control their lives to be located within themselves. They believe that events depend entirely upon their own behaviour. External types on the other hand consider the forces that control their lives to be located outside themselves, and believe that luck, chance, fate, and powerful others are in control of their destiny.

Howard found that individuals with internal locus of control exhibited more favourable attitudes to using microcomputers than those people with an external locus of control. These findings coincide with DeSanctis' research (1982), which found that internal types had greater motivation and had been shown to expend more effort, resources and time in making decisions than external types. She speculated and confirmed that "internals" tend to use a computerized decision support system more than "externals."

Similar results were found by Arndt et al. (1983). In their study of secretarial staff using word processing equipment, they found that individuals with external locus of control were more anxious about using the equipment, and therefore used it less than those with internal locus of control.

Demographic Variables

The demographic variables of interest include a wide range of personal characteristics such as intellectual abilities and knowledge about computers, as well as sex, age, experience, education and organizational level. Depending on the research questions and the dependent variables of the research, the results pertaining to personal and situational variables had been inconsistent. For example, in one study, Lucas (1975) found that less time in the job position predicted higher levels of use, whereas Fuerst and Cheney (1982) found that more time in the job led to greater use.

These contractictory results support the notion that demographic variables influence usage and attitudes in more complex ways than had been hypothesized in previous research. However, their influehce can be studied in carefully controlled environments.

Management Support

Effective management support, in the form of hardware, software, data and people has been cited as a strategy that will increase the likelihood of implementation success. Lucas (1978) reported that management support was significantly correlated with five of the seven usage variables in one of his studies. High levels of management support and involvement in information systems activities was also found to result in favourable attitudes by both the information services staff and users. Rudelius, Dickson and Hartley, (1982) report that lack of top management interest was a major reason a decision support system fell into disuse.

The importance of management support was emphasized by Hammond (1982), in his study of information centres. He states that one of the major functions of an information centre is to provide support to users. However, there is also evidence to indicate that management support might not be critical. Fuerst and Cheney (1982) reported that top management support in the design and use of decision support systems was not important.

Computer Experience and Training

As with most new things, knowledge about the technology and

successful experiences with it normally improves a person's attitude towards using that technology, by reducing or eliminating any fears they may have. Computer technologies are no exception. Howard's research showed a strong inverse correlation between computer experience and computer anxiety. These results are similar to those obtained by Raub (1981) and Arndt et.al. (1983) who also found significant negative correlations between experience and anxiety.

In end user computing, Rivard (1982) found that the computer experience of users affected their perceptions of the user friendliness of tools and their attitudes towards end user computing. Similarly, Kasper and Cerveny (1985) found that users with significant computer experiences developed a greater number of end user applications than those who had less experience.

User training has been hypothesized to be an important consideration in developing and using decision support systems (McLean and Riesing, 1980). Fuerst and Cheney (1980) also found that training had a strong effect on usage of decision support systems.

Policies

Gerrity and Rockart (1984) recommend that as a first step in the management of end user computing, a set of policies,

standards and guidelines must be developed to ensure a standard technical environment. Policies fall into six groups (1) purchase justification (2) hardware standards, (3) software standards (4) usage guidelines (5) application guidelines and (6) data administration (Amoroso, 1986; Keen and Woodman, 1984). Rockart and Flannery (1983) also address the issues of documentation, backup and control. Amoroso (1986) reported that system utilization will increase with the cognizance and assistance of end-user policies.

Quality of the System

A significant factor in many studies of MIS usage and attitudes is system quality. Lucas (1978) confirmed, in a number of studies, that the quality of a system was an important determinant of its success as measured usage. Not only did system quality have a direct impact on system usage but it also affected users' attitudes and perceptions of the system, which had a further impact on usage.

System quality has four distinct dimensions (Bikson and Gutek, 1983). These factors can be interpreted as follows:

1. Functionality: how the system enters, alter, organizes, and stores information.
2. Equipment performance, including speed and quality of maintenance.

3. Interaction: whether the user has what is needed to interact effectively with the computer.

4. Environment: adequacy, convenience, and comfort of equipment.

In their study of managers and professionals, Bikson and Gutek found that these factors accounted for over 60% of the variation in user satisfaction. However, only the functionality aspect of quality was significantly correlated with system utilization.

CONCLUSION

The outline of a model of MIS research in implementation, presented in this chapter, identified system usage as one of the important criterion in determining success. Among the variables which affect usage are the attitudes of users. Several studies of user attitudes were reviewed, showing the inconsistencies that arise due to a lack of reference to an underlying theory of attitude. Fishbein's theory of reasoned action was presented as a model that can be used as a reference theory. A review of other variables that are correlated with usage and attitudes, was also presented.

CHAPTER 3 - RESEARCH MODEL

This chapter is devoted to the presentation of a research model of microcomputer usage, and the formulation of a number of research propositions.

A RESEARCH MODEL FOR PREDICTING USAGE OF MICROCOMPUTERS

A diagram of the model, based on Fishbein's Theory of Reasoned Action, is shown in Figure 3 on page 60.

The constructs in the model are derived from the research discussed in Chapter 2. A deviation from the Fishbein model is that the intention construct is not included. The variable of interest is system usage, and not intention to use. Exclusion of this variable should not affect the validity of the model since the intention to perform a behaviour will always predict the behaviour, subject to the fact that there are no intervening variables that might affect this relationship (Ajzen and Fishbein, 1980). A person's intention to use microcomputers will always result in his using them if there are no unforseen events beyond his control which might affect his usage. For microcomputer usage, this would be the lack of availability or difficulty of access to a system. This possibility was controlled for in this study by including only those users who had easy access to a system. Each of the subjects had a

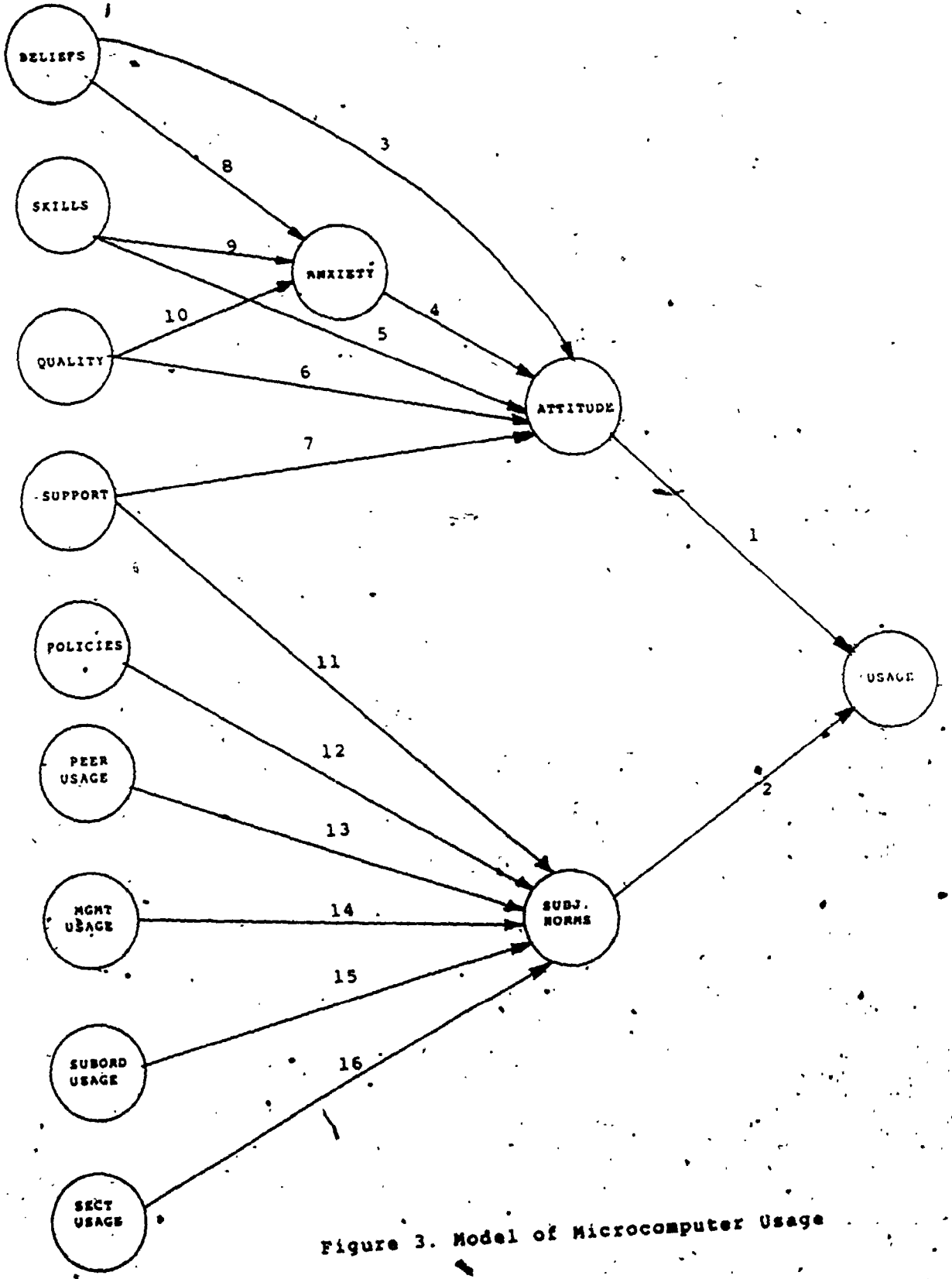


Figure 3. Model of Microcomputer Usage

microcomputer on his/her desk, or had one easily available for his/her use.

VARIABLES AND RELATED PROPOSITIONS

The most important variable being studied is system usage. Fishbein's theory indicates that the two constructs that affect usage are attitudes of users towards the use of microcomputers, and the subjective norms regarding microcomputer use. These two constructs are the key to this research for two reasons. First, there have been no studies in the MIS literature using subjective norms as a construct. The research findings will thus make a new and interesting contribution. Second, the definition of attitude is different from the definitions used in other attitude research studies in MIS. The definition used in this study is based on Fishbein's theory, and unlike most other studies, is narrowly defined as the attitude towards personal use of microcomputers - not computers in general, or computer technology. Fishbein asserts that this is a very important distinction, since the results of many studies focussing on the object, rather than the behaviour, were inconclusive.

The independent variables fall into two groups, those that affect attitudes and those that affect subjective norms. The variables that impact attitudes towards usefulness of

computers are the system quality, computer anxiety of the users, their beliefs about the impact of computers, and management support and commitment.

The second group of variables relate to the subjective norms. These include management support and commitment, the microcomputer policies of the organization, and the level of use of microcomputers by other groups in the organization, such as upper management, peer managers, subordinates, and secretaries.

The next section discusses the propositions derived from the model. The list of 16 propositions is stated followed by the reasons for each proposition.

Proposition 1. Microcomputer usage will be higher for users who have positive attitudes towards using microcomputers.

Proposition 2. Microcomputer usage will be higher for users who believe that the subjective norms in the organization support computer usage.

Proposition 3. Users who believe that computers have a largely positive impact on society will have a more favourable attitude towards using the microcomputers.

Proposition 4. Users with higher levels of computer anxiety will have less favourable attitudes towards their use of microcomputers.

Proposition 5. Users with higher computer skills will have more positive attitudes towards their use of microcomputers.

Proposition 6. Users who have high quality, highly functional and user friendly systems will have more positive attitudes towards using them.

Proposition 7. Users who perceive that support for computer usage is high will have more positive attitudes towards using microcomputers.

Proposition 8. Users with more favourable assessments of the possible impact of computers will have less computer anxiety.

Proposition 9. Users with higher computer skills will have lower levels of computer anxiety.

Proposition 10. Users who have high quality, highly functional and user friendly systems will have lower levels of computer anxiety.

Proposition 11. Users who perceive that support for computer usage is high will believe that the subjective norms in the organization support computer usage.

Proposition 12. Users who perceive that computer policies are helpful and encourage the use of computers will believe that the subjective norms in the organization support computer usage.

Proposition 13. High levels of peer use of microcomputers will lead users to believe that the subjective norms in the organization support computer usage.

Proposition 14. High levels of upper management use of microcomputers will lead users to believe that the subjective norms in the organization support computer usage.

Proposition 15. High levels of subordinate use of microcomputers will lead users to believe that the subjective norms in the organization support computer usage.

Proposition 16. High levels of secretarial use of microcomputers will lead users to believe that the subjective norms in the organization support computer usage.

System Usage

Computer usage is a behaviour. As proposed by Fishbein, a behaviour has two basic determinants, attitude towards the behaviour and subjective norms. The many studies that support the first proposition have been reviewed in Chapter 2 (Lucas, 1978, Maish 1979, Robey, 1979, Nilles, 1976, Swanson, 1974).

The second proposition states that subjective norms also have an impact on usage. There are no studies in the MIS literature using the construct, as a predictor of usage. However, there are studies which used constructs like atmosphere (Schewe, 1976), psychological climate (Manley, 1975), feelings about system staff (Maish, 1979), attitude about system staff (Lucas 1979). All these constructs were found to have an impact on usage. The definitions of these terms were frequently not very clear but included an element

of the social influences that are encompassed in the meaning of subjective norms.

Attitudes toward Microcomputer Usage

Many variables have been studied and were found to have an impact on users' attitudes towards the use of computers. The variables being investigated in this study are users' beliefs of the impact of computers, their computer skills, the quality of the system and computer anxiety. Although a number of personal and demographic variables e.g., cognitive style, locus of control, age, sex, intellectual abilities, have been found to have an influence on attitudes, the results concerning these variables have generally been inconclusive. Most of these variables are inherent to a person and are difficult to change or control. They are, therefore of limited interest in a practical sense, and have not been included in the study.

The third proposition states that attitudes are influenced by the users' beliefs about the impact of computers on society. This relationship has been studied by Howard (1986) and Raub (1981). The findings were weak. However Fishbein (1980) suggests that general beliefs about the target object (in this case, microcomputers) would affect the specific behavioural attitudes about that object (attitudes towards usage of microcomputers).

Computer skills are defined in this study as a combination of experience, training and typing skills. Experience was shown to directly affect user's attitudes (Howard, 1986) and Rivard (1982) discovered that the computer background of users affected their attitudes towards end user computing. Regarding training, Schewe (1976) reported that user education was a key variable influencing attitudes. Bikson and Gutek (1983), in a survey among managers investigated the importance of typing skills and found that such skills were an important influence on usage. The relationship between computer skills and attitudes is stated in proposition 5.

Proposition 6 states the relationship between quality of a system and attitudes. The quality of the system and its affect on attitudes towards computers has been studied by many researchers (Lucas, 1978, Liang, 1986, Bikson and Gutek, 1979). All concluded that system quality is an important ingredient in improving users' attitude towards computers.

The construct quality consists of four factors - functionality, performance, interaction and environment. The most important factor contributing to positive attitudes is functionality. (Bikson and Gutek, 1983). MIS capability was a critical variable in influencing user attitudes (Schewe, 1976). Other variables related to usage are response time

(Schewe, 1976; Fuerst and Cheney, 1982); accuracy and relevancy of output (Schewe, 1976; Srinivasan, 1985; Fuerst and Cheney, 1982; O'Reilly, 1982), presentation format (Srinivasan, 1985; Fuerst and Cheney, 1982), and quality of user interface (Fuerst and Cheney, 1982; Raymond, 1985).

Computer Anxiety

Computer anxiety, as defined by Howard (1986), is the tendency of a particular person to experience a level of uneasiness over his impending use of a microcomputer that is disproportionate to the actual threat presented by the computer. Both Howard (1986) and Raub (1981) found that this anxiety was a key determinant of the attitudes that users had about using computers. This relationship is stated in proposition 4.

The variables affecting anxiety are the user's perceptions about how computers impacted society, and the user's computer skills. These variables are reflected in propositions 8 and 9.

Proposition 10 states that the quality of the system will also affect anxiety. There are no empirical studies that tested this relationship. One of the roots of computer anxiety is operational in nature, i.e., users find it frustrating to operate a computer. The reasons for this lie

in the poor design of the machine, e.g., poor user interface, poor video quality, slow response rate, frequent breakdowns, etc. It is reasonable to assume that all of these quality aspects of microcomputers would have an impact on the user's anxiety about using them.

Proposition 11 and 12 are related to the support provided to users. Management support has been shown to be a critical element in the wider usage of computers (Schewe, 1976; Robey, 1979; Schultz and Slevin, 1975; Raymond, 1985). The availability of support has implications for both attitudes and subjective norms. Adequate support, both to overcome problems and to ensure availability of the computers, can improve the attitudes of users, in addition to, indicating to users that it is important to the management of the organization that the systems are used. This creates subtle pressure on users to use the system. As stated in propositions 7 and 11, good organizational support impacts both the attitudes towards usage and the subjective norms.

Subjective Norms

Subjective norms are the social influences imposed on individuals to conform to the standards of behaviour set by the organization. If the norm in the organization is for individuals to use microcomputers extensively and the user thinks he should comply with the norms, then this user will

likely use his microcomputer. These pressures come from four sources: management, peers, subordinates and secretaries. If the level of usage among these four groups of people is high, users will perceive that they should be using their system more often. Propositions 13 to 16 state these relationships.

Proposition 12 states that computer policies will influence the subjective norms. Pressure from management can also be manifested in the microcomputer policies of the organization. Policies which encourage microcomputer usage would seem to suggest that wider usage is the norm. On the other hand, where policies are restrictive, members in the organization would feel that usage should be minimized.

SUMMARY

This chapter stated the 16 propositions that relate computer usage to various causal variables. The two variables that affect usage are attitudes towards using computers and subjective norms. These variables are affected by a range of variables characterizing the organization, the individual and the system. The next chapter will describe how the variables were operationalized and measured.

CHAPTER 4 - RESEARCH METHODOLOGY

The aim of this study was to test the hypotheses presented in the previous chapter. This chapter describes the methodology employed and the instruments used for the study.

Population of Interest

Before describing the methodology used for the study it is necessary to define precisely the population of interest. These are managers who use microcomputers in organizations. This section describes what is meant by 'user' and 'microcomputer' in this research.

The User

The user in this study is specifically defined as a manager or professional who has easy access to a microcomputer in the daily execution of his or her job. The tasks performed can include routine work like typing, communicating (e.g., via electronic mail), using a spreadsheet, or more specialized work like data retrieval, data analysis or programming. An important criterion is that the use of the microcomputer is voluntary. For any of the tasks that can be done with the help of a microcomputer, the user can also choose other ways of completing them. For example, the user can type his own correspondence on the microcomputer using a

word processing package, or he can dictate or handwrite it, then give it to his secretary to complete. He can communicate by electronic mail through the computer or he can use the telephone, write a memo or meet the other person. This study focuses on managers; secretarial and other support staff are excluded. For such employees, microcomputer use would generally be mandatory, not optional.

A second criterion is that the user must have very easy access to a computer. In most instances, this means that it is available on his desk or that he shares the usage with only one or two other persons in the same general area of work. Difficulty of access would therefore not constitute a reason for not wanting to use a microcomputer.

Another characteristic of the user which had to be met in this study is that he or she must have used the system for at least six months. This is necessary to avoid the learning curve effects of initial usage. It is envisaged that new users can spend a lot of time overcoming the initial problems, when learning how to use a microcomputer. The extra time spent on learning, not on actual work, would skew the results of the study.

The Microcomputer

The definition of a microcomputer used in this study is a general purpose system that can run most of the common, easily available packages like word processing, spreadsheets, data base or statistical software. It does not include specialized microcomputers used by researchers or engineers for specific, narrowly defined tasks.

Operational Definitions and Questionnaire Development

This section defines how each of the constructs in the model is operationalized and the questions used in the questionnaire to measure them. The questionnaire (Appendix 10) was used to gather data on the 13 constructs and user demographics.

Beliefs about Computers and their Impact on Society

Both Howard (1986) and Raub (1981) used the individuals' beliefs about the computer's impact on society as an independent variable in the study of computer anxiety and attitudes. The scale used in this study is borrowed from their research. It consists of nine items and is measured with 5-point Likert scale. In his study, Howard obtained a reliability coefficient (Cronbach's alpha) of 0.76 with n = 111.

Computer Skills

Computer skills are defined as a combination of the user's experience with computers, the training they obtained and their typing skills.

The training dimension of this construct has two parts: training on mainframe systems, and training on microcomputers. The questions included in the questionnaire to measure training, exposure and skills, are as follows:

1. Mainframe training. This measure is the sum of the responses to four questions asking respondents about their level of mainframe computer training from different sources, college courses, vendor training, in house training and self study.

2. Microcomputer Training. This measure incorporates the microcomputer training acquired by respondents from the four sources outlined under mainframe training.

3. Experience. This measure is defined by the sum of the responses to six questions which ask the participants about their exposure to different aspects of computer software, languages and development of computer systems.

4. Overall computer skills. This is a self rated measure asking respondents to rate their computer skills on a 7 point scale ranging from novice to expert.

5. Typing skills. Similar to the previous measure, respondents were asked to rate their typing skills on a 7 point scale ranging from novice to expert.

Quality of the System

As discussed in chapter 2, system quality, as it is defined by Bikson and Gutek (1983), has four different dimensions:

functionality, equipment performance, interaction, and environment. The scale used to measure this construct taps all of these dimensions. It includes ten items which measure the various dimensions and one item measuring the overall perception of quality.

Management Support

User support can take many forms. As suggested by Amoroso (1986), in end user computing there are two broad categories of support that can be provided. The first category is application development support. This is quite specific in nature. It includes support in the form of an information centre, availability of development assistance, specialized instruction and guidance in using end user tools. The second category is of a more general nature. It includes top management encouragement, allocation of resources, and MIS staff support. The scale developed for this study, made up of eight items, had three items of a specific nature and five general measures. It is assumed that in the use of microcomputers, both categories of support would be important.

Policies

To develop this scale, a list of potential policies pertaining to microcomputers in organizations was created.

For each of the six items, the respondents were asked to indicate whether such policies existed and if they did, how helpful each one was. There was also a general question asking respondents how they felt about the overall effect of these policies in the performance of their jobs.

Peer, Management, Subordinate and Secretarial Usage

Two questions were used to measure each of the four constructs. The first one asked about the level of usage on a 5 point scale ranging from "very high" to "very low". The second question asked about the growth of computer usage. This was measured on a 5 point scale ranging from "rapid growth" to "no growth".

Computer Anxiety

Raub (1981) developed a scale to measure computer attitudes. In this scale, she identified three factors: an appreciation of computers and a desire to learn more about them, computer anxiety, and fears about computers' possible negative impact on society. The second factor consisting of ten items, will be used to tap user's anxiety about computers. This scale was used by Howard (1986) who reported a satisfactory reliability (Cronbach aplha value of 0.85 with n = 111).

Attitudes towards usage of microcomputers.

This construct describes a particular user's attitude towards his personally using a microcomputer in accomplishing managerial tasks. As proposed by Fishbein (1980), this is different from users attitudes towards computers in general. Although many instruments have been used to measure this construct, they were, for various reasons, unsatisfactory. First they were too broadly defined. They included not only attitudes towards computers in general, but also attitude towards computer staff and towards the capability of the computers. Second, questions pertaining to beliefs did not measure the strength of those beliefs. For the purpose of this study, a new scale was developed to measure this construct.

The attitude construct used for this study is cognitive in nature, i.e., beliefs about using computers and the evaluation of these beliefs. As recommended by Ajzen and Fishbein (1980), the first step in the construction of such a scale is to determine the salient beliefs about the outcomes of using microcomputers. They suggest that any measure should consist of between 7 and 9 outcomes. For each of these beliefs respondents will evaluate (1) the likelihood of the outcomes and (2) its importance to them. The scores for each belief were multiplied and the measure

of cognitive attitude was derived as the sum of these products.

A review of the literature suggests many beliefs that users have about the outcomes of using microcomputers. Howard's (1986) scale had six outcomes. They were:

1. computers provide quicker access to information.
2. it takes too long to learn and use computers.
3. computers suffer from a lack of capability to perform tasks for real business situations.
4. using microcomputers is not consistent with normal managerial tasks.
5. computers are more trouble and expense than they are worth.
6. there is a problem with proliferation of computers leading to incompatibilities of hardware, software and data.

From discussions with four practicing managers and the faculty at the business school, it was decided that items 3, 5 and 6 were not critical outcomes of using microcomputers. However, others were suggested and a final list of 8 outcomes was compiled:

1. Provides access to higher quality information for better decisions.
2. Allows one to be more independent of subordinates and secretaries.
3. Exposes one to the vulnerability of computer breakdown and loss of data.
4. Gives one the opportunity to be more innovative and creative in analyses and output.

5. Provides opportunities to enhance one's managerial image.

6. Improves one's productivity on the job

7. Poses the difficulty of integrating the use of the computer into one's existing job routines.

8. Absorbs a significant amount of time in performing many everyday tasks.

The scale which measures attitudes towards using microcomputers was designed to determine first, the individual's agreement with the likelihood of each of these 8 outcomes; and second, the desirability of each outcome. Each of these items was measured on a seven point Likert scale. The two scores on each belief item were multiplied and the attitude measure was obtained by adding the eight products.

Subjective Norms

Subjective norms were measured in a similar fashion to attitude. The first step was to determine who were the important referents in the organization. The list included, top management, immediate bosses, peer managers and subordinates. Questions were created to measure (1) the individual's belief about what each of these referents thought of him/her using microcomputers and (2) his/her motivation to comply with that belief. These two scores were multiplied, and the sum of the four products was adopted as

the subjective norm regarding microcomputer usage, as perceived by that individual.

System Usage

This variable has been used in many MIS studies but its operational definitions were varied. As suggested by Ryan and Bonfield (1975) for marketing researchers,

> More scrutiny should be paid to the operationalization of behaviour. Most researchers have considered only single criterion, single observation behavioural measures.. Alternative observation models which may be more reliable should be tested.

This is especially true of the MIS research on attitudes and usage behaviour. Most researchers have used single dimensions and single questions. To overcome this shortcoming, five dimensions of usage were employed for this study. These dimensions were derived from the various usage studies.

1. The dimension suggested by Cheney and Dickson (1982) and Lucas (1973) is the inclusion of computer analysis in decision making. It was used by Amoroso (1986).

2. The most widely used and sometimes the only dimension is the actual time spent on the computer. For purposes of this study the self reported time was used.

3. Another dimension suggested by Raymond (1985) is the frequency of use. This provides a slightly different perspective than time of use. A person would be considered a heavy user if he uses the mitrocomputer for many different tasks even though the time spent on each specific task might be very short. Srinivasan (1985)

included both dimensions 2 and 3 in his measure of usage.

4. Another dimension which was used by Maish (1979), was the level of sophistication of use. This serves to measure the proficiency of use of the computer.

5. A final dimension for microcomputer usage was the actual number of software packages that are used. In a microcomputer environment, unlike a mainframe setting, users have a much wider choice as to what packages they can use. In such an environment a good indication of overall usage and the variety of tasks performed on the microcomputer can be provided by measuring the number of different packages each manager used.

The measurement approaches for the five dimensions of microcomputer usage are discussed below.

1. Inclusion of computer analysis in decision making. The scale developed for measuring this dimension listed eight tasks - looking for trends, finding problems, planning, forecasting, budgeting, communicating with others, controlling and guiding activities and making decisions. The measure for this dimension is the number of these activities that the managers reported they performed with the aid of microcomputers.

2. Frequency of use. This was measured with a six point scale from "Several times a day" to "Less than once a month".

3. Actual time spent on the computer. This was measured with a six point scale from "Almost Never" to "More than 3 hours per day"

4. Number of packages used. To measure this, a list of 10 different categories of packages were listed and respondents were asked to indicate their use on a scale measured on a four-point scale from "Not and all" to "To a great extent". The measure is the sum of all the categories that were used by the respondent.
5. Level of sophistication of usage. For each of the 10 software packages listed, respondents were asked to indicate their level of expertise in their usage, if they used them. Each scale was measured on a five-point scale ranging from "Novice" to "Expert". The total measure was the sum of the levels of expertise indicated for each category of package used.

Table 1 gives a summary of the constructs in the model with their names and number of indicators used in each measure.

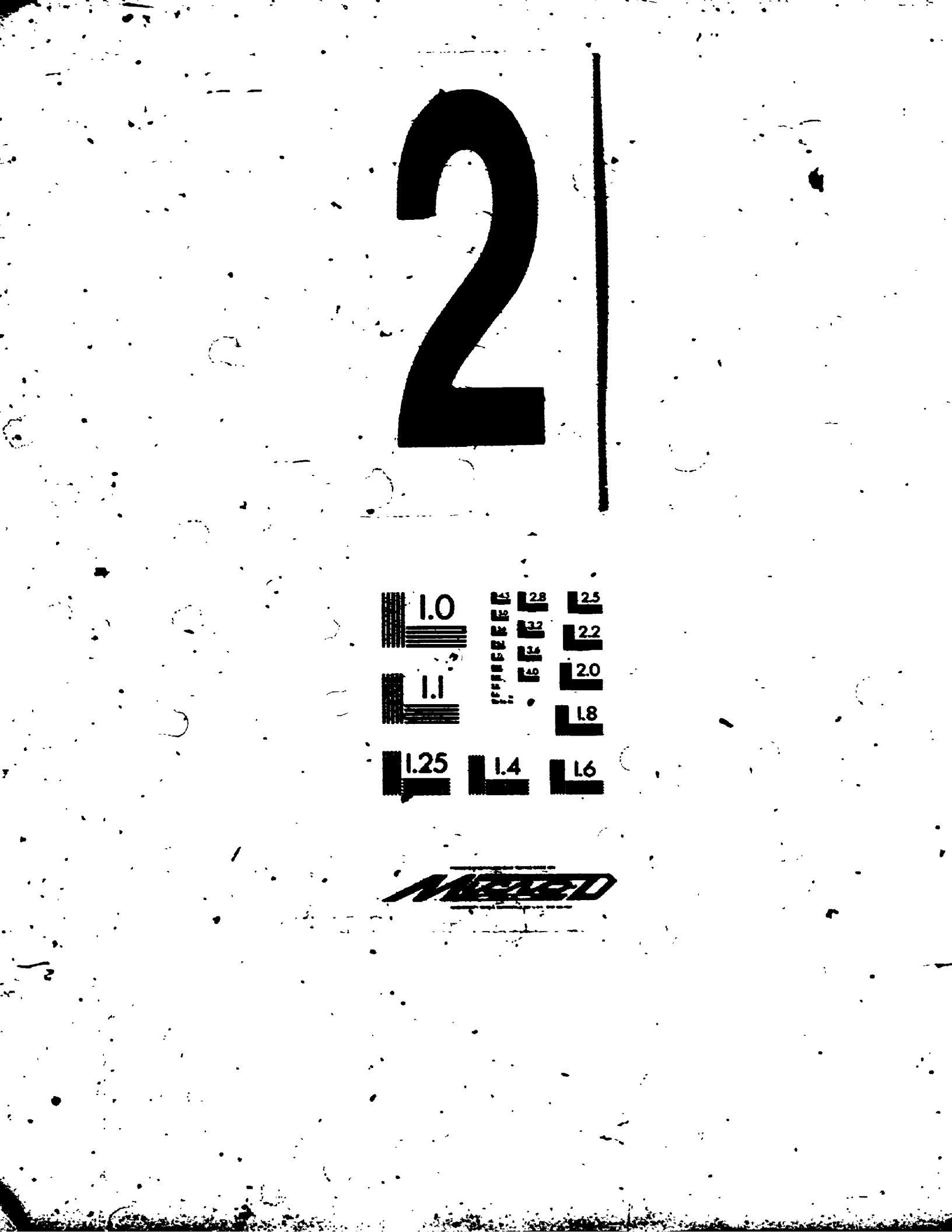
Methodology

A study of practicing managers in organizations, using the questionnaire as the main data collection instrument, was chosen as the most appropriate methodology. The subjects in the study, as described above, were managers and professionals who had microcomputers on their desks, or who had easy-access to one, and whose use of the computers was optional. They were drawn from a sample of 54 large corporations operating in Ontario.

Table 1

Constructs and Indicator Variables

Construct	Indicators	Label	Section in Questionnaire
BELIEF	belief1 to belief9	belie1 to belie9	B
SKILLS	mainframe training	mframe	A
	micro training	micro	
	computer experience	exp	
	computer skills	compskil	
	typing skills	typskil	
QUALITY	quality1 to quality11	qual1 to qual11	H
SUPPORT	support1 to support8	suppo1 to suppo8	C
POLICIES	policy1 to policy7	pol1 to pol7	C
PEER USAGE	level of usage	usage1	D
	growth of usage	growth1	
MGMT USAGE	level of usage	usage2	D
	growth of usage	growth2	
SUBOR USAGE	level of usage	usage3	D
	growth of usage	growth3	
SECT USAGE	level of usage	usage4	D
	growth of usage	growth4	
ANXIETY	anxiety1 to anxiety10	anxie1 to anxie10	B
ATTITUDE	attitude	cogb	F
SUBJ NORMS	subjective norms	nbmc	F
USAGE	extent of usage	exusge	H
	expertise in usage	expert	
	use for job functions	jobuse	
	time of use	timeuse	
	frequency of use	frequse	


2
1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0

Initial Study and Pretest

An exploratory study was done at the School of Business at the University of Western Ontario.

In 1985, through a grant from IBM, all of the faculty and some secretaries and staff were given PC AT's. In the first study, twenty of the initial recipients were interviewed to investigate their levels of usage, types of packages used and how the machines had changed their jobs. Based on the interviews with this sample of users, a distinct difference in usage, as noted in Chapter 1, was discovered. The major complaint of the infrequent users was that the system was too difficult to use, that there were too many technical problems, or that they were not convinced of the system's reliability. Others felt they were more efficient at doing things the old way and that using computers did not improve their productivity. However, all felt that their secretaries were more efficient and productive.

The results of this exploratory study were used in the development of the current study to investigate the factors determining levels of usage of microcomputers. The study was conducted in two phases. The first phase of the study was used to refine the model and the measurement instrument. In the first wave of the first phase, the questionnaire and an accompanying memo (Appendix 1) were sent to 35 faculty

members at the School. Twenty-two were returned. The major comment to this questionnaire was that it was much too long and tedious to fill out. Question wording was also ambiguous. The questionnaire was refined and shortened from 14 to 9 pages. In the second wave, the revised questionnaire was sent to the remaining sixteen professors who did not complete the first questionnaire. Eleven were returned with further comments on how the instrument could be improved. The questionnaire was again amended with these suggestions.

Data Collection

Phase 2 of the study was conducted using practicing managers in several large companies in Ontario. The population of interest was all managers who have access to microcomputers and who might be using them. To take a totally random sample of this population would necessitate the location of a sampling frame of all managers, and randomly selecting from this list. This "pure" approach to selecting respondents is obviously not practical, as no such list exists. A somewhat more practical approach was therefore adopted:

1. In the first step, a letter was sent to chief executive officers of 354 companies in Ontario. These companies were selected from Canada's 500 largest companies. The letter (Appendix 2) explained the purpose of the study

and requested their permission for managers in their organizations to participate.

2. Of the total sent, 77 companies (22%) agreed to participate. Another 53 companies (15%) replied saying they could not participate at that time.

3. The contact persons in the 77 companies were reached by telephone to inform them of the details of the study and to enquire as to the number of managers who would be participating. The point was emphasized that the managers had to be randomly selected from their organizations. Fifteen percent of the companies felt that the time for the study was inconvenient and declined to participate.

4. 766 questionnaires were sent to the contact persons in the remaining 62 companies, with a letter explaining how the questionnaires should be distributed (Appendix 3), a sample memo which would accompany the questionnaire when sent to the participating managers (Appendix 4), and a short summary of the reason for the study (Appendix 5). From this group, eight companies did not return any questionnaires. The other 54 companies returned a total of 519 completed questionnaires. (See Appendix 6 for a response rate summary and Appendix 7 for the list of companies and number of questionnaires sent and returned

from each.) The response rate the questionnaires was 67.7%.

It can be argued that the major weakness of this sampling design is that the selected sample was not random and that the results could therefore be biased. Some of the variables studied might be consistently related to a firm's willingness to participate. However, while the companies were not randomly selected, the participants in each organization were. The unit of analysis in this study was the individual manager and the selection of this unit was random within each company. The potential source of bias was, therefore, largely circumvented.

The demographic profile of the respondents (Appendix 8) gives an indication of the "randomness" of the sample. There is great variety in the profiles on a number of dimensions. For example:

1. The participants came from 44 different divisions in their organizations. The largest group was from the MIS division with 63 respondents, and formed only 12% of the sample. The requirement that respondents were to be spread randomly throughout the company, seems to have been fulfilled.

2. The positions of the respondents spanned all organizational levels from president to first line supervisor. Although only three presidents participated, the other respondents seemed to be spread evenly across the other levels.

3. The budget controlled by the respondents was distributed evenly across all five categories listed.

4. The highest educational level of respondents was concentrated in the university and graduate degree categories. These two categories represented 67% of all participants. This is not unexpected as all of them were managers.

5. There were a large number of people with a background in Business or Commerce (about 25%). Again, this is not unexpected. The rest of the respondents were spread over 24 other areas of study.

6. Eighty five percent of the respondents were male and 15% were female. This reflects accurately the proportion of male versus female managers in the Canadian workforce.

7. With respect to the age of respondents, the largest group was in the 31 to 40 category, and formed about 48 % of the sample. The 41 to 50 category accounted for a

further 26%. Considering that most of the managers were lower to middle level executives, the age ranges form a compatible pattern.

This inspection of the demographic profile of participants shows that no one group of people is over-represented. Most of the figures reflect the proportions that occur in the population at large. The sample, therefore appears to be an accurate representation of the population of managers working in large Canadian corporations.

Non-Response Bias

Another issue in any questionnaire collection process is the problem of non-response. For the data to be representative of the population, there must be no difference between those who responded and those who did not. The only exact method to test for this is to have some non-respondents fill out the questionnaire and compare the results with those of the initial respondents. However, this process is very difficult and is not often attempted in practice. An alternative method, though not as precise, is suggested by Oppenheim, 1966. He found that very late respondents are similar to non-respondents. In order to test for non-response bias, he suggests comparing early respondents with late respondents in terms of their answers to the questionnaire.

The questionnaires were sent out in late July and responses started arriving the first week of August. A reminder was sent in mid-September. All but 44 questionnaires were returned by the end of September. These 44 questionnaires were compared with the remaining 475. A t-test comparing the differences in response to the 159 items showed no difference for all but 9 items, which were different at $p<.01$ level. (See Appendix 9). This number can be attributed to chance and there is therefore, no conclusive evidence of any differences between respondents and non-respondents in the data.

CHAPTER 5 - DATA ANALYSIS

This chapter describes the data analysis and presents the results of the study. A descriptive analysis of the data is presented followed by the statistical testing of the model. Structural equation modeling, as implemented by the computer program LISREL was used to statistically test the proposed hypotheses and to estimate the model. Before presenting the detailed analyses, a brief description of the LISREL technique, together with the assumptions, strengths and limitations of the method is given. This is followed by an analysis of the measurement and structural portions of the model. Finally, the results obtained from the qualitative data are presented.

Descriptive Statistics

Table 2 summarizes the descriptive statistics for all the indicators and constructs in the study.

Beliefs about Impact of Computers

The beliefs of the participating managers in the sample about the impact of computers on society were favourable. Using a scale where 1 represents unfavourable and 5 represents favourable, the score of 3.77 indicated a very positive outlook. There are no established norms for this

Table 2

Variable Means, Standard Deviations and Ranges

Variable	Mean	Standard Deviation	Minimum	Maximum
BELIEF	3.767	.565	1.89	5.00
belie1	3.718	1.123	1	5
belie2	3.257	1.210	1	5
belie3	4.517	.926	1	5
belie4	3.463	1.042	1	5
belie5	3.275	1.087	1	5
belie6	3.899	.985	1	5
belie7	4.229	.901	1	5
belie8	3.900	1.083	1	5
belie9	3.649	1.231	1	5
SKILLS	4.040	1.864	.00	9.80
mframe	2.751	2.686	.00	12.00
micro	3.314	1.957	.00	11.00
exp	6.742	4.056	.00	18.00
compskil	3.988	1.682	1.00	7.00
typskil	3.449	1.714	1	7
QUALITY	3.452	1.309	1	5.18
qual1	3.592	1.478	1	5
qual2	3.164	1.471	1	5
qual3	3.418	1.448	1	5
qual4	3.119	1.394	1	5
qual5	3.137	1.396	1	5
qual6	3.274	1.493	1	5
qual7	3.472	1.482	1	5
qual8	3.231	1.512	1	5
qual9	3.509	1.417	1	5
qual10	3.316	1.476	1	5
qual11	4.744	2.085	1	7
SUPPORT	3.446	.848	1.00	5.00
suppo1	3.043	1.228	1	5
suppo2	3.998	1.102	1	5
suppo3	4.000	1.168	1	5
suppo4	3.513	1.276	1	5
suppo5	3.796	1.281	1	5
suppo6	3.315	1.298	1	5
suppo7	2.881	1.293	1	5
suppo8	3.025	1.170	1	5
POLICIES				
pol	4.326	1.203	1	7
PEER USAGE	3.078	1.118	1.00	5.00
usage1	3.000	1.268	1	5
growth1	3.156	1.103	1	5

Table 2 (continued)

Variable Means, Standard Deviations and Ranges

Variable	Mean	Standard Deviation	Minimum	Maximum
MGMT USAGE	2.275	1.061	1.00	5.00
usage2	2.140	1.149	1	5
growth2	2.409	1.093	1	5
SUBOR USAGE	3.633	1.007	1.00	5.00
usage3	3.602	1.134	1	5
growth3	3.663	1.045	1	5
SECT USAGE	3.465	1.148	1.00	5.00
usage4	3.486	1.311	1	5
growth4	3.443	1.156	1	5
ANXIETY	1.464	.484	1.00	4.40
anxie1	1.249	.627	1	5
anxie2	1.804	1.158	1	5
anxie3	2.109	1.006	1	5
anxie4	1.350	.795	1	5
anxie5	1.140	.514	1	5
anxie6	1.326	.831	1	5
anxie7	1.208	.576	1	5
anxie8	1.247	.575	1	5
anxie9	1.456	.714	1	4
anxie10	1.753	1.040	1	5
ATTITUDE				
cogb	51.222	32.786	-51.0	135.00
SUBJ NORMS				
nbmc	8.622	20.608	-55.0	72.00
USAGE	4.118	2.043	.00	10.60
exusge	3.380	2.118	.00	10.00
expert	4.017	4.132	.00	27.00
jobuse	5.287	2.662	.00	8.00
timeuse	3.376	1.721	.00	6.00
frequse	4.532	1.947	.00	6.00

quantity, but Howard (1986) obtained an average score of 2.78, using executive MBA students, and Raub (1981) obtained a score of 2.12, using college students. The difference between scores in Howard's and Raub's studies and this research can be accounted for by the fact that managers, who have had opportunities to witness the usefulness of computers in business applications, would have generally more positive beliefs about the impact of computers than would college students. The higher score in this study can also be explained by the time period that has elapsed since Howard's study. Howard's research was conducted in 1983 and since that time there has been phenomenal growth in microcomputer usage in organizations The greater exposure of managers to microcomputers and their uses could account for the higher score in this study.

Computer Skills

The score obtained for computer skills was 4.04 which was relatively low. It occurs primarily because training in both the use of mainframe systems and microcomputers was low. With a maximum score of 12, the score was 2.75 for training on mainframes and 3.31 for training on microcomputers. The higher score for microcomputer training was attributable to a higher level of self study. In fact, 22% of managers received all their training through self study. Their exposure to computer systems development and implementation

was also low (6.64 out of a maximum of 18). The rating of their own computer skills was just below the mid point, 3.98 out of 7.

The mean score on typing skills was 3.45 on a 7 point scale (1=novice, 7=expert). With 4 considered the point above which one has reasonable skills, the score of 3.45 would therefore indicate that typing skills for this group of managers was relatively weak. The finding is in contrast to the results reported by Bikson and Gutek (1983). They found that 49% of users had good-to-excellent typing skills, and only 1% had no prior skills. In this study, only 29% were rated in the good-to-excellent category (those scoring at least 5 on the scale). Fifteen percent had virtually no typing skills (those who scored 1 on the scale).

Two reasons can be given for this difference in results. First, Bikson and Gutek sampled advanced system users. It can be assumed that these users were very familiar with computers before upgrading to these advanced systems, and would already have developed typing skills. In this study, users were from a general population of computer users, many of whom might be relatively new to computers.

Second, in the four years that elapsed between the two studies, microcomputers have gained wider usage. During the years when microcomputers were first introduced into

businesses, it was the people who were comfortable with the technology (e.g., having good typing skills), who were more willing to use them. As computer technology has improved, microcomputers have become more user friendly, through the use of windows, menus, and mice. The need for good typing skills is diminishing, and wider use by people with lower typing skills has been the result.

Quality

Managers in this sample were quite satisfied with their microcomputers. The score measuring the overall satisfaction with the microcomputer systems was 4.74 on a 7 point scale (7=extremely satisfied, 1= extremely dissatisfied). For the individual items, the strength of satisfaction was not as great, but still positive. The managers were most satisfied with the ability of microcomputers to assist them in their jobs, and least satisfied with the quality and promptness of maintenance and repair. Bikson and Gutek (1983) found that managers were most satisfied with the printout and video display, and least satisfied with maintenance and repair.

Support

Both general organizational support and specific system support appear to be adequate in the organizations where the respondents worked. The mean score was 3.45 on a 5-point

scale. The highest value in the individual items pertained to support from a central support group, e.g. an information centre. It is reasonable to expect that, since the organizations were all large firms, most of them would have some kind of information centre or central support facility to assist users. A recent Cwrth survey indicated that over half of the Fortune 1000 firms had information centres.

There appears, on the other hand, to be a lack of information support provided to users regarding new and different software applications. In fact, this was the only item that rated below 3 on the scale.

Policies

The majority of managers were aware of the existence of microcomputer policies in their organizations. Seventy percent knew about their hardware acquisition policies and 63% knew of policies regarding new software acquisition. About 50% knew of policies regarding access to corporate data, and data backup and security. However, only about one third of managers were aware of policies on documentation. These results are consistent with descriptions in the literature. Most companies have rules and policies about resource acquisition. Departments have to justify these acquisitions with cost-benefit analyses or on some other criteria. But policies to ensure integrity of data, backups,

security and documentation are non-existent in most companies. To the question of how helpful were these policies, the managers' responses were only slightly positive (4.31 on a 7 point scale). The largest group (43%) felt that the policies were neither helpful nor unhelpful.

Peer, Management, Subordinate and Secretarial Usage

Microcomputer use among other groups in the organizations where the respondents worked was moderate. The greatest usage was among the subordinates of managers, who had a mean score of 3.63 (1=low usage 5=high usage). Second highest usage was among secretaries (3.46), followed by peer managers (3.08). Upper management usage was lowest, well below the mid point of 3. These scores seem to reflect the patterns of use cited in the popular literature. Junior managers, who do more analytical work, gathering information and preparing reports, would be greater users of computers, since the machines are of great assistance in the performance of these tasks. As managers move up the hierarchy, they spend more time making decisions based on information and reports prepared by their subordinates. They also spend more time in face-to-face communication and other tasks where computers are of less value. Their need and motivation to use microcomputers is, therefore reduced.

Anxiety

The descriptive data for anxiety showed a very low incidence of computer anxiety. On a 5 point scale, the mean score was 1.46. Furthermore, from this sample, only 1% of managers can be said to have some form of anxiety (those scoring above 3 on the scale). It can be argued that using 3 as the break point is arbitrary and that other logical benchmarks could be selected. Regardless of benchmarks, however, this data indicates that the level of computer anxiety was very low. This finding is compatible with Howard's study (1986), which reported a value of 2.7%. The lower value in this study can be explained by the growth in microcomputer exposure and usage in businesses during the period between the two studies. Bikson and Gutek (1983) also found that more than two-thirds of managers from their sample were not anxious about using computers. These results suggest that the reports of computer anxiety in the popular literature are exaggerated. "Such stories make good reading, but the study indicates that these cases may be quite rare" (Howard, 1986).

Attitudes

The managers had notably positive attitudes towards using their microcomputers. Using a scale where -144 means extremely negative and +144 means extremely positive the

observed mean of 51.22 indicates a generally favourable attitude. With respect to what they believed were the major advantages of using microcomputers, the ability to be more innovative was rated highest. The managers believed that computers provided the possibility for more creative analyses and outputs. This was followed by the productivity gains that could be obtained when using microcomputers. The least important factor was the fear that they might be vulnerable to computer breakdowns and loss of data. In terms of the importance of the beliefs in the performance of their jobs, having the information to make better decisions was rated highest. The least important factor was the belief that computers provided the facility for them to be more independent of their secretaries and subordinates.

Subjective Norms

The managers perceived some pressures from referents in their organizations to use microcomputers in performing their jobs; though the pressure was rather weak. The mean score was 8.62. (This scale had a mid point of 0, -72 was extreme negative and +72 was extreme positive). The scores on the perceptions of pressures from the different referent groups also reflected this positive pressure. About one third of the scores clustered around the zero point with the remaining two thirds spread equally on both sides. The perception was that these referent groups were ambivalent

about whether computers were used or not. The scores on how they evaluated the pressures from these referent groups appeared as expected. The largest number would conform to pressures from immediate superiors. Pressures from upper managers was next in importance. Conforming to pressures from subordinates and secretaries ranked third and fourth with both scores below their mid points.

Microcomputer Usage

The average number of software packages used by the managers was just over 3. The most used software were the spreadsheet packages. Eighty-four percent of respondents said they used them. The next most popular were word processing programs with 56% of managers reporting usage. Graphics packages, used by 47% of managers, ranked third. The least used packages were fourth generation languages (10%). Modeling systems and statistical packages also ranked near the bottom with 13% and 12% respectively, saying that they used them. These results are very similar to a study by Lee (1985) on usage patterns of microcomputers by managers. He reported that 74% of respondents used spreadsheets, and 44% used word processors. These two types of packages were used by the greatest number of people. However, compared to this study, Lee reported a much smaller group of graphics users (29.7%). From this result, it appears that graphics packages are increasing in importance

This is not surprising, given the degree of attention that graphics is receiving from software developers.

The use of microcomputers for task performance was quite high. For each of the eight tasks listed, more than 50% of managers said that they were performed with the aid of microcomputers. The largest number reported using their microcomputers for planning (75%). Seventy-one percent used microcomputers for budgeting and help in decision making. These results are compatible with the wide use of spreadsheet programs. Spreadsheet software is ideally suited for such tasks as planning, budgeting and for creating different scenarios for decision making. Despite the extensive use of computers in task performance, most managers reported that they were relatively inexperienced with the packages. They reported the most experience with spreadsheets: seventy percent ranked themselves as 3, 4 or 5 on a scale ranging from 1 (novice) to 7 (expert). For each of the other software packages, less that 50% placed themselves in these three categories.

About 60% of managers spent from half an hour to two hours a day using their microcomputers; 20% spent more time and 20% spent less. Because of the different methods of measurement, this result cannot be directly compared with Lee's (1985), where the managers averaged 9.48 hours per week on their microcomputers. A simple approximation in this

data, however, indicates that the time spent is comparable to Lee's figure.

For frequency of use, 48% reported using their computers several times a day. Half of the rest were at their terminals once a day and the other half used their machines a few times a week.

Home use of microcomputers was rare. Of the 206 respondents (40%) who reported that they had microcomputers at home, 89% said they rarely used them (less that one hour a day).

LISREL Modeling

In this section, the LISREL structural modeling technique is presented, together with some strengths and weaknesses of the method.

LISREL is one of several routines for parameter estimation in covariance structure analysis. However, it has been the most frequently used tool for this analysis in sociology, psychology, econometrics and marketing, since it was first commercialized in 1979 (Fornell, 1983). Structural equation analysis techniques are defined as "second generation" modeling techniques. The advantage of using these techniques, as opposed to first generation models such as path analysis and canonical correlations is the ability of

the second generation models to bring together psychometric and econometric analysis in such a way that the best features of both are exploited. It is possible to form econometric structural equation models that incorporate the psychometrician's notion of unobserved latent variables (constructs) and measurement error in the estimation procedure. In behavioural research in MIS, theoretical constructs are typically difficult to operationalize in terms of a single measure, and measurement error is often unavoidable. Consequently, given an appropriate statistical testing method, the structural equation models are likely to become indispensable for theory evaluation in this type of research.

In employing causal structural equation modeling, the objective is to derive a measurement model linking indicator variables to latent variables, and a particular cause-effect pattern of relationships among the latent variables. The researcher determines whether the co-variances obtained among the indicator variables (calculated from the data) are consistent with this model. In other words, the objective is to minimize the difference in the covariance generated from the path coefficients with the original covariance matrix generated from the data.

LISREL is a general computer program for estimating the unknown coefficients in a set of linear structural equations

and for testing the overall fit of the proposed model to the data. The LISREL model assumes a causal structure among a set of latent variables. These latent variables appear as underlying causes of the observed variables. The model consists of two sets of equations. The measurement model equations specify how the latent variables, or hypothetical constructs are measured in terms of the observed variables, and are used to describe the measurement properties (validities and reliabilities) of the observed variables. The structural equation model specifies the causal relationships among the latent variables and is used to describe the causal effects.

The Structural Equation Model

The structural equation model refers to relations among the exogenous and endogenous constructs or latent variables. The general form of the structural equation model is:

$$\eta = \beta\eta + \Gamma\xi + \zeta$$

- where η is an m X 1 vector of latent <u>endogenous</u> variables
- ξ is an n x 1 vector of latent <u>exogenous</u> variables
- β is an m x m matrix of coefficients of the effects of endogenous (η's) on endogenous variables (η's)
- ζ is an m x 1 vector of residuals in the equations

- Γ is an m x n matrix of the coefficients of the effects of exogenous variables (ξ's) on endogenous variables (η's)

The Measurement Model

The measurement model is concerned with reliability and construct validity, the extent to which the operationalization of a construct actually measures what it purports to measure. It specifies the relationships between unobserved latent variables and observed indicator variables. Two separate equations describe this model:

1. $Y = \Lambda_y \eta + \varepsilon$ where

   - Y is a p x 1 vector of measures of endogenous variables
   - Λ_y is a p x m matrix of coefficients (loadings) of y on latent (unobserved) endogenous variables (η's)
   - ε is a p x 1 vector of errors of measurement of y.

2. $X = \Lambda_x \xi + \delta$ where

   - X is a q x 1 vector of measures of exogenous variables
   - Λ_x is a q x n matrix of coefficients of x on unobserved exogenous variables (ξ's)
   - δ is a q x 1 vector of errors of measurement on x.

The assumptions in LISREL analysis are

1. δ is uncorrelated with ξ
2. ε is uncorrelated with η
3. ζ is uncorrelated with ξ
4. ε , δ and ζ are mutually uncorrelated
5. β has zeroes in the diagonal and $I-\beta$ is non-singular.

Two additional assumptions for employing the maximum likelihood technique for estimating the model are; (1) the data are derived from a random sample of independent observations from a population, and (2) the observed variables have a multi-variate normal distribution (Joreskog and Sorbom, 1986). As outlined in the description of data collection procedures, the data for this study were obtained from a randomly selected sample of managers. All measures yield interval level date. Multi-variate normality is assumed.

Strengths of Causal Modeling

The model formulated for the study, while grounded in well tested theory, is still fairly exploratory. While it can be argued that use of a causal modeling technique (as implemented in LISREL) is somewhat premature, there are many offsetting advantages to employing LISREL.

LISREL provides the techniques to examine, what Bagozzi (1981) calls the third level of understanding in explanation. He says:

> The third level of understanding in explanation introduces, as a hypothesis, a particular structure of relationships among both the phenomenon to be explained and the set of explanatory variables. Typically, this will entail two dimensions. First, the articulation of all variables in some causal ordering will be based upon theoretical considerations, past research, methodological factors, logical reasoning,

or other information. Second, the functional form of each causal relationship must be specified.

This study is attempting to do exactly this.

LISREL allows the testing of both the measurement model and the structural model together, unlike standard path analysis or regression analysis, where the measures are first tested before application to the structural equations. The ability to use multiple indicators in the structural model provides "the most complete solution to the estimation problem of structural models" (Kenny, 1979), particularly when the research involves testing a causal model in which it is assumed that the latent variables cannot be measured perfectly. Path analysis is predicated on three main assumptions: (1) the variables are measured without error, (2) the residuals are not correlated and (3) the causal model is recursive. These assumptions are rarely met in practice, especially in non-experimental social science research. A basic assumption of this research is that perfect measurement of many of the constructs is not possible.

Kenny (1979) argues that one commonly accepted approach toward establishing useful causal relations involves the careful study of cross-sectional relationships as is proposed in this research. The technique of causal modeling

forces the researcher to specify relationships and assumptions clearly. In the logical chain of the research stream, cross-sectional studies would be followed by longitudinal research and then by experiments where causal variables could be manipulated so that greater confidence in the causal aspect of the findings is achieved. The other approach suggests that causal relationships should first be tested under experimental conditions to see whether they exist at all. This second approach is not feasible for the current study, since it is impossible to design an experiment to test the relationships.

Problems in LISREL estimation

Most problems in LISREL estimation lie in the chi-square statistic, which measures the overall fit of the model. This statistic is the likelihood ratio test statistic for testing the model against the alternative that the derived covariance matrix is unconstrained, assuming that the model is correct, and the sample size is sufficiently large. However, the use of chi-square is not valid for several reasons. In most empirical work the model is only tentative and is regarded as an approximation to reality. From this point of view, the statistical problem is not one of testing a given hypothesis but rather of fitting the model to the data and deciding whether the fit is adequate. Even if it is desired to test the composite hypothesis that the model

is true in the total population, one must remember that the chi-square is a valid test statistic only if

1. all the observed variables have a multivariate normal distribution,
2. the analysis is based on the sample covariance matrix - standardization is not permitted,
3. the sample is fairly large (Joreskog and Sorbom, 1986).

These assumptions are seldom fulfilled in practice.

Other limitations suggested by Fornell, Tellis and Zinkhan (1982) include:

1. Problems with model identification which become more acute when methods factors have to be explicitly used.
2. Problems with the chi-square test, the power of which is unknown. Knowledge of the power curve of the chi-square is critical for theory evaluation in structural equation models because the testing is organized such that the a priori expectation is that the null hypothesis will not be rejected. In contrast, in most significance testing the theory is supported if H0 is rejected. If the power of the chi-square test is low, the null hypothesis will seldom be rejected and the researcher using structural equation models may accept a false theory, making a type II error.
3. The problem of improper or inadmissible solutions. First, it is possible to locate what is called a "local minimum." This is a value of the fitting function that appears to be the smallest possible when there are, in fact, other smaller values. Second, the values of the of the parameters that minimize the fitting function may be outside the range of feasible values. For example, a variance may be estimated to be negative or a correlation to be greater than 1.0. Such occurrences are thought to result from misspecified models or insufficiently large sample sizes.

To circumvent the problems with the chi-square statistic, Joreskog and Sorbom. (1986) suggest that rather than

regarding chi-square as a test statistic, one should regard it as a goodness (or badness) of fit measure in the sense that large chi-square values correspond to bad fit and small chi-square values to good fit. The degrees of freedom serves as a standard by which to judge whether chi-square is large or small. Wheaton et. al (1977) suggest that a ratio of chi-square to degrees of freedom that is less that 5.0, can be considered to show adequate fit.

In summary, LISREL provides the most suitable technique for this study. The relationships have been hypothesized based on a well established theory. The measures have multiple indicators. The LISREL model tests the theoretical part with the measurement part together, which was not possible with first generation statistical tools. There are certain limitations too, especially with the use of the chi-square statistic. However, most of these problems can be avoided if (1) the data is approximately multivariate normal (2) the sample size is fairly large and (3) use of the chi-square is made with caution. The advantages of using LISREL are summarized by Hughes, Price and Marrs (1986) who state:

1. The statement of theory is more exact.
2. The testing of theory is more precise.
3. The communication of theory is enhanced.

Analysis Procedure

This section presents the statistical analysis of the data.

The measurement model is first tested and modified. This is followed by the testing and revision of the structural model to improve its fit.

The procedure outlined by Lomax (1982) was followed in developing and testing the initial model, and revising it to arrive at the final model. The procedure lists a number of steps designed to result in an objective, efficient causal modeling process. The 13 steps are outlined below:

1. Construct the hypothetical structural model. Define the latent dependent and independent variables and the causal relationships among the latent variables.
2. Substantiate the structural model by reviewing the relevant literature.
3. Select an appropriate population to be sampled.
4. Define a set of indicator variables for each of the latent variables.
5. Collect the data
6. Decide whether to utilize the correlation or variance-covariance matrix for analysis.
7. Construct a detailed figure of the proposed causal model that allows derivation of the matrix equations for both the measurement and structural models.
8. Test the initial hypothesized model.
9. Examine the measurement portion of the LISREL model by following steps 9 and 10. It is necessary to investigate aspects of the measurement model prior to those of the structural model. Because the latent variables are defined by the indicator variables, the optimal measurement model should be established in the initial stages of the model fitting process.
10. Examine for correlated error terms in the indicator variables and free that parameter if it can be substantively justified.

11. Examine the structural portion of the model by following steps 11 to 13. Inspect the t-values for each of the structure coefficients to see if they are significantly different from zero. Fix the non-significant parameters to zero and test a subsequent model for which the difference in chi-square should be non significant.

12. Review the modification indices for the parameters of beta and gamma previously fixed at zero. Select the parameter of largest magnitude and allow it to become free, if the path can be justified theoretically.

13. Be sure that (a) the final structural model is best fitting in a statistical sense and, more important, (b) that the model is consistent with what is known theoretically.

The first five steps were described in Chapters 2, 3 and 4.

The next step requires a decision about whether to use the correlation or covariance matrix as input to the analyses. There are two reasons that require the use of the covariance matrix. The first is when the original metric of the data has to be retained. When estimating the impact of one variable if an antecedent variable is changed by one unit, the covariance matrix has to be used. The second reason is that the chi-square statistic is only valid as a test statistic when the covariance matrix is used as input.

For this study, the metric of measurement was not important as most of them were arbitrarily assigned as numbers on five or seven point Likert scales. Also, in view of the tremendous criticisms directed at the chi-square, it was decided that other measures would be used to determine the

goodness of fit of the model. The correlation matrix was therefore used as input in the analysis of the data.

Step 7 of the procedure suggested by Lomax (1982) is the construction of the detailed figures of the proposed causal model that allows the derivation of the matrix equations for both the measurement and structural models. (See Figure 4 on page 114 for the proposed causal model).

The measurement model specifies the relationships between unobserved and observed variables. The matrix equations defining the Measurement Model for Y are shown in table 3. The matrix equations defining the measurement model for X are shown in table 4.

The structural equation model defines the relationships among the exogenous and endogenous constructs or latent variables. The matrix equations defining the initial structural model are shown in Table 5.

Assessing the measurement model

Steps 8 and 9 of the procedure outlined by Lomax (1982), recommend testing the hypothesized model with the examination of the measurement part of the model prior to the structural part. This process is designed to ensure that

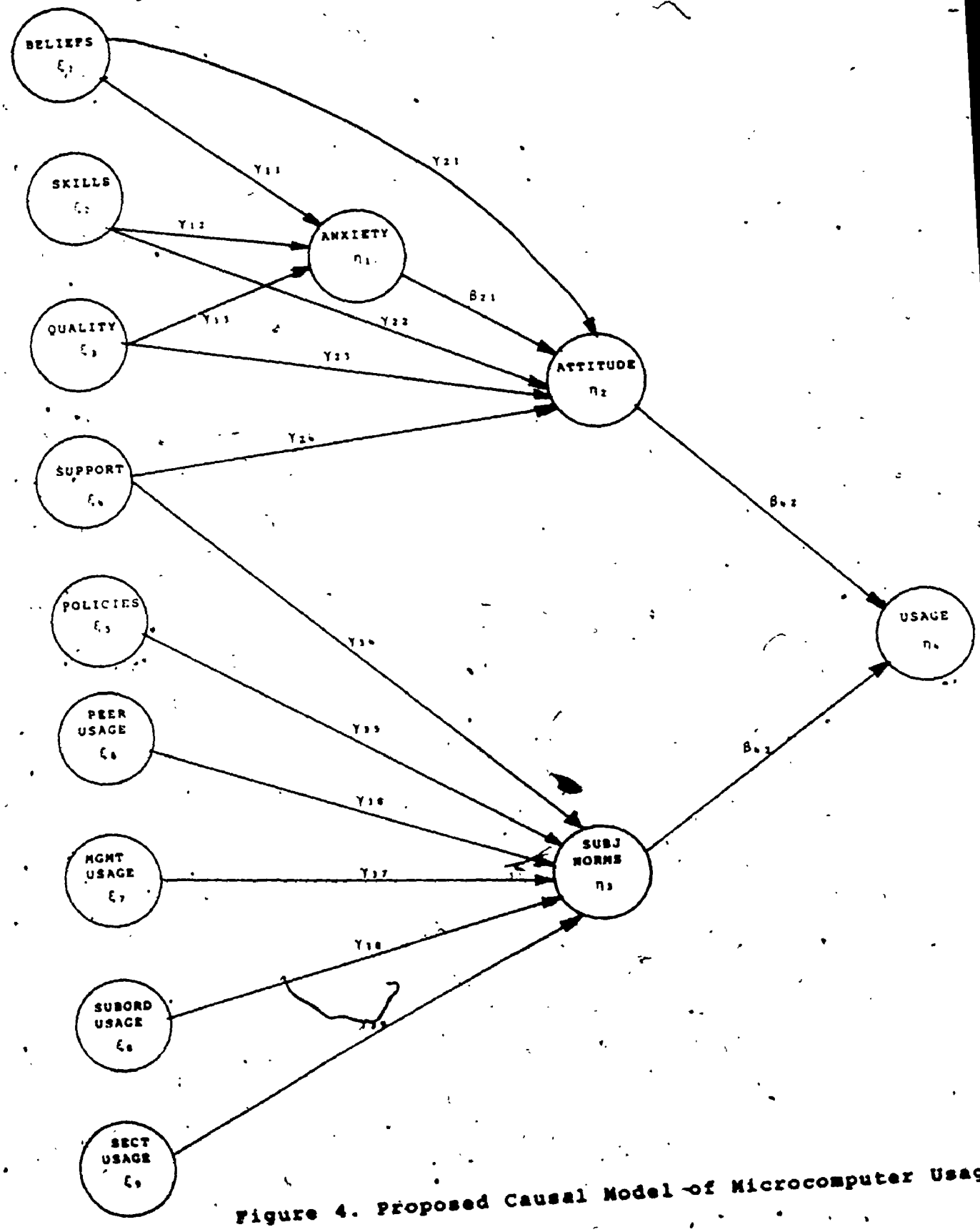


Figure 4. Proposed Causal Model of Microcomputer Usage

Table 3

Matrix equations defining the Measurement Model for Y

$$Y = \Lambda_y \eta + \varepsilon$$

$$\begin{bmatrix} y_1 \\ y_2 \\ y_3 \\ y_4 \\ y_5 \\ y_6 \\ y_7 \\ y_8 \\ y_9 \\ y_{10} \\ y_{11} \\ y_{12} \\ y_{13} \\ y_{14} \\ y_{15} \\ y_{16} \\ y_{17} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ \lambda_{21} & 0 & 0 & 0 \\ \lambda_{31} & 0 & 0 & 0 \\ \lambda_{41} & 0 & 0 & 0 \\ \lambda_{51} & 0 & 0 & 0 \\ \lambda_{61} & 0 & 0 & 0 \\ \lambda_{71} & 0 & 0 & 0 \\ \lambda_{81} & 0 & 0 & 0 \\ \lambda_{91} & 0 & 0 & 0 \\ \lambda_{101} & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & \lambda_{144} \\ 0 & 0 & 0 & \lambda_{154} \\ 0 & 0 & 0 & \lambda_{164} \\ 0 & 0 & 0 & \lambda_{174} \end{bmatrix} \begin{bmatrix} \eta_1 \\ \eta_2 \\ \eta_3 \\ \eta_4 \end{bmatrix} + \begin{bmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \varepsilon_3 \\ \varepsilon_4 \\ \varepsilon_5 \\ \varepsilon_6 \\ \varepsilon_7 \\ \varepsilon_8 \\ \varepsilon_9 \\ \varepsilon_{10} \\ \varepsilon_{11} \\ \varepsilon_{12} \\ \varepsilon_{13} \\ \varepsilon_{14} \\ \varepsilon_{15} \\ \varepsilon_{16} \\ \varepsilon_{17} \end{bmatrix}$$

Note: To define the model, the unit of measurement of each latent variable must be assigned. The most convenient way of assigning a unit of measurement is to fix a one in each column of Λ_y and Λ_x (Joreskog and Sorbom, 1986). In the Λ_y and Λ_x, one λ in each column has been set equal to unity to fix the scales of measurement in the latent variable.

Table 4

Matrix Equations defining the Measurement Model for X

$$X = \Lambda_x \xi + \delta$$

$$\begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \\ x_5 \\ x_6 \\ x_7 \\ x_8 \\ x_9 \\ x_{10} \\ x_{11} \\ x_{12} \\ x_{13} \\ x_{14} \\ x_{15} \\ x_{16} \\ x_{17} \\ x_{18} \\ x_{19} \\ x_{20} \\ x_{21} \\ x_{22} \\ x_{23} \\ x_{24} \\ x_{25} \\ x_{26} \\ x_{27} \\ x_{28} \\ x_{29} \\ x_{30} \\ x_{31} \\ x_{32} \\ x_{33} \\ x_{34} \\ x_{35} \\ x_{36} \\ x_{37} \\ x_{38} \\ x_{39} \\ x_{40} \\ x_{41} \\ x_{42} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ \lambda_{21} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ \lambda_{31} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ \lambda_{41} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ \lambda_{51} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ \lambda_{61} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ \lambda_{71} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ \lambda_{81} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ \lambda_{91} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & \lambda_{112} & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & \lambda_{122} & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & \lambda_{132} & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & \lambda_{142} & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & \lambda_{163} & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & \lambda_{173} & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & \lambda_{183} & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & \lambda_{193} & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & \lambda_{203} & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & \lambda_{213} & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & \lambda_{223} & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & \lambda_{233} & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & \lambda_{243} & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & \lambda_{253} & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & \lambda_{274} & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & \lambda_{284} & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & \lambda_{294} & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & \lambda_{304} & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & \lambda_{314} & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & \lambda_{324} & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & \lambda_{334} & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & \lambda_{366} & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & \lambda_{387} & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & \lambda_{408} & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \lambda_{429} \end{bmatrix} \begin{bmatrix} \xi_1 \\ \xi_2 \\ \xi_3 \\ \xi_4 \\ \xi_5 \\ \xi_6 \\ \xi_7 \\ \xi_8 \\ \xi_9 \end{bmatrix} + \begin{bmatrix} \delta_1 \\ \delta_2 \\ \delta_3 \\ \delta_4 \\ \delta_5 \\ \delta_6 \\ \delta_7 \\ \delta_8 \\ \delta_9 \\ \delta_{10} \\ \delta_{11} \\ \delta_{12} \\ \delta_{13} \\ \delta_{14} \\ \delta_{15} \\ \delta_{16} \\ \delta_{17} \\ \delta_{18} \\ \delta_{19} \\ \delta_{20} \\ \delta_{21} \\ \delta_{22} \\ \delta_{23} \\ \delta_{24} \\ \delta_{25} \\ \delta_{26} \\ \delta_{27} \\ \delta_{28} \\ \delta_{29} \\ \delta_{30} \\ \delta_{31} \\ \delta_{32} \\ \delta_{33} \\ \delta_{34} \\ \delta_{35} \\ \delta_{36} \\ \delta_{37} \\ \delta_{38} \\ \delta_{39} \\ \delta_{40} \\ \delta_{41} \\ \delta_{42} \end{bmatrix}$$

Table 5

Matrix Equations defining the Initial Structural Model

$$\eta = \beta\eta + \Gamma\xi + \zeta$$

$$\begin{bmatrix} \eta_1 \\ \eta_2 \\ \eta_3 \\ \eta_4 \end{bmatrix} = \begin{bmatrix} 0 & 0 & 0 & 0 \\ \beta_{21} & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & \beta_{42} & \beta_{43} & 0 \end{bmatrix} \begin{bmatrix} \eta_1 \\ \eta_2 \\ \eta_3 \\ \eta_4 \end{bmatrix} + \begin{bmatrix} \gamma_{11} & \gamma_{12} & \gamma_{13} & 0 & 0 & 0 & 0 & 0 & 0 \\ \gamma_{21} & \gamma_{22} & \gamma_{23} & \gamma_{24} & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & \gamma_{34} & \gamma_{35} & \gamma_{36} & \gamma_{37} & \gamma_{38} & \gamma_{39} \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} \xi_1 \\ \xi_2 \\ \xi_3 \\ \xi_4 \\ \xi_5 \\ \xi_6 \\ \xi_7 \\ \xi_8 \\ \xi_9 \end{bmatrix} + \begin{bmatrix} \zeta_1 \\ \zeta_2 \\ \zeta_3 \\ \zeta_4 \end{bmatrix}$$

the latent variables are accurately defined by the indicator variables, before attempting the model fitting procedures in the structural model. The measurement model assessment is concerned with construct validity. Two important dimensions of construct validity are 1) convergent validity, including reliability and 2) discriminant validity.

Convergent validity refers to the degree to which two or more attempts to measure the same construct, by different methods are in agreement (Campbell and Fiske, 1959). Reliability and convergent validity were specifically assessed by examining:

1. the reliability of each measure
2. the composite reliability of each scale - its internal consistency and
3. the average variance extracted by each construct.

The reliability of a measure y is:

$$\rho_y = \frac{\lambda_y^2}{\lambda_y^2 + \text{var}(\varepsilon_y)}$$

where λ_y is the factor loading of y on its associated construct in a single factor model, and ε_y is the error in measurement (Fornell and Larcker, 1981). For standardized variables, this reliability is simply the square of the loading.

Fornell and Larcker (1981) propose a measure of composite reliability or internal consistency as:

$$\rho_\eta = \frac{(\sum_{i=1}^{p} \lambda_{y_i})^2}{(\sum_{i=1}^{p} \lambda_{y_i})^2 + \sum_{i=1}^{p} var(\varepsilon_i)}$$

where the y's are the multiple measures of a construct. Composite reliability is similar to Cronbach's alpha as a measure of reliability except the latter assumes that each indicator of a construct contributes equally - the loadings (λ's) are all set to one.

Fornell and Larcker (1981) propose that to more fully examine the shared variance in the measurement model, the average variance shared with a construct be assessed. The formula is

$$\rho_{vc(\eta)} = \frac{\sum_{i=1}^{p} \lambda_{y_i}^2}{\sum_{i=1}^{p} \lambda_{y_i}^2 + \sum_{i=1}^{p} var(\varepsilon_i)}$$

With standardized variables, this reduces to the mean of the squared loadings of the measures of the construct. Fornell and Larcker suggest that if the shared variance is less that 0.50, i.e., the variance due to error in measurement is greater than that captured by the construct, the convergent validity of the construct is suspect. This measure is a more conservative measure than the composite reliability.

Results

The results of the initial measurement model generated by the LISREL program are shown in Table 6.

Belief: Although this scale was developed and tested by Raub (1981) and later used by Howard (1986), it presented some problems in this study. Items 2 to 5 had loadings of less than 0.5. The reliability of the measures (squared loadings) ranged from 0.030 to 0.080 indicating that error variances were greater than 0.92. The composite reliability was 0.685, which was below the value of 0.8, recommended by Nunally (1967). The weakness of this scale is also shown by the low portion of explained variance. Only 22.5% of the variance was shared with the construct. This scale requires further examination.

Skills: Of the five items in this scale, the loading for the typing skills measure was low (0.317). The reliability of this measure was only 0.10. The loading for microcomputer training was somewhat weak, with a value of 0.476. The other three measures loaded well with values greater than 0.7. The composite reliability was 0.804. However, the portion of variance explained was 0.479, which falls below the threshold value of 0.5. The results indicate that using typing skills as one of the dimensions of computer skills

Table 6

Initial Measurement Model

CONSTRUCT/ Indicator Variable	Standardized Loading	T Value	r^2	Reliability	Portion of Variance Explained
BELIEF				0.685	0.225
belie1	0.531	0.000	0.282		
belie2	0.274	5.001	0.075		
belie3	0.172	3.269	0.030		
belie4	0.177	3.351	0.031		
belie5	0.283	5.142	0.080		
belie6	0.600	8.977	0.360		
belie7	0.675	9.526	0.455		
belie8	0.660	9.428	0.435		
belie9	0.526	8.290	0.276		
SKILLS				0.804	0.479
mframe	0.723	0.000	0.523		
micro	0.476	10.058	0.227		
exp	0.874	18.301	0.764		
compskil	0.883	18.415	0.780		
typskil	0.317	6.686	0.101		
QUALITY				0.964	0.710
qual1	0.866	0.000	0.728		
qual2	0.811	23.541	0.658		
qual3	0.848	25.542	0.719		
qual4	0.826	24.319	0.682		
qual5	0.833	24.686	0.694		
qual6	0.827	24.343	0.683		
qual7	0.853	25.841	0.728		
qual8	0.797	22.820	0.635		
qual9	0.906	29.174	0.820		
qual10	0.856	25.999	0.733		
qual11	0.853	25.828	0.728		
SUPPORT				0.842	0.409
suppo1	0.573	0.000	0.329		
suppo2	0.498	9.174	0.248		
suppo3	0.473	8.804	0.223		
suppo4	0.573	10.203	0.328		
suppo5	0.574	10.224	0.330		
suppo6	0.784	12.533	0.615		
suppo7	0.746	12.175	0.556		
suppo8	0.803	12.694	0.645		
POLICIES					
pol	1.000	0.000	1.000		
PEER USAGE				0.878	0.782
usage1	0.922	0.000	0.850		
growth1	0.846	17.369	0.715		

Table 6 (continued)

Initial Measurement Model

CONSTRUCT/ Indicator Variable	Standardized Loading	T Value	r^2	Reliability	Portion of Variance Explained
MGMT USAGE				0.890	0.802
usage2	0.934	0.000	0.872		
growth2	0.856	17.462	0.733		
SUBOR USAGE				0.833	0.715
usage3	0.908	0.000	0.824		
growth3	0.778	14.727	0.605		
SECT USAGE				0.852	0.742
usage4	0.899	0.000	0.808		
growth4	0.822	14.762	0.676		
ANXIETY				0.820	0.318
anxie1	0.461	0.000	0.213		
anxie2	0.432	7.166	0.187		
anxie3	0.493	7.777	0.243		
anxie4	0.646	8.960	0.417		
anxie5	0.569	8.422	0.323		
anxie6	0.684	9.191	0.468		
anxie7	0.667	9.090	0.445		
anxie8	0.495	7.799	0.245		
anxie9	0.505	7.886	0.255		
anxie10	0.622	8.809	0.387		
ATTITUDE					
cogb	1.000	0.000	1.000		
SUBJ NORMS					
nbmc	1.000	0.000	1.000		
USAGE				0.868	0.584
exusge	0.656	0.000	0.447		
expert	0.561	11.370	0.327		
jobuse	0.737	14.496	0.564		
timeuse	0.873	16.582	0.791		
frequse	0.874	16.592	0.793		

MEASURES OF GOODNESS OF FIT FOR THE WHOLE MODEL:

DEGREES OF FREEDOM	1603	
CHI-SQUARE	4476.36	(p=0.000)
GOODNESS OF FIT INDEX IS	0.768	
ADJUSTED GOODNESS OF FIT INDEX IS	0.743	
ROOT MEAN SQUARE RESIDUAL IS	0.097	

was not appropriate. The measure for computer skills was therefore revised with the typing skills measure excluded.

Quality: This 11-item scale met all of the threshold values. The lowest loading was 0.797, the composite reliability was 0.964 and the percent of variance explained was 0.702. These values indicate a very strong measure.

Support: Five of the items on this scale had loadings between 0.4 and 0.6, while another three had much higher loadings (greater that 0.74). This suggests that the scale might be multidimensional. Evidence of this was also revealed by the portion of variance explained, which was only 0.407. Further examination of this scale is necessary.

Peer, Management, Subordinate and Secretarial Usage: All four of these two-item scales displayed good convergent validity. Loadings on the items ranged from 0.78 to 0.93, composite reliabilities, from 0.83 to 0.89 and portion of variance explained from 0.71 to 0.80. These values are all above the threshold values.

Microcomputer Usage: This scale also exhibited good psychometric properties. Loadings were all greater than 0.5. The reliability was 0.868 and the proportion of variance explained was 0.584.

The preliminary analysis indicates that four of the scales need to be revised from the perspective of reliability and convergent validity. These are: SKILLS, BELIEFS, SUPPORT and ANXIETY. Factor analysis was used to check the multidimensionality of these scales. Although the construct structure might be somewhat different in the factor analytic context than in a structural model, factor analysis is, nevertheless, a useful technique to detect the problems with the scales.

Anxiety Scale

The anxiety scale developed by Raub (1981) and used by Howard (1986) yielded one factor. Howard reported a reliability (Cronbach's alpha) of 0.85. However, as suspected, factor analysis revealed two distinct factors.

The two factors and their loadings and reliabilities were:

Factor 1 - Reliability = 0.677

Variable	Loading	Question
ANXIE1	-0.58007	I am confident I could learn computer skills
ANXIE2	0.59885	I am unsure of my ability to learn a computer programming language
ANXIE3	-0.62290	I will be able to keep up with the important technological advances of computers
ANXIE9	0.72420	I have difficulty understanding most technological matters
ANXIE10	0.70158	Computer terminology sounds like confusing jargon to me

Factor 2 - Reliability = 0.772

Variable	Loading	Question
ANXIE4	0.58238	I feel apprehensive about using a computer terminal
ANXIE5	0.70835	If given the opportunity to use a computer, I am afraid I might damage it in some way
ANXIE6	0.82215	I have avoided computers because they are unfamiliar to me
ANXIE7	0.81457	I hesitate to use a computer for fear of making mistakes that I cannot correct
ANXIE8	0.50551	I am unsure of my ability to interpret the output from a microcomputer.

These factors reflect two different aspects of computer anxiety. Factor 1 represents a broader, and more general aspect. It indicates a concern about computer technology and terminology, and a fear of not being able to acquire computer skills. These can be termed general anxiety, or technology anxiety. Factor 2 indicates a more specific aspect of computer anxiety - an anxiety about using microcomputers. Each of the questions indicates some aspect of fear of using computers. This second factor is more relevant to this study, where attitudes towards usage and actual usage of microcomputers are the key variables to be examined. This factor was therefore incorporated into the revised model.

Management Support Scale

This scale was developed specially for this study, and has

not, therefore been tested. As indicated in the initial measurement model, it might contain more than one factor. In fact, factor analysis revealed two factors.

Factor 1 - Reliability = 0.830

Variable	Loading	Question
SUPPO1	0.61294	I am convinced that management is sure as to what benefits can be achieved with the use of micros
SUPPO5	0.74669	I am always supported and encouraged by my boss to use the computers in the performance of my job
SUPPO6	0.77369	Management have provided most of the necessary help and resources to get to get us used to the computers quickly
SUPPO7	0.66717	We are constantly updated on new software that can help us use the microcomputers more effectively
SUPPO8	0.83689	Management is really keen to see that we are happy with using these microcomputers

Factor 2 - Reliability = 0.698

Variable	Loading	Question
SUPPO2	0.78696	There is always a person in the organization whom we can turn to for help in solving problems with the computer system
SUPPO3	0.85822	A central support group (eg. information centre) is available to help with problems
SUPPO4	0.61134	Training courses are readily available for us to improve ourselves in the use of microcomputers

Examination of the questions indicates a difference in the nature of the management support corresponding to the two factors. Factor 2 reveals a more tangible and specific form of support. It requires the provision of physical resources

to provide this support, eg. investment in an information centre, training resources or a hot line.

On the other hand, Factor 1 incorporates more generalized organization support or encouragement, as opposed to providing specific physical resources. It indicates an environment where computer usage is looked upon as important, and managers are viewed positively if they use microcomputers in the execution of their jobs. Both factors should have relevance in microcomputer support and usage, but the first factor was chosen to be incorporated into the case of microcomputer usage. It is felt that an atmosphere of encouragement and positiveness about microcomputer usage would be more important than just providing physical resources.

Beliefs about the Impact of Computers

This scale was used by Howard (1986) to measure the respondent's beliefs about the impact of computers on society. It is a one factor scale with a reliability coefficient (Cronbach's alpha) of 0.76 with n = 111. However, in this study, factor analysis indicated two factors.

Factor 1 - Reliability = 0.700

Variable	Loading	Question

BELIE1	0.61896	Computerizing businesses will have the effect of making jobs more mechanical and less personal
BELIE2	0.40560	In the future, power will be concentrated in the hands of the technology elite
BELIE5	0.36070	Human beings will misuse the power of the computer
BELIE6	0.66699	Computers are changing the world too rapidly
BELIE7	0.70626	Our country relies too much on computers
BELIE8	0.72445	Computers dehumanize society by treating everyone as a number
BELIE9	0.67964	Computers have the potential to control our lives

Factor 2 - Reliability = 0.334

Variable	Loading	Question
BELIE3	-0.73763	Computers are beneficial aids to modern society
BELIE4	-0.75749	Computers will create more jobs than they will eliminate

It is difficult to understand the reason for these two separate factors. Questions 3 and 4 seem to tap the same meaning as all the other factors, but their loadings on factor 1 were only 0.06782 and 0.06794 respectively. The only reason may be that their wording is positive, whereas the other items are negatively phrased. Respondents may have had some problems in answering these two items. They load heavily on factor 2, but it is not clear how to interpret this factor differently from factor 1. The reliability of this factor is also rather low. Examination of factor 1 indicates that items 2 and 5 had much lower loadings than the other five items. A reliability analysis indicated that the reliability of the scale would increase if these two

items were excluded. Therefore, the final scale used in the revised model consisted of items 1, 6, 7, 8 and 9.

Table 7 shows the revised measurement model. Apart from the four scales that were changed, the loadings, reliabilities and variance explained for the other 7 multiple indicator constructs did not change appreciably. Comments on the four scales that were amended follow.

Skills. The exclusion of the measure, typing skills, from this construct improved both the composite reliability and the portion of variance explained to 0.838 and 0.576, respectively. Both these values indicate that the revised scale is a strong measure for the construct, skills.

Beliefs. With the elimination of 4 of the indicators, the composite reliability improved from 0.685 to 0.737 and the portion of variance explained increased from 0.203 to 0.362. These are significant improvements. However, both values are still below the threshold values of 0.8 for composite reliability and 0.5 for variance explained. Further improvement in the scale is not possible in the present circumstance, and for this study, the scale will be used in this revised form.

Support. Removing three of the indicators from this 8 item scale resulted in a small decrease in the composite

Table 7

Revised Measurement Model

CONSTRUCT/ Indicator Variable	Standardized Loading	T Value	r^2	Reliability	Portion of Variance Explained
BELIEF				0.737	0.362
belie1	0.533	0.000	0.284		
belie6	0.579	8.687	0.335		
belie7	0.662	9.307	0.439		
belie8	0.680	9.406	0.462		
belie9	0.538	8.312	0.289		
SKILLS				0.838	0.576
mframe	0.730	0.000	0.533		
micro	0.477	10.093	0.227		
exp	0.891	18.641	0.795		
compskil	0.865	18.340	0.749		
QUALITY				0.964	0.712
qual1	0.866	0.000	0.751		
qual2	0.811	23.553	0.658		
qual3	0.848	25.560	0.720		
qual4	0.826	24.329	0.682		
qual5	0.833	24.688	0.693		
qual6	0.826	24.349	0.683		
qual7	0.853	25.852	0.728		
qual8	0.797	22.834	0.635		
qual9	0.906	29.193	0.820		
qual10	0.856	26.003	0.733		
qual11	0.853	25.835	0.728		
SUPPORT				0.833	0.505
suppo1	0.577	0.000	0.333		
suppo5	0.605	10.567	0.366		
suppo6	0.772	12.375	0.597		
suppo7	0.725	11.924	0.526		
suppo8	0.840	12.898	0.705		
POLICIES					
pol	1.000	0.000	1.000		
PEER USAGE				0.878	0.782
usage1	0.924	0.000	0.854		
growth1	0.843	17.363	0.711		

Table 7 (continued)

Revised Measurement Model

CONSTRUCT/ Indicator Variable	Standardized Loading	T Value	r^2	Reliability	Portion of Variance Explained
MGMT USAGE				0.890	0.803
usage2	0.939	0.000	0.881		
growth2	0.851	17.308	0.725		
SUBOR USAGE				0.833	0.715
usage3	0.910	0.000	0.828		
growth3	0.776	14.595	0.602		
SECT USAGE				0.852	0.742
usage4	0.899	0.000	0.808		
growth4	0.822	14.731	0.676		
ANXIETY				0.786	0.431
anxie4	0.634	0.000	0.403		
anxie5	0.608	10.972	0.370		
anxie6	0.781	13.019	0.611		
anxie7	0.738	12.618	0.545		
anxie8	0.474	8.917	0.224		
ATTITUDE					
cogb	1.000	0.000	1.000		
SUBJ NORMS					
nbmc	1.000	0.000	1.000		
USAGE				0.869	0.584
exusge	0.657	0.000	0.447		
expert	0.562	11.388	0.327		
jobuse	0.738	14.519	0.564		
timeuse	0.874	16.609	0.791		
frequse	0.875	16.619	0.793		

MEASURES OF GOODNESS OF FIT FOR THE WHOLE MODEL:

DEGREES OF FREEDOM	940	
CHI-SQUARE	3192.56	(p=0.000)
GOODNESS OF FIT INDEX IS	0.790	
ADJUSTED GOODNESS OF FIT INDEX IS	0.758	
ROOT MEAN SQUARE RESIDUAL IS	0.113	

reliability (0.841 to 0.833) but a significant improvement in the portion of variance explained (0.407 to 0.505). This represents a definite improvement over the original version of the scale. It is acceptable according to the threshold values.

Anxiety. This scale poses some problems. For the new five-item scale, the composite reliability fell from 0.816 to 0.786, and the portion of variance explained increased from 0.318 to 0.431. Since the decrease in reliability is small compared to the increase in portion of variance explained, the newer five-item scale is preferable. To further justify the use of the shortened version of the scale, the factor analysis procedure revealed two very different factors, (1) anxiety about computers and computer technology and (2) anxiety about using computers. This second factor was found to have more relevance for the study which concerns attitudes about usage and actual use of microcomputers.

To assess the improvement in the measurement model, the difference in chi-square and degrees of freedom was calculated:

	Initial Model	Revised Model	Difference
Chi-square	4476.36	3192.56	1283.80
Degrees of Freedom	1602	940	626

Joreskog and Sorbom (1986) state that

> a large drop in chi-square compared to the difference in degrees of freedom, indicates that the changes made in the model represent a real improvement. On the other hand, a drop in chi-square close to the difference in number of degrees of freedom indicates that the improvement in fit is obtained by "capitalizing on chance", and the added parameters may not have real significance and meaning.

Under this criterion, the difference in chi-square of 1283 with a decrease of 626 degrees of freedom represents a real improvement in the model.

Following Lomax (1982), the next step in the analysis is to examine the possibility of correlated error terms.

One of the strengths of LISREL structural equation modeling, unlike most other statistical techniques, is that correlation between error terms is allowed. Examination of the matrices of modification indices in the LISREL output enables one to assess which error terms are likely to be correlated. It can be shown that this modification index equals the expected decrease in chi-square if a single

constraint is relaxed and all estimated parameters are held fixed at their estimated values. The fixed parameter corresponding to the largest such index is the one which, when relaxed, will improve fit maximally. The improvement in fit is measured by a reduction in chi-square which will be at least as large as the modification index. However, this procedure should be applied with caution. It is recommended that this only be used if relaxing a parameter makes sense from a substantive point of view, and when the values of the parameter can be clearly interpreted (Joreskog and Sorbom, 1986).

An inspection of the output of modification indices showed that the largest value of 389.99, was the parameter connecting the error terms for QUAL4 and QUAL5. This indicates that if the error terms between the indicators QUAL4 and QUAL5 are allowed to covary (instead of being fixed at 0), the decrease in chi-square of the whole model will be at least 389.99. The wordings of the two questions were:

QUAL4 Promptness of maintenance and repair

QUAL5 Quality of maintenance and repair

There is a good reason why the error terms might be correlated for these two questions. The focus that respondents took was on maintenance and repair, rather than on quality. The parameter was relaxed allowing the error terms in the two items to covary.

The next parameter to be relaxed was between EXUSGE (extent of usage) and EXPERT (experience in usage). There is an indication of method bias between these two measures. The third parameter relaxed was between BELIEF6 and BELIEF7. The problem in this instance can be attributed to the wording of the questions. The result of freeing these three parameters was a marked improvement in the model as measured by the drop in chi-square. With a loss of 3 degrees of freedom, the chi-square fell by 744. (See Table below)

	Model with Error terms Constrained	Model with Error terms Relaxed	Difference
Chi-square	3192.56	2447.84	744.72
Degrees of Freedom	940	937	3

Further relaxation of correlations between error terms could not be substantively justified, and the measurement part of the model was allowed to stand.

It should be noted that relaxing the correlated error terms did not materially change the loadings of the indicators on the different latent variables.

Summary

On the whole, the measurement model was satisfactory. Apart

from the belief and anxiety scales, the other eight multiple indicator scales exhibited strong psychometric properties for both convergent validity and reliability.

It is surprising that the two scales, borrowed from other researchers did not meet the criteria for either composite reliability or portion of variance explained. Elimination of weaker items in the scales did improve the measures but their psychometric properties were still questionable. One approach to this problem is to assume that the scales are good, since they have been used and tested in other studies, and therefore use them despite their weak measurement properties. The other approach is to revise the scale as dictated by the data in the current study. The major advantage of the former approach is that the results of the study will be directly comparable with prior studies. However, if there are strong reasons for taking the latter approach, it should be pursued.

For this study, the second approach was taken. The scales were revised and improved before proceeding with analysis of the structural model. There are three reasons which justify this action.

First, although the two scales used in this study were the same as those used by Howard (1986), the samples for the studies were different. Howard used 111 executive MBA

students; this study used 519 practicing managers. One might argue that these two populations are not really that different. However, it is envisaged that managers attending MBA classes, taking courses in computers, could have a different outlook on computers and their impacts than managers who are not MBA students.

Second, the time lapse between the two studies could also have an effect. In the intervening four years, there has been a tremendous increase in the number of personal computers used in business. (Business Week of Nov. 30 1987 reported that shipments of personal computers in 1983 was approximately $10 billion The projected 1987 shipments amounted to $25 billion). Public awareness of computers, their uses, problems and impacts has also increased. Stories about computers appear frequently in the popular press and other media. All these events would certainly have an effect on peoples' awareness of the impact of computers, and their anxiety towards them.

Third, the sample sizes for the two studies are significantly different. It is possible that the larger sample size used in this study would have greater statistical power to detect differences in the scales that was not possible with Howard's smaller sample.

Evaluation of Structural Model

Given the revised measurement model, the hypothesized structural model is evaluated. Table 8 gives the values of the path coefficients, the corresponding standard errors and t-values.

The next step is to assess the reasonableness of this model. As suggested by Joreskog and Sorbom (1986), the following quantities should be examined;

1. Parameter estimates which have negative variances, correlations which are larger than one in magnitude, covariance or correlation matrices which are not positive definite.
2. Extremely large standard errors
3. Squared multiple correlations or coefficients of determination which are negative.
4. Parameter estimates which are correlated very highly.

Based on the above criteria, the model appears to be strong.

The next step is to assess the goodness of fit of the model. One goodness of fit indicator is the chi-square statistic. Bearing in mind its problems, the chi-square will not be used as a test statistic but as an indication of fit. The fit is assessed in the sense that large values indicate poor fit, and small values indicate good fit. The degrees of freedom serves as the standard by which to judge whether chi-square is large or small. A value of chi-square which is

Table 8

Maximum Likelihood Parameter Estimates
Initial Structural Model

Parameter	Path	Standard Error	T Value	Standardized Value	
beta21	ANXIETY-->ATTITUDE	0.089	-3.009	-0.169	**
beta42	ATTITUDE-->USAGE	0.031	8.807	0.431	**
beta43	NORMS-->USAGE	0.027	3.684	0.160	**
gamma11	BELIEFS-->ANXIETY	0.063	-1.876	-0.105	
gamma12	SKILLS-->ANXIETY	0.053	-6.517	-0.397	**
gamma13	QUALITY-->ANXIETY	0.037	-4.604	-0.232	**
gamma21	BELIEFS-->ATTITUDE	0.091	3.412	0.175	**
gamma22	SKILLS-->ATTITUDE	0.074	1.816	0.098	
gamma23	QUALITY-->ATTITUDE	0.053	5.204	0.240	**
gamma24	SUPPORT-->ATTITUDE	0.077	3.746	0.168	**
gamma34	SUPPORT-->NORMS	0.103	4.741	0.280	**
gamma35	POLICIES-->NORMS	0.047	-1.802	-0.084	
gamma36	PEERUSE-->NORMS	0.063	2.360	0.137	*
gamma37	MGMTUSE-->NORMS	0.059	3.154	0.175	**
gamma38	SUBORUSE-->NORMS	0.069	-0.152	-0.010	
gamma39	SECTUSE-->NORMS	0.065	-0.688	-0.040	

** p < .01

* p < .05

Squared Multiple Correlations for Structural Equations

ANXIETY	ATTITUDE	NORMS	USAGE
0.322	0.284	0.184	0.222

TOTAL COEFFICIENT OF DETERMINATION
FOR STRUCTURAL EQUATIONS 0.535

MEASURES OF GOODNESS OF FIT FOR THE WHOLE MODEL:

DEGREES OF FREEDOM	937	
CHI-SQUARE	2447.84	(p=0.000)
GOODNESS OF FIT INDEX IS	0.825	
ADJUSTED GOODNESS OF FIT INDEX IS	0.799	
ROOT MEAN SQUARE RESIDUAL IS	0.112	
TUCKER & LEWIS COEFFICIENT	0.955	

Note: All parameters are fully standardized
Variances of indicators are equal to 1

less than 5 times the number of degrees of freedom can be considered adequate for large models. (Wheaton, et. al., 1977). Using this test, the value of chi-square of 2447 for 937 degrees of freedom indicates a reasonably good fit.

Another criterion is the goodness of fit index and adjusted goodness of fit index. The values of 0.825 and 0.799 respectively, though reasonable, are somewhat low.

Bagozzi (1980) suggests that the Tucker and Lewis coefficient can used to give an indication of goodness of fit. This coefficient, unlike the chi-square statistic, is not as sensitive to sample size. The Tucker and Lewis coefficient for this model was 0.955, which does indicate a reasonable fit.

A third criterion is the root mean square residual. This is a measure of the average of the residual variances and covariances. The value obtained in the model was 0.112, and is somewhat high, indicating a poor fit.

For an overall evaluation, the goodness of fit cannot be said to be excellent, but given the large number of parameters to be estimated, it is reasonable.

The next step in the process is to improve the fit of the model according to Step II of Lomax (1982). The path

coefficients (beta's and gamma's) were examined to see if any were significantly different from 0. Parameters, whose t-values are greater than 2 or less than -2, are judged to be different from 0 (Joreskog and Sorbom, 1986). For the initial structural model five parameters (t-values) fell into this group. They were gamma11 (-1.876), gamma22 (1.816), gamma35 (-1.802), gamma38 (-0.152) and gamma39 (-0.688).

These values were all fixed at zero and the model re-analyzed. The results are shown in Table 9.

There was a very small improvement in the model (a reduction of chi-square of 407 with a loss of 185 degrees of freedom). The Tucker and Lewis coefficient also indicated a marginally better fit (an increase in value from 0.955 to 0.959). However, the root means square residual increased from 0.112 to 0.125, an indication of a poorer fit. These uncertain results are partly explained by the fact that 3 of the 5 paths. that were fixed at 0 had t-values reasonably close to 2. The values were not significant at $p<0.05$ but were significant at $p<0.10$. The indication is that the parameters might not have truly been zero, which could partly explain the discrepancies in the results. A comparison of the path coefficients, squared multiple correlations and coefficient of determination for the initial and revised models indicated that the values were only marginally different. It

Table 9

Maximum Likelihood Parameter Estimates
Revised Structural Model

Parameter	Path	Standard Error	T Value	Standardized Value	
beta21	ANXIETY-->ATTITUDE	0.079	-4.314	-0.216	**
beta42	ATTITUDE-->USAGE	0.031	8.787	0.430	**
beta43	NORMS-->USAGE	0.027	3.682	0.160	**
gamma11	BELIEFS-->ANXIETY			0.000	
gamma12	SKILLS-->ANXIETY	0.052	-7.450	-0.442	**
gamma13	QUALITY-->ANXIETY	0.037	-4.502	-0.227	**
gamma21	BELIEFS-->ATTITUDE	0.087	4.216	0.208	**
gamma22	SKILLS-->ATTITUDE			0.000	
gamma23	QUALITY-->ATTITUDE	0.052	5.538	0.254	**
gamma24	SUPPORT-->ATTITUDE	0.079	3.894	0.176	**
gamma34	SUPPORT-->NORMS	0.092	4.621	0.244	**
gamma35	POLICIES-->NORMS			0.000	
gamma36	PEERUSE-->NORMS	0.059	2.288	0.125	*
gamma37	MGMTUSE-->NORMS	0.058	3.113	0.168	**
gamma38	SUBORUSE-->NORMS			0.000	
gamma39	SECTUSE-->NORMS			0.000	

** p < .01

* p < .05

Squared Multiple Correlations for Structural Equations

ANXIETY	ATTITUDE	NORMS	USAGE
0.321	0.283	0.177	0.222

TOTAL COEFFICIENT OF DETERMINATION
FOR STRUCTURAL EQUATIONS 0.532

MEASURES OF GOODNESS OF FIT FOR THE WHOLE MODEL:

DEGREES OF FREEDOM	752	
CHI-SQUARE	2040.17	(p=0.000)
GOODNESS OF FIT INDEX IS	0.837	
ADJUSTED GOODNESS OF FIT INDEX IS	0.813	
ROOT MEAN SQUARE RESIDUAL IS	0.125	
TUCKER & LEWIS COEFFICIENT	0.959	

Note: All parameters are fully standardized
Variances of indicators are equal to 1

was decided that since there was very little difference in the two models, the initial model would be used for further analysis, since it contained more information.

In the next step of the process (Lomax, step 12), the modification indices were examined to select the fixed parameters of betas and gammas, that could be relaxed to improve the fit of the model. Such a path, for which relaxation could be substantively justified from a theoretical perspective, was not found. The initial model was therefore, retained for purposes of interpretation.

Testing of Propositions

This section interprets the results of the structural model to provide evidence for support or lack of support for each of the propositions presented in Chapter 3. These propositions were tested by examining the betas and gammas in the structural model and their statistical significance. Each proposition is restated, and evidence for support will be given. The model including the path coefficients, is shown in Figure 5 on page 144

Proposition 1. Microcomputer usage will be higher for users who have positive attitudes towards using microcomputers.

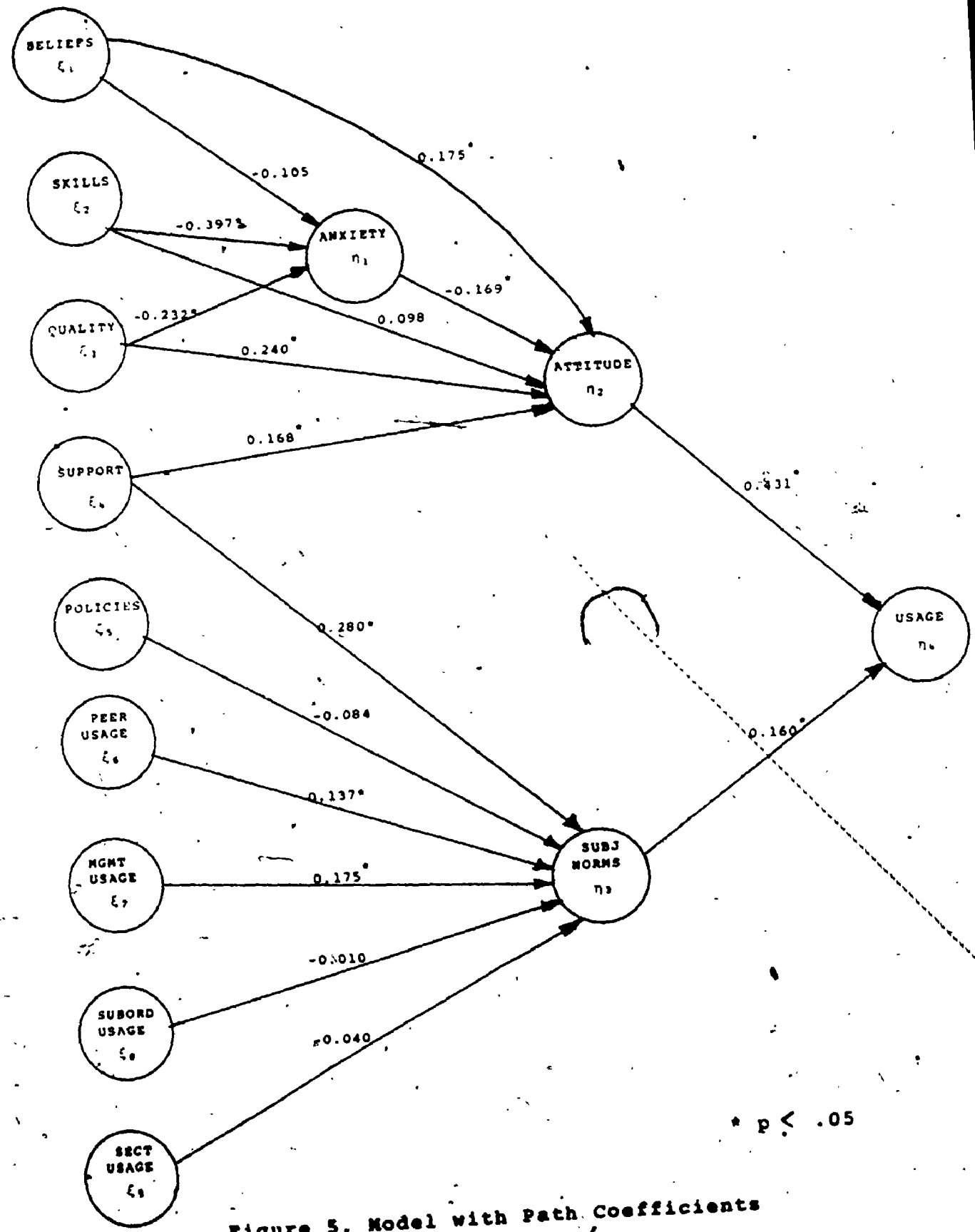


Figure 5. Model with Path Coefficients

There is very strong support for this proposition (beta = 0.431, p < .001). This is the strongest link in the whole model. The implication is that attitudes towards using microcomputers play a strong role in determining microcomputer usage. These attitudes are based on the belief that computers are useful to managers in the performance of their jobs.

Proposition 2. Microcomputer usage will be higher for users who believe that the subjective norms to computer usage in the organization support computer usage.

There is support for this proposition (beta = 0.160, p <.001), although the relationship is not as strong as that for attitudes. As proposed by Fishbein, both attitudes and norms are important determinants of microcomputer usage behaviour.

Proposition 3. Users who believe that computers have a largely positive impact on society will have a more favourable attitude towards using microcomputers.

There is support for this relationship (gamma = 0.175, p < 0.001). This is contrary to Howard's (1986) study. He found only a spurious correlation. The statistical evidence in this relationship is quite strong. There are two possible reasons for the discrepancy. First, the scale for the beliefs about the impact of computers was changed in this study. The instrument, though it had fewer items, was a

stronger measure. Second, the sample size for this study was larger. The better measurement properties of the scale and the larger statistical power may explain why this relationship was significant in this study and not in Howard's.

Proposition 4. Users with higher levels of computer anxiety will have less favourable attitudes towards their use of microcomputers.

Anxiety is shown here to have a negative influence on attitudes (gamma = -0.169, $p < .01$). Managers with higher levels of computer anxiety had less favourable attitudes towards using microcomputers. Howard also found a strong significant negative relationship.

Proposition 5. Users with better computer skills will have more positive attitudes towards their use of microcomputers.

Statistical evidence of this link was not supported (beta = 0.098 at $p < .05$), although it was supported at $p < .10$. This is a rather surprising finding. Computer skills were a composite of training and experience and most the empirical evidence showed strong correlations between training or experience and attitudes (Schewe, 1976; Rivard, 1982). Although the direct effect is small and not significant, the total effect is much larger (0.225). There is an indirect effect through the anxiety construct. Better computer skills

cause managers to be less anxious about using computers (to be shown later) and managers with lower anxiety about computers would have more positive attitudes towards using them. The indirect effect, through an intervening variable accounted for much of the correlation between these two variables.

Proposition 6. Users who have high quality, highly functional and user friendly systems will have more positive attitudes towards using them.

There is evidence of a strong relationship in the data (gamma = 0.240, $p < .001$) between quality of the system and attitudes.

Proposition 7. Users who perceive that support for computer usage is high will have more positive attitudes towards using microcomputers.

This proposition is supported (gamma = 0.168, $p < .001$). As defined earlier, this construct represents organizational support, wherein management provided encouragement and a sense of positiveness about computer usage in the organization.

Proposition 8. Users with more favourable assessments of the possible impact of computers will have lower levels of computer anxiety.

This proposition with (gamma = -0.105, $p < .1$) was not supported at the level of $p < .05$, but was supported at $p < .1$. Howard's study found stronger support for this proposition. He found that users with with less positive attitudes about what computer technology is doing to society, were more anxious about them. The reason for this difference in results, is attributed to the change in the anxiety scale. Howard's scale not only consisted of items relating to anxiety about usage but also anxiety about computers in general. This study confined the measure only to anxiety about usage. Beliefs about the evil effects of computers on society might not make people anxious about using them, but might lead to negative attitudes about using them (as shown earlier). Cases have been cited of people who refuse to use automated teller machines, not because they were afraid of or unsure about using them but because they believed the widespread use of these machines would cause loss of jobs.

Proposition 9. Users with higher computer skills will have lower levels of computer anxiety.

Proposition 10. Users who have high quality, highly functional and user friendly systems will have lower levels of computer anxiety.

Both the above propositions were strongly supported. For proposition, 9, gamma = -0.397 at $p < .001$ and for

proposition 10, gamma = -0.232 at p < .001. Computer skills acquired through training play a very important role in alleviating computer anxiety. Functional, user friendly systems were also important in helping reduce the anxiety of managers toward using computers.

Proposition 11. Users who perceive that support for computer usage is high will believe that the subjective norms in the organization support computer usage.

This proposition is strongly supported (gamma = 0.280, p <.001). Managers who believe that upper management has provided the organizational resources for improving the usage of computers in the workplace, will feel the social pressures to use them.

Proposition 12. Users who perceive that computer policies are helpful and encourage the use of computers will believe that the subjective norms in the organization for computer usage are high.

This proposition was not supported (gamma = 0.084, p <.1). The instrument used to measure policies did not question the existence of policies, rather it assessed whether these policies were a help or a hindrance. As reported earlier, most people gave a neutral reply, since in many of the organizations, computer policies were, to a large extent, non-existent. This indifference to the usefulness of

policies resulted in the insignificant relationship with subjective norms.

Proposition 13. High levels of peer usage of microcomputers will lead users to believe that the subjective norms in the organization support computer usage.

Proposition 14. High levels of upper management usage of microcomputers will lead users to believe that the subjective norms in the organization support computer usage.

Support for both these propositions was evident in the data. For proposition 13, gamma = 0.137, $p < .002$, and for proposition 14, gamma = 0.175, $p < .001$. The presence of peer managers and higher level managers who use their own systems extensively led users to believe that they should be using them too. Furthermore, the data indicate that upper management usage has a stronger effect on perceived subjective norms than peer management usage.

Proposition 15. High levels of subordinate usage of microcomputers will lead users to believe that the subjective norms in the organization support computer usage.

Proposition 16. High levels of secretarial usage of microcomputers will lead users to believe that the subjective norms in the organization support computer usage.

Neither of these propositions was supported. Extensive use by subordinates or secretaries was not perceived by the managers to have an influence on their usage decisions. This

is not unexpected since these managers think it is the job of their subordinates or secretaries to use computers in the pursuit of their tasks, but that they are not influenced by it.

Analysis of Qualitative Data

This section examines the qualitative responses in the questionnaire. Respondents were asked in the final question to suggest ways in which microcomputers can be used more effectively. The question was

> In this final section, we would like to find out in what ways you think that microcomputer usage can be improved in your organization. Please list any suggestions you may have in making microcomputer usage more effective and efficient.

Of the 519 questionnaires returned, 325 respondents from 50 companies had comments. In all, there were 629 items, distributed according to table 10.

The most frequently cited response to improving usage was training. Ninety two (15% of the 629 comments or about a third of the managers) indicated that provision of more training would help them in their use of microcomputers. This result is not unexpected. As reported earlier, 22% of respondents learned how to use microcomputers entirely through self study, which was, quite likely inadequate. There were many suggestions on how training could be

Table 10

Responses to Open Ended Question

Description	No.	Percent of total Comments	Percent of total Managers
Training	92	14.6	28.3
Links to Mainframe	60	9.5	18.5
PC Networked	48	7.6	14.8
Exchange of Information	44	7.0	13.5
Educate Senior Managers	37	5.9	11.4
Support	34	5.4	10.5
Microcomputer Policies	31	4.9	9.5
Standardization	31	4.9	9.5
More PC's	29	4.6	8.9
Easier access to PC's	29	4.6	8.9
More user friendly	20	3.2	6.2
Common Data Base	20	3.2	6.2
Electronic Mail facility	19	3.0	5.8
Better Documentation	16	2.5	4.9
Proper Planning	15	2.4	4.6
Better printers	13	2.1	4.0
Better quality systems	13	2.1	4.0
Information Centre Support	12	1.9	3.7
Purchase Plans	9	1.4	2.8
More functions	8	1.3	2.5
Access to home use	6	1.0	1.8
Provision of Backups	5	0.8	1.5
More Encouragement	4	0.6	1.2
Better Security	4	0.6	1.2
Other	30	4.8	9.2
	629	100.0	194.7

improved. The preference expressed was for more in-house courses. Those provided by vendors or outside consultants were too general, and were not job or organization specific. The respondents suggested that the most advanced users in the organization should be giving training, since they were the most familiar with the packages, the job and the organization. Other suggestions for training included, quick half-hour overviews, using tutorial packages, and evening or weekend sessions. There was a common lament from a group of advanced users, who said that "training should be ongoing, not a 'one shot deal' when new systems are acquired." These users felt the need for newer and easier ways to do what they were currently doing on their system.

An idea, closely linked to the need for more training, was the need for more exchange of information. Eight percent of the comments raised this point. There was a perception, that a few people in the organizations knew a great deal about the systems, but the information was not shared. The ways suggested for achieving greater sharing of knowledge was the conducting of seminars, having user group meetings, organizing "show and tell" sessions, and disseminating newsletters and catalogues of available and upcoming user features.

Another way suggested for increasing usage was the education of upper levels of management. In all 37 or 7% of the

comments included this. The sentiment expressed was the need for "automating" upper management. As cited by one respondent,

> Our organization is taking a bottom up approach. I am a firm believer in top down, where senior management is first initiated in basic programming to assist in developing "straight line" or problem to solution thinking (rather than the circular thinking human instinct), then provided with the resources (time and equipment) to allow familiarization and gain basic knowledge. Senior management will then have the ability to direct, and control, and in many cases, force subordinates to use micros efficiently and effectively. If we wait for the current new hires (students, etc.) who are computer literate to work up through the system, it will be quite some time before we have senior managers who can properly control the micro office environment, by which point there will be numerous bad habits and inefficiencies to change.

Another manager expressed:

> Management must "create the need" to use microcomputers. That is, expectations must be increased so that subordinates have an incentive to use the tools. Where possible, establish measurable objectives and goals for managers, only achievable via usage of PC's. Without these benefits there will not be a difference in the performance of users and thus no incentive for using automated tools.

Great demand was expressed for networked PC's and links to the mainframes. In all, 9% of the comments suggested networks and 7% suggested mainframe links. The reason given was that much time was spent re-entering data, already available on the mainframe, into the PC's for analysis. The managers felt that the time used for such tasks was wasted. Similar comments were expressed about networked PC's. There often arose a need to exchange data with other managers, and diskette transfer was bothersome, time-consuming and

unreliable. Related to the linking of the systems, was a need for a common data base and electronic mail facility. One respondent said,

> More widespread use of electronic would enormously increase usage. The corporate culture should no more permit one to ignore electronic mail than it permits one to ignore paper mail.

Five percent of the comments were about the need for more effective microcomputer policies. They were policies regarding acquisitions for both hardware and software, controls for accuracy and integrity of data, using corporate data, backup of systems, documentation, proper procedures on repair and maintenance, data access and security. This need was be summed up by one manager who said,

> We need a plan with regard to the employment of microcomputers in the workplace. To this point it has been ad hoc; but some computers have found their way in. Some policies concerning purchase of both hardware and software are needed. Disagreement at the top level as to the kind of systems we should have results in lack of consistency (a likely weakening of purchasing power). Managers (often lacking experience) are making decisions about design and purchase of hardware and software without benefit of objective expertise.

Specific policy issues raised were the lack of standardization and compatibility in hardware, software, documentation and user interface. A group of managers expressed frustration with the lack of integration, the need

to learn different systems, and the inability to communicate across systems.

A number of comments raised issues about the quality aspects of the system. The managers expressed the need for better quality machines (2%), more user friendly systems (3%) and more readable documentation. Problems with documentation were summed up by one respondent,

> Improve on users manuals! Manuals are generally written by technical people for technical people and are therefore difficult to understand especially if you are a self teaching person. Contrast computer manuals with those supplied with other consumer products i.e. intelligent telephones, recorders, stereos etc and you will find greater use of pictures and examples. MS-DOS manuals generally do not give enough examples of various combinations that can occur when using commands such as copy etc. I believe that lack of good user manuals is what turns people off microcomputers.

Summary

This chapter presented the data analysis technique and the results of the survey. Structural equation modeling, using LISREL as the statistical technique was used to analyze the data. The analysis indicated the hypothesized model, though not excellent was reasonably strong. The conclusion is

that Fishbein's Theory of Reasoned Action is appropriate for the study of microcomputer usage.

An important finding in the descriptive data was that subjective norms have an independent effect on computer usage. This relationship was not discussed in any previous research. Managers in the organizations had notably positive attitudes towards computer usage and there was very little incidence of computer anxiety. Usage was moderate and the levels of expertise was quite low. Training in microcomputers was low, with a large part of it obtained through self study. In the test of the model, 11 of the 16 propositions were supported. Attitudes and subjective norms were important determinants of microcomputer usage behaviour, with attitudes having the stronger effect.

The qualitative responses reflected closely the results obtained from the quantitative data. Training was the most important issue raised. The lack of use by upper management in the numerical data was reflected in the qualitative data as well. A number of managers thought education of top management would increase usage at the lower levels. This compatibility in the results adds a certain validity to the data.

CHAPTER 6 - SUMMARY AND IMPLICATIONS

The purpose of this chapter is to summarize the research study. It includes a review of the purpose of the study, the methodology employed, the findings and some strengths and limitations of the research and suggestions for future research. It concludes with a list of implications of the research for management.

Summary of Purpose of Research

The purpose of this study was to investigate the factors that contribute to microcomputer usage by managers in organizations. A conceptual model of microcomputer usage was developed. The model was based on Fishbein's theory of reasoned action, which states that a person's behaviour has two determinants, attitudes towards the behaviour and the subjective norms or social influences that motivate performance of the behaviour. This model and its relationships was empirically tested with data gathered from a number of organizations.

Summary of Methodology

The method of investigation was a field study using a

questionnaire as the data collection instrument. In all, 54 corporations from the list of Canadian largest 500 companies, participated in the study. A large diversity of industries - banking, insurance, manufacturers, resource companies, wholesalers and retailers, was represented in the sample of companies.

An average of 10 managers from each company responded to the survey, yielding a total of 519 completed questionnaires. These managers held a great variety of positions in their companies and represented all levels of management.

Summary of Variables used and Measurement Model

The data used for the study was obtained from 120 items in the questionnaire. Combinations of these items were used to measure the 13 constructs represented in the model.

The usage construct was of central importance in the research. This was a new scale developed to overcome many of the weaknesses in the scales that have been used in earlier research. This scale was designed to tap 5 different dimensions of usage; time, frequency, expertise, extent of usage and purpose of use. This scale showed high reliability and convergent reliability.

New scales were also developed to measure attitudes towards computer usage and subjective norms. Both were generated according to procedures suggested by Ajzen and Fishbein (1980). The attitude scale was created as a combination of the respondents' beliefs about the outcome of computer usage, and their ratings of the importance of these outcomes. Similarly, the scale for subjective norms was a combination of the ratings of the perceived social influences towards computer usage, and the likelihood of the respondents' motivation to comply with these pressure.

The beliefs about impact of computers on society and the anxiety scale were from a study by Howard (1986). Both these multiple indicator scales presented some measurement problems. The scales were modified for use in the testing of the model.

The scale to measure management support was an 8 item measure. It was shortened to 5 items to improve its psychometric properties. All the other multiple indicator scales showed high reliabilities and convergent validity. Microcomputer policies and typing skills were measured with single item scales.

The measurement portion of the model was moderately strong. All the scales, except the two from previous research showed very good measurement properties.

Summary of findings

In this section, a summary of the findings of the descriptive data, the statistical analysis, and the qualitative analysis will be presented.

Descriptive Data

The results from the descriptive data were comparable to many of the previous studies of microcomputer usage. The general perspective was that respondents had a positive outlook of computers and their usage. They believed that the expanding use of computers would have positive effects on their lives and society. Contrary to many reports in the popular press and media, there were very few signs of computer anxiety among managers. They were unafraid of using them and had very positive attitudes of how the machines could help them in the performance of their jobs. They believed that the microcomputer was an important tool enabling them to be more creative in the analyses and presentation of information. They were generally quite satisfied with the quality of the machines and did not fear that the security of their data might be compromised through accidental erasures or breakdowns. However, a majority felt that maintenance and repair of the machines could be improved. Usage of the computers in certain tasks was high. They were planning, budgeting or forecasting, mainly with

the use of spreadsheet programs. The time spent on the microcomputers was about one and a half hours a day. However, despite the moderate usage of the computers, the managers had relatively low expertise in most of the software packages. They used only the most basic functions of any package. The reason appeared to be the lack of training, since a large proportion of managers were self-trained in microcomputer usage, which was apparently, inadequate.

Management support for computer usage was available, normally through an information centre, but there appeared to be a lack of dissemination of information about new products and new uses of the computers.

Computer policies regarding justification and acquisition of microcomputers exist in most organizations, but in most companies, these were the only policies. Other policies regarding access to corporate data, security and backups and documentation standards were largely non-existent.

Statistical Analysis

The research question proposed in Chapter 1 was "What are the factors that contribute to microcomputer usage by managers in organizational settings." The results of the statistical analysis indicate that the computer skills of

the user, the quality of the system, the support provided by the organization, the user's beliefs about the impact of computers on society, and the users anxiety about usage had an influence on usage. However, the links were not direct. These factors affected the users' attitudes towards computer usage which in turn affected their use. Similarly, management use and peer use of computers also had an impact on usage. Again, the impact was indirect. These factors were seen by users as a social pressure to use computers, which in turn led to greater usage.

The model of microcomputer usage also proposed that subordinate and secretarial usage might impact usage by increasing the subjective norms towards usage. These two propositions were not supported by the data. Similarly, perceptions on the usefulness of policies regarding use of microcomputers did not affect usage.

Qualitative Data

In response to the question asking about ways to improve usage, the most frequently cited factor was training. Users expressed a need for more training, both at entry level as well as more advanced levels. Apart from acquiring more computer skills through education and training, users also suggested that freer and easier flow of information among

organization members would also facilitate the acquisition of skills.

Another important suggestion was the linking of computer systems into a network and to the company's mainframe. Users felt that a standalone system had its benefits, but the benefit could be greatly increased if facilities were available to ease communication, and downloading and exchange of data among users.

The respondents felt that the education of senior managers would also increase usage. The awareness of the benefits of microcomputers in job performance, by upper levels of management would filter down the ranks and create greater motivation for their use. This awareness could also lead to greater understanding of microcomputer usage. The understanding would be reflected in more effective policies regarding microcomputers. Better policies was also high on the managers' list of factors contributing to enhanced use of microcomputers. An important policy cited was the need for standardization of systems, as well as policies regarding backups, security and documentation.

Strengths and Limitations and Suggestions for Future Research

This section presents the strengths and limitations of the

study with suggestions of how further work can be done to overcome the limitations. It concludes with directions for future research in this area.

The major strength of the research is the use of a well proven model (The Fishbein Theory of Reasoned Action), borrowed from another discipline, to provide the theoretical foundation for the study of attitude. The model has been used in many other disciplines, psychology, marketing, sociology and economics, but has not been applied to research in MIS. This study is attempting to break new ground by providing a reference theory, based upon a tested model, upon which other research studies can be built (Keen, 1980). An important contribution of the research is the support for the relationship between subjective norms and computer usage. No previous research has discussed this relationship explicitly. Knowledge of this relationship has important implications for implementation of microcomputer technology in organizations.

The study is taking the direction suggested by Melone (1986). She raised the issue that the concept "user satisfaction" has some problems when used to evaluate a computer system. It is not clearly defined, nor is there a theoretical base for its development. She suggests that user attitude might be a better substitute, as it already has a strong theoretical foundation in many other disciplines.

The research design and sample selection can be considered a strength. Careful attempts were made to ensure randomness of the sample, instead of using a nonrandom convenient sample. With the use of managers in a field setting, the results can be generalized to companies in general with greater confidence. The greater statistical power, provided by the relatively large sample size gives greater confidence in the overall interpretation of the results, as well.

The measurement part of the model has some strengths as well as some limitations. One important strength is the development of the usage construct. Most of the existing measures were too narrowly defined, concentrating only on single dimensions of usage. The broader measure developed in this study showed very good measurement properties. The measures of attitude and subjective norms were also well constructed with strong theoretical bases. However, each was measured with only one value. Burnkrant and Page (1982) have suggested other methods to measure both attitudes and subjective norms. Further research can be done to develop these different measures.

A notable weakness concerns the measure of microcomputer policies. Only one item was used in this construct. Respondents were asked whether policies were useful or were a hindrance. Since many managers were not aware of explicit policies, they tended to give a neutral answer. The

existence of policies and their use was not accurately tapped with this measure. A multiple indicator scale needs to be developed to measure this construct.

Some of the scales had only two indicators, and typing skills was measured with only one indicator. For greater reliability of the measures, Dimnik (1986) recommends that each construct should be measured with at least 3 indicators.

There is a limitation in the structural model. The issue is whether it is appropriate to derive the model from the data and then re-estimate it on the same data. Many studies employ this procedure, but Long (1983) warns that since the model was selected by the data, it should not be tested with the same data. For this study, new data should have been collected to retest the revised model. Another procedure that could have been employed was to split the observations into two sets, using one set to derive the model, and the second hold-out set to test the model. This was not done here; the reduced size in the model testing sample would have caused problems, as LISREL is quite sensitive to inadequate sample sizes.

Another problem with the analysis is the assumption of causality in the relationships in the model. With any cross-sectional study, this assumption is always suspect.

There is arguably no indication of causality when all data is collected in one time setting. The only way to show causality in field settings is to use a longitudinal design. However, the use of a cross sectional study in this case can be justified. In the logical chain of research, cross sectional studies can be used as exploratory vehicles to determine certain relationships. Further research can then be conducted using longitudinal studies to investigate the directions of causality.

The thrust of this research was the investigation of the influence of attitudes on usage behaviour. However, attitudes can also be formed from behaviours. For example, a person who uses a computer and is happy with it can develop positive attitudes towards using it. If he finds that usage is difficult, his attitudes can become negative. The effects of usage on attitudes has rarely been considered in MIS research. A better understanding of this non-recursive relationship between attitudes and usage would have very important implications for post-implementation strategies in the adoption of new technology. Further research in this aspect of the attitude-usage relationships is therefore important.

Another direction for future research is to investigate the consequences of system usage. The implicit assumption in this study is that higher usage of microcomputers will lead

to better performance. This may not always be the case. Bralove (1983b) says that there is always a worry in organizations that the managers may be too mesmerized by the glitter of the technology and the tangible outputs of computers. These managers spend so much of their time examining more and more scenarios, generating numbers to the nth decimal point and providing elegant outputs that they ignore the less tangible matters, which very often can be more important for the decision at hand. The fear in these organizations is that computers can vastly oversimplify businesses. Some evidence of usage leading to poorer performance by managers is provided by Baker (1986).

This study concentrated on the "quantity" of usage, regardless of how it affected performance. Further research can be directed specifically at the "quality" of usage, i.e., usage that leads to better performance.

Implications for Management

The research identified and tested some important relationships that organizations can use to their advantage.

The key to increasing usage is to improve the attitudes of managers to using them and to increase the subjective norms for computer usage.

One clearly identified factor that can be used to improve attitudes is to provide more training, through formal courses as well as information exchange sessions. The need for managers to understand computing systems, their languages and capabilities has been cited as a key issue in the expansion of microcomputer usage. Organizations have to make a realistic investment in training if they are to derive the maximum benefits of microcomputers. This view is strongly supported by Strassman (1985) who said, "there are three top priorities to changing and improving work in the automated office: training, training and training." Evidence of the success of training in boosting microcomputer penetration was cited by Bozman (1987). His study of Price Waterhouse revealed that their success was in large part due to two important policies: "top management insisted on corporate wide microcomputer standards and enterprise wide training from day 1."

The study also showed that policies regarding microcomputer standards was important. It was not apparent in the "hard" data due to weaknesses in the measure, but it was cited as a very important factor in the qualitative responses. Keen and Woodman (1984) call the lack of standards "the time bomb of incompatibility." Business Week (1985), in a survey of 600 managers, said that many companies were fearful of further investments in microcomputers because they had been burned

trying different brands of computers that could not communicate with one another.

The data from the study also showed that managers believed that it was the ability of the microcomputer to assist in improving their jobs, that prompted them to use the machines. To provide the capabilities, microcomputers must be of high quality, be easy to use and have the required functions. Organizations must therefore provide their people with user friendly, trouble free systems, if they want to increase usage. This fact is supported by a Business Week survey (1985) which found that "many workers still shy away from PC's because most machines were onerous and too hard to use."

The data suggests that the function most needed to increase usage is the ability for systems to be able to "talk" to each other. Strassman (1985) has said that

> The ultimate goal of information technology is to improve the sharing of knowledge among people. Buying isolated office automation products, computer processing and personal computers without also obtaining the means of communication among them is like buying a truck to haul a load around a backyard. Case studies have shown that most of the benefits from information technology are derived from improvements in intra group communications rather than from acceleration of an individual's work. A critical minimum number of connected workstations must be present before a group can try out new approaches to organizing work. Standalone products improve efficiency to some extent, especially for isolated staff jobs involving lengthy computations, but it is necessary to develop information networks on a substantial scale before one achieves major

> improvements in office communications. I doubt most of the claims about benefits obtained from a proliferation of personal computers without network connections and without access to shared resources. It is known that managers and professionals spend more than half their time communicating with each other. It follows that they need equipment that enhances their communication of the information technology if it is to be of much value.

Another important result of the statistical analysis showed that senior management use of microcomputers would increase usage in the ranks. The qualitative data cited the need for education of senior managers. The implication is that upper management must provide the leadership for initiating and sustaining the effective use of microcomputers in the organization. To provide this leadership, they must learn and understand computers and be seen to use them in their own working environments. Bozman (1987) suggests that the success of microcomputer expansion in Price Waterhouse was partly due to the fact that a lot of partners took a very active interest in using them.

Conclusion

This study shows that Fishbein's Theory of Reasoned is useful in helping understand microcomputer usage. It provides a much needed underlying theory for developing further research in implementation of computer systems. It can be used to help researchers better understand the importance of attitudes and how these attitudes can be used

to predict computer usage. This has important implications for both MIS research and practice.

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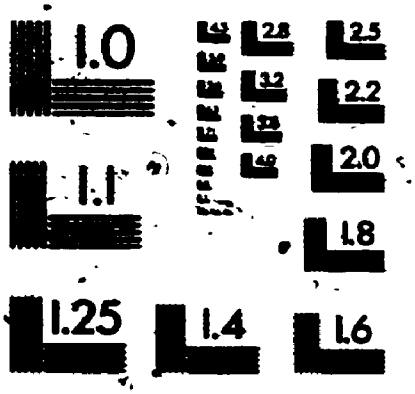

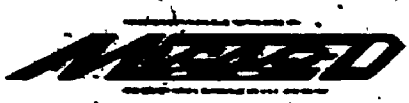

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LIST OF APPENDICES

Appendix 1

Memo to faculty accompanying questionnaire

DATE: May 25, 1987

TO:

FROM: Francis Pavri, Ph.D Candidate

SUBJECT: Microcomputer Research Study

I am writing to you to ask you to participate in a study to investigate the factors that contribute to the success of implementation of microcomputers in organizations. This is one phase of my Ph.D thesis.

The use of microcomputers by managers has been quite pervasive in many companies, but many cases have been reported of managers not using them to their full potential. I would like to investigate the factors that contribute to the effective and efficient use of microcomputers by managers and how the management in the company can provide a suitable environment for their use.

I would like your cooperation in completing the attached questionnaire. This is the second part of the pilot phase of my study. An earlier version of this questionnaire was sent to some members of the faculty and this second version includes many of their recommendations as to how the questionnaire can be improved. The results of this phase will help me refine my model and questionnaire, before I take it out to industry at large. The results will also be used to help the Business School satisfy one of the deliverables within the C&SP agreement that the school has with IBM Canada. In pretests, this questionnaire has taken 30 minutes to complete.

Please be assured that the study is completely confidential and all data collected will only be used in aggregate form. I would gladly provide you with a copy of my preliminary report, if you are interested.

In filling out the questionnaire, if you find that items are unclear or difficult to answer, or ways in which the questionnaire can be improved, please let me know by writing in the comments area at the end of the questionnaire.

I would appreciate if you can send the questionnaires back by June 4. Thank you for your participation. If you have any questions, you can drop me a note or call me at ext. 5134 or send electronic mail message to PAVRI.

Appendix 2

Letter to CEO's requesting their participation in the study

Dear

I am a Ph.D candidate at the University of Western Ontario. I am writing to you to ask your company to participate in an important study concerning the use of microcomputers in organizations.

The use of microcomputers by managers has been quite pervasive in companies, but cases have been reported of many managers not using them to their full potential. I would like to investigate the factors that contribute to the effective and efficient use of microcomputers and how the management in a company can provide a suitable environment for their use.

This study would require some of your managers who are currently using microcomputers to complete a questionnaire, and a select few to be interviewed. If you are willing to have your organization participate in this study, would you please provide me, on the attached sheet, the name of a contact person in your organization with whom I may further liaise to clarify the details of the study.

Please be assured that the study is completely confidential, and the data collected will be published in aggregate form only. I would gladly provide you with a copy of my final report, which I expect to complete in the last quarter of 1987.

Your participation in this study will contribute greatly to its success. If you would like to clarify any issues, please call me at (519) 679-2111 ext 5134 or (519) 679-7723. Thank you.

Sincerely,

Francis Pavri
Doctoral Candidate

Appendix 3

Letter to contact person in participating company

Dear

Thank you for agreeing to participate in the study concerning the use of microcomputers by managers in organizations.

I would appreciate if you will distribute the questionnaires (attached) to a number of managers in your organization. I enclose a sample memo which you can modify to accompany the questionnaire. If you would like more copies, please let me know. When distributing these surveys, there are a few points that should be noted.

1. The participants should have managerial or supervisory rank. The study is of managers, not secretaries or clerical staff.

2. These managers should have easy access to microcomputers. They do not necessarily need to have them on their desks. The machines can be shared by a few managers or access can be through an information centre.

3. The distribution of the questionnaires should be random. They should not be confined to the IS group or any other single department, or managerial rank but spread over different managers in different departments. We are looking for managers with different usage patterns and only a random distribution will be able to capture these patterns.

I am enclosing a short write-up of the aims of the study which will give you a better idea of the project.

Thank you again for your help. I hope to receive the completed questionnaires shortly. Please call me if you would like to discuss any other issues. I can be reached at (519) 679-2111 ext 5134 or (519) 679-7723. Thank you.

Sincerely,

Francis Pavri
Doctoral Candidate

Appendix 4

Sample Memo accompanying letter to company

DATE:

TO:

FROM:

SUBJECT: Microcomputer Study

Francis Pavri, a Doctoral Candidate at the University of Western Ontario has requested our participation in a Microcomputer Research Study he is conducting.

Information technology, in particular the microcomputer, has come to play important role in our organization. It is crucial that we develop a better understanding of the various factors that affect managers' decisions as to whether to adopt this technology. The purpose of Francis' research is to develop and test a model of the relationships between a variety of external variables, and individual managers' intentions to use microcomputers; and also between the managers' intentions and actual usage of the technology.

The study is being conducted in a large number of major Canadian firms and Francis has asked that our company be one of the research sites. This would entail a number of managers filling out a questionnaire.

Our company should benefit from the study by better understanding the reasons for microcomputer usage. It will specifically help us understand how to better manage the introduction of this type of technology so as to maximize the benefit that accrues from it.

I would appreciate if you can spend some time to complete the attached questionnaire and send it back to me within a week.

Thank you.

Appendix 5

Summary of Study accompanying letter to Company

An Empirical Study of the Usage of Microcomputers by Managers

The Problem

Information technology - computers, communication networks and the like - has assumed a role of growing importance in both private and public sector organizations during the 1980's. And this technology is no longer the private preserve of small groups of computer specialists; rather, the office automation and end user computing movements are placing information technology into the hands of workers at all levels, in all areas.

The emergence of the business microcomputer has played a central role in this trend. Many of the information processing and communication tasks that were previously performed on larger computers are now being carried out on microcomputers by the very managers who need the information - the 'end users.' However, the rapid growth of microcomputers in the workplace has not been without problems. The term 'user friendly' entered our vocabulary mainly because many desktop computer systems aren't. In some offices, having a microcomputer has been viewed as a status symbol, but the systems themselves have gathered dust. In other cases, the system is used, but only a little; adoption of new applications has been slow or nonexistent. In still other cases managers prefer to delegate the actual task of using the computer to subordinates, even in situations where it is clearly more advantageous for the manager to use the computer himself or herself.

Because information technology, in particular the microcomputer, has come to play such an important role in modern organizations, it is crucial that we develop a better understanding of the various factors that affect managers' decisions as to whether to adopt this technology. The purpose of this research is to develop and test a model of the relationships between a variety of external variables, and individual managers' intentions to use microcomputers; and also between the managers' intentions and actual usage of the technology.

The Study

A cross-sectional questionnaire methodology will be used. The questionnaire instrument has been developed to measure the factors contributing to managerial attitudes and organization norms. The instrument has been carefully tested in the Western Business School. It will now be applied in a major field study of 600 managers, in a number of major Canadian firms.

The study's findings should provide much valuable general insight into the major reasons for microcomputer usage. It will specifically help us understand how to better manage the introduction of this type of technology into firms so as to maximize the benefit that accrues from it.

Appendix 8

Summary of Response rates

Response to Letter	Numbers
Number of companies contact by letter	354
Number of companies who agreed to participate	77
Number of companies who refused participation	53
Number of non respondents	224
Response to Phone Calls	
Number of companies by phone	77
Number of companies who agreed to participate	62
Number of companies who refused to participate	15
Number of companies who did not return any questionnaire	8
Total number of companies who participated	54
Response of questionnaires	
Number of questionnaires sent	766
Number of questionnaires returned	519
Number of unusable questionnaires	26
Number of questionnaires used for analysis	493

Appendix 7

Companies which participated in the study

	COMPANY	SENT	RETURNED
1	Equitable Life	10	6
2	Emco Supply	10	7
3	Dofasco	2	2
4	Peter Kiewit Sons	3	2
5	May & Baker	3	2
6	Harding Carpets	6	4
7	Rio Algom	3	0
8	Global Communications	20	17
9	Canadian Oxygen Limited	5	5
10	Canadian Foundation Company Ltd.	6	4
11	Hayes-Dana	5	4
12	Selkirk Communications	12	7
13	Canada Starch	1	1
14	C-I-L	20	14
15	Indal	5	4
16	Gesco Industries	10	4
17	Sun Life Assurance Co. of Canada	25	22
18	Warner Lambert Canada	25	20
19	CDC Life Services Inc.	3	2
20	Campbell Resources	4	0
21	Union Gas Ltd.	25	16
22	Mitel	10	8
23	Bay Mills Ltd. (Midland Division)	6	5
24	Bay Mills Ltd (Homeshield Division)	1	0
25	Pepsi-Cola	5	0
26	Bank of Nova Scotia	20	18
27	Canada Trust	20	17
28	Molson Breweries of Canada Ltd.	15	11
29	Monarch Investments	1	1
30	Wang Canada	20	8
31	Oshawa Group	12	9
32	J.S. Redpath	11	8
33	Ultramar Canada Inc	20	18
34	Bank of Montreal	20	19
35	Torstar Corporation	15	10
36	John Deere Limited	9	9
37	Quaker Oats Co. of Canada	30	11
38	H.J. Heinz of Canada	5	4
39	Hudson's Bay Company	4	3
40	Goodyear Canada	15	11
41	Citibank Canada	15	5
42	Sears Canada	20	17
43	Algoma Central Railway	7	7

Appendix 7 (continued)

	COMPANY	SENT	RETURNED
44	Cadillac Fairview	3	0
45	VS Services	5	4
46	Crown Life	12	11
47	Four Seasons Hotels	3	2
48	Gandalf Technologies	15	10
49	NCR Canada	15	12
50	Toronto Dominion Bank	30	25
51	Suncor	20	12
52	Delta Hotels	16	15
53	Hewlett-Packard (Canada)	15	1
54	Northern Telecom Canada Limited	30	15
55	Imperial Life	12	0
56	Bristol-Myers Canada	20	19
57	Ciba-Geigy Canada Ltd.	20	18
58	Imperial Oil	10	9
59	Volkswagen Canada	10	8
60	Ontario Northland Transportation	5	0
61	Toshiba of Canada	1	0
62	Lawson Mardon Group	40	16
	TOTAL	766	519

Response rate = 67.7%

Appendix 8

Demographic Profile of Respondents

Division in which the respondents worked

	FREQUENCY	PERCENT
Accounting	55	10.6
Finance	60	11.6
Subsidiary Company	11	2.1
Data Services	3	.6
Engineering	11	1.9
R & D	11	2.1
Manufacturing	9	1.7
MIS	63	11.9
Systems and Communications	1	.2
Human Resources	19	3.7
Quality Assurance	2	.4
Sales	24	4.6
Materials Management	6	1.2
Marketing	29	5.6
Product Development	7	1.3
Distribution	6	1.2
Customer Services	1	.2
Operations	40	7.7
Legal	2	.4
Administration	61	11.8
Internal Audit	4	.8
Tax	3	.6
Business Development	2	.4
Estimating	2	.4
Contracting	1	.2
Planning	19	3.7
Transportation	1	.2
Service	5	1.0
Credit	1	.2
Merchandizing	5	1.0
Purchasing	4	.8
Treasury	9	1.5
Advertising	2	.4
System Research & Development	6	1.2
Training-Education	2	.4
Corporate Banking	6	1.2
Inspection	2	.4
News	6	1.2
Production	3	.6
Programming	1	.2
Actuarial	2	.4
Public Relations	2	.2
Retail	1	.2
Space Management	1	.2

Appendix 8 (continued)

Position of Respondents

	FREQUENCY	PERCENT
President	3	.6
Vice President	35	6.7
Asst Vice President	13	2.5
Director	48	9.2
Controller	33	6.4
Accountant	24	4.6
Manager	249	48.0
Assistant Manager	11	2.1
Supervisor	72	13.9
Engineering Support	5	1.0
Product Manager	1	.2
Treasurer	5	1.0
Chemist	4	.8
Chief Estimator	1	.2
Statistician	1	.2
Design Engineer	3	.6
Buyer	2	.4
Tax Consultant	1	.2

Line or Staff

	FREQUENCY	PERCENT
Line	175	33.7
Staff	336	64.7

Level in the Company
(1=President 7=First Line Manager)

	FREQUENCY	PERCENT
1 President	4	.8
2	38	7.3
3	96	18.5
4	124	23.9
5	73	14.1
6	55	10.6
7 First Line Manager	117	22.5

Appendix 8 (continued)

Budget Controlled by Respondents

	FREQUENCY	PERCENT
None	77	14.8
Under $50000	34	6.6
$50001 to $250000	57	11.0
$250000 to $500000	48	9.2
$500001 to $1 million	62	11.9
$1 million to $5 million	89	17.1
Over $5 million	91	17.5
Not applicable	58	11.2

Number or people reporting to Respondent

	FREQUENCY	PERCENT
None	89	17.1
1 to 4	175	33.7
5 to 10	157	30.3
11 or more	82	15.8
	12	2.3

Highest Educational Level of Respondents

	FREQUENCY	PERCENT
Completed high school	26	5.0
Some community college	32	6.2
Completed community	38	7.3
Some University	74	14.3
Completed University	192	37.0
Graduate Degree	154	29.7

Appendix 8 (continued)

University Major of Respondents

	FREQUENCY	PERCENT
Accounting	68	13.1
Engineering	4	.8
Nuclear Physics	2	.4
Commerce	42	8.1
Computer Science-Programming	15	2.9
Electronics	2	.4
Business	88	17.0
Chemistry	14	2.7
Engineering	39	7.5
History	3	.6
Science	24	4.6
Marketing	3	.6
Mathematics	29	5.6
Textile Technology	4	.8
Arts	12	2.3
Law	3	.6
Economics	16	3.1
English	2	.4
Agriculture	1	.2
Music Education	2	.4
Journalism	2	.4
Broadcast Technology	1	.2
Philosophy	2	.4
Actuarial Science	2	.4
Social Sciences	2	.4
Architecture	1	.2

Sex of Respondents

	FREQUENCY	PERCENT
Male	441	85.0
Female	74	14.3

Appendix 8 (continued)

Age of Respondents

	FREQUENCY	PERCENT
25-30	77	14.8
31-40	248	47.8
41-50	133	25.6
51-60	50	9.6
61-65	6	1.2

Appendix 9

Comparisons of Data Received before and after 30 September, 1987

Means

Variable	Before 30 Sept.	After 30 Sept.	2-tail Probability
EXP2	1.4	1.2273	.033
IMPAC9	3.6186	3.9767	.041
ANXIE2	4.1695	4.4884	.016
HELP1	2.4903	2.0588	.017
HELP2	2.5503	2.1875	.02
HELP6	2.8605	2.0833	.014
PERCEP6	3.2817	2.7143	.031
PERCEP8	4.1634	3.5116	.017
INFAC2	2.2126	1.7955	.02
	N=475	N=44	

The University of Western Ontario
School of Business Administration

Microcomputer Research Project

RESEARCH QUESTIONNAIRE

The purpose of this questionnaire is to measure your attitudes and beliefs about the benefit of computers, as well as other factors that contribute to the effective use of microcomputers. Your cooperation in the study will contribute greatly to its success. Please answer all questions. Your answers will be treated in absolute confidence. Any data collected will only be used in aggregate form.

PLEASE ANSWER BASED ON YOUR OWN FEELINGS. THERE ARE NO RIGHT OR WRONG ANSWERS. ONLY YOUR OPINION IS IMPORTANT.

THANK YOU VERY MUCH FOR YOUR COOPERATION.

Should you have any questions relating to this survey, please get in touch with me.

Francis Pavri
Doctoral Candidate
School of Business Administration
University of Western Ontario
London, Ontario N6A 3K7
Tel: (519) 661-2111 x 5134 or (519) 679-7723.

PLEASE NOTE

1. Each scale should be circled in the number that describes your evaluation of the item being judged.
2. Please answer every question and circle every scale.
3. Each scale should be circled in only one position.
4. Work rapidly. Rely on your first impressions.
5. Pretests of this questionnaire indicate the average completion time is about 30 minutes.

SECTION A: Computer Training and Experience

Which of the following categories best describes the level of training you have had in the use of computers, both mainframe and microcomputers.

	Mainframe Courses				Microcomputer Courses			
	None			Extensive	None			Extensive
1. General Courses at a community college or university	1	2	3	4	1	2	3	4
2. Training provided by vendors or outside consultants	1	2	3	4	1	2	3	4
3. In house company courses	1	2	3	4	1	2	3	4
4. Through self study	1	2	3	4	1	2	3	4

Please rate your experience in working with computers, both mainframe systems and microcomputers, by circling the choice that corresponds to your level of experience in each category.

	Level of Experience			
	None			Extensive
1. Using microcomputer packages such as spreadsheets, word processing or data management	1	2	3	4
2. Use of a fourth generation computer language or query language, such as Focus, Ramis, SQL, etc	1	2	3	4
3. Building models: financial, statistical etc. on a microcomputer or mainframe system	1	2	3	4
4. Programming in a computer language such as Cobol, Fortran or Basic	1	2	3	4
5. Participated in the non-technical design of computer systems such as feasibility studies and requirement analyses	1	2	3	4
6. Participated in the technical design of computer such as system analysis, design and implementation	1	2	3	4

How do you rate your computer skills.

NOVICE | 1 | 2 | 3 | 4 | 5 | 6 | 7 | EXPERT

How do you rate your typing skill

NOVICE | 1 | 2 | 3 | 4 | 5 | 6 | 7 | EXPERT

SECTION B: Potential Impact of Computers

In this section, there are a series of statements on the potential impact of computer technology on society. Please rate your agreement or disagreement with each of the statements by circling the appropriate number.

	Strongly Agree		Undecided		Strongly Disagree
1. Computerizing businesses will have the effect of making jobs more mechanical and less personal	1	2	3	4	5
2. In the future, power will be concentrated in the hands of the technology elite	1	2	3	4	5
3. Computers are beneficial aids to modern society	1	2	3	4	5
4. Computers will create more jobs than they will eliminate	1	2	3	4	5
5. Human beings will misuse the power of the computer	1	2	3	4	5
6. Computers are changing the world too rapidly	1	2	3	4	5
7. Our country relies too much on computers	1	2	3	4	5
8. Computers dehumanize society by treating everyone as a number	1	2	3	4	5
9. Computers have the potential to control our lives	1	2	3	4	5

In this section, we would like to gauge how comfortable you are with the general use and understanding of computers.

	Strongly Agree		Undecided		Strongly Disagree
1. I am confident I could learn computer skills	1	2	3	4	5
2. I am unsure of my ability to learn a computer language	1	2	3	4	5
3. I will be able to keep up with the important technological advances of computers	1	2	3	4	5
4. I feel apprehensive about using a microcomputer	1	2	3	4	5
5. If given the opportunity to use a microcomputer, I am afraid I might damage it in some way	1	2	3	4	5
6. I have avoided microcomputers because they are unfamiliar to me	1	2	3	4	5
7. I hesitate to use a microcomputer for fear of making mistakes that I cannot correct	1	2	3	4	5
8. I am unsure of my ability to interpret the output from a microcomputer	1	2	3	4	5
9. I have difficulty understanding most technological matters	1	2	3	4	5
10. Computer terminology sounds like confusing jargon to me	1	2	3	4	5

SECTION C: Management Support and Policies

In this section, we would like to find out how you feel about the resources provided by management and others to help you in your usage of microcomputers.

	Strongly Agree		Undecided		Strongly Disagree
1. I am convinced that management is sure as to what benefits can be achieved with the use of microcomputers	1	2	3	4	5
2. There is always a person in the organization whom we can turn to for help in solving problems with the computer system	1	2	3	4	5
3. A central support group (eg information centre) is available to help with problems	1	2	3	4	5
4. Training courses are readily available for us to improve ourselves in the use of microcomputers	1	2	3	4	5
5. I am always supported and encouraged by my boss to use the computers in the performance of my job	1	2	3	4	5
6. Management has provided most of the necessary help and resources to get us used to the computers quickly	1	2	3	4	5
7. We are constantly updated on new software that can help us use the microcomputers more effectively	1	2	3	4	5
8. Management is really keen to see that we are happy with using our microcomputers	1	2	3	4	5

Do formal microcomputer policies about the following items exist in your organization? If they exist, are they helpful or unhelpful?

	Yes	No	Don't Know	Extremely Helpful				Extremely Unhelpful
1. Hardware acquisition	1	2	3	1	2	3	4	5
2. Software acquisition	1	2	3	1	2	3	4	5
3. Data backup procedures	1	2	3	1	2	3	4	5
4. Documentation standards	1	2	3	1	2	3	4	5
5. Access to corporate data	1	2	3	1	2	3	4	5
6. Other policies (please specify)	1	2	3	1	2	3	4	5

In general, how helpful do you feel are these policies in the performance of your job?

EXTREME HELP | 1 | 2 | 3 | 4 | 5 | 6 | 7 | EXTREME HINDRANCE

SECTION D: Organization Usage

Please indicate the level and rate of growth of usage of microcomputers by other members in your organization.

	Level of Usage (Very High 1 2 3 4 5 Very Low)	Rate of Growth (Rapid Growth 1 2 3 4 5 No Growth)
1. Managers in my Peer Group	1 2 3 4 5	1 2 3 4 5
2. People in Top Management	1 2 3 4 5	1 2 3 4 5
3. Subordinates	1 2 3 4 5	1 2 3 4 6
4. Secretaries	1 2 3 4 5	1 2 3 4 5

SECTION E: Feelings about Microcomputer Usage

In this section, please rate the scales below according to how you feel about using your microcomputer.

The scales are presented as follows:

ADJECTIVE X | 1 | 2 | 3 | 4 | 5 | 6 | 7 | ADJECTIVE Y

For these scales, the scale positions are defined as follows:

(1) extremely X
(2) quite X
(3) slightly X
(4) neither X nor Y; equally X or Y
(5) slightly Y
(6) quite Y
(7) extremely Y

The following example illustrates the scale positions and their meanings. My vacation in the Bahamas was:

RESTFUL	1	2	3	4	5	6	(7)	HECTIC
HEALTHY	1	(2)	3	4	5	6	7	UNHEALTHY
WONDERFUL	1	2	3	(4)	5	6	7	TERRIBLE
LONG	1	2	3	4	(5)	6	7	SHORT

According to the responses, the person's vacation was extremely hectic, quite healthy, neither wonderful nor terrible and slightly short.

Using a microcomputer in my job is

REWARDING	1	2	3	4	5	6	7	UNREWARDING
PLEASANT	1	2	3	4	5	6	7	UNPLEASANT
FRUSTRATING	1	2	3	4	5	6	7	FUN
ENJOYABLE	1	2	3	4	5	6	7	UNENJOYABLE
NEGATIVE	1	2	3	4	5	6	7	POSITIVE
INTERESTING	1	2	3	4	5	6	7	UNINTERESTING

SECTION F: Beliefs about Microcomputer Usage

In this section, we would like to find out what you believe are the advantages and disadvantages of your using microcomputers in your job.

	Strongly Agree			Neutral			Strongly Disagree
1. Using a microcomputer helps me make better decisions by giving me access to higher quality information	1	2	3	4	5	6	7
2. Using a microcomputer allows me to be more independent of my subordinates and secretaries	1	2	3	4	5	6	7
3. Using a microcomputer exposes me to the vulnerability of computer breakdown and loss of data	1	2	3	4	5	6	7
4. Using a microcomputer allows me to be more innovative by providing the opportunities for more creative analyses and outputs	1	2	3	4	5	6	7
5. Using a microcomputer gives me the opportunity to enhance my managerial image	1	2	3	4	5	6	7
6. Using a microcomputer improves my productivity on the job	1	2	3	4	5	6	7
7. When I use a microcomputer, I find it difficult to integrate the work on the computer into my existing work	1	2	3	4	5	6	7
8. Using a microcomputer can take up too much of my time in performing many tasks	1	2	3	4	5	6	7

Please rate the beliefs, embodied in the previous questions, according to their importance or unimportance in your job

	Extremely Important			Neutral			Extremely Unimportant
1. Having information to make better decisions	1	2	3	4	5	6	7
2. To be more independent of my secretaries and subordinates	1	2	3	4	5	6	7
3. Security of information in my job	1	2	3	4	5	6	7
4. Having the ability to be more innovative with analysis and outputs	1	2	3	4	5	6	7
5. Presenting a managerial image in my job	1	2	3	4	5	6	7
6. Having the ability to improve my productivity	1	2	3	4	5	6	7
7. Integrating the work of the computer into my current job routines	1	2	3	4	5	6	7
8. Taking time to work on the microcomputer	1	2	3	4	5	6	7

SECTION G: Perceptions of Others towards your Usage

In this section, we would like to have your perceptions of how other expect you to use your microcomputer.

	Strongly Agree			Neutral			Strongly Disagree
1. Most people who are important to me in my job think I should be using the microcomputers regularly in my job.	1	2	3	4	5	6	7
2. People in top management think I should be using the microcomputer regularly in my job.	1	2	3	4	5	6	7
3. My immediate superiors think I should be using the microcomputer regularly.	1	2	3	4	5	6	7
4. My fellow managers think I should be using the computer more in my job.	1	2	3	4	5	6	7
5. My subordinates think I should be using the computer more in my job.	1	2	3	4	5	6	7
6. Generally speaking, I want to do what people in top management think I should do.	1	2	3	4	5	6	7
7. Generally speaking, I want to do what my immediate superiors think I should do.	1	2	3	4	5	6	7
8. Generally speaking, I want to do what my fellow managers think I should do.	1	2	3	4	5	6	7
9. Generally speaking, I want to do what my subordinates think I should do.	1	2	3	4	5	6	7
10. My superiors will expect better performance from me now that I have been given a micro to assist in my job.	1	2	3	4	5	6	7
11. My using a microcomputer well will cause my peers to consult me with problems with their usage of micros.	1	2	3	4	5	6	7
12. My using a microcomputer well will cause my subordinates to consult me with problems with their usage of micros.	1	2	3	4	5	6	7

Finally please rate the importance of these expectations.

	Extremely Important			Neutral			Extremely Unimportant
13. Having my superiors expect better performance from me is.	1	2	3	4	5	6	7
14. Having my peers to ask me for help with problems in their microcomputer usage is.	1	2	3	4	5	6	7
15. Having my subordinates to ask me for help with problems in their microcomputer usage is.	1	2	3	4	5	6	7

SECTION H: Microcomputer Usage

1. Do you use your microcomputer.

   1. NO → Go to Question 8 on the next page
   2. YES

2. With respect to the requirements of your current job, please indicate your extent of usage and your level of expertise on the use of microcomputer packages. Circle the number according to the following categories.

	Extent of Usage				Level of Expertise				
	Not at All			To a Great Extent	Novice				Expert
a. SPREADSHEETS (eg. Lotus 1-2-3)	1	2	3	4	1	2	3	4	5
b. WORD PROCESSORS (eg. Wordperfect)	1	2	3	4	1	2	3	4	5
c. DATA MANAGEMENT PACKAGES (eg. dBASE III)	1	2	3	4	1	2	3	4	5
d. MODELING SYSTEMS (eg. IFPS/PC)	1	2	3	4	1	2	3	4	5
e. STATISTICAL PACKAGES (eg . SAS/PC or SPSS/PC)	1	2	3	4	1	2	3	4	5
f. GRAPHICS PROGRAMS (eg. Chartmaster, GDDM)	1	2	3	4	1	2	3	4	5
g. COMMUNICATIONS PACKAGES OR ELECTRONIC MAIL	1	2	3	4	1	2	3	4	5
h. FOURTH GENERATION LANGUAGES (eg. FOCUS)	1	2	3	4	1	2	3	4	5
i. THIRD GENERATION LANGUAGES (eg. Fortran, Basic)	1	2	3	4	1	2	3	4	5
j. OTHERS. (Please specify programs by name) _____	1	2	3	4	1	2	3	4	5

3. With respect to the requirements of your current job, please indicate to what extent do you use the microcomputer to perform the following tasks.

	Not at All			To a very Great Extent
a. LOOKING FOR TRENDS	1	2	3	4
b. FINDING PROBLEMS	1	2	3	4
c. PLANNING	1	2	3	4
d. FORECASTING	1	2	3	4
e. BUDGETING	1	2	3	4
f. COMMUNICATING WITH OTHERS	1	2	3	4
g. CONTROLLING AND GUIDING ACTIVITIES	1	2	3	4
h. MAKING DECISIONS	1	2	3	4

4. On an average working day, how much time do you spend on the system?

   1. ALMOST NEVER
   2. LESS THAN HALF HOUR
   3. FROM HALF HOUR TO 1 HOUR
   4. 1 TO 2 HOURS
   5. 2 TO 3 HOURS
   6. MORE THAN 3 HOURS

5. On the average, how frequently do you use a microcomputer?

   1. SEVERAL TIMES A DAY
   2. ABOUT ONCE A DAY
   3. A FEW TIMES A WEEK
   4. A FEW TIMES A MONTH
   5. ONCE A MONTH
   6. LESS THAN ONCE A MONTH

6. If you have a microcomputer at home, how much time do you spend working on it at home?

   1. ALMOST NEVER
   2. LESS THAN HALF HOUR
   3. FROM HALF HOUR TO 1 HOUR
   4. 1 TO 2 HOURS
   5. 2 TO 3 HOURS
   6. MORE THAN 3 HOURS
   7. I DO NOT HAVE A MICROCOMPUTER AT HOME

7. In this section, please rate how satisfied you are with the following characteristics of your microcomputer system.

	Extremely Satisfied		Neutral		Extremely Dissatisfied
Computer system's appropriateness for assisting your own particular job functions	1	2	3	4	5
Back-up to prevent accidental file loss	1	2	3	4	5
Keyboard layout	1	2	3	4	5
Promptness of maintenance and repair	1	2	3	4	5
Quality of maintenance and repair	1	2	3	4	5
Quality of printout	1	2	3	4	5
Quality of video display	1	2	3	4	5
Speed of response	1	2	3	4	5
Ease of use	1	2	3	4	5
Management of files (copying, deleting, renaming and general organization of files	1	2	3	4	5

In general, how satisfied are you with your microcomputer system?

EXTREMELY SATISFIED | 1 | 2 | 3 | 4 | 5 | 6 | 7 | EXTREMELY DISSATISFIED

How long have you been using your microcomputer?

_____ MONTHS

Go to next section in the next page →

8. I am not using a microcomputer because I find it difficult to gain access to a machine.

AGREE | 1 | 2 | 3 | 4 | 5 | 6 | 7 | DISAGREE

9. I am not using a microcomputer because I do not know how to type well.

AGREE | 1 | 2 | 3 | 4 | 5 | 6 | 7 | DISAGREE

10. I am not using a microcomputer because I am too busy to learn how to use it.

AGREE | 1 | 2 | 3 | 4 | 5 | 6 | 7 | DISAGREE

11. I intend to begin using microcomputers

1. WITHIN THE NEXT MONTH
2. WITHIN THE NEXT THREE MONTHS
3. WITHIN THE NEXT SIX MONTHS
4. NEVER

SECTION I: Background Information

The following information is needed to help us with the statistical analysis of the data. This information will allow comparisons among different groups of managers, and comparisons with similar managers in other organizations.

1. The division and/or department in which you work:

   _____

2. Your position._____

3. Do you consider your position a line or staff? (Circle number)

   1. LINE
   2. STAFF

4. On a scale of 1 to 7, please indicate your level in the organization. (1=President or CEO and 7=First line Manager)

   President or CEO | 1 | 2 | 3 | 4 | 5 | 6 | 7 | First Line Manager

5. Approximately how large is the budget for which you are held directly accountable. (Circle number)

   1. NONE
   2. UNDER $50,000
   3. $50,001 TO $250,000
   4. $250,001 TO $500,000
   5. $500,001 TO $1 MILLION
   6. $1 MILLION TO $5 MILLION
   7. OVER $5 MILLION
   8. NOT APPLICABLE.

6. How many people report directly to you.

   1. NONE
   2. 1 TO 4
   3. 5 TO 10
   4. 11 OR MORE
   6. NOT APPLICABLE

7. What is your highest level of education?

   1. COMPLETED HIGH SCHOOL
   2. SOME COMMUNITY COLLEGE/TECHNICAL PROGRAM
   3. COMPLETED COMMUNITY COLLEGE/TECHNICAL PROGRAM
      (Specify Major)_____
   4. SOME UNIVERSITY
   5. COMPLETED UNIVERSITY UNDERGRADUATE
      (Specify Major)_____
   6. GRADUATE DEGREE
      (Specify Major)_____

8. What is your sex?

   1. MALE
   2. FEMALE

9. What is your present age? _____ YEARS

In this final section, we would like to find out in what ways you think that microcomputer usage can be improved in your organization. Please list any suggestions you may have in making microcomputer usage more effective and efficient.

Thank you very much for your cooperation. Please check that you have answered all questions. If you have any other comments you would like to make, please feel free to write them below.