1994

Predicting Application Software Usage: A Longitudinal Study

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PREDICTING APPLICATION SOFTWARE USAGE:

A LONGITUDINAL STUDY

by

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Submitted in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy

Faculty of Graduate Studies
The University of Western Ontario
London, Ontario
July 1994

ISBN 0-315-93213-9

Canada

ABSTRACT

While organizations may purchase computer systems, ultimately it is people who have to use them before companies can achieve the anticipated benefits from technology investments. With a view to improving usage levels, understanding how people react to new systems has been a long-standing concern of practitioners and IS researchers. This research borrowed a behavior prediction model (Triandis 1980) from Social Psychology and applied it to the problem of understanding the human factors that influence application software usage levels.

A longitudinal study was conducted on individuals voluntarily attempting to switch from one software application to another. A pretest yielding 38 responses was used to refine the survey instrument and implementation procedure. The main study yielded 160 pairs of usable responses from a sample of people purchasing competitive upgrades directly from a software vendor. The software upgrade context was either a presentation management application or a spreadsheet. The Partial Least Squares causal modelling technique was used to analyze the data.

Results indicated that use expectations for use of the new software and habits associated with previously used software were both strong predictors of a new application's use. Fully 50.5% of the variation in system use was captured. Of the factors hypothesized to influence use expectations, affect, computer self-efficacy, social contracts, and perceived consequences were all significant. Only the influence of norms on use expectations were not found to be significant.

This research has established that factors which influence other types of behavior also influence the behavior of voluntarily using a software application. For practitioners, this underscores the importance of the behavioral side of determining system use. The factors identified as influencing behavioral intentions also suggest specific areas for managerial attention during an application's implementation.

For IS researchers, the principal contribution of this work is the testing of a theory rich model in the IS field. Insight has been gained into the factors influencing voluntary system use. Psychometrically sound scales have been developed and refined for use with the theory. On a more general level, the results indicate the suitability of Social Psychology as a referent discipline for investigating system usage.

DEDICATION

This thesis is dedicated to God.

All things are possible which are in accordance with His will.

ACKNOWLEDGMENTS

While my name is the only one to appear on this document, a thesis is clearly the culmination of a process involving many people. To varying degrees, everyone involved in the Ph.D. program at the Western Business School played a part in the completion of this work. My thanks to all of you for providing a supportive and professional environment in which to learn.

The Ph.D. class of 1987 deserves special thanks. Despite the grueling workload, friendship and scholarship were always found together. Cooperation in learning, not competition was the culture we lived by. You made the program fun.

Several MIS Doctoral Candidates, now Ph.D.'s, also contributed to the form and substance of this work. Numerous discussions with Jim Wyse, Deborah Compeau, Betty Vandenbosch, and Barb Marcolin helped to shape this work throughout its course.

I owe a tremendous debt of gratitude to my advisor Dr. Chris Higgins. His high research standards coupled with a genuine concern for students made this work both challenging and possible. He was a source of ideas, encouragement and resources, always at the right time. He sets a worthy example as an academic and as a friend.

Finally, and most importantly, I thank my wife Angela for her willingness to embark on this adventure with me. Her love, support and encouragement were unfailing throughout the program. She gave unselfishly so that I could fulfill a dream.

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CHAPTER 1 - INTRODUCTION

The Management Problem

Organizations worldwide now spend more than 360 billion dollars annually on computing (Fortune 1993). The impact of these expenditures goes beyond the simple dollar value as computing transforms the way people and organizations work. The lure of improved competitiveness, a desire to cut costs, or increase creativity, for example, has brought organizations, and the individuals they employ, headlong into the information age. Whether or not the experience proves to be a benefit to the organization depends on many things including whether they have made the right technology choices and whether those choices are used by people.

When a company purchases a system it is only purchasing the potential to perform the tasks for which the system was designed. Whether that potential is released depends heavily on the implementation process. According to Delone and McLean (1992) system use is a key link in the chain between a quality system and the impact it has on an organization. Stated simply, a system must be used to be beneficial. Unfortunately, not all efforts at implementing systems result in their use (Lucas 1975b; Robey 1979). Many organizations fail to realize all of the potential benefits of their systems, while others are categorical failures. A better understanding of the factors influencing an individual's decision whether or not to use a system is needed to facilitate the successful implementation of systems.

Over the years much has been learned about the factors influencing use. Research by Lucas (1973, 1975b, 1975c, 1978b), Schultz and Slevin

(1975a), Schewe (1976), Robey (1979), and many others (Ives, Olson and Baroudi 1983; Davis 1989; Davis, Bagozzi and Warshaw 1989; Thompson, Higgins and Howell 1991) has identified many factors which impact system use. However, our understanding of people, and how they react to new systems is still limited. An observation made by Lucas in 1975 is as valid today as when it was originally stated.

> Concentration on the technical aspects of systems and a tendency to overlook organizational behavior problems and users are the reasons most information systems have failed ... Of course, we recognize that systems can fail for technical reasons related to hardware and software; however, technical problems with information systems are much better understood today than are organizational behavior difficulties. (Lucas 1975, 2:3)

While the technical quality and scope of information systems have improved greatly since 1975, our understanding of how people react to new systems has not kept pace.

A better understanding of how individuals make choices with respect to using new systems is needed to improve the implementation process. An implementation process which takes into account the way people react to new systems would have many benefits. Fewer implementation failures and higher usage rates would increase the return organizations get on their 360 billion dollar a year investment in computing. Resources spent on system implementation could be allocated more effectively either reducing the investment needed or achieving better results for the same expenditure. Perhaps the greatest benefit would be an increased ability to ease an individual's transition to a new system. Knowing how people react to new

systems is an important step in improving the management of information systems.

The Current State of Research

The complex set of social, organizational, and technological interactions which occur with the introduction of a new system make even a basic understanding of the process quite difficult to achieve. One way information systems researchers have approached this problem is by focusing on users' attitudes and how they affect and are affected by the decision to use a system. Unfortunately, not enough progress has been made in IS attitude research in the 20 years since Lucas (1973) used favorable user attitudes as a measure of the information services department's effectiveness. This area is still awaiting the emergence of a dominant theoretic model, clear conceptual and operational definitions of constructs, and reliable measurement instruments.

The inconsistent and often contradictory results which have marked this situation have a principal underlying cause which was identified by Swanson in 1982. He stated that "variations in the attitude concept itself appear to explain much of the variation in research results" (Swanson 1982, 161). The application of the attitude label to very different theoretic concepts is directly responsible for much of the apparent contradiction in how attitudes influence system use and success. The loose and often non-existent definitions of attitudes within most studies make any comparison of results between studies tenuous at best.

Another problem in the implementation literature is that attitudes are used both as an independent variable to predict system use in some studies and as a dependent variable to measure system success in other studies. For example, Schewe (1976) used attitudes to predict system use while Lucas (1978b) employed attitudes as a surrogate measure of system success. Others have modeled a reciprocal relationship between use and attitudes. Zmud (1979) developed a model of the impact of individual differences on MIS success. In that model user attitudes both preceded and were a consequence of system use.

The IS field will have difficulty developing a cumulative attitude research tradition until we develop consistent definitions and operationalizations of attitudes. Furthermore, an understanding of how attitudes can be both a causal antecedent and a consequence of system use requires a strong theoretic model of how attitudes affect and are affected by system use. While such theories do exist in Social Psychology, they have only recently been employed by IS researchers.

The success of borrowing from relevant referent disciplines is illustrated by three studies. Moore (1989) used Roger's (1983) Diffusion of Innovation model and Fishbein and Ajzen's (1975) Theory of Reasoned Action to generate a new Innovation decision model investigating the attitudinal and decision context factors affecting a person's use of a new system. Thompson et al. (1991) used Triandis' (1980) behavior prediction theory to inquire into the factors affecting the utilization of personal computers. Compeau (1992) employed social cognitive theory (Bandura 1986) to examine

a number of attitudinal and other factors influencing system usage. By borrowing a clear theoretical foundation from a relevant referent discipline, and by clearly defining and measuring the constructs, these three studies have contributed substantially to our understanding of the attitudinal and social context factors influencing system use.

Theoretical Foundations and Research Objectives

The primary objective of this research is to improve our ability to predict the degree to which an individual will use a computer-based system. A second objective is to be able to explain what factors influence intentions to use or to not use systems. This research will focus on people and their reaction to systems, as opposed to focusing on the technical aspects of the systems. The hardware and software platforms supporting systems are changing so rapidly that a model tied to a specific technology is in danger of becoming outdated with the next wave of technology. An assumption of this research is that people's reactions to new technology are relatively stable when compared to the rapid evolution of information systems (IS) technology. If the use of a system can be predicted independently of the technology upon which it is based, then IS research will have a lasting foundation upon which to build future work. Toward this end we will borrow Triandis' (1980) behavior prediction theory from Social Psychology and apply it in an IS context.

Triandis' Behavior Prediction Model

Within Social Psychology there are a variety of competing approaches to predicting behavior. The available theories range from those with a strictly cognitive approach such as Neisser's (1966), to those with a strictly behavioral view such as Skinner (1977). In the strictly cognitive approach it is assumed that people think before they act, and that only their thoughts will affect behavior. At the opposite end of the spectrum, the behavioral view suggests that behavior depends solely on the reinforcement received for past behaviors. No thoughts are hypothesized to intervene between the stimulus and the organism's response. The problem with these extremes is that they fail to capture the complexity of human behaviors.

Triandis' model lies between the extremes of purely cognitive and purely behavioral psychology. He borrows from both approaches to form a more complete explanation of behavior. Triandis proposes that behavior is caused by both what a person intends to do (i.e., behavioral intent) and by their habits (See figure 1). Behavioral intent and habits are moderated by objective factors which make an intended behavior easy or difficult to perform (i.e., facilitating conditions) and by the person's physiological arousal (i.e., relevant arousal). Behavioral intent, in turn, is influenced by affect (i.e., feeling of pleasure or displeasure associated with performing the behavior), social factors, and perceived consequences (i.e., the costs and benefits to the person of performing the behavior). Social factors is an umbrella term describing a variety of factors which capture the individual's internalization of the reference group's culture. Commonly identified social

factors include self-efficacy (i.e., how the person views their ability to master new tasks), norms (i.e., perceptions of how others think the individual should behave) and social contracts (i.e., agreements with others to behave in specific ways).

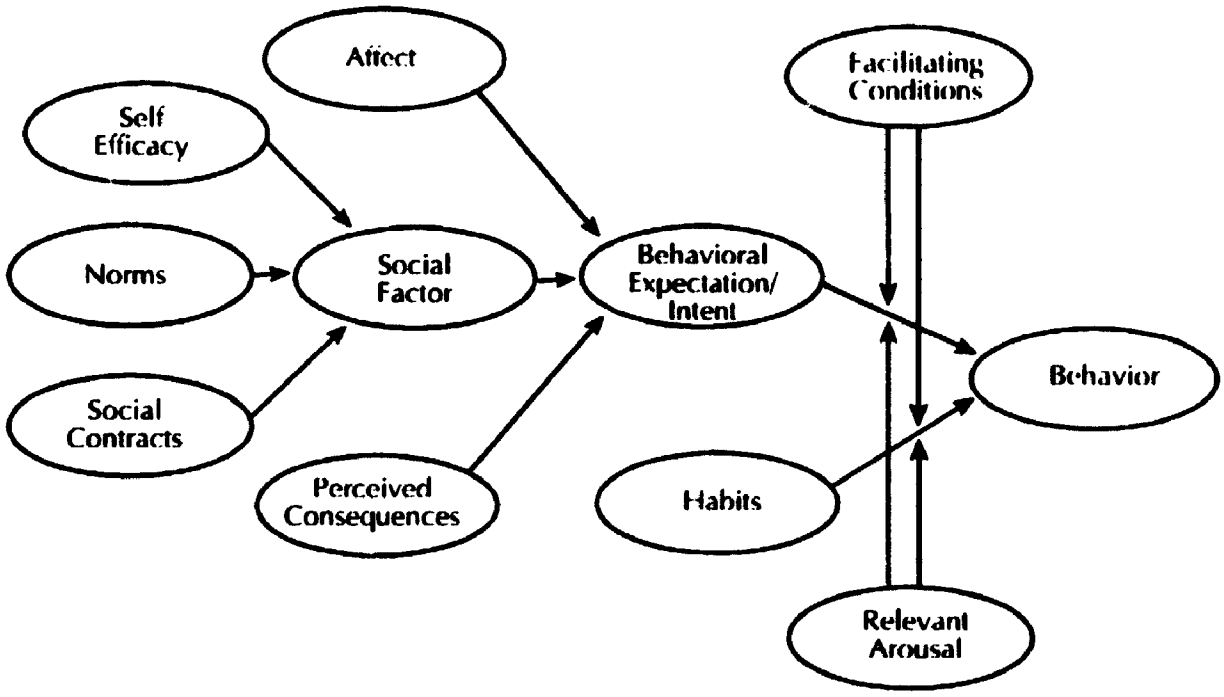

Figure 1 - Triandis' (1980) Behavior Prediction Model

There is considerable support for applying Triandis' theory to predict a variety of behaviors. Triandis (1980) cites a number of studies which used his model to predict behaviors such as donating blood (Pomazal 1974; Brinberg 1979), teacher behavior in classrooms (Landis, Triandis, and

Andamopoulos 1978), the fertility-relevant behaviors of women (Davidson, Jaccard, Triandis, Morales, and Diaz-Guerrero 1976), predicting re-enlistment in the National Guard (Hom 1978), and having Pap tests done (Seibold and Roper 1979). Other evidence for the applicability of Triandis' model across a variety of behaviors appears in the four studies presented below.

Sheth (1982) evaluated the appropriateness of Triandis' model for predicting consumer choice behavior in marketing. He observed that, as a model of choice behavior, Triandis is more comprehensive than most others proposed in Social Psychology. Sheth states that "the Triandis model provides a more realistic view of how consumers make choices" (Sheth 1982, 163). McQuarrie and Langemeyer (1987) present evidence that Triandis is more flexible and applicable to real world contexts than either the strictly cognitive or behavioral extremes. In a study of planned versus actual spending among owners of personal computers, McQuarrie and Langemeyer compared the predictive ability of Fishbein and Ajzen's (1975) purely cognitive model, Triandis' (1977) model, and Foxall's (1983) purely behavioral model. They found that neither intentions alone (i.e., Fishbein and Ajzen 1975), or past behavior alone (i.e., Foxall 1983) provided as good a prediction of behavior as Triandis' middle position. Similar results were found by Valois et al. (1988) in a study of exercise intention and behavior. In a comparison of Fishbein and Ajzen's (1975) cognitive model and Triandis' (1977) model they found that Triandis provided the better explanation of behavioral intentions. Thompson et al. (1991) used a model based on Triandis' work to investigate the optional use of personal computers by

knowledge workers. The results indicated support for four of the six hypothesized relationships.

One of the most common situations in the IS context is that of an individual faced with changing from one computer-based system to another. Examples include the migration of applications from mainframes to microcomputers, switches from expensive specialized hardware and software to generic versions, switches from stand-alone packages and environments like DOS to integrated packages and environments like Windows, replacing a manual system with an automated one, changes from one hardware vendor to another (for example from IBM to APPLE), and upgrades from previous versions of software to new ones. The elements of Triandis' theory are apparent within these contexts. Triandis proposes that behavior is caused both by what a person intends to do and by his or her habits. Habits are crucial to understanding any change process (Lewin 1947; Schein 1964). Their importance to systems implementation lies in the fact that old habits must be broken before new ones can be established. Facilitating conditions, such as easy access to the computer, as proposed by Davis et al. (1989), will moderate use of the system. A system which is difficult to access could easily override intentions to use it. Relevant arousal is not applicable to the IS context in that it is hard to imagine a physiological reaction leading to usage.

Behavioral intent results from a combination of Affect, Perceived Consequences, and Social Factors. Affect refers to how pleasurable the person finds the use of the system. If people enjoy their interaction with the system they may tend to use it more. This fits well with the generally

accepted importance of user-friendliness to system success (Meads 1985). Perceived consequences capture the perceived costs and benefits to the individual of using the system. Within the IS context perceived consequences include increased efficiency, effectiveness, and effort spent learning the system (Lucas 1978b, Davis 1989, Davis et al. 1989). The Social Factor includes a potentially unlimited number of aspects from the referent group's subjective culture. In the IS context this would include peer, superior, and subordinate support for using the system (i.e., social norms, Pavri 1988), the individual's confidence in his or her ability to use the system (i.e., self-efficacy, Compeau 1991), and any specific agreements made to either support or resist the new system (i.e., social contracts).

The Research Approach

A longitudinal study was designed to test the predictive and explanatory capacity of Triandis' (1980) behavior prediction model in the context of a software upgrade. This was done by attempting to predict an individual's future use of a software application based on their impressions of the product after a short trial use. Several factors hypothesized to influence those initial impressions were also investigated.

The study was conducted in two steps. The first step involved measuring the intentions to use a recently purchased upgrade, and the hypothesized antecedents of their intentions. A total of 805 people who had recently purchased an upgrade to either Aldus Persuasion or Quattro Pro were surveyed. Only those whose use of the upgrade was voluntary were included in the study. Three months later, a follow-up survey measured the

use of the upgrade. Structural equations modeling was used to examine the influence of affect, computer self-efficacy, norms, social contracts, and expected consequences on use expectations. The impact of use expectations and habits on use three months later was also assessed.

Contributions

The old adage which says that the only constant in life is change applies well to those involved with computer software. It often seems that just as we have begun to master the last "best software package on the market" a new one appears that is even better. Organizations must constantly evaluate their existing software base to decide whether the recently offered improvements are significant enough to warrant the cost. Against this background of rapid change, managers are faced with the difficult task of implementing software innovations. Information systems researchers are faced with the problem of investigating a phenomenon which constantly changes. This research is an attempt to address both problems and has the potential to contribute significantly to both the practice and the study of systems implementation.

This research recognizes that the nature of systems being considered for use by individuals varies widely across hardware types and over time. Rather than investigating the technological aspects of implementation which are transient, it focuses on the people involved in the change, and their ability to deal with it. The underlying assumption is that people change much less rapidly than does the technology. This work is an attempt to establish some basic principles about people undergoing technological change

which will transcend specific technologies. A general model of how people decide to use or reject software innovations would be of considerable use to both practicing managers and researchers. The implications of this work to managers and academics are discussed below.

Managerial Implications

The decision to implement a new system often involves a substantial commitment of resources. This research has the potential to improve the implementation success rate, and lower the costs of implementing a new system in several ways. The model may be used in a voluntary implementation process to gauge the level of future use. In cases where the expected use is below a level needed to achieve the proposed benefits, remedial action could be taken to prevent failure. In the opposite case, where expected use is well into acceptable ranges, resources could be diverted to other projects. A more efficient allocation of implementation resources would result, thus improving the return or the project investment.

The explanatory power of the model would also help the manager to identify the cause of an impending failure, and to decide what type of remedial action might be appropriate. For example, the model might show low computer self-efficacy indicating that the potential users were uncertain of their ability to learn to use the new system. To counteract this, a training program which focused on building their confidence at using the system could be implemented. The increased understanding of the human side of system use should make the transition easier for those involved in it. Since implementation resources are never infinite, the model might also be used in

deciding where to allocate those limited resources to achieve the maximum benefit.

A better understanding of how to help people through the software change process would make it feasible to adopt software innovations more frequently and at a lower cost. An organization which is better at implementing new systems than its competitors may be able to turn that technological responsiveness into a competitive edge.

Academic Implications

The most significant academic contribution of this work will be to test a well established model from Social Psychology in an IS context. The application of a strong theory to the problem of predicting system use has the potential to improve the rate of progress and quality of work in this area. Triandis' model, with its focus on the individual rather than the technology, may also provide insights into the implementation process which are not tied to the technology. The perspective gained in this study will not be made obsolete by the next significant change in technology.

Another strength of this work is that it builds on a brief but promising set of existing IS studies (Pavri 1988; Davis 1989; Davis et al. 1989; Thompson et al. 1991; Compeau and Higgins 1991, Adams et al. 1992). The need for IS researchers to build a cumulative tradition has been identified by many researchers (Robey 1979; Keen 1980; Goodhue 1988; Davis et al. 1989). This work accomplishes this in two ways. First, the research model continues in the theoretic direction established by the studies identified

above by borrowing its foundation from Social Psychology. Second, the scales which will be used to investigate the model have either been taken directly, or are closely based on scales already tested in the IS context. Another step will be taken in evaluating and refining those scales.

Social Psychology will benefit from this work in that it represents another test of Triandis' model in a context that has not been tested before.

Dissertation Organization

Chapter Two will begin with a review of IS research on predicting system use and other selected IS work which relates to the constructs in Triandis' model. While this research proposes to apply Social Psychological theory to the problem of predicting system use, the problem under investigation remains solidly in the IS system use tradition. For this reason, a detailed examination of related use research is required in order to place the current approach in context. This will also serve to highlight the similarities between earlier approaches and the proposed application of Triandis' behavior prediction theory.

The second half of Chapter Two provides a detailed explanation of Triandis' model. Existing IS knowledge is combined with Triandis' theory to form a conceptual model with testable hypotheses.

Chapter Three describes the research methodology used. The data analysis technique and the operationalization of the constructs is described. Then, the location of research sites and the pretest implementation is

outlined. Finally the pretest results and refinements to the measurement model are presented followed by a discussion of non-response bias.

Chapter Four contains the main study data analysis. The first part of the chapter evaluates the main study measurement model. The second part discusses the structural model results.

In Chapter Five the results of the study are reviewed. The strengths and limitations of the work are discussed. Implications are then drawn in both the academic and managerial areas. The chapter concludes with recommendations for future research.

CHAPTER 2 - RESEARCH IN INFORMATION SYSTEMS ON FACTORS INFLUENCING SYSTEM USE

In the first part of this chapter we will review the IS research on predicting system use and other selected IS work which relates to the constructs in Triandis' model. In the second part, Triandis' model is described in detail and the research hypotheses are presented. Each hypothesis in Triandis' model is integrated with the relevant IS literature. A form of the model suitable for testing in the IS context is presented at the end of the chapter.

System Implementation Outcomes - A Review of the Literature

A chronological approach is taken to reviewing IS research on predicting computer system use. This review highlights the progress made to date and suggests a direction for further work. Attitudes in general, user satisfaction in particular, and computer system use have all appeared in the literature as outcomes of the system implementation process.

The IS heritage of work in predicting system use is found in an extensive program of research published by Lucas (1973, 1974a, 1974b, 1975a, 1975b, 1975c, 1978a, 1978b). This series of often-cited articles represents a substantial portion of the early IS foundation for research into predicting system use.

Lucas (1973) identified variables associated with favorable user attitudes towards computer services, and studied the manipulation of those variables in the interest of improving user attitudes. It was assumed that

favorable user attitudes towards electronic data processing (EDP) staff and towards computer potential represented two measures of the IS department's effectiveness. A correlation analysis was performed on data gathered from a survey of 616 users in seven companies. Significant relations were found between user attitudes towards computer services, user perceptions of service, and company computer practices. The model for future research presented in the article (Lucas 1973, 169) provides a good summary of the factors Lucas considered in assessing user attitudes, user perceptions, and company computer practices.

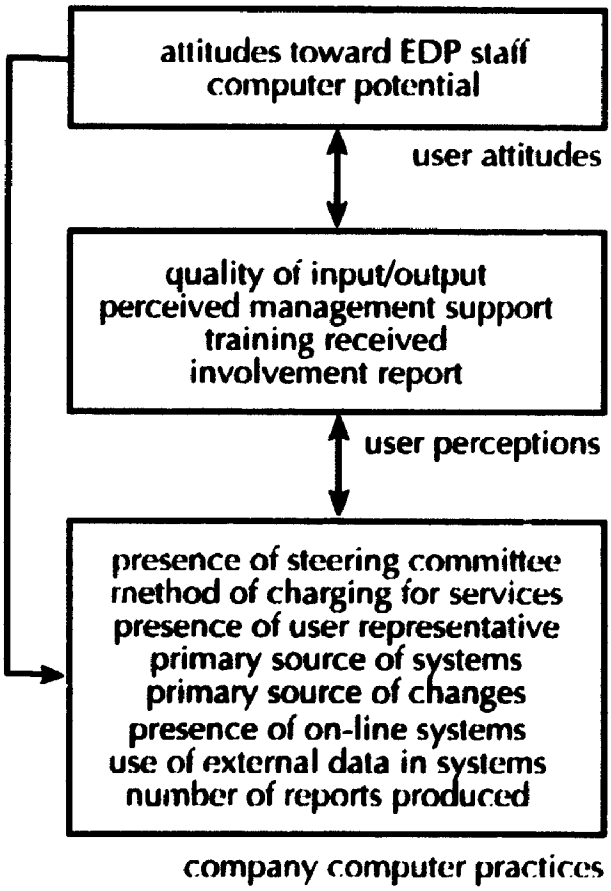

Figure 2 - Lucas' 1973 Model

In his book Why Information Systems Fail, Lucas (1975b) pulled all of the factors affecting system use and performance from his earlier works into one comprehensive model of information systems within organizations. Results from six different studies, many of which formed the basis for earlier publications, were used to test the relationships among the factors in the model shown below.

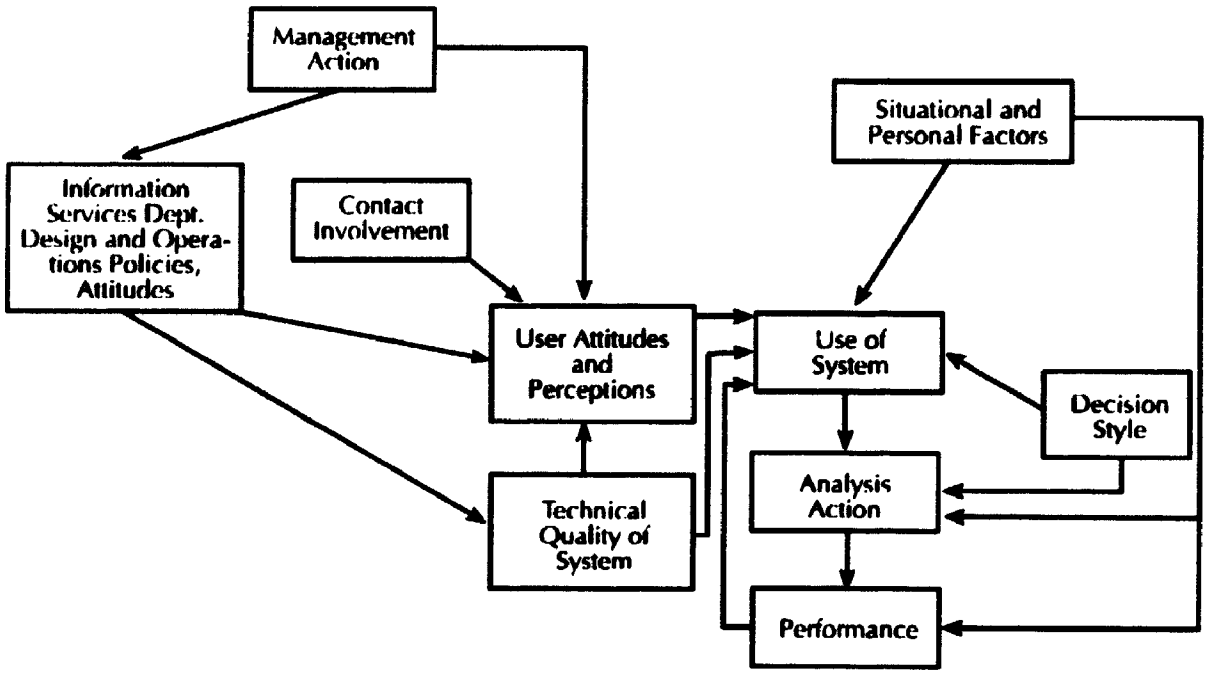

Figure 3 - Lucas' 1975b Model

The strongest support was found for the following four hypotheses:

Systems with higher technical quality result in more favorable user attitudes and perceptions of information systems and the information services staff. (Lucas 1975b, 67)

> Favourable user attitudes and perceptions of information systems and the information services staff lead to high levels of use of an information system. (Lucas 1975b, 87)
>
> High levels of system use result from a system with high technical quality. (Lucas 1975b, 87)
>
> Different situational and personal factors lead to differing levels of performance. (Lucas 1975b, 102)

Overall, the model was better at explaining system use than at explaining the link between system use and job performance.

Taking these two articles as representative of Lucas' early work (1973, 1974a, 1974b, 1975a, 1975b, 1975c, 1978a) some summary comments are in order. While the work does establish a conceptual foundation and an elaborate model for research into system use and job performance, the foundation is methodologically weak. Many of the key constructs lack clear theoretical definition. Attitudes, for example, were used in all of the studies but were never defined. Without clear definitions it is impossible to evaluate the operationalization of the constructs. No scale reliabilities were reported in any of the articles, which makes it impossible to assess the quality of the measurement models.

It is tempting to discount this work completely, given the methodological problems associated with it. However, the sheer volume of data gathered across several different industries at different times lends some credibility to the model presented in 1975b. At the very least, the work serves to establish a tentative link between user attitudes and perceptions, situational and personal factors, and system use.

Not all of the research from the 70's on predicting system use suffers from the methodological problems discussed above. An article by Schultz and Slevin (1975) sought to develop an instrument that could be used by OR/MS researchers for data collection in a variety of settings. Although the work was done in the OR/MS context, it is nonetheless relevant to information systems research. Schultz and Slevin (1975) stated that "the first stage in investigating the organizational validity of OR/MS models is an evaluation of individual attitudes toward the OR/MS innovation" (Schultz and Slevin 1975, 155). They identified three basic research questions associated with investigating implementation attitudes:

1. What are the key attitudinal dimensions affecting implementation success?

2. How can these attitudes be measured?

3. How do these attitudes affect implementation success? (Schultz and Slevin 1975, 155)

Over 80 implementation attitude items and 11 organization context items were developed based on a broad search of the organization and implementation literature. The items were administered in a paper based questionnaire to managers in a basic metals manufacturing company. A total of 94 usable responses were received.

Two key questions guided the analysis. Did conceptually meaningful and understandable attitudinal factors emerge from the questionnaire? Were these attitudinal dimensions correlated with the dependent variables

having to do with model use and perceptions (Schultz and Slevin 1975, 161)? Factor analysis with orthogonal rotation was used to empirically identify factors from the data. It is important to note that the analysis was not used to confirm preconceived constructs. Rather, the factors emerged from the data analysis and were then interpreted.

Of the 67 items used in the analysis, ten were discarded and the remaining 57 organized into seven attitude factors. The seven factors were:

1. Job performance and performance visibility;
2. Interpersonal relations, communications, and interaction;
3. Changes in organization structure;
4. Goal clarity, congruence and achievability;
5. Project technical, organizational, and top management support;
6. Client/researcher relationship; and,
7. Results urgency to user, boss, and top management.

Factor scores from the seven attitude factors were then used in regression analyses to predict system success. Success was measured as a combination of factors including; the individual's intent to use the system, his or her expectations that others would use the system, and an evaluation of the worth, accuracy and overall success of the system. The results indicated that "the importance of this project to you" and "the chance of success using this technique" were most highly correlated with the "probability of own use." This suggested that personal factors might be the key to successful implementation.

Schultz and Slevin contributed to the prediction of system success by making two important observations. Personal factors appear to strongly influence whether or not an individual uses a system, and attitudes seem to

precede intended use. By employing intended use as a surrogate measure for system success the authors also implicitly establish a link between intended use and actual use.

Schewe (1976) adapted Fishbein's early work on predicting an individual's Behavior (Fishbein 1967) to the problem of predicting system usage. Schewe's theoretical model is shown below.

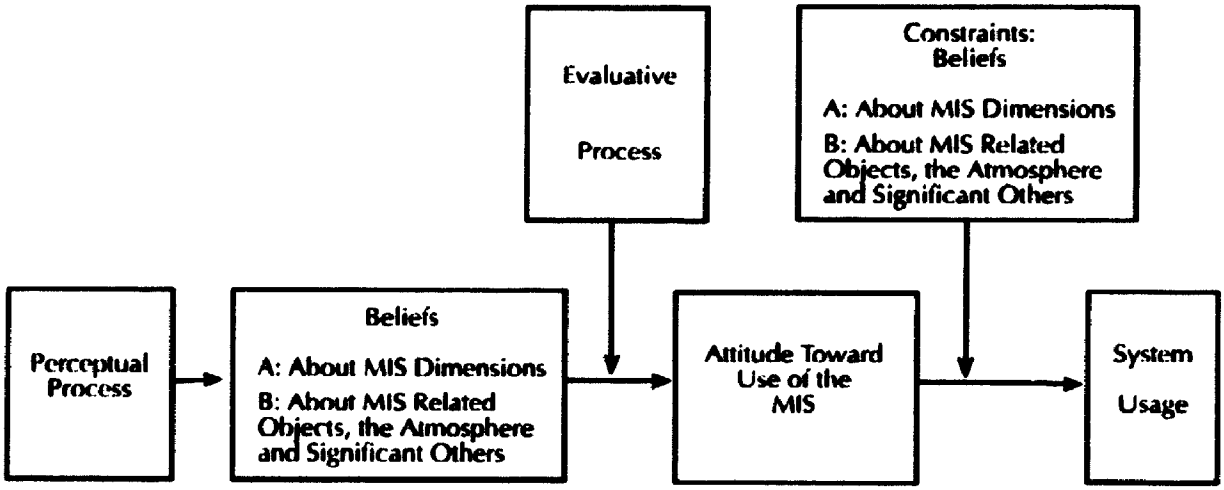

Figure 4 - Schewe's 1976 Model

Data were gathered from 79 middle managers in ten food processing firms. A stepwise regression analysis was used to determine which of the items influenced requests for additional information. Of the five propositions tested, only Proposition Three is of interest to this review. It states that "Favourable user attitudes toward use of the MIS increase his initiations of

requests from the information system" (Schewe 1976, 582). The oth[illegible] propositions all related to comparing batch and interactive systems.

The results indicated that attitudes did not appear to have any real influence on Behavior. According to Schewe, "many plausible situations not included in this exploratory study may well intervene between attitudes and Behavior and cause a seemingly inconsistent relationship" (Schewe 1976, 588). Another possible explanation not identified by Schewe is that the assumptions underlying the use of regression as an analysis technique were violated enough that the results from the analysis may not be interpretable. Schewe tested Proposition Three by using all variables simultaneously in a stepwise regression to predict usage. From the theoretical model shown above we see that beliefs lead to attitudes, and would therefore be closely correlated to attitudes. It is this author's observation that, given the theoretical basis for expecting high multicollinearity between measures of beliefs and attitudes, it does not make sense to use them both as independent variables in a regression analysis to predict system usage. The use of multiple measures of a construct as separate independent variables also does not make sense. To do so would suggest the existence of high multicollinearity and might invalidate any conclusions drawn from the analysis.

Lucas (1978b) takes a very different approach to predicting implementation success than in his earlier work. Instead of trying to build an elaborate model to capture the entire set of variables influencing system use, Lucas focused on a few key variables. In his model shown below we see

that the quality of an information system is hypothesized to affect the costs of using the system, as well as the benefits of the system. Quality, costs and benefits are then posited to affect the success of implementation. One of the strengths of this model is its intuitive appeal. It seems plausible that the costs of making a change, together with the benefits of the change, would be weighed by an individual when considering whether to use a system.

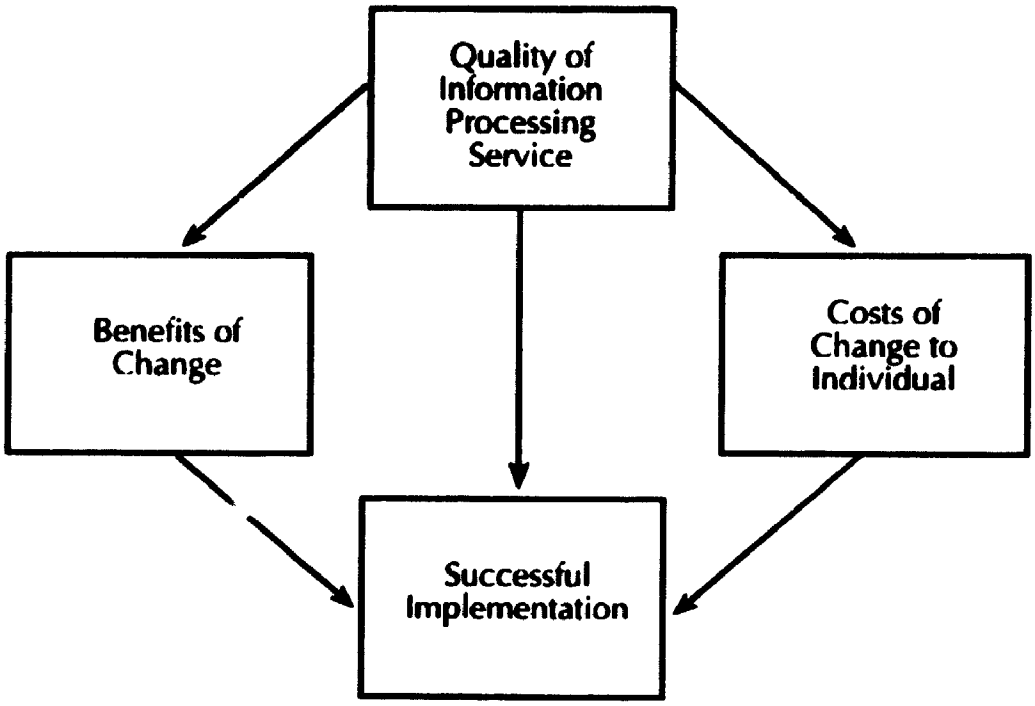

Figure 5 - Lucas' 1978b Model

The implementation of a new order processing system for salespersons at a large apparel manufacturing company was used to evaluate the model.

Data were gathered from 56 individuals in the experimental division, and from 58 individuals in a control group. Correlation analysis was used to interpret the data. A particular strength of the field study is that it was longitudinal, thus permitting some investigation of causal relationships.

Lucas' research model differed from the theoretical one shown above in that quality of the information processing service was dropped as a construct. The salesmen's overall satisfaction with the system was used as the measure of implementation success. Significant correlations were found between the costs of the change to the individual, the benefits of the change, and overall satisfaction with the system.

Robey and Zeller (1978) found an interesting research opportunity in comparing the "successful use of an information system by one department, and the rejection and failure of the same system in another similar department of the company" (Robey and Zeller 1978, 70). This facilitated the investigation of individual, process and organizational differences between the successful and unsuccessful implementations since the technical features of the two systems were identical.

Various research techniques were used to gather information on the two departments which had implemented the Quality Information System (QIS). Interviews were conducted, a questionnaire based on Schultz and Slevin's (1975) work was administered, and objective characteristics of the divisions were compiled. One drawback acknowledged by the authors is that all data were gathered after the adoption and rejection decisions had been made. While this prevents any assessment of causality, several interesting

differences between the divisions emerged. At the individual level, Robey and Zeller found that the divisions differed in their evaluations of the effect the QIS would have on job performance and visibility, and in the urgency and importance of the QIS in the organization. The adopting division rated both more highly. The divisions did not differ on their evaluations of the QIS's effect on interpersonal relations, organizational changes, goals, top management and other departmental support, and the assessment of the relationship between the developers and the users. The organizational characteristics of complexity, formality and centralization also differed across the divisions. The adopting group was smaller and its organization less complex. It had more formalized interactions, and a more centralized authority. The adopting division also had a strong supporter and advocate of the QIS in a management position, which is something the rejecting division did not have.

This work serves to highlight the importance of organizational and behavioral factors in the system implementation process. The authors concluded by emphasizing the need for "a rather broad analysis of the factors affecting implementation of MIS" (Robey and Zeller 1978, 75).

A study by Robey (1979) addressed many of the shortcomings of the earlier works relating attitudes to system use by using a psychometrically sound measurement instrument to relate attitudes to actual system use. Robey used Schultz and Slevin's (1975) attitude questionnaire to predict voluntary system use. An objective measure of system use was chosen as the dependent variable.

Data were gathered from 66 salespersons in a large industrial products manufacturer who were using a customer order information system. The results showed that user attitudes were significantly correlated with system use. Obser ed correlations ranged between .42 and .79.

Zmud (1979) organized the individual differences literature around a proposed model of the impact of individual differences upon MIS success. That model, shown below, emphasized the distinction between cognitive and attitudinal determinants of MIS success. The relationships presented in the model are associative only and should not be interpreted as causal.

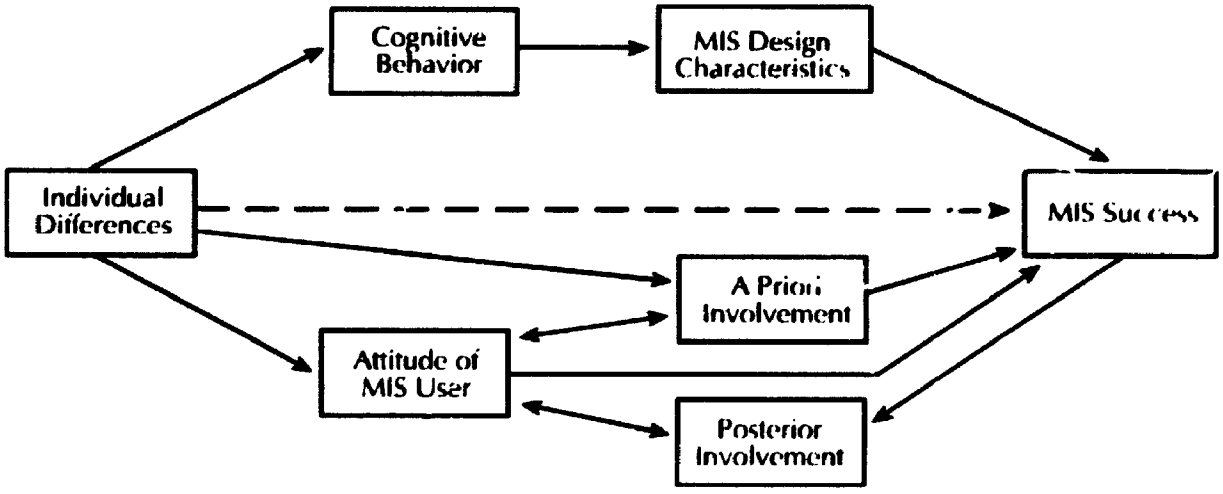

Figure 6 - Zmud's 1979 Model

The model's emphasis on individual cognitive style can be explained by its orientation toward decision support systems. Even with this orientation,

there are several factors identified in the review which are applicable to a variety of information systems. They include user satisfaction, user performance, attitudes, beliefs, values, and ease of use.

A shortcoming of the literature noted by Zmud was that "many of the studies reported were not conducted in a MIS context; and, many of the MIS-based studies were of a laboratory nature and/or utilized students as subjects. The replication of these studies in real MIS environments would be beneficial" (Zmud 1979, 974). He concluded by saying that individual differences (including those factors explicitly identified above) are largely responsible for determining the success of an MIS.

Ginzberg (1981) examined the implementation literature for issues common across various stages of the implementation process. The Kolb/Frohman model of change provided the conceptual definitions for the stages of implementation. Data were collected from 35 users of 27 information systems to identify generic implementation issues. A principal components analysis yielded six factors:

1. Extent of project definition and planning;
2. Organizational commitment to the project;
3. Breadth of analysis;
4. User responsibility for system;
5. Commitment to change; and
6. User ownership of system.

System success or failure was measured by a single question evaluating the user's overall satisfaction with the system. While no single factor could reliably distinguish between satisfied and dissatisfied users, three factors did show promise; the organization's commitment to the project,

the commitment to change, and the extent of project definition and planning. Ginzberg suggests that special attention to these issues should increase the probability of a successful MIS. The fact that all three issues arise early in the implementation process might also provide advance warning of impending failure. Care must be taken when assessing the study's results based on such a small sample.

Swanson (1982) reviewed how user attitudes have been measured and applied in the IS context. He identified two complementary perspectives from which attitudes have been employed: the implementation perspective; and the information perspective. The implementation perspective focuses on "contributing to a theory of MIS development in which MIS success and failure is explained" (Swanson 1982, 157). The information perspective is concerned "with an understanding of the process by which users are informed by an information system" (Swanson 1982, 157).

Swanson presented a channel disposition model in which the net utility of a system was measured by the users' disposition to use the system. "Channel disposition" was defined as the individual's attitude that reflected a tendency towards use. Attributed information quality and attributed access quality were posited as the antecedents of channel disposition. Attributed information quality captured the expected benefits of system outputs. Attributed access quality reflected the expected costs of getting the information. Stated more directly, the tendency to use a system was hypothesized to be a function of the benefits and costs of using that system.

A model of channel selection was also posited which attempted to explain user choice when several alternatives were present.

While the article does not test either of the models, Swanson did provide a list of attributes that any test of channel disposition (system use) should posses. The measure must have construct validity derived from the theoretical framework. It must be reliable, have discriminant validity, be problem-diagnostic and cost-effective. Both costs and benefits of using the system must be evaluated from the user's perspective. The measure should be oriented toward decision making (a characteristic of the decision support system focus of the work). It should explain the choice among alternatives. The organization context of the individual and the problem must be taken into consideration. Implicit in this list is that research included in his review would have benefited from improvements on many of these dimensions.

As early as 1979 Robey (1979) suggested a model for future attitude research in IS based on expectancy theories of motivation. In 1983 DeSanctis (1983) took this approach by using Vroom's (1964) expectancy theory of motivation to investigate user attitudes and expectations and their impact on users' Behavior. De Sanctis turned to Vroom's (1964) expectancy theory as the theoretical foundation for her work after having identified a general lack of underlying theory in IS linking user attitudes and expectations to system use. The focus of the research was on those factors affecting the use of a decision support system. Performance enhancement expectations and levels of effort required to use a system were hypothesized to affect system use. The hypothesis was tested in a longitudinal lab study of 88 undergraduate

students involved in an automated business simulation. The students were trained on a decision support system (DSS) which could be used during the business simulation. Use of the DSS was measured in three ways, by total queries made, by total "good" queries made, and by the number of data values accessed.

The results provided weak to moderate support for an expectancy theory explanation of decision support system use. Correlations between the independent and dependent variables ranged between .04 and .26. While the quantitative results were weak, the study has other strengths identified by the authors. It was longitudinal. It integrated expectancy theory with the investigation of decision support systems. The study also specified the underlying theory in advance, rather than finding a reference theory to fit existing data. The major weakness of the study is the lack of generalizability of results due to the undergraduate student sample, and the laboratory context of the work.

Ives, Olson and Baroudi (1983) sought to establish a standard user information satisfaction (UIS) instrument which could be used as a surrogate for measuring the impact of a system on organization effectiveness. A standard measure of UIS would alleviate the difficulty in comparing results from different measures with varying and unknown validity. After reviewing existing user information satisfaction measures they decided to build on the work of Pearson (1977). Pearson's instrument was tested on a sample of 480 production managers. A thorough review of the instrument's reliability, content validity, predictive validity, and construct validity led to the

identification of items with "undesirable psychometric properties." The refined user information satisfaction (UIS) measure was then tested on a sample of 200 production managers.

Ives and Olson (1984) reviewed the literature relating user involvement to MIS success. Their objective was to determine the importance of user involvement to the success of an information system. Their findings, which were based on a review of 22 studies, indicated that the enthusiastic support for user involvement found in the literature was not supported empirically. Methodological flaws including; selection biases, reliability of measures, general applicability of questionnaires, ex post facto measurement of independent variables, single system surveys, and a lack of underlying theory invalidated most of the existing work relating involvement to success.

The authors encouraged borrowing theory from other disciplines, and adopting standard validated instruments, to improve cross-study comparisons. Cognitive and motivational factors were suggested as moderators between involvement and predicted outcome variables. Laboratory experiments, longitudinal studies, and field tests were recommended for enhancing our understanding of causality.

Igbaria and Parasuraman (1989) performed a path analytic study of the impact of individual characteristics and computer anxiety on attitudes toward microcomputers. Their model, shown below, was implemented using the scale described in a later publication by the same authors (Igbaria and Parasuraman 1991).

A pilot study of 183 employed MBA students, and a follow-up study of 166 managers was used to test the model. Path analysis using least squares multiple regression was the statistical analysis technique used. Age, education, external locus of control, math anxiety, the feeling-thinking dimension of cognitive style, and computer anxiety accounted for 36% of the observed variation in the subjects' attitudes toward microcomputers.

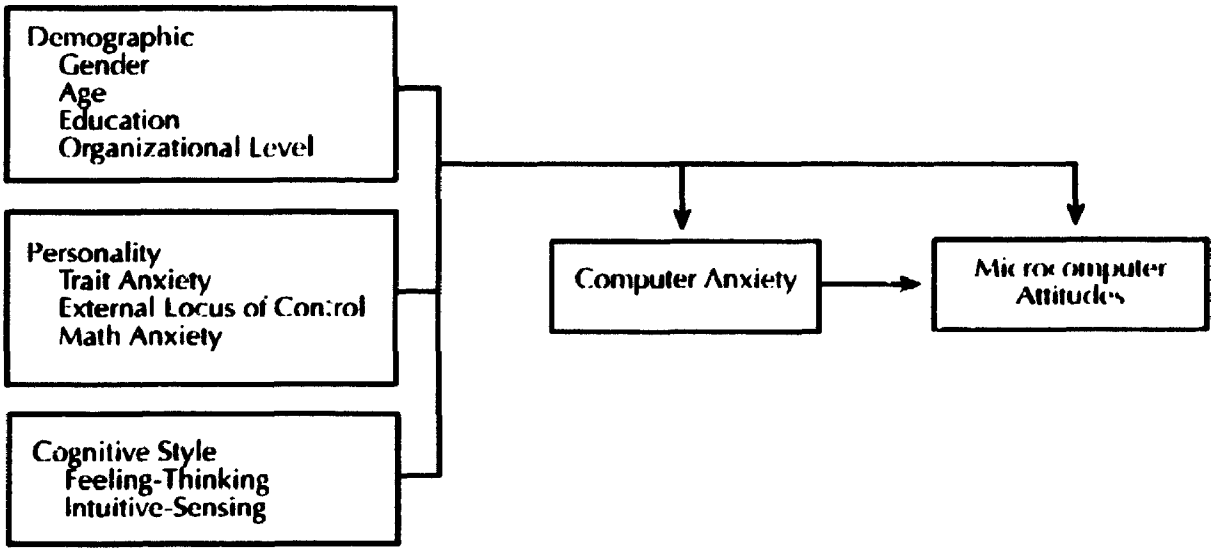

Figure 7 - Igbaria and Parasuraman's 1989 Model

What Igbaria and Parasuraman labeled microcomputer attitudes was a mix of cognitive, affective, and behavioral components based on Triandis (1971). A combination of the individuals' perceptions about microcomputers, how they felt toward using them, and their predisposition toward using or not using microcomputers made up the microcomputer attitudes construct. Unfortunately, Igbaria and Parasuraman made no attempt to link these components to the behavior of using a system.

Goodhue (1988) reviewed the IS literature surrounding the attitude construct and system use. In his own words:

> The results of these studies have been decidedly mixed. Some have found statistically significant links; others have not. It is difficult to extract from these results any generally accepted finding or an underlying model upon which future research can be built. One possibility is that these contradictory results are due in part to the lack of a strong theoretical basis. (Goodhue 1988, 183)

In an effort to overcome these problems, Goodhue suggested job satisfaction research as a source of theory which would help to relate attitudes to job performance.

The model derived from the job satisfaction literature focused on the fit between job tasks and IS capabilities as an antecedent to attitudes and performance. Task, IS environment, and individual characteristics were posited to affect the correspondence between job tasks and IS capabilities. Goodhue distinguished between the subjective attitudinal assessment of the correspondence (attitudes), from the more objective assessment of characteristics (beliefs). Beliefs were seen as antecedents of the decision to use a system while attitudes were defined as a consequence of use. While Goodhue did not attempt to empirically test the model, he did clearly identify the lack of a strong underlying theory as the source of many problems in understanding the role of attitudes in IS research.

Trice and Treacy (1988) reviewed the IS literature employing utilization as a dependent variable. The authors reviewed how 17 articles, published between 1976 and 1985, had defined and measured system use.

They suggest that a failure to accumulate substantial knowledge in this area is due largely to a lack of underlying theory. The inconsistent definitions and operationalizations of use found in their review were attributed to the absence of strong theory. To address this problem they presented four theories as relevant to investigating different types of IS usage. The four theories are the Lewin-Schein model of change, Fishbein's Theory of Reasoned Action, theories of task-technology fit, and individual differences and information systems characteristics.

While the authors state that no single definition of use would be applicable for all four areas, they felt that convergence on a single definition within each area should be a possible. They stressed that the definition would have to closely fit the definition of use as implemented in the referent theory.

Rivard and Huff (1988) proposed and tested a model of the factors affecting end-user computing success. Data were gathered in a two-stage process. In stage one in-depth interviews were used to refine the preliminary model. The refined model was then tested with a survey which yielded 272 usable responses from non data processing personnel involved in end-user computing. The data were analyzed using two distinct approaches. A bivariate analysis using Spearman rank correlation coefficients and the Mann-Whitney U test were used to test individual hypotheses. Partial Least Squares (PLS) was used to analyze the model as a whole. The results from both approaches were consistent.

Forty-two percent of the variation in success, defined as overall user satisfaction, was explained by the model. Success was influenced by user satisfaction with the independence from the Data Processing (DP) department, user satisfaction with the environmental setup, the user friendliness of the software tools, user attitudes, user satisfaction with DP support, the degree of DP push, DP readiness for change, and the user's computer background. Only the proposed relationship between user satisfaction and the goodness of fit between user pull and DP push was not supported.

Limitations of the study, identified by the authors, included weaknesses pertaining to the reliability of the scales which ranged between .63 and .87, and validity of the measures. The dependent variable, overall user satisfaction was measured with a single item scale. All measures were perceptual as opposed to objective. The authors support the development of more direct and objective measures to increase the validity and reliability of the measurement model.

From the perspective of the proposed research, it is interesting that Rivard and Huff's work applies the user attitude concept in the non-traditional information system setting of end-user computing. This suggests that a model such as Triandis', with its attitude focus, could be used to investigate system use in settings where the user, and not the IS department, was the source of the innovation.

Pavri (1988) used Fishbein's (Ajzen and Fishbein 1980) Theory of Reasoned Action in his doctoral thesis to study the factors contributing to

microcomputer use. Pavri used LISREL to analyze cross-sectional data gathered from 519 managers in 54 organizations. The results indicated that positive attitudes towards usage, and subjective norms supporting usage, both led to higher levels of microcomputer use. Computer anxiety, computer skills, system quality and management support all affected attitudes towards usage. Subjective norms were affected by management support, use by upper level managers and use by peers.

This work is significant in that it is a successful example of borrowing theory from Social Psychology to improve the quality and rate of progress of IS research. It is also one of the few works in this area which uses an analysis technique (LISREL) capable of capturing the meaning of individual constructs while placing them within a causal network for systemic interpretation as well. The conceptual content of a construct in LISREL is calculated partially based on its measures and partially on its place within the causal network. When analyzed this way, a construct gains meaning from both its measures and its place in the causal network.

Another work which took a similar approach to Pavri's is Moore's (1989) doctoral dissertation. Moore used Fishbein's Theory of Reasoned Action as the basis for developing an innovation decision model. Moore then used the model shown below to investigate the decision to use an information technology innovation.

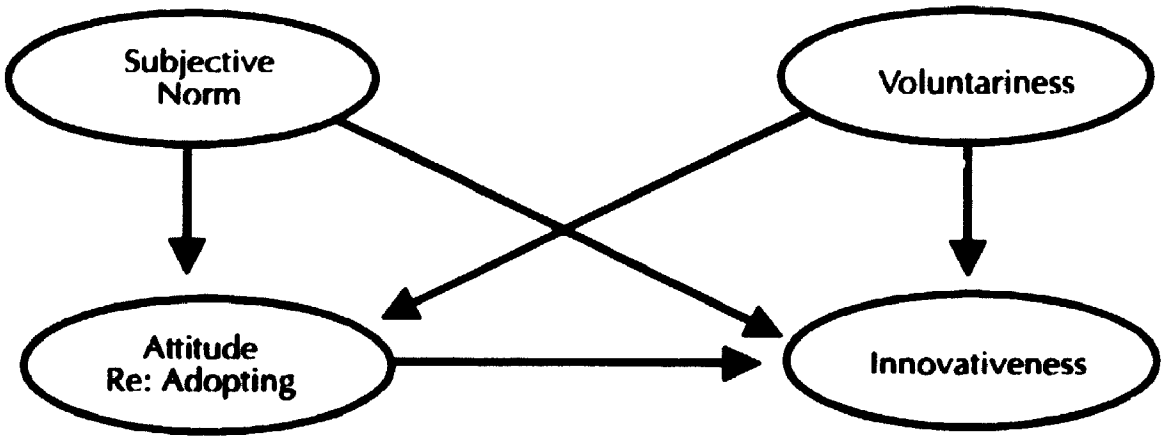

Figure 8 - Moore's 1989 Model

Data were gathered from 540 personnel in a variety of departments in seven different organizations. Two techniques were used to analyze the data, regression and LISREL. As regression cannot simultaneously assess the interrelationship between the measurement model and the theoretical model only the LISREL results will be discussed. Attitudes toward adopting, subjective norm., and voluntariness were found to affect innovativeness. Voluntariness and subjective norms both had a direct effect on innovativeness, and an indirect effect through attitudes toward adopting. Supervisors, senior management, peers and subordinates were all important in the formation of subjective norms. Of all the dimensions of attitudes identified in the model shown above, only avoidance proved to have no significant relation to attitudes. In total, 68% of the observed variation in innovativeness (measured primarily as earliness of adoption) was explained by the model.

A particular strength of this work was the time spent improving the reliability and validity of the measurement model. Scale reliabilities as

measured by Cronbach's alpha ranged between .70 and .98. High scale reliabilities, and a strong underlying theory are strict prerequisites for using LISREL as an analysis technique.

Davis (1989) stated that "(v)alid measurement scales for predicting user acceptance of computers are in short supply. Most subjective measures used in practice are un-validated, and their relationship to system usage is unknown" (Davis 1989, 319). He takes a step toward alleviating this problem by developing and validating scales for measuring the perceived usefulness, and the perceived ease of use of an information system. Both of these constructs were hypothesized to be fundamental determinants of user acceptance.

The scale development process began by clearly defining perceived usefulness and perceived ease of use. Fourteen candidate items were drawn from a variety of related literatures. Pre-test interviews reduced each scale to ten items which were then tested on 112 users of two systems. The scales were then reduced to six items each and re-tested in a lab study of 40 MBA students. Final reliabilities for the scales were .98 for usefulness and .94 for ease of use. Convergent and discriminant validities were also reported as being high.

The relationships between ease of use, usefulness, and expectations of use was investigated for both stages in the scale development process. The results indicate that usefulness and use expectations are closely correlated (.56 to .85). Ease of use and use expectations are also correlated, but to a

lesser extent (.12 to .59). The author suggests that ease of use may be an antecedent of usefulness, a point requiring further investigation.

Having achieved his objective of developing two psychometrically sound measurement scales, Davis suggested that further work was needed on how other variables related to use. The enjoyment related to the process of using a system was one such variable identified. The gap between expectations of usefulness and actual usefulness was also presented as an important area for further work.

Davis, Bagozzi, and Warshaw (1989) compared the predictive and explanatory power of Fishbein and Ajzen's (1975) Theory of Reasoned Action (TRA) with the Technology Acceptance Model (TAM) developed by Davis (1986) in his doctoral dissertation. The models were used in an attempt to predict a person's computer acceptance from his or her intentions. Attitudes, subjective norms, perceived usefulness, and perceived ease of use were used to explain intentions.

A longitudinal study was conducted with 107 MBA students who were potential users of a word processing program. Data were gathered after a one hour introduction to the system and again 14 weeks later. Initial intentions were correlated 0.35 with system use 14 weeks later. The intention usage correlation was 0.63. Perceived usefulness strongly influenced intentions accounting for over half of the variance observed. Perceived ease of use accounted for a small but significant part of intentions. While the results provided mixed support for both the TRA and TAM, the authors suggested a third more parsimonious causal structure where

intentions are determined by perceived usefulness and perceived ease of use.

This piece of research is distinguished by several characteristics. It is grounded in theory from the well-established field of Social Psychology, the measurement model is strong (reliabilities range from .82 to .95), and the longitudinal nature of the study makes it possible to draw causal linkages between perceived usefulness, perceived ease of use, intentions, and usage.

Thompson et al. (1991) investigated the optional use of personal computers by knowledge workers using a model based on Triandis' (1980) work. A sample of 212 knowledge workers from nine divisions of a multinational firm was collected. The authors used partial least squares, a second generation multivariate analysis technique suited to the investigation of causal models, to evaluate their data. Results moderately supported the overall model with four of the six hypothesized relationships showing significance. The research model is shown below.

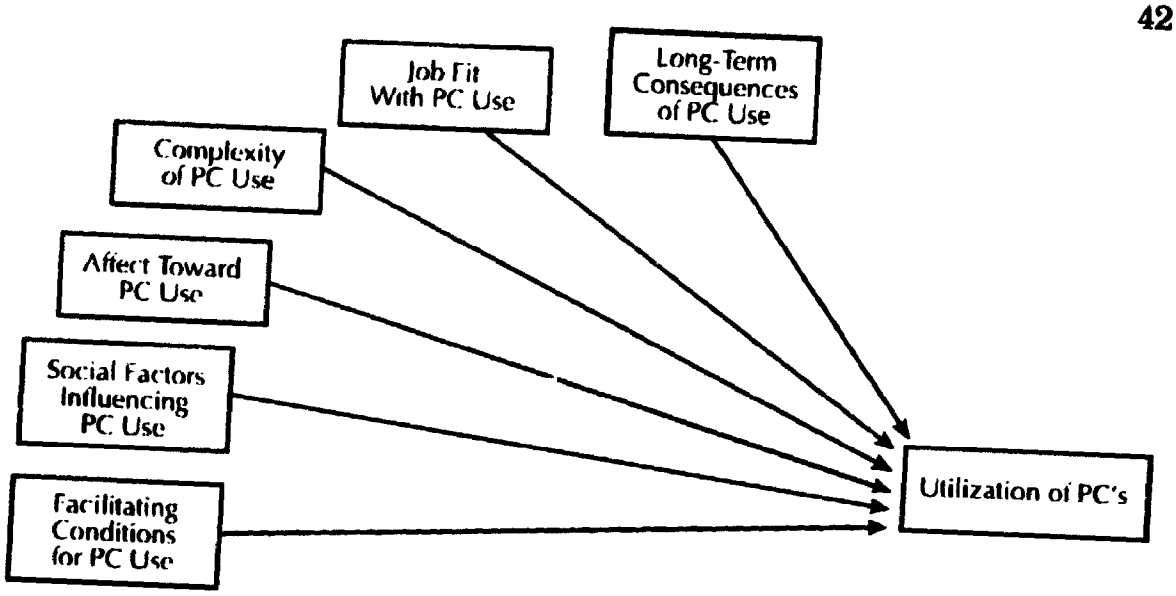

Figure 9 - Thompson, Higgins and Howell's 1991 Model

The four supported hypotheses were: social factors positively influenced the utilization of PC's; complexity of use was negatively related to utilization; job fit was positively related to utilization; and long term consequences of use were positively related to utilization.

The absence of a significant relationship between affect and utilization may be attributed to how affect was measured. The three item measure of affect captured how interesting, fun, and applicable PCs were to the type of job the respondent wanted. Triandis (1980) defines affect as "the feelings of joy, elation, or pleasure, or depression, disgust, displeasure, or hate associated by an individual with a particular act" (p. 211). While "fun" does fit within Triandis' definition, "interesting" and "applicable to the job" do not.

The inappropriate measurement of affect may explain the non-significant results.

Thompson et al.'s (1991) work is representative of the kind of research needed to make further progress in predicting computer system utilization. It had a strong theoretical base. All constructs and their measurement were clearly defined. The measurement model was empirically evaluated, and the theoretical model was evaluated using an appropriate statistical technique.

Igbaria and Parasuraman (1991) identified several shortcomings of earlier research on the role of attitudes in system use, including differences in the conceptualization and operationalization of attitudes, lack of specificity in measures, failure to establish construct validity, use of single item measures, and considerable variation in the target of attitudes. They addressed these concerns by developing and construct validating a measure of attitudes toward using microcomputers.

The process began with a literature review and an open-ended listing of the advantages and disadvantages of using microcomputers by 37 full time managers. The resulting 66 item pool was administered to 183 employed adults from a variety of organizations. Principal Components was then used to identify underlying constructs. The five constructs identified were perceived utility, limited hardware/software capacity, problems in use, time requirements, and user friendliness. Reliability of the factors was assessed using Cronbach's alpha. Reliabilities ranged between .74 and .90.

Construct validity for the five factors was tested by placing them in a nomological network of other constructs hypothesized to influence attitudes. Gender, age, computer anxiety, computer experience and training, and organizational support were hypothesized to affect attitudes. Attitudes in turn were hypothesized to affect system use and user satisfaction. Discriminant validity problems with the reduced attitude scales forced the researchers to group the five attitude constructs identified in the previous paragraph, into a single attitude construct. The results supported all of the hypothesized relationships except the effect of gender on attitudes.

Webster and Martocchio (1992) argue that the majority of ineffective computer use is caused by behavioral rather than technical factors. As a step toward addressing this concern, they developed and validated a measure of microcomputer playfulness. The authors defined microcomputer playfulness as "an individual's tendency to interact spontaneously, inventively, and imaginatively with microcomputers" (p. 202). The relationship between microcomputer playfulness and computer attitudes, anxiety, competence, efficacy, and training outcomes was also investigated.

Of the five studies conducted, four were done with undergraduate and graduate students, the fifth was done with university employees. The sample sizes ranged between 32 and 158, for a total of 423 across all five groups. A principle components factor analysis was used to extract seven items from the original 22 item microcomputer playfulness scale. Correlation analysis was then used to investigate the relationship between microcomputer playfulness and a variety of related constructs. The following

correlations emerged as being significant at the 0.05 level. Microcomputer playfulness was positively correlated with computer attitudes, computer competence, computer efficacy, involvement, positive mood, satisfaction, and learning. Microcomputer playfulness was inversely correlated with computer anxiety.

The major contribution of the work was the systematic operationalization of the microcomputer playfulness construct. The further testing of existing scales for the other factors investigated by the authors also served to contribute to the growing body of research on behavioral factors influencing systems use.

Adams, Nelson and Todd (1992) conducted two cross-sectional studies to replicate the validation of Davis' (1989) measures of perceived usefulness, and ease of use for determining system use. In the first study they surveyed users of voice mail and electronic mail in ten different organizations. Based on 118 responses, the authors found that the psychometric properties of the two scales held up well. The perceived usefulness scale had Cronbach's α of 0.94 for electronic mail and 0.93 for voice mail. The ease of use scale had alpha's of 0.88 for electronic mail and 0.81 for voice mail.

LISREL , a structural equation modelling technique, was used to assess the ability of perceived usefulness and ease of use to predict use. Like Davis (1989), they found that ease of use was not an important determinant of use. Perceived usefulness alone accounted for 15.5 percent of the variation observed in electronic mail use, and 17 percent of voice mail use.

In their second study, Adams et al. administered questionnaires to undergraduate and MBA students who used one or more of three selected microcomputer applications. Based on 73 responses, the authors reported Cronbach α measures of reliability between 0.91 and 0.96 for both scales. Once again LISREL was used to evaluate the relationship between perceived usefulness, ease of use, and use. The results in the second study were mixed and insignificant due to statistical power problems caused by the small sample size.

Fichman (1992) developed a framework for classifying diffusion of innovation research conducted in the IS field. The framework identifies two dimensions with two classes on each dimension. The first dimension, locus of adoption, distinguishes between technology innovations which are adopted by individuals versus organizations. The second dimension looks at the class of technology as having a low knowledge burden or low user interdependencies versus those with a high knowledge burden or high user interdependencies.

The author states that classic diffusion of innovation theory was developed in low knowledge, low user interdependent circumstances where the locus of adoption was individual. While some IS contexts fit this description, using diffusion of innovation theory in contexts with a high knowledge burden, high interdependence among potential adopters, or an organizational perspective requires careful adaptation of the theory. Fichman demonstrated the utility of his framework by reviewing and classifying 18 articles from the IS field.

Shortcomings of Previous Research Efforts

While the literature just reviewed does provide some insight into the factors impacting system use, that insight would have been improved had the quality of the research been better. This concern with the quality of research in IS is not new. Robey (1979) criticized the lack of clear operational definitions, the use of single item scales, failures to report scale reliabilities, data driven approaches to theory generation, and unclear theoretical distinctions between constructs. Zmud (1979) suggested the quality of IS research could be improved by moving it out of the lab and away from students as research subjects. DeSanctis (1983) cited the lack of a theoretical base in earlier studies as her reason for having turned to expectancy theory. Ives and Olson (1984) stated that much of the existing research lacked a theoretical base and was methodologically flawed. Goodhue (1988) echoed these concerns for developing a strong theoretical base.

The problems with the literature can be organized into two broad categories, theoretical and methodological. Looking first at the theoretical problems, it becomes apparent that most of the literature just reviewed was not grounded in theory. Only the following eight articles reported drawing directly from an established theory for their research models: Schewe (1976) was based loosely on Fishbein's (1967) theory; DeSanctis (1983) drew from Vroom's (1964) expectancy theory; Goodhue (1988) borrowed from the job satisfaction literature; Pavri (1988) adhered closely to Ajzen and Fishbein's (1980) theory of reasoned action; Davis (1989) borrowed from behavioral decision theory; Moore (1989) relied on the theory of reasoned action and

diffusion of innovation theory; Davis, Bagozzi and Warshaw (1989) tested Ajzen and Fishbein's (1980) model against Davis' (1986) technology acceptance model; and, Thompson, Higgins, and Howell's (1991) model was based on Triandis' (1980) Behavior prediction model.

Without an underlying theory it becomes difficult to make clear theoretical distinctions between constructs. Much of the confusion surrounding the use of attitudes and their relationship to system use is a direct result of this problem. Lucas' (1973) use of attitudes as an assessment of the EDP staff and computer potential bears very little resemblance to Rivard and Huff's (1988) use of attitudes as a predictor of user satisfaction. The fact that neither study attempted to define theoretically what was meant by the term "attitude" makes any interpretation of the measurement tenuous at best. Unfortunately, this has been the norm rather than the exception in this area of research (Lucas 1973, 1974a, 1975a, 1978a, 1978b).

A common methodological problem is the tendency for IS researchers to take a data driven approach to theory generation. We see many attempts to generate theory by gathering data and looking for constructs within it. Schultz and Slevin (1975) used principal components analysis to develop constructs from a widely selected set of variables. Several of Lucas' works (1974a, 1975c, 1978a, 1978b) rely on stepwise multiple regression, or principal components analysis, as a theory generation technique. Stepwise multiple regression was also used by Schewe (1976).

Other methodological problems include the use of single item measures whose reliability cannot be determined, and a failure to report

reliabilities (Schewe 1976; Lucas 1973, 1974a, 1974b, 1975a, 1975b, 1975c, 1978a, 1978b). In other studies, the generalizability of results are called into question due to the use of students as research subjects (DeSanctis 1983; Igbaria and Parasuraman 1988; Davis, Bagozzi and Warshaw 1989).

The pervasiveness of the theoretical and methodological problems with most of this earlier research prevents us from saying much about the factors influencing system use. Fortunately, more recent work has begun to make progress. Underlying this progress is the successful borrowing of theory from other disciplines, and the development and validation of measurement appropriate to testing those instruments in the IS context. Examples of work which combines good theory with sound measurements include Pavri (1988), Davis (1989), Moore (1989), Davis, Bagozzi and Warshaw (1989), Igbaria and Parasuraman (1989), Thompson, Higgins and Howell (1991), Igbaria and Parasuraman (1991), and Compeau and Higgins (1991).

This research proposes to build on this brief but promising tradition by using existing quality instruments to test the explanatory and predictive power of Triandis' (1980) Behavior prediction model. The primary difference between this and previous work is that Triandis' model has not been tested in the IS context. The work by Thompson et al. (1991) while based on Triandis, was not a test of Triandis. Having excluded use expectations and habits from the research model makes their work substantially different from the more complete test of Triandis proposed in this research.

A Different Approach

Reference disciplines in general have been identified as a source of theory which could improve the overall quality and rate of progress of IS research (Robey 1979, Keen 1980, Goodhue 1988, Trice and Treacy 1988, Davis et al. 1989). Viewing the problem of predicting system usage as a problem in predicting human behavior points toward Social Psychology as a source of relevant theory.

Several IS researchers (Pavri 1988; Thompson 1988; Moore 1989; Davis, Bagozzi and Warshaw 1989; Davis 1989) have already staked out positions based on a theory from Cognitive Psychology, Fishbein's Theory of Reasoned Action (1980). More recently, Thompson et al. (1991) shifted from the strictly cognitive view of Fishbein towards a mix of cognitive and behavioral elements in the form of Triandis' (1980) behavior prediction model. A purely behavioral approach such as Skinner's (1963) radical behaviorism is another possibility as yet untested in IS research. Which of these three approaches (strictly cognitive, a mix of cognitive and behavioral, or radical behaviorism) would be most fruitfully applied to the IS context is an important question. Before this question can be answered, a brief description of each position is needed.

Cognitive psychology is based on the idea that "the world of experience is produced by the man who experiences it" (Neisser 1966, 3). Individuals are assumed to have no direct contact with the world. Only internalized representations are accessible. All experience is mediated by our sensory organs and our interpretations of the experience. "Such terms as sensation,

perception, imagery, retention, recall, problem-solving, and thinking, among many others, refer to hypothetical stages or aspects of cognition" (Neisser 1966, 4). It is assumed that people think before they act, and that only their thoughts will affect behavior. No allowance is made for action without thought such as habits.

Behaviorists at the other extreme would assert that all behaviors result from schedules of reinforcement. No thoughts are hypothesized to intervene between the objective stimulus and the organism's response. Why clutter the understanding of behavior with cognitive schema which are at least as complex as the original phenomenon being studied? They take a very direct approach to predicting and explaining behavior by only incorporating objectively observable schedules of reinforcement as predictors. Skinner (1977) states "The whole field of the processing of information can be reformulated as changes in the control exerted by stimuli" (p. 186). "The mental apparatus studied by cognitive psychology is simply a rather crude version of contingencies of reinforcement and their effects" (p. 187).

The middle ground, taken by Triandis, is that behavior is caused by a mix of cognitive and behavioral elements. While this middle position does not have the philosophical purity of the more extreme positions, it does appear to have some practical superiority. McQuarrie and Langmeyer (1987) examined planned versus actual spending among owners of home computers from the three perspectives of Fishbein's cognitive stance, Foxall's behaviorist stance, and Triandis' mixed stance. They found that prior behavior made a contribution independent of intentions. Triandis' theory

was better for predicting spending levels on new computer systems. They observed that "outside of carefully controlled laboratory contexts, Triandis' theory would appear to be more flexible and to have wider applicability" (p. 155).

The flexibility and wide applicability of Triandis' model is supported by the work of Davidson et al. (1976). They tested the cross-cultural applicability of Traindis' model in the context of predicting fertility related intentions of American and Mexican women across a variety of educational and economic groups. The model was successful at providing highly accurate predictions of intentions across the varied cultures, education levels, income levels, and religious groups included in the study. The multiple correlations of the predictors with intentions ranged between .61 and .88 for the 14 different groups studied. The average correlation was .77. The generalizability of Triandis' model as evidenced in Davidson et al.'s work, supports the position that the model could be useful in predicting behavior in the IS context.

Further support for the middle ground of Triandis is found in Brinberg (1979b). Brinberg compared Triandis' 1977 model with Fishbein and Ajzen's 1975 cognitive model in the context of predicting undergraduate student church attendance. In a two part study, Triandis' model was found to be a more effective predictor of the church attendance intentions of 242 subjects. The difference in the variance accounted for in denominational groups was between 4.5% and 25.3% higher for Triandis' model over Fishbeins'.

Given the extremes of pure cognitive or behavioral psychology, this research will pursue the objective of predicting and explaining the use of a software package from the middle position presented by Triandis. The reason for using Triandis' model, as opposed to some other middle position model, is twofold. First, it is closely related to Fishbein's Theory of Reasoned Action, a cognitive model which has already received some support in the IS literature (Pavri 1988, Thompson 1988, Moore 1989, Davis, Bagozzi and Warshaw 1989, Davis 1989). Second, initial support for Triandis can be found in Thompson et al. (1991).

Overview of Triandis' Model

This section describes Triandis' (1980) model of interpersonal behavior. Each of the constructs shown in the figure below will be defined and discussed. We will begin with the dependent variable behavior and continue with the other constructs in increasing order of causal distance from behavior.

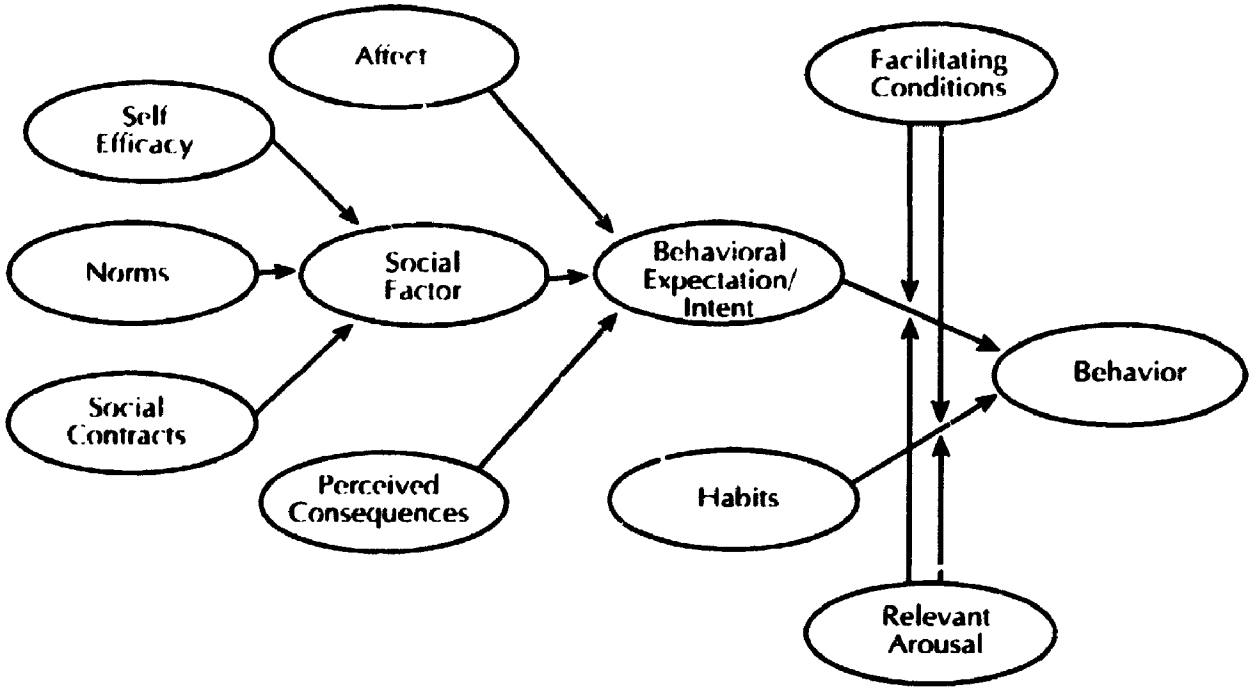

Figure 10 - Triandis' 1980 Model of Interpersonal Behavior

Behavior

The term behavior is very general and takes in a broad class of reactions to various stimuli. While we can talk about behavior, what we measure are acts. "An act is a socially defined pattern of muscle movements" (Triandis 1980, 201). An act "includes both muscle movements and a minimum of meaning" (Triandis 1980, 201). Throughout this section we will consider, as an example, the behavior of a person deciding to switch to the Quattro Pro spreadsheet application from a Lotus 123 spreadsheet.

Behavioral Intentions

Behavioral intentions are "instructions that people give to themselves to behave in certain ways" (Triandis 1980, 203). Behavioral intentions are quite specific in that they relate to the performance of a particular act. Care must be taken not to confuse them with general intentions which correspond to goals that may require a series of acts to complete. For example, a general intention to improve one's job performance might include several specific behavioral intentions such as working longer hours, and becoming more proficient at using a computer. Behavioral intentions, measured as either intentions or expectations, have already proven to be good predictors of a wide variety of behaviors in Social Psychology research (i.e., Triandis 1980; Ajzen and Fishbein 1980). The difference between behavioral intentions and behavioral expectations is explained below.

The distinction between behavioral intentions and behavioral expectations is clearly drawn in an illustration used by Warshaw and Davis (1985).

> The ball player steps up to bat, eyes Fernando Valenzuela on the mound, and nervously awaits his first pitch. If we stopped play and questioned the batter, our dialogue might be as follows:
>
> > We. Do you intend to hit the ball?
> > He. Of course!
> > We. But will you hit the ball?
> > He. Probably not.
> > (Warshaw and Davis 1985, 213-214)

Intentions indicate what we would like to do, whereas expectations indicate what we expect to be able to do.

Intentions also have a shorter time horizon than expectations. If you asked someone, "Do you intend to go to a movie this Friday night?", they could respond by saying yes or no. If you asked them, "Do you intend to go to a movie three months from now?", they would probably say no. The same question phrased differently, "Do you expect to go to a movie three months from now?", has a good chance of getting a yes response.

This research used expectations over intentions for the reasons outlined by Warshaw and Davis (1985). They suggest there may be problems with the intention construct which favor using expectations in its place. Three areas of concern they identify are that subjects often report expectations when asked for intentions, expectations are often mis-labeled intentions by researchers, and expectations may be a better predictor of future behavior.

Use expectations with respect to using a software innovation could be summed up in the following statement. "I expect to use Quattro Pro in my job."

Habits

Habits are automatic reactions to situations. No conscious self-instruction precedes the behavior. The person can respond without having to think about what to do. The strength of a habit depends on how long, how frequently, and how intensely the behavior has been performed.

While habits are more likely to play a role in frequently encountered, low cost behaviors they are not limited to such behaviors (English and

English 1958, Mixcn 1980). According to Dewey (1932) habits are predispositions to ways or modes of responding to circumstances. Regularly turning to Lotus 123 to meet spreadsheet needs would constitute a habit. In a change situation, the habits associated with using Lotus 123 would need to be overcome in the process of switching from Lotus to Quattro Pro.

Facilitating Conditions

Facilitating conditions moderate the impact of intentions and habits on behavior. Facilitating conditions are objective factors which may help or hinder the performance of an act. Acts which take very little effort to perform are considered to have high facilitating conditions. Conversely, any act which takes a great deal of energy to complete has low facilitating conditions.

In switching from Lotus to Quattro Pro some examples of facilitating conditions would include the ease of access to a computer, the ease of access to the software, and the availability of documentation.

Care must be taken not to confuse the objective factors which are labeled facilitating conditions, with a person's perceptions of other factors. A perception that the user support personnel are unable to provide help with Quattro may or may not be accurate. Only objective factors are included in facilitating conditions. Perceptions are captured in the social factors and expected consequences constructs which will be discussed later.

Relevant Arousal

Triandis defines relevant arousal as the physiological arousal of the person which is relevant to a specific act. "Either high drive or a situation which is relevant to the individual's values may increase the probability of the act" (Triandis 1980, 205). As was discussed earlier, it is difficult to imagine a normal situation in which a person's basic physiological state would be aroused by using a computer system. For this reason relevant arousal will not be included in the research model.

Affect

Affect refers to "the feelings of joy, elation, or pleasure, or depression, disgust, displeasure, or hate associated by an individual with a particular act" (Triandis 1980, 211). Affect has a very short time perspective and includes only those feelings experienced during the act.

The term affect has been used in psychology to describe a variety of concepts. As defined by Triandis, affect is the result of a cognitive process identifying, weighting, and evaluating dimensions of the act being performed. An alternative view of affect, presented by Zajonc (1980), views affect as occurring with minimal prior thought. The view of affect used in this study will be the cognitive one defined by Triandis.

Affect associated with using Quattro Pro might include the fun of using the mouse driven interface or the pleasure of exercising creativity in generating graphs.

Social Factors

Triandis uses Social Factors as a label for a group of constructs which capture elements of "The individual's internalization of the reference group's subjective culture, and specific interpersonal agreements that the individual has made with others, in specific social situations" (Triandis 1980, 210). From this definition we see that social factors can include perceptions of a virtually unlimited number of aspects of the culture. Three aspects explicitly identified by Triandis include norms, interpersonal agreements, and self efficacy.

Perceived Consequences

Perceived consequences summarize the expected outcomes of the behavior, together with the value of those consequences to the individual. A summation of the consequences weighted by their perceived probability constitutes the individual's expected value of the behavior.

The expected benefits of using Quattro Pro such as increased productivity, and more professional looking output are offset by the costs associated with learning to use the new system. Adding up the perceived costs and benefits plays an important part in the decision whether to use a new system.

Self Concept

Self concept encompasses many aspects of how a person sees himself or herself. It includes a variety of beliefs such as the morality, social desirability, and appropriateness of the behavior being considered.

One aspect of self concept that relates well to using a new computer system is how proficient the person sees him or herself at learning to use new software. A person who is confident in his or her ability to master the new system quickly and accurately is more likely to switch than someone who is uncertain of his or her ability to do so. The individual's computer self-efficacy, his or her confidence that efforts spent trying to learn a new system will be successful, will affect his or her willingness to try, and his or her persistence.

Norms

"Norms are self-instructions to do what is perceived to be correct and appropriate by members of a culture in certain situations" (Triandis 1980, 208). Norms correspond to what the individual perceives as being expected of him or her in a particular situation. The importance of subjective norms to predicting behavioral intentions is well established in Social Psychology (Triandis 1971, Fishbein & Ajzen 1980).

There are many people whose opinions may affect one's decision to use Quattro Pro. The co-worker who thinks it is the best spreadsheet available, the boss who mistrusts any new software, and the subordinate who resents any form of change. All of these people contribute to a person's perception of

whether it is correct and appropriate to use Quattro Pro. Each of their opinions will affect the usage decision to a varying degree.

Social Contracts

Social contracts are contractual arrangements between two or more individuals. Social contracts can be either verbal or written agreements to act in a specified way. Only those contracts which deal specifically with the behavior under consideration are relevant. The importance of contracts to a person's commitment to performing a behavior, and their willingness to persist under adverse circumstances has been established by Kanfer et al. (1974) and Karoly and Kanfer (1974).

An agreement with your boss to give Quattro Pro a thorough evaluation would certainly affect any consideration of not trying the system. A deal made with your co-workers to resist the change would also affect your willingness to try it.

The existence of a social contract does not violate the condition that performance of the behavior under consideration be voluntary. The existence of a social contract does not mandate a particular behavior, it simply adds to the factors influencing the individual.

Summary of Triandis' Model

To summarize, Triandis posits that a person's behavior is influenced by his or her intentions and habits, moderated by facilitating conditions and relevant arousal. Intentions are formed based on affect toward the behavior,

the perceived consequences of the behavior being considered, and social factors. Social factors are multidimensional and include norms, social contracts, and the person's self efficacy.

Research Model and Hypotheses

Triandis' model has several characteristics which make it particularly well suited to predicting the use of information systems. The model is sensitive to the organizational context of the information system. The social factors and perceived consequences place the individual's decision making process within the context of an organization. Perceived consequences capture what the individual expects to get from using the system in return for the effort he or she will expend to learn and use it. How the person sees the system's user friendliness is captured by affect. Habits relate to the old way of doing things. Breaking habits is an important part of any change process. Finally, facilitating conditions take into account those things which might prevent a person from using the system even if he or she intended to.

This research will apply Triandis' (1980) model of behavior to predicting and explaining the use of computer-based systems. The research context will be chosen carefully to increase the opportunity for observing situations in which the relative influence of use expectations and habits varies. An ideal research context would also facilitate the identification of habits which are relative to the behavioral decision being made. Fortunately, the replacement of one system with another is a situation in which both of the above conditions can be met.

Triandis hypothesizes that habits are directly proportional to the number of times in the history of an organism that a particular behavior has occurred. In the context of a system being replaced, measuring the frequency, and duration of time spent using the old system readily identifies habit-forming past behaviors relevant to the new behavior under consideration. Since the frequency and duration of use for the old system will be different for different users, this context also provides the needed variation in habits to evaluate the role of habits in the model.

This research also requires that the individuals faced with the decision have complete volition in choosing how much to use the system. The context of individuals voluntarily upgrading from one brand of application to another is used to ensure that the change is voluntary. Several major microcomputer software vendors have offered competitive upgrades in which users can replace a competing product with the vendor's product at a substantially reduced price. A risk-free trial period is also included in which the user can return the upgrade for a full refund if not satisfied. These offers represent an ideal circumstance under which to examine voluntary change.

The Research Model

What follows is a descriptive overview of the research model. The detailed rationale and supporting evidence is presented in the statement of hypotheses.

Triandis' model is very general which makes it applicable to a variety of research contexts. For use in this context, predicting the use of a software

application, the model required some modification. The modifications were kept to a minimum to provide as complete a test of the model as possible given the research context.

Facilitating conditions will be used as a screening construct to ensure that no objective factors existed which would prevent subjects from using their new software. Easy access to a computer with the software, and to the reference manuals are the objective factors that will be considered. Subjects who do not have easy access to both will be screened out of the study.

Relevant arousal will not be included in the model as it is difficult to imagine a normal situation, in this research context, in which a person's basic physiological state would be aroused by using a computer system.

Computer self-efficacy will be substituted for Triandis' self-concept. Self-concept is by definition multidimensional. While this multidimensionality is appropriate to the Social Psychological context from which Triandis' model is drawn, computer self-efficacy is more appropriate to the narrower context of using a computer-based system. Self-efficacy is the belief that one's efforts to perform a particular act will meet with success. It is a component of self-concept which has already shown promise in the IS context (Hill, Smith, Mann 1987, Compeau 1991). Computer self-efficacy will capture only those aspects of self-concept most relevant to using a system, rather than attempting to measure the whole of an individual's self-concept.

The final change is to drop the organizing construct "Social Factors." Social factors is a convenient label to use when discussing computer self-

efficacy, subjective norms, and social contracts, but was never intended to be directly measured.

A diagram of the research model follows.

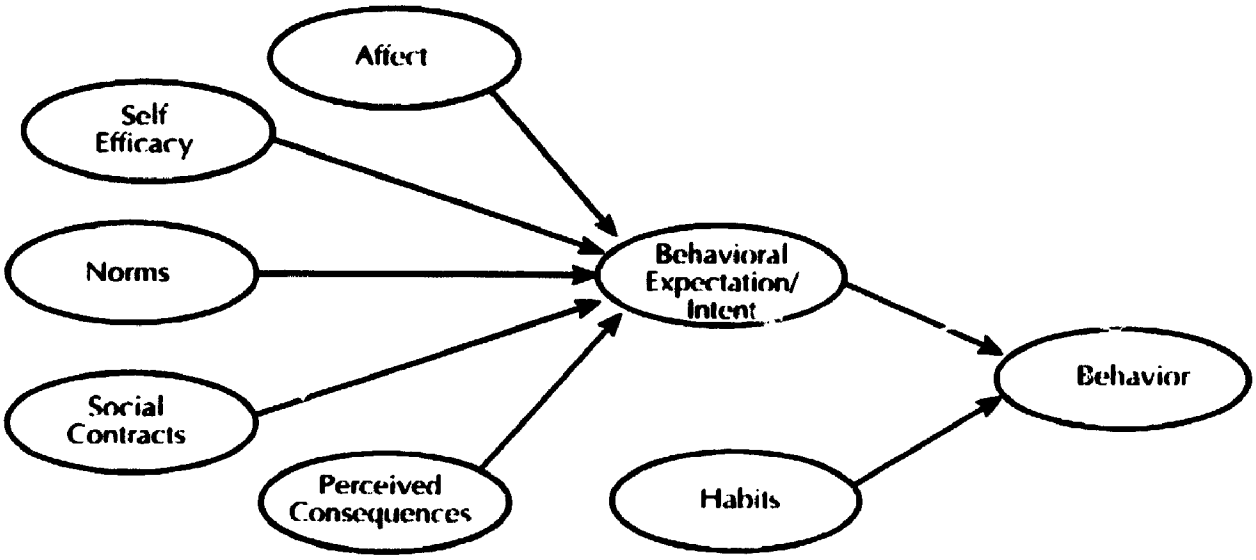

Figure 11 - The Research Model

Hypotheses

Since the objective of this research is to test Triandis' model in an IS context, each of the hypotheses that follow correspond to one of the relationships shown in the diagram of the research model above.

H1: There will be a positive relationship between use expectations formed during the use of a new system and future usage levels of the system.

Behavioral intentions have already proven to be good predictors of a wide variety of Behavior in Social Psychology research (see Triandis 1980, Ajzen and Fishbein 1980). Although several IS researchers (Pavri 1988, Thompson 1988, Moore 1989, Thompson, Higgins and Howell 1991) have based their work on models from Social Psychology which include intentions/expectations as a predictor of behavior, all of them chose to drop intentions/expectations from their final models. In each case the direct influence of other variables on behavior was used to simplify the model. As one of the objectives of this research is to test a more complete version of Triandis' model in the IS context, expectations will be retained.

Warshaw and Davis tested the comparative predictive ability of intentions versus expectations on 197 undergraduate students. The results indicated that expectations were significantly better predictors of behavior for all of the 18 behaviors measured.

In a meta-analysis of another intention model, Sheppard, Hartwick and Warshaw (1988) also found that use expectations were better than intentions for predicting behavior. Their conclusions were based on an analysis of 87 separate studies from the fields of Social Psychology and Marketing.

Warshaw and Davis (1985) identify two studies (Landis, Triandis and Adamopoulos 1978; Triandis, Malpass and Feldman 1976) in which Triandis used expectations when applying his model. Given the apparent greater predictive ability of expectations, and Triandis' implicit approval of their use in his model, this study used use expectations.

H2: Habits associated with using the original system will be inversely related to future usage levels of the new system.

No examples of using habits to predict behavior are available in the IS literature. Thompson et al. (1991), in their development of a conceptual model of personal computer utilization, acknowledge the importance of habits in determining system use (p. 130). They then identified discriminant validity problems between habits and use which led them to drop habits from their model. This research is not exposed to this problem as the habits of interest relate to the original system, not to the new system's use.

The importance of habits in predicting behavior has been well established outside of the IS literature. Landis, Triandis, and Adamopoulos (1978) used Triandis' (1977) model to study the relative impact of habits and intentions on teacher behavior in the classroom. This study found that, for the well established behavior of a teacher in the classroom, habits were a much stronger predictor of behavior than intentions. A post-hoc analysis also suggested that intentions became more important predictors as the habit component was suppressed. As stated by the authors, the results showed that for new behaviors, intentions dominate, while automatic behaviors are best predicted by habits.

More direct support for the importance of habits in predicting behavior is found in Sugar's (1967) work. Sugar found that habits were the strongest single predictor of smoking in college students. Wittenbraker and Gibbs (1983) established the importance of habits in predicting seat belt usage. In a longitudinal study of 134 psychology students, they found that habits more

strongly influenced the behavior of wearing seat belts than either subjective norms or intentions.

Other indirect support for the importance of habits in determining behavior comes from the use of change management models such as Lewin's (1947). Zand and Sorensen (1975) used Lewin's (1947) theory of change to investigate successful and unsuccessful applications of management science. The three stages of Lewin's theory, unfreezing, moving, and refreezing, were used to investigate the forces influencing the implementation from the organization's perspective. If we switch from the organization's perspective to the individual's perspective, Lewin's unfreezing and moving requires that individuals break old habits in adopting new behaviors.

H3: Affect related to using the new system will be positively related to use expectations.

In this context affect includes only those feelings experienced while engaged in using the software innovation. Affect is related to user friendliness but should not be confused with it. While there is no universally accepted definition of user friendliness, Mead's (1985) discussion provides some common ground from which to work. Mead suggests that a system must have four characteristics in order to be considered friendly. The system must be easy to learn and easy to use. It must prevent the user from inadvertently losing work, and it should be enjoyable to use. The first three characteristics, ease of use, ease of learning, and safe to use, all relate to the effort expended in using a system. These three fit within Triandis' concept of

expected consequences. The last characteristic, enjoyable to use, is a component of affect.

The positive relationship between user friendliness and system use (Carroll and Thomas 1988) provides indirect support for affect. In a conceptual piece, Carroll and Thomas (1988) suggest that we need to distinguish between the concepts of ease and fun when considering the quality of software. For them, ease fundamentally implied simplicity. Fun carries no such connotation, and often implies the opposite. Many activities are not fun because they are too easy. Ease and fun are hypothesized to affect system use in different ways. From the perspective of this research, a system which is fun will generate positive affect. Affect then has an impact on use expectations.

More direct support for the importance of affect in predicting use expectations is provided by the work of Davidson et al. (1976). In this study, affect was found to be the single strongest predictor of a variety of fertility intentions across a wide cultural range of American and Mexican women.

Other support for the importance of affect in determining use expectations is found in the marketing literature. Bettman and Sujan (1987), in a review of research in consumer information processing, identified affect as an important variable in understanding consumer behavior. They suggest that the effort required to overcome the difficulty in clarifying the relationship between affect and cognition is warranted. "Though it might be extremely difficult to resolve such issues as the dominance of affect over cognition (or vice versa), this emphasis has been very useful in a practical

sense" (p. 220). If we draw a parallel between consumer behavior and the use of information systems, affect would appear to be important in predicting system use.

H4: The perceived consequences of using the new system will be directly related to use expectations.

For a potential user the relevant perceived consequences are those outcomes associated with using the new system. Outcomes can be both positive (such as improved job efficiency) and negative (such as the time it will take to learn and use the new system). How the individual weighs these benefits and costs will affect the expectations of use.

Early support for the relationship between perceived consequences and use is found in Robey (1979). Robey's performance subset of the attitude factors roughly corresponds to Triandis' Expected Consequences. The performance factor had the highest correlation of all the attitude factors with each of the objective measures of system use (.79 and .76).

In an effort to develop improved measures for assessing systems quality, Davis (1989) investigated user's perceptions of a system's usefulness and ease of use. Usefulness relates to the influence on job performance. Ease of use summarizes the effort needed to take advantage of the system's usefulness. Used together, they capture both the cost and benefit sides of perceived consequences.

Davis, Bagozzi and Warshaw (1989) used perceived usefulness and perceived ease of use in a longitudinal study of 107 MBA students to predict

behavioral intentions toward using a word processing system. At time one, usefulness and ease of use accounted for 45% of the observed variation in intentions. At time two, usefulness alone accounted for 57% of the variation in intentions, with ease of use explaining a small but significant 6% of the variation in intentions. An interesting result from this study is that ease of use appears to impact use primarily through usefulness. This implies that usefulness on its own might be a sufficient measure of perceived consequences.

Evidence of the importance of perceived consequences in predicting use expectations is also found in Davidson et al.'s (1976) work on using Triandis' model to predict the fertility intentions of American and Mexican women. Perceived consequences were the second strongest predictor of fertility intentions

H5: Computer self-efficacy will be positively related to use expectations.

Computer self-efficacy is the belief that one's efforts to use a computer will meet with success. Self-efficacy affects a person's willingness to try new behaviors, his or her persistence in completing the behavior, the stress and anxiety experienced during the attempt, and the actual level of performance achieved (Bandura 1982).

Hill, Smith and Mann (1987) investigated the role of efficacy expectations in predicting people's readiness to use computers. From a sample of 304 college students they found that self-efficacy influenced the

decision to use computers independently of the perceived consequences of doing so. A second study of 133 undergraduates found that previous experience with computers did affect self-efficacy, but that experience did not exert any influence on the decision to use computers over that already captured by self-efficacy.

Igbaria and Parasuraman (1988), in their analysis of factors affecting attitudes towards microcomputers, found that education is associated with decreased anxiety and favorable attitudes towards using microcomputers. They suggested that "increased educational attainment may foster feelings of 'self-efficacy'"(Igbaria and Parasuraman 1988, 383).

Gist et al. (1989) tested the effects of alternative training methods on self-efficacy and computer usage performance. While the training methods used are not of interest to this research, the observed link between self-efficacy and performance is. They found that for the 108 university managers and administrators who participated in the study, those with higher self-efficacy scores mastered the software better than those with lower self-efficacy scores.

Compeau and Higgins (1991) tested the relationship between computer self-efficacy and the expected outcomes of using a computer. Computer self-efficacy was found to be significantly correlated with the expected outcomes of using a computer ($r=0.29$, $p=.00$). Individuals who believed themselves to be capable of using a computer were more likely to

anticipate positive rewards from their use of computers. (Compeau and Higgins 1991, 44).

H6: Subjective norms towards using the new system will be positively related to use expectations.

The link between subjective norms and use expectations is well established in psychology (Fishbein and Ajzen 1975, Davidson et. al 1976, Fishbein 1980, Ajzen and Fishbein 1980), and in innovation research (Tornatzky and Klein 1982). Support for the relationship in IS is found in Pavri (1988) and Thompson et al. (1991). Pavri (1988) found a positive relationship between social norms and the optional use of personal computers by managers. Thompson et al. (1991) found that social factors, which he operationalized as subjective norms, positively influenced the utilization of PC's.

H7: Social contracts will be positively related to use expectations.

For this research the contracts of interest are those which relate specifically to the system being replaced and to the one being implemented. Interpersonal agreements to use or not to use either of these systems may affect observed usage.

Although no IS examples assessing the influence of social contracts were found, Triandis (1977, p.14) cites evidence from Social Psychology in support of the influence social contracts have on the performance of intended behaviors. Kanfer et al. (1974) used a lab experiment to compare the effect of

informal verbal contracts versus formal written contracts on undergraduate students' level of commitment to, and actual performance of a specified behavior. Their results indicate that a subject's willingness to endure the execution of an unpleasant task is directly related to the explicitness of the contract made with the researcher. In another study, Karoly and Kanfer (1974) assessed the importance of adult-child contractual interactions in determining a child's self-control. The results suggest that informal contracts may be an important determinant of self-control in children.

Conclusion

This chapter presented a chronological review of selected IS research that attempts to predict system use. The review highlighted the fact that very little progress had been made until recently due to a lack of underlying theory, and to generally poor methodology of the earlier work. More recently, the incorporation of theory from referent disciplines, and close attention to methodology has produced significant results.

The current research builds on this brief but promising tradition by applying Triandis' (1980) behavior prediction model to the problem of predicting and explaining system use. The rationale for selecting Triandis from among a variety of possibilities from Social Psychology was presented along with a detailed description of the model. Finally, the research hypotheses were developed from and supported by the literature.

CHAPTER 3 - METHODOLOGY

Introduction

This chapter presents the approach taken to test the research model described in chapter two. It begins with a discussion of the objectives of this research and the selection of an appropriate sampling frame and data analysis technique for meeting those objectives. The operationalization of constructs is described next followed by the pretest implementation and measurement model evaluation. The changes made to the research instrument are then described. Finally, the implementation of the main study and the respondent demographics are presented.

Sampling Frame

The main objective of this research was to address the problem of predicting and explaining the varying degrees of an individual's use of a system. Triandis' (1980) model for predicting voluntary behavior provided an opportunity to address this problem in the information systems context. In order to retain as much of the original theoretical strength of Triandis' model as possible, it was necessary to test it in an IS context in which the behavior being predicted was voluntary.

To facilitate the identification of relevant habits, a second condition was imposed. The functionality of the original and the new system had to be similar. The original and the new system had to be feasible alternatives for performing the tasks for which the change was being considered, otherwise no choice would exist. The closer the intended functionality of the two

systems, the greater the relevance of those habits relating to use of the original system. For example, changing from a spreadsheet to a database is not directly comparable as there are functions in spreadsheets which could not practically be replaced by functions in a database. The habits associated with using a spreadsheet would not be directly relevant to using a database. A better change for the purpose of this research would be from one spreadsheet to another thus maximizing the relevance of habits.

Another issue was to locate a sample large enough to test the model subject to the conditions described above. Two possible sources for the sample were explored. The first was corporate consumers of information technology. While many corporations do have a sufficiently large number of employees and systems in place to meet the sample size and change comparability requirements, the voluntariness of the changes presented to employees is often questionable. Initial inquiries into this area were unsuccessful at finding a voluntary corporate implementation.

The second potential source for locating a sample proved fruitful. Instead of trying to locate corporate consumers of information technology, suppliers of the technology were sought out. An opportunity presented itself which met the voluntariness of the change, comparability of the change, and potential for a sufficiently large sample. Many manufacturers of microcomputer software offer inexpensive upgrades to users of competitors' products. A software manufacturer would offer a competitors' customers an opportunity to switch to their products at a price substantially below the list price. Typically such offers are made through advertisements placed in

trade journals, newspapers, and technical publications. For example, Borland placed several ads in PC Magazine offering users of selected spreadsheets the opportunity to upgrade to Quattro Pro for $99, a substantial reduction from the then $495 list price. Ads for these competitive upgrades provided the opportunity to identify a sufficient number of people undergoing a voluntary software change between comparable products. The companies offering the upgrades keep lists of all people who have purchased an upgrade.

A longitudinal study was needed to test the cause and effect relationship between use expectations and behavior. According to Cook and Campbell (1979, p.31) there are three important criteria for inferring cause. The cause and the effect must covary, the cause must precede the effect , and alternative explanations must be ruled out. A longitudinal study was needed to meet the second of Cook and Campbell's criteria for drawing causal conclusions by establishing the temporal precedence of use expectations over use.

A large sampling frame was also needed to allow for the anticipated low final response rates typical in longitudinal research. In a longitudinal study with paired responses, all respondents to the first measure who do not also respond to the second measure are eliminated from the final analysis.

Based on the above constraints, the population of interest was defined as individuals undergoing a voluntary software change between comparable products.

Data Analysis Technique

A structural equation modelling technique was chosen for data analysis. Structural equation modelling is superior to description and empirical association as it accommodates prior theoretical knowledge into the evaluation of empirical data. With structural equation modelling, the proposed theory both contributes to the assessment of the empirical data, and is reassessed by it (Fornell 1982). Partial Least Squares (PLS) was chosen as the data analysis technique. PLS is a regression based technique (Pedhazur, 1982; Wold, 1985).

As an example of structural equation modeling, PLS analyses models having multiple constructs or latent variables, each of which is measured by multiple scale items or manifest variables. The prior specified relationships in the theoretical model between constructs are assessed simultaneously with the relationship between each scale item and its construct. Constructs get their meaning from both their measures and the embedded theoretical context. The simultaneous assessment is far superior to other modeling techniques, such as regression, which evaluate the measurement of a construct and its theoretical context independently.

The capacity of structural equation models to recognize and adjust for measurement error in both the measure of a construct and between the constructs in a model also contributes to the suitability of this approach for analyzing social science data which are seldom error free (Barclay, 1986).

PLS was chosen over the more widely known Linear Structural Relations (LISREL) (Joreskog and Sorbom, 1981) implementation of structural equation modeling primarily for two reasons. First, PLS uses ordinary least squares to minimize the residual variance between constructs and their measures. Thus, PLS assumes the indicators are a collection of variables of unknown dimensionality and unknown representativeness. This makes PLS highly suitable for assessing measurement models early in their development. LISREL uses maximum likelihood to minimize the residual covariance among constructs in the model. Thus, LISREL assumes that the constructs are clearly defined and have well defined, highly reliable measures. Given that this was an early test of Triandis' model in the IS context, and that the measures of the constructs were not well established, the assumptions made by PLS fit the context of this research better than those of LISREL.

Second, PLS can be used on smaller sample sizes than LISREL. PLS analysis is based on iterative multiple regressions. The model is broken into small subsets and multiple regression is used to estimate the loadings of measures on their constructs, and the correlation between constructs within each subset. Successive iterations break the model into overlapping but different subsets. The iterations continue until selected convergence criteria are met for the parameters being estimated. The sample size required need only meet the size requirement of the most complex subset used. Using the general rule of 10 cases per variable for a multiple regression, the required sample size becomes the larger of either 10 times the maximum number of indicators on a construct, or 10 times the number of constructs in the most

complex regression (Fornell, 1982; Barclay 1986). LISREL typically requires at least 200 cases. Recognizing the resource constraints of this study in both time and money, and the increased difficulty in collecting large amounts of longitudinal versus cross sectional data, PLS was the more appropriate choice.

Operationalization of Constructs

A secondary objective of this research was to contribute to a cumulative research tradition within the discipline by utilizing measures from existing IS research in the implementation of Triandis' model. Borrowing from existing research was also consistent with improving the quality of the measurement model to facilitate a better test of the theoretical model. Where possible, appropriate scales which had already demonstrated good psychometric properties were chosen over developing a new scale with unknown quality. A good measurement model is a necessary prerequisite for testing the theoretical model. All other things being equal, a stronger measurement model facilitates a more reliable test of the underlying theory.

"Appendix A - Pretest Initial Measure" and "Appendix B - Pretest Follow-up Measure" present the surveys referred to below. The survey was conducted in two parts. The first part measured the hypothesized antecedents of use. The second part measured use three months later. Both parts were constructed according to Dillman's (1978) total design method.

Consistency across the various scales was maintained for instruction and response formats. Visually the layout followed Dillman's

recommendations. An effort was also made to keep the overall length of the questionnaires as short as possible to maximize the response rate. In cases where long scales were available from the literature, a subset of those scales were selected for pre-testing and then used in this research. Even so, the initial questionnaire booklet was 20 pages in length. This included 15 pages of questions, a front and back cover, and three blank pages. The follow-up questionnaire was 4 pages long which included two pages of questions, a front and a back cover.

The next section discusses the operationalization of each of the constructs starting with use and working backwards through the hypothesized causal antecedents of use.

Use

The behavior measured was the new software application's degree of use three months after the hypothesized antecedents of had been measured. The measure of use was based on Thompson's (1989) measure of personal computer use. The items in Thompson's scale which differentiated between application types and work contexts were not needed for this research. Only the act of using the recently upgraded application was relevant. Frequency of use was measured using a seven point Likert-type scale ranging from several times a day to not at all (A4 appendix B). Intensity of use was measured in hours per week (A5 appendix B). These measures of use were taken as part of the follow-up measure (appendix B) which was administered three months after the initial questionnaire.

Use expectations

The measure of use expectations was based on the measure of use from the follow-up questionnaire. According to Triandis (1980), the expectations measure must align with the use being predicted. A high degree of correspondence is needed to ensure that the expectations correspond to the use being predicted. In this case, the expectations measured corresponded to the expected frequency and intensity of future use. This scale measured the individuals expectations for their use of the new application three months after the first questionnaire. Using the same format as the measure of use, expectations for future use were measured with a seven point Likert-type scale ranging from several times a day to not at all (K5 appendix A). Expected future intensity of use was measured in hours per week (K6 appendix A). A third item was added to capture the expectations of an increase or decrease in future use (K4 appendix A). The behavioral expectation measures, and all remaining constructs, were captured on the initial measure questionnaire as they were hypothesized to be causal antecedents of the use measured on the follow-up questionnaire.

Habits

Triandis states that the best measurement of habits would be a count of the number of times in an organism's life that a particular act has appeared. Acknowledging the impracticality of such a measure, he goes on to suggest that a self-report of how frequently the act has been performed could be used. Landis et al. (1978), Wittenbraker et al. (1983) and Godin et al. (1986) all followed Triandis' recommendation by employing single item, self-

reported frequency measures of habits. The habits of relevance here related to the past use of the original software application. A scale was developed to capture the use frequency and also intensity for the application being upgraded from. Use frequency was measured on a seven point Likert-type scale ranging from several times a day to not at all (K2 appendix A). Intensity of use was measured in hours per week (K3 appendix A).

Affect

The affect or pleasure experienced from using the new application was measured using Compeau's (1991) five item affect scale. Respondents indicated their agreement or disagreement with statements such as "I like working with X," and "I find X irritating to use." The five items were presented in a seven point Likert-type format (F1 to F5 appendix A).

Perceived Consequences

The perceived consequences were measured by adding a value component to each item on Compeau's (1991) outcome expectations scale. The value component was needed to capture both the probability and the importance of a particular outcome as described by Triandis (1979 p. 218). Respondents were asked to rate the likelihood of six different possible outcomes from using the new software (I1 to I6 appendix A). The outcomes included such things as "using X will make me better organized in my job," and "using X will increase the quantity of output for the same amount of effort." The seven point Likert-type scale ranged from extremely likely to extremely unlikely. The second part of each question asked the respondent

to rate hc . important that particular outcome was to them. This was also measured using a seven point Likert-type scale ranging from extremely important to extremely unimportant.

Norms

The measurement of norms was based on Moore's (1989) subjective norms scale. Both the original and the modified scale conform to Ajzen and Fishbein's (1980) recommendations for measuring subjective norms. Six paired items were presented in a seven point Likert-type format (D1 to D6 appendix A). Each item consisted of two parts. The first part evaluated the individual's perception of how likely or unlikely it was that a particular referent group thought they should be using the new software. The second part asked the individual to rate the importance of what the referent group thought. The two parts combined to indicate the perceived pressure to conform to what others expected of him or her in a particular situation.

Computer Self-efficacy

Compeau's (1991) measure of computer self-efficacy was used as the basis for measuring the individual's confidence that their efforts to learn the new application would produce results. Conceptually, Compeau's computer self-efficacy matches the concept of self-efficacy as used in this research. A five item subset of the original ten item scale was used. Three of the original items were dropped as they did not apply to the upgrade context of this research. Two additional items which overlapped other items in the scale were dropped to reduce the overall length of the scale and the questionnaire.

The items were presented in a seven point Likert-type format (E1 to E5 appendix A).

Social Contracts

Social contracts are specific interpersonal agreements to perform or not to perform a specified behavior. As no appropriate scales could be located in the information systems context, one was specifically developed according to the description of social contracts provided by Triandis (1980). Respondents were asked whether anyone had explicitly encouraged or discouraged them from using the new software. Part two of the question asked whether the respondent had indicated that they would use the system (J1 to J2 appendix A).

The questionnaires were pre-tested as described in the next section.

Instrument Pretest Implementation

Potential research sites were located by searching PC Magazine, PC Computing, and The Globe and Mail for companies offering competitive upgrades. A total of six different software manufactures offering seven different products were located (presented in table 1).

Table 1 - Competitive Upgrade Offers Located

Company Name	Product Offered	Product Class
Aldus	Persuasion	Presentation
Borland	Quattro Pro	Spreadsheet
DacEasy	Accounting	Accounting
Fox Software Inc.	FoxPro	Database
Lotus Development Corp.	Ami Pro & 123	Word Processing & Spreadsheet
Lotus Development Corp.	Freelance Graphics	Presentation
Microsoft Canada Inc.	Excel	Spreadsheet

Before making contact, each company was researched to gather background on their business, and the range of products offered. Given the relatively small number of potential research sites it was important to appear knowledgeable in the initial contact to maximize the sites' willingness to participate. "Standard & Poor's register of Corporations, Directors and Executives" was used to determine the corporate head office address, phone number, names of top executives, annual sales, and number of employees for each of the publicly traded, or listed corporations. For those not listed, a call was made to the upgrade offer number presented in the ad to get the corporate office phone number. A second call to the corporate office usually provided the name and phone number of the company president or vice president of marketing. For one company a commercial bulletin board

service was used to contact a company representative using the service. That representative provided an introduction to the company's director of marketing research. The same commercial bulletin board service was also used to gather recent news information on all of the potential sites.

PC Magazine, PC Computing, and software retail stores were used to gather information on the range of products offered by the companies. Detailed information on the specific products being offered in the competitive upgrade plans was also gathered. This information took the form of retail brochures, product reviews, and whenever possible, an actual session using the company's product.

The next step was to contact the Vice-president of marketing, or in the case of the smaller companies the president, to present the project and invite participation. The companies were offered the results of the research in return for a list of customers who had purchased their competitive upgrade. Of the six companies contacted, two agreed to participate in the research, one liked the idea but was too busy during the time frame of the research to participate, a fourth refused to participate as a matter of company policy, and the remaining two never returned numerous calls.

All of the four companies contacted expressed concern about releasing a partial list of their customers. The two that agreed to participate required written assurances that their list would only be used for this research, that limited contacts would be made, and that all materials and contacts made with their customers would be approved by them first.

The first questionnaire was pre-tested on a sample of 200 people drawn from a list of 4000 names and addresses of people provided by Aldus. The list of 200 names was randomly selected from the list of people who had purchased the competitive upgrade. All people with incomplete information were eliminated from the list and additional names were drawn to maintain the total at 200. Each of the 200 people were then assigned a serial number to facilitate matching of the first and second responses.

The questionnaire (appendix A), a covering letter explaining the purpose of the research (appendix C), and a stamped and addressed return envelope was mailed out to the 200 people. The guidelines presented by Dillman (1978) for conducting mail surveys were followed as closely as the imposed contact limitations would permit. Of the 200, six were returned as undeliverable, four were returned indicating that they had not recently purchased an upgrade, and 39 were returned completed for an initial response rate of 20.5%. One of the 39 responses was unusable. No follow up to the initial mailing was done as Aldus would only approve two contacts, one for the first mailing and one for the second.

Several factors contributed to the low response rate on the first measure. The length of the questionnaire at 20 pages greatly exceeds the maximum of 12 pages recommended by Dillman. While he does not attempt to quantify the impact of longer questionnaires on response rates, he does suggest that the impact is significant (1978, p. 55). The inability to perform a follow-up also substantially reduced the response rate. Dillman states that "Without the follow-up mailings, response rates would be less than half those

normally attained by the Total Design Method" (1978, p. 180). A third factor was the quality of the original list. There was no way, from the original list, to know when the person had purchased the upgrade. The length of use reported in the pretest ranged from one to twelve months with 21% having used it for six or more months. The questionnaire, and this study, were specifically oriented to recent new users. It is impossible to tell how many of the 200 potential respondents did not return the questionnaire because they did not consider themselves recent new users.

Based on the initial response rate problems, Aldus agreed to allow a second contact for the follow-up measure and for the main study.

The follow-up measure was mailed out to each of the 38 respondents two months and three weeks after the first questionnaire had been completed (appendix B). As part of the first measure, respondents were asked to report the date on which they had completed the questionnaire. Allowing for time in transit, this put the follow-up measure of use in front of them approximately three months after the first one. Once again a covering letter reminding them of their original participation (appendix D), and a stamped and addressed return envelope were included with the survey. Eight of the 38 original respondents did not reply to the second mailing immediately.

A reminder mailing was conducted four weeks after the follow-up mailing. It included a second letter encouraging their participation (Appendix E) and another questionnaire. All eight responded to the reminder mailing for a follow-up measure response rate of 100%.

Procedure for Assessing Pretest Results

The pretest was used to assess and refine the measurement model in preparation for the main study. Scale assessment was conducted using techniques appropriate to preparing for a Partial Least Squares (PLS) analysis of the main study. The refinement of a measurement model in PLS has two basic parts (Fornell and Larcker 1981, p.45-46). The first part assesses the internal consistency of the measures used. The objective is to assess how well the measures capture the underlying constructs. The second part examines the discriminant validity of the scales. This part determines if the measures taken reflect the conceptual independence of the underlying constructs. The following sections present the pretest measurement model assessment.

Reliability of the Measurement Model

The first step in assessing the reliability of the measurement model is to examine the individual item reliabilities. Item reliabilities are simply the square of the loading of the item on its construct. An item is considered to be acceptable if more of its variance is explained by the construct than by error. Any item with a loading of 0.7 or greater, or an item reliability of 0.5 or more is considered acceptable. When loadings below 0.7 are encountered it is necessary to determine if the measure is not reliable, if it is measuring a different construct, or if the construct is multidimensional.

Next the internal consistency of each construct is examined. The internal consistency is analogous to the individual reliabilities. It is an

aggregate measure of the construct's measurement reliability and is calculated as:

$$\rho_{\eta} = \frac{\left(\sum_{i=1}^{p} \lambda_{yi}\right)^2}{\left(\sum_{i=1}^{p} \lambda_{yi}\right)^2 + \sum_{i=1}^{p} Var(\varepsilon_i)}$$

Where

ρ_{η} is the reliability for construct η

λ_{yi} is the loading of item i on the y'th construct

ε_i is the measurement error of the i'th measure

Equation 1 - Construct Measurement Reliability

where y, i = 1 to p are the multiple measures of a construct (Werts, Rock, Linn and Joreskog, 1978). This is similar to Cronbach's α as a measure of construct reliability except that Cronbach's α assumes that each item contributes equally to the construct. Nunnally's (1978) standards for interpreting Cronbach's α can be used to assess this measure of internal consistency (Bagozzi, 1982).

Finally, the average variance in the construct extracted by the measurement items is evaluated as suggested by Fornell and Larcker (1981).

The average variance extracted is:

$$\rho_{vc(\eta)} = \frac{\sum_{i=1}^{p} \lambda^2_{yi}}{\sum_{i=1}^{p} \lambda^2_{yi} + \sum_{i=1}^{p} Var(\varepsilon_i)}$$

Equation 2 - Average Variance Extracted Measurement Reliability

which, with the standardized variables used by PLS, reduces to the mean of the squared loadings of the p measures of the construct η:

$$\rho_{vc(\eta)} = \frac{\sum_{i=1}^{p} \lambda^2_{yi}}{p}$$

Equation 3 - Average Variance Extracted Reduced

The interpretation of the average variance extracted is analogous to interpreting the individual item reliability. A good scale will extract more variance from the construct than is present due to error (Fornell and Larcker, 1981 p. 46).

Discriminant Validity of the Measurement Model

The next step in assessing the overall quality of the measurement model is to check to ensure that conceptual independence of the constructs is reflected in the measurement model. The first step is to verify that each measure loads more highly on the construct it was intended to measure than it does on any other construct. This is done by examining the PLS loading structure matrix. Items which load more highly on constructs other than the one they were intended to measure bring the ability of the measurement model to distinguish between the constructs in the conceptual model into question.

The second step is to compare the square root of the average variance extracted for each construct with the correlations among the constructs. Each construct should have more in common with its measures than it has with any other construct in the model (Fornell and Larcker 1981, p 46).

Cronbach's α was also reported in table 2 to facilitate comparison between the scales used in this work and other studies. The α statistic was not discussed in the text as it is unable to capture the interplay between theory and data present in a PLS analysis. Assessing the internal consistency statistic is the PLS equivalent of reviewing Cronbach's α for the scales.

Table 2 - Pretest Internal Consistency

Scale Name / Items	Loading	Item Reliability	Internal Consistency	Average Variance Extracted	Cronbach's α
Affect			0.65	0.60	0.81
F1	0.89	0.80			
F2	0.93	0.86			
F3	0.88	0.77			
F4	0.51	0.26			
F5	0.57	0.32			
Computer Self-efficacy			0.62	0.55	0.79
E1	0.84	0.71			
E2	0.86	0.74			
E3	0.56	0.31			
E4	0.68	0.46			
E5	0.73	0.53			
Norms			0.82	0.81	0.95
D1	0.96	0.91			
D2	0 79	0.6[illegible]			
D3	0.93	0.8[illegible]			
D4	0.92	0.85			
D5	0.88	0.77			
D6	0 90	0.82			
Perceived Consequences			0.52	0.42	0.70
I1	0.67	0.44			
I2	0.65	0.43			
I3	0.73	0.53			
I4	0.64	0.41			
I5	0.71	0.50			
I6	0.44	0.19			
Use Expectations			0.77	0.74	0.61
B2	0.81	0.66			
B3	0.94	0.88			
B4	0.83	0.69			
Habits			0.84	0.83	.56
K5	0.84	0.71			
K6	0.98	0.95			
Use			0.80	0.78	.51
A4	0.90	0.82			
A5	0.87	0.75			

Table 3 - Pretest Factor Loading Structure Matrix

	Affect	Computer Self-efficacy	Norms	Social Contracts	Perceived Conseq.	Use Expect.	Habits	Use
F1	**0.892**	0.724	0.224	-0.046	0.65[illegible]	0.547	0.129	0.545
F2	**0.927**	0.591	0.436	-0.52	0.639	0.645	0.056	0.520
F3	**0.876**	0.574	0.403	-0.042	0.647	0.515	0.098	0.441
F4	**0.510**	0.352	0.220	0.248	0.450	0.199	0.172	0.433
F5	**0.565**	0.390	0.301	-0.062	0.391	0.299	-0.045	0.334
E1	0.664	**0.841**	0.051	-0.051	0.469	0.391	-0.063	0.340
E2	0.628	**0.863**	0.214	-0.111	0.561	0.300	0.013	0.302
E3	0.327	**0.560**	0.034	-0.058	0.161	0.203	0.086	0.121
E4	0.382	**0.676**	0.249	0.068	0.281	0.269	0.172	0.295
E5	0.497	**0.728**	-0.013	0.034	0.293	0.173	-0.015	0.198
D1	0.350	0.072	**0.955**	0.348	0.434	0.460	0.258	0.520
D2	0.451	0.334	**0.786**	0.066	0.434	0.408	0.242	0.441
D3	0.371	0.148	**0.934**	0.305	0.401	0.445	0.438	0.560
D4	0.373	0.165	**0.923**	0.221	0.441	0.450	0.223	0.392
D5	0.360	0.146	**0.878**	0.253	0.411	0.473	0.197	0.442
D6	0.328	-0.005	**0.904**	0.245	0.319	0.471	0.202	0.510
J	-0.027	-0.040	0.270	**1.000**	0.202	0.100	-0.074	0.087
I1	0.345	0.152	0.242	0.356	**0.665**	0.357	-0.058	0.268
I2	0.478	0.275	0.376	0.164	**0.652**	0.398	0.156	0.412
I3	0.493	0.305	0.239	0.277	**0.725**	0.366	0.033	0.176
I4	0.422	0.337	0.212	-0.049	**0.644**	0.420	0.040	0.095
I5	0.662	0.563	0.374	-0.084	**0.707**	0.514	0.167	0.276
I6	0.316	0.221	0.298	0.286	**0.437**	0.257	0.033	0.[illegible]51
B2	0.539	0.421	0.240	-0.064	0.548	**0.812**	0.125	0.290
B3	0.613	0.336	0.452	0.075	0.590	**0.939**	0.160	0.540
B4	0.441	0.260	0.569	0.214	0.459	**0.831**	0.299	0.558
K5	-0.142	-0.218	0.208	-0.016	-0.139	0.010	**0.840**	0.164
K6	0.187	0.140	0.295	-0.091	0.199	0.299	**0.976**	0.407
A4	0.547	0.352	0.411	0.109	0.298	0.557	0.277	**0.904**
I1	0.474	0.278	0.543	0.039	0.379	0.411	0.367	**0.866**

Bold elements are the items intended to load on the construct.

Table 4 - Pretest Discriminant Validity Coefficients

Construct	1.	2.	3.	4.	5.	6.	7.	8.
1. Affect	**0.77**							
2. Computer Self-efficacy	0.70	**0.74**						
3. Norms	0.41	0.16	**0.90**					
4. Social Contracts	-0.27	-.40	0.27	**1.00**				
5. Perceived Consequences	0.73	0.51	0.45	0.20	**0.65**			
6. Use Expectations	0.61	0.38	0.50	0.10	0.61	**0.86**		
7. Habits	0.10	0.04	0.28	-0.07	0.11	0.23	**0.91**	
8. Use	0.58	0.36	0.53	0.09	0.38	0.55	0.36	**0.89**

The **bold** diagonal elements are the square root of the variance shared between the constructs and their measures. Off diagonal elements are the correlations among constructs. For discriminant validity the diagonal elements should be larger than any other corresponding row or column entry.

Evaluation of Pretest Measurement Model

Use: The measure of use demonstrated good convergent and discriminant validity. The two items loaded 0.90 and 0.87 (table 2), well above the minimum 0.70. The construct reliability (internal consistency) was strong at 0.80. The average variance extracted was 78%. An examination of the loading structure matrix (table 3) shows good discriminant validity. The highest cross loading was 0.56. A comparison of the square root of the variance shared between the construct and its measures (table 4, 0.89) and the correlations among constructs show that the use construct has more in

common with its measures than it does with other constructs. This scale will be left intact for the main study.

Habits: The measure of habits showed good internal consistency. Item loadings were 0.84 and 0.98. The scale's internal consistency was acceptable at 0.84 with an average variance extracted of 0.83. The scale also discriminated well between habits and the other constructs in the model. The highest cross loading was 0.37. An examination of table 4 also shows strong discriminant validity. This scale will remain unchanged for the main study.

Use expectations: The use expectations scale also demonstrated good convergent and discriminant validity. Item loadings ranged between 0.81 and 0.94 The internal consistency of 0.77 is above the minimum 0.70 recommended by Nunnally (1978, p245). The average variance extracted of 0.74 indicates that the construct accounts for more of the observed variance in the measures than is present due to error. An examination of the cross loadings for discriminant validity revealed generally good discrimination between constructs. One item from the affect scale did cross load at 0.65. Given that affect is hypothesized to be a causal antecedent of expectations, and that the 0.65 cross loading is substantially below the weakest item loading of 0.81 for expectations, the use expectations scale will remain unchanged for the main study.

Perceived Consequences: The internal consistency of the perceived consequences scale was poor. The item loadings ranged between 0.44 and 0.73. One item in particular, I6 (appendix A), loaded substantially lower

(0.44) on the construct than the next worst item at 0.64. A comparison of item six with the first five items suggested that it may not have been measuring the same construct. Item six states "Using X will make me less reliant on support staff" while all of the other items relate to how using X will improve the individual's own performance on such factors as organization, effectiveness, time spent, output quality, and output quantity. The first five items all relate to factors under the individual's control in doing their job, the last item is different in that it probes the relationship between the individual and others that they rely on to do their job.

The internal consistency of the perceived consequences scale of 0.52 is also below the minimum recommended by Nunnally (1978). The average variance extracted of 0.42 also points to a internal consistency problem with more than 50% of the variance in the construct being due to error. There are also some discriminant validity concerns raised by the cross loadings of items from the affect scale on the perceived consequences scale. Given the marginal loading of the items on perceived consequences, the four cross loadings in the 0.64 to 0.62 range pointed to discriminant validity problems. This is further supported by table 4. The square root of the variance shared between the perceived consequences construct and its measures (0.65) is less than the correlation between it and the affect construct (0.73).

The problems with the perceived consequences scale were addressed in two ways. The first was to strengthen the internal consistency of the measure by dropping the unreliable item I6. The second step was to replace an item from the affect scale which had long term consequence implications

with one that had the appropriate short term perspective associated with the definition of affect. The ability of the measurement model to discriminate between perceived consequences and affect was also enhanced by the changes made to the measurement of affect as discussed later.

Social Contracts: The single item social contracts measure used in the pretest cannot be evaluated statistically. However, based on a qualitative review of the pretest responses, three groups emerged, co-workers, friends, and vendor representatives. The measure was expanded to a three item scale to include these groups for the main study. It appeared that many respondents on the pretest may not have taken the time to think about social contracts they may have made before indicating a null response. To avoid this potential problem in the main study a revision was made to the scale. Three seven point likert-type format items were generated that asked respondents to rate any social contract they had made with a co-worker, friend, or software vendor. Each item allowed respondents to rate the strength of existing social contracts to use or not use the new software.

Norms: Norms demonstrated strong internal consistency. Individual item loadings ranged between 0.79 and 0.96. The internal consistency was strong at 0.82. The average variance extracted at 0.81 was well above the minimum 0.50 required.

The norms scale also showed good discriminant validity. The highest cross loading was 0.57. The square root of the average variance extracted of 0.90 is well above the highest correlation of 0.50 between norms and use expectations. The scale will be used intact for the main study.

Computer Self-efficacy: The internal consistency of the computer self-efficacy scale was mixed. Two of the five items had loadings below 0.7. Item E4's loading was 0.68, marginally below the acceptable level of 0.7. An examination of the item did not reveal any reason why this should have occurred. Item E3's low loading of 0.56 was explained by the question's content. All of the other items in the scale queried the respondents' confidence in their ability to complete a task which would require them to use new features of the software based on the availability of various resources. Item E3, however, asked respondents to rate their confidence after having seen someone else perform the task. The difference between having seen it done, and having to do it yourself, may account for the low loading of item E3.

The internal consistency of the computer self-efficacy scale at 0.62 was below the recommended 0.7. The low loading of item E3 contributed to this. The average variance extracted was in the acceptable range at 0.55. The discriminant validity of the scale was marginal. One of the affect items loaded strongly on this construct at 0.72. Two computer self-efficacy items also loaded on the affect construct at 0.63 and 0.66. The effect of these cross loadings is apparent in the comparison of the square root of the variance shared between computer self-efficacy and its measures at 0.74 with the correlation between computer self-efficacy and affect at 0.70.

It was not surprising to find a conceptual closeness in the measurement of a person's enjoyment of a behavior and their confidence in being able to perform the behavior. Better measures of both constructs were

needed to be able to distinguish between two so closely related constructs. To refine the measures to improve both the internal consistency and discriminant validity for the main study three things were done. First, the affect measure was improved to reduce its cross loading with computer self-efficacy. Second, the inconsistent E3 computer self-efficacy scale item "... if I had seen someone else using it before trying it myself" was replaced with the logically consistent item "... if I had only the on-line help for reference." Third, the scale was lengthened by adding an additional item from the original Compeau (1992) scale to provide the opportunity for further scale refinement in the main study.

Affect: Problems with the internal consistency and discriminant validity of the affect scale contributed to many of the issues already discussed. Two of the affect items loaded quite poorly on the construct with loadings of only 0.51 for item F4 and 0.57 for item F5. Item F4 queried the respondents' agreement or disagreement with the statement that "using X is frustrating for me." Given that affect is the short term pleasure or disgust associated with a behavior, the use of the word frustrating had longer term implications than was appropriate. For the main study the word "frustrating" was replaced with "irritating" to lessen the consideration of past experiences in evaluating the current behavior, thus making the it m more consistent with the rest of the scale.

Item F5 asked respondents to rate their degree of agreement or disagreement with the statement "I get bored very quickly when working with X." The wording of the question was changed to "working with X is

boring" for the main study to eliminate the highly subjective evaluation of "very quickly." In the original question it was impossible to determine whether subjects were disagreeing with being bored, or with how quickly they were bored.

The overall internal consistency for the scale at 0.65 was below acceptable levels. The refinement of items F4 and F5 as discussed above should address this. The average variance extracted for the scale was an acceptable 0.60.

The affect scale did show discriminant validity problems with several items cross loading on the computer self-efficacy scale as already discussed. The variance shared between the items and the construct at 0.77, when compared to the correlation of 0.70 between affect and computer self-efficacy also indicated a discriminant validity problem. The refinement to both the affect and computer self-efficacy scales already discussed should address this in the main study.

Main Study Implementation

Several refinements were made to the survey based on the pretest. First, all of the individual item refinements described above were incorporated into the scales. Second, the changes made to the social contracts measure allowed the first measure to be printed in a 16 page booklet with only one blank page as opposed to the original 20 page booklet with three blank pages.

The sample for the main study was drawn from the population of people purchasing either the Aldus Persuasion or the Borland Quattro Pro competitive upgrade. The companies were asked to provide a list of the names and addresses of customers who had purchased a competitive upgrade in the previous six weeks. It was necessary to ask only for recent purchasers as one of the objectives of the study was to predict future use of a system based on the user's impressions in the adoption consideration process. A screening question was included in the survey to ensure that use of the upgrade was voluntary.

There were problems in both cases obtaining the desired lists of names and addresses. In one case, identifying only recent purchasers proved to be a problem which could only be overcome through a manual screening of records. In the other case, there were lengthy delays within the company between requesting, producing and sending out the list. This was also eventually overcome.

The survey was administered differently for the two participating companies. Both companies were concerned that their customers would not feel harassed as a result of having purchased their product. As a result, both companies limited the allowable contact to two mailings. Fortunately, based on their participation in the pre-test, Aldus was willing to increase the allowable contacts to four mailings for the main study. This permitted the use of follow-up reminders with Aldus customers. The basic format involved administering the initial questionnaire measuring the constructs

hypothesized to precede use, followed three months later by the follow-up questionnaire measuring use. The details for each implementation follow.

Administration of survey to Aldus customers

The administration of the survey to Aldus customers was done in four mailings. The first mailing distributed the initial measure. The second mailing was a reminder to non-respondents. The third mailing distributed the follow-up measure of use to all initial measure respondents. The fourth and final mailing was a follow-up measure non-response reminder. Aldus agreed to the increased rate of contact with their customers over what was permitted in the pre-test. Having been careful to get prior approval on all materials distributed, and the absence of negative feedback from their customers on the pretest may have contributed to their willingness to permit an increase in contact level. This administration of the survey to Aldus customers is described more completely below.

The first mailing distributed the initial measure (appendix F) and a covering letter (appendix G) to the 501 potential respondents. One month later a reminder letter (appendix H) was sent to non-respondents asking them why they had not responded. This was a one page letter which included five standard reasons for not responding and an open ended "other" category. Non-respondents were asked to check one of the five and return the letter. Of the 378 who had not responded 169 replied to the reminder mailing. The results from that mailing will be discussed more completely at the end of this chapter. The reminder mailing generated an additional 19 responses.

Removing the 18 surveys that were returned as undeliverable by the post office, the 50 people who had saved the questionnaire but did not reply within the time frame of the research, the 34 people who asked for another survey and did not respond within the time frame of the research, and the 70 who reported that they were never going to try Persuasion left an overall sample size of 329. Of these, 142 responses were received for an initial measure Aldus response rate of 43.2%. This calculation is summarized in the table below.

Table 5 - Aldus Response Rate Calculation

Reason for not responding	N	%
Questionnaires in the initial mailing	501	
Less those returned by post office	18	
Less those who did not try Persuasion	70	
Less those who did not reply within time frame of research	84	
Eligible sample size	329	100
Total responses received	142	43.2

This response was substantially better than the pretest response rate of 20.5%, but still below the 50% or higher usually achieved using Dillman's Total Design Method (TDM). Even in its shortened form, the 16 page questionnaire was still longer than the 12 page maximum recommended in the TDM. Three of the respondents indicated that they had not used any presentation package previously, yet they had purchased an upgrade. This raised the question: how many of the sample did not respond because they had purchased the upgrade for a friend?

Two months and three weeks after the date the first measure was filled in by each respondent the second measure of use was sent out. One month later another copy of the questionnaire and a letter encouraging them to reply was sent out to all second measure non-respondents. The second measure follow-up elicited an additional 26 responses bringing the total to 114 for the second measure. A total of 80.3% of the people who responded to the first measure also responded to the second measure.

Administration of survey to Borland customers

The administration of the surveys to Borland customers followed the same format as for Aldus with the exception of the reminder to the initial measure non-respondents. Only one contact was approved for the initial measure as Borland wanted to ensure that their customers did not feel harassed as a result of purchasing a Borland product. Of the 304 surveys sent out, 75 were completed, with 12 having been returned as undeliverable. This produced an initial Borland response rate of 26%. The length of the questionnaire, and the inability to do a follow-up, as discussed previously, contributed to the low response rate.

The follow-up measure was sent to Borland respondents two months and three weeks after the date the first survey was filled in. One month after the follow-up mailing a reminder letter and a second copy of the survey was distributed to non-respondents. A total of 54 people returned the follow-up measure for a response rate of 72%.

Demographics

The main study respondents are primarily well educated males, who are established in the companies they work for, and whose jobs are technical, managerial, or professional. Seventy-four percent of the first measure respondents were male, 26 percent were female. They averaged seven years with their current employer and had an average of five people reporting to them. Only four percent of the sample reported being employed in the secretarial or clerical field. Business as an educational background accounted for 30% of the sample with the remaining 70% being fairly evenly distributed across arts, sciences, engineering, computer science and the social sciences. The average age was 41 years. Other demographics appear in table 6 below.

Table 6 - Demographics

Functional Area Represented	Number of Respondents	% of Sample
Accounting	12	7.9
Engineering	11	7.3
General Management	17	11.3
Production	8	5.3
Marketing or Sales	17	11.3
Information Systems	15	9.9
Human Resources	3	2.0
Consulting	24	15.9
Other	44	29.1

Level of Position Held	Number of Respondents	% of Sample
Executive	27	17.9
Middle Management	33	21.9
First Line Management	12	7.9
Professional	42	27.8
Technical	14	9.3
Secretarial or Clerical	6	4.0
Other	17	11.3

Table 6 continued

Demographics

Educational Level	Number of Respondents	% of Sample
Some Vocational or High School	1	.7
Vocational or High School	6	3.9
Some College or University	26	17.1
College or University Degree	41	27.0
Some Graduate Work	28	18.4
Graduate Degree	50	32.9

Educational Background	Number of Respondents	% of Sample
Business	45	29.8
Arts	21	13.9
Sciences	17	11.3
Engineering	23	15.2
Computer Science	20	13.2
Social Science	9	6.0
Other	16	10.6

Non-response Follow-up

The last issue dealt with in this chapter is non-response bias. Given the first measure response rate of 41% for Aldus and 26% for Borland, the potential for the views of non-respondents to differ from those observed, and to draw the results into question is serious and should be addressed. This concern was addressed in two ways. During implementation of the survey a very brief follow-up questionnaire was sent to all Aldus non-respondents to determine the status of their responses. Once all data had been gathered, Armstrong and Overton's (1977) procedure for assessing non-response bias was applied. These are discussed in detail below.

A letter (appendix H) was sent to each of the 378 Aldus first measure non-respondents asking them the status of their questionnaire. The letter incorporated a five item question asking them why they had not responded. Seven of the letters were returned as undeliverable. Why the original questionnaires corresponding to the addresses had not also been returned remains unexplained. Of the 371 letters delivered, 169 were completed and returned for a response rate of 46%. The results are summarized in table 7.

Table 7 - Aldus Questionnaire Status Results

Reason for not responding	N	%
I have saved the questionnaire and will fill it out once I have tried Persuasion.	50	30
I cannot find the questionnaire. Please send me another one.	26	15
I did not receive the questionnaire. Please send me one.	8	5
I do not expect to try using Persuasion. Your questionnaire does not apply to me.	70	41
I simply do not want to fill out the questionnaire.	15	9
Total	169	100

Forty-one percent of the follow-up non-respondents, representing 14% of the original sample, reported that they had not returned the questionnaire because they did not use the product. As this study was interested in predicting future use based on an initial trial, the 14% who did not try the product were not eligible to be included in the sample. The reasons for not using the product were not specified.

The response rate was also reduced by the number of people who had saved the questionnaire and intended to fill it out once they had tried the software. Thirty percent of the follow-up respondents (10% of the total sample) were in this category. Due to the time constraints of this study, these people were also ineligible to be included in the sample.

Unfortunately, similar data could not be collected from Borland customers. Borland was very concerned that their customers not feel harassed as a result of buying a Borland product and did not allow a follow-

up letter. This is understandable as the companies offering competitive upgrades were attempting to lure customers away from competitors' products by offering significant price discounts. Once a new user was gained, the company expected to increase future revenue by selling upgrades and complementary products. All of the companies contacted for this research were very sensitive about their market share and very protective of customers. They did not want to risk losing customers as a result of this research.

Even allowing for the above factors, the combined response rate of 33% indicates a need for further analysis of the potential for non-response bias. Following the procedure suggested by Armstrong and Overton (1977), the demographics of early responses were compared with those of late respondents to assess differences. A potential for non-response bias is indicated if early respondents differ significantly from late respondents.

The first thirty respondents were compared with the last thirty respondents on the characteristics of age, sex, education level, field studied, functional area, level of position held, months with present organization, and the number of people reporting to them. An n of 30 was chosen to facilitate the calculation of a reasonable estimate of population variance for use in the tests. A two tailed t-test was used to compare ratio data such as age, while a chi squared test was used for the nominal and ordinal data such as field studied and position level. The results, shown in table 8 below, failed to show significant differences between early and late respondents on any of the

demographics. While this test did not indicate any response problems, the potential for non-response bias does still exist.

Table 8 - Non-response Bias Comparisons

Early Versus Late Respondents

Demographic	t-test	Chi Squared
Age	α=0.333	
Sex		α=0.508
Education Level		α=0.663
Field Studied		α=0.876
Functional Area		α=0.225
Level of Position Held		α=0.353
Months With Organization	α=0.124	
Number of People That Report to You	α=0.712	

This chapter presented the development and pre-testing of the survey instruments used in the main study. The constructs were operationalised, tested and the measurement scales refined. The implementation of the main study was described, response rates were reported and discussed. The main study demographics were presented and the issue of non-response bias was addressed.

The next chapter presents the data analysis for the main study.

CHAPTER 4 - DATA ANALYSIS

Introduction

This chapter presents the analysis of the main study data. It begins with an evaluation of the revised measurement model. Each construct is reviewed to assess the quality of its measurement . Next the research model and hypotheses are re-stated prior to evaluating the structural model. Each path in the model, with its corresponding hypothesis, is then evaluated.

Evaluation Main Study Measurement Model

The evaluation of the main study measurement model proceeded along the same lines as the pretest evaluation. First, the individual item reliability was assessed by examining the loading of each scale item on the corresponding construct (Table 9). The evaluation criterion is that a loading must be 0.70 or higher for the construct to have captured more of the variance in the scale item than is present due to error. Next the internal consistency of each scale was examined (Table 10). The internal consistency measure is analogous to Cronbach's α, and was interpreted using Nunnally's (1978) guidelines of 0.70 as acceptable for "modest" reliability appropriate to the early stages of research. Finally, the discriminant validity of the measurement model was assessed by comparing the average variance extracted in the measures by the construct with the correlations between constructs (Table 11). Each construct should have more in common with its own measures than it does with other constructs in the model. To assess this, the average variance extracted was compared to the correlations among constructs. Discriminant validity is acceptable when the average variance

extracted is larger than the correlation between the construct and other constructs in the model. Individual item loadings were also examined to verify that no item loaded more highly on another construct than on the construct it was intended to measure.

Cronbach's α for internal consistency is also reported at the end of the results for each scale to facilitate comparison between the results in this study and other work (Table 10). Some interesting differences between the Cronbach's α measure of internal consistency and Fornell and Larcker's measure of internal consistency appeared in this study. The differences illustrate the argument made by Fornell and Larcker that their measure is superior to Cronbach's α in that it does not assume that each measure contributes equally to the construct, and that the loading estimates are calculated within the causal framework of the model (Fornell and Larcker 1981). In a causal framework, each construct gains meaning from its measures as well as from it place within the framework. The practical implication of this is that, relatively speaking, scales with fewer items should draw more heavily on their place in the causal framework than scales with more items, all else being equal.

All scales used in this study which were borrowed intact from other research had Fornell and Larcker internal consistency scores that were lower than the corresponding Cronbach's α. For the new scales the pattern was reversed. The Cronbach's α was substantially lower than the Fornell and Larcker measure. This suggests that for the borrowed scales, not all of the meaning from the original context translated into the context of this study.

Use: The measure of use of the new software application showed good individual item reliability. The two items loaded 0.92 and 0.93 (Table 9) on the construct, well above the minimum 0.70 recommended by Carmines and Zeller (1979). The scale's internal consistency was strong at 0.86, also well above the 0.70 suggested as acceptable by Nunnally (1978). A comparison of the average variance extracted by the construct from the measures indicated the scale has good discriminant validity as well. The 0.92 square root of the average variance extracted is well above the highest correlation between use and the other constructs of 0.68. The highest individual item cross loading of 0.664 is also well below the item's loading on use of 0.928.

Although the use scale items remained unchanged from the pretest, the scale showed better overall reliability and internal consistency than it did in the pretest. The internal consistency rose from 0.80 to 0.86 (Table 12). The average variance extracted increased from 0.78 to 0.85 (Table 12). Discriminant validity decreased slightly with the difference between the highest construct correlation, and the square root of the average variance extracted dropping from 0.31 to 0.24. Even though the discriminant validity difference did drop from the pretest to the main study, the discriminant validity was still very strong and also fit better with the underlying theory.

The Cronbach's α for the two item scale was 0.58, substantially below the 0.86 Fornell and Larcker internal consistency statistic. This suggests that the use scale may have gained meaning from its context within the proposed causal framework.

Table 9 - Main Study Factor Loading Structure Matrix

	Affect	Computer Self-efficacy	Norms	Social Contracts	Perceived Conseq.	Use Expect.	Habits	Use
F1	**0.888**	0.502	0.290	0.154	0.585	0.540	-0.038	0.384
F2	**0.868**	0.383	0.351	0.221	0.639	0.458	0.056	0.286
F3	**0.792**	0.250	0.201	0.232	0.527	0.357	-0.015	0.159
F4	**0.713**	0.378	0.101	0.060	0.332	0.310	0.042	0.209
F5	**0.773**	0.312	0.154	0.210	0.504	0.334	0.028	0.158
F6	**0.856**	0.423	0.167	0.218	0.522	0.402	0.095	0.266
E1	0.433	**0.818**	0.152	0.076	0.256	0.282	0.080	0.200
E2	0.395	**0.825**	0.087	0.028	0.198	0.191	0.015	0.110
E3	0.371	**0.772**	0.164	0.165	0.191	0.256	0.127	0.158
E4	0.317	**0.751**	0.242	0.180	0.168	0.187	0.018	0.039
E5	0.434	**0.888**	0.180	0.211	0.243	0.322	0.079	0.134
E6	0.251	**0.702**	0.140	0.207	0.158	0.243	0.108	0.151
D1	0.218	0.217	**0.807**	0.168	0.256	0.173	-0.066	0.108
D2	0.176	0.127	**0.694**	0.107	0.255	0.123	-0.070	0.172
D3	0.219	0.174	**0.900**	0.219	0.317	0.334	-0.030	0.270
D4	0.237	0.149	**0.858**	0.294	0.327	0.255	0.087	0.202
D5	0.259	0.121	**0.863**	0.273	0.358	0.279	0.015	0.226
D6	0.216	0.209	**0.760**	0.168	0.326	0.281	-0.033	0.282
J1	0.164	0.147	0.294	**0.864**	0.253	0.417	0.118	0.242
J2	0.197	0.155	0.092	**0.692**	0.191	0.231	0.079	0.092
J3	0.164	0.126	0.130	**0.666**	0.197	0.173	0.103	0.026
I1	0.518	0.165	0.235	0.165	**0.862**	0.457	-0.047	0.300
I2	0.597	0.248	0.407	0.243	**0.913**	0.578	-0.005	0.375
I3	0.593	0.214	0.315	0.285	**0.887**	0.497	0.075	0.360
I4	0.565	0.291	0.310	0.292	**0.873**	0.531	0.037	0.333
I5	0.542	0.208	0.384	0.274	**0.841**	0.496	0.047	0.404
K1	0.530	0.309	0.323	0.358	0.624	**0.827**	0.005	0.439
K2	0.449	0.335	0.191	0.321	0.506	**0.903**	0.255	0.631
K3	0.308	0.172	0.296	0.353	0.372	**0.815**	0.385	0.704
B3	-0.021	0.051	-0.100	0.045	-0.053	0.155	**0.895**	0.233
B4	0.066	0.116	0.060	0.184	0.081	0.301	**0.940**	0.304
X4	0.353	0.208	0.216	0.158	0.418	0.628	0.245	**0.918**
X5	0.228	0.115	0.281	0.208	0.334	0.664	0.301	**0.928**

Bold elements are the items intended to load on the construct.

Table 10 - Main Study Internal Consistency

Scale Name / Items	Loading	Item Reliability	Internal Consistency	Average Variance Extracted	Cronbach's α
Affect			0.71	0.67	0.90
F1	0.89	0.79			
F2	0.87	0.75			
F3	0.79	0.63			
F4	0.71	0.51			
F5	0.77	0.60			
F6	0.86	0.73			
Computer Self-efficacy			0.68	0.63	0.88
E1	0.82	0.67			
E2	0.83	0.68			
E3	0.77	0.60			
E4	0.75	0.56			
E5	0.89	0.79			
E6	0.70	0.49			
Norms			0.71	0.67	0.90
D1	0.81	0.65			
D2	0.69	0.48			
D3	0.90	0.81			
D4	0.86	0.74			
D5	0.86	0 74			
D6	0.76	0.58			
Social Contracts			0.63	0.56	0.63
J1	0.86	0.75			
J2	0.69	0.48			
J3	0.67	0.44			

Table 10 - Main Study Internal Consistency Continued

Scale Name / Items	Loading	Item Reliability	Internal Consistency	Average Variance Extracted	Cronbach's α
Perceived Consequences			0.79	0.77	0.92
I1	0.36	0.74			
I2	0.91	0.83			
I3	0.89	0.79			
I4	0.87	0.76			
I5	0.84	0.71			
Use expectations			0.75	0.72	0.52
K1	0.83	0.68			
K2	0.90	0.82			
K3	0.81	0.66			
Habits			0.85	0.84	0.55
B3	0.90	0.80			
B4	0.94	0.88			
Use			0.86	0.85	0.58
A4	0.92	0.84			
A5	0.93	0.86			

Table 11 - Main Study Discriminant Validity Coefficients

Construct	1.	2.	3.	4.	5.	6.	7.	8.
1. Affect	**0.82**							
2. Computer Self-efficacy	0.47	**0.79**						
3. Norms	0.27	0.20	**0.82**					
4. Social Contracts	0.22	0.19	0.26	**0.75**				
5. Perceived Consequences	0.64	0.26	0.38	0.29	**0.88**			
6. Use expectations	0.50	0.32	0.32	0.41	0.59	**0.85**		
7. Habits	0.03	0.10	-0.01	0.13	0.03	0.05	**0.92**	
8. Use	0.34	0.23	0.21	0.29	0.40	0.68	0.16	**0.92**

The bold diagonal elements are the square root of the variance shared between the constructs and their measures. Off diagonal elements are the correlations among constructs. For discriminant validity the diagonal elements should be larger than any other corresponding row or column entry.

Table 12 - Measurement Model Improvements From Pretest to Main Study

	Internal Consistency		Square Root of Average Variance Extracted		Cronbach's α	
	Pretest	Main	Pretest	Main	Pretest	Main
Use	0.80	0.86	0.78	0.85	0.51	0.58
Habits	0.84	0.85	0.91	0.92	0.56	0.55
Use expectations	0.77	0.75	0.86	0.85	0.61	0.52
Perceived Consequences	0.52	0.79	0.65	0.88	0.70	0.92
Social Contracts	NA	0.63	NA	0.75	NA	0.63
Norms	0.82	0.71	0.90	0.82	0.95	0.90
Computer Self-efficacy	0.62	0.68	0.74	0.79	0.79	0.88
Affect	0.65	0.71	0.77	0.82	0.81	0.90

NA indicates the statistic is not appropriate for the single item measure of social contracts used in the pretest.

Habits: The measure of habits associated with using the previous software package was strong. Individual item loadings were 0.90 and 0.94 indicating good reliability. The Fornell and Larcker internal consistency

statistic of 0.85 was well above the minimum 0.70 recommended by Nunnally (1978). The scale's discriminant validity was also very strong. The square root of the average variance extracted of 0.92 is well above the highest correlation between habits and the other constructs of 0.13. This is also reflected in the fact that neither of the use items cross loaded substantively on any other construct.

The habit measure was unchanged between the pretest and the main study. Its quality remained consistent. Item loadings changed from 0.84 to 0.90, and from 0.98 to 0.94 respectively. Internal consistency went from 0.84 in the pretest to 0.85 in the main study. The square root of the average variance extracted increased slightly from 0.91 to 0.92.

Cronbach's α for the habit scale was 0.55, well below the 0.70 needed for "modest" reliability in the early stages of research. However, the Fornell and Larcker internal consistency statistic was 0.75, suggesting the scale is acceptable. As discussed earlier, this demonstrates the importance of evaluating a scale within the context of a theory as discussed by Fornell and Larcker (1981).

Use expectations: The scale capturing an individual's expectations of their future use of the new software application demonstrated good reliability, consistency and discriminant validity. Individual item loadings were 0.81, 0.94 and 0.83. The internal consistency of the scale was acceptable at 0.75. The discriminant validity was strong. The square root of the average variance extracted of 0.85 (found on the diagonal of table 11) is substantially larger than the largest corresponding correlation between

constructs of 0.59. An examination of the individual scale item cross loadings also indicated good discrimination between constructs. The behavioral expectation item K1 which measured the expected increase or decrease in future use did cross load at 0.62 on perceived consequences. However, the 0.62 cross loading is well below the 0.83 loading of the item on its own construct.

The main study statistics for the measure of habits changed only slightly from their pretest counterparts. Item loadings changed form 0.81 to 0.83, 0.94 to 0.90, and 0.83 to 0.82. The internal consistency statistic dropped from 0.77 to 0.75. The maximum correlation between use expectations and the other constructs increased slightly from 0.25 to 0.26.

The Cronbach's α measure of internal consistency for the main study measure of habits was 0.52 compared to the Fornell and Larcker measure of 0.75.

Perceived Consequences: The measure of the individual's perceptions of the consequences of using the new software, and the value of those consequences, performed well. The internal consistency of the revised perceived consequences scale improved substantially over the pretest. In the pretest, there were discriminant validity problems between the affect scale and the perceived consequences scale. The problems were addressed by improving the affect scale and by dropping an inconsistent item from the perceived consequences scale. These improvements had the desired effect. The pretest range of individual item loadings of 0.44 to 0.73 improved substantially for a main study range of 0.84 to 0.91. The internal consistency

of the scale was good at 0.79, an improvement over the pretest value of 0.52. Discriminant validity also improved substantially with the square root of the average variance extracted going from 0.65 in the pretest to 0.88 in the main study. The correlation of 0.73 between perceived consequences and affect found in the pretest reduced to 0.64. This, coupled with the improvement in average variance extracted indicated acceptable discriminant validity in the main study. The scale items also discriminated well between perceived consequences and the other constructs. All item cross loadings were below 0.60. The improved scale demonstrated good discriminant validity.

As the first of the longer scales to be discussed, the Cronbach's α measure of internal consistency for perceived consequences is also the first to be higher than the corresponding Fornell and Larcker internal consistency measure. The α of 0.92 is much larger than the Fornell and Larcker measure of 0.79. This suggests that, while the scale has strong meaning independent of the current theoretical context, that some of that meaning may have been lost within the causal framework proposed in this research. However, even within the current context, the scale demonstrated significantly strong measurement characteristics to allow further interpretation to be done.

Social Contracts: The one item measure of interpersonal agreements to use or to not use the new software found in the pretest was replaced with a new three item scale. The new scale showed acceptable characteristics. Item loadings were 0.86, 0.69 and 0.67. All three questions have good face validity, and the average variance extracted for the scale of 0.56 indicates that more of the construct was captured than was present due to error. The

scale demonstrated good discriminant validity. The highest correlation between constructs from table 11 of 0.41 is well below the 0.75 square root of the variance shared between the construct and its measures. The highest individual item cross loading was 0.42. No comparisons to pretest statistics could be made as the single item measure used in the pretest does not permit their calculation.

The internal consistency of the scale as measured by Cronbach's α and Fornell and Larcker were equal at 0.63.

Norms: The scale used to measure norms, the perceptions of what the respondent believed significant others thought he or she should do, combined with the respondents' motivation to comply with what those others thought, remained unchanged from the pretest. Individual item loadings ranged between 0.76 and 0.90 with the exception of item D2 which loaded at 0.69. Item D2 questions the influence friends had on the respondents' behavior. The other five items in the scale all asked about the influence of people at work. While it makes sense that people at work will influence work related behavior more strongly than friends, friends do influence behavior. Item D2 was retained. Internal consistency was acceptable at 0.71. The norms scale showed good discriminant validity. The square root of the average variance extracted of 0.82 is well above the highest correlation between constructs of 0.38 between norms and perceived consequences. The highest cross loading for a scale item was 0.36.

Overall the measurement quality statistics decreased between the pretest and the main study. The range of item loadings decreased from 0.79

to 0.96 in the pretest to 0.69 to 0.90 in the main study. Internal consistency, while remaining acceptable, dropped from 0.82 to 0.71. The average variance extracted also dropped from 0.95 to 0.90. Two factors may account for this. First, the increase in the sample size from 39 in the pretest to 160 in the main study permitted a more accurate evaluation of the scale. Second, as the other scales were modified and improved their relative contribution to the structure of the theoretical model increased. This may have reduced the relative contribution of the unchanged norms measure. The main study norms measure is still within acceptable limits.

Computer Self-efficacy: The measure of an individual's confidence, that their efforts to learn the new software will produce results, improved significantly over the pretest. The loading of all six items in the revised scale ranged between .70 and .89 up from the 0.56 to 0.86 range of the original scale. The internal consistency improved from 0.62 to 0.68. The discriminant validity of the scale also improved. The correlation between affect and computer self-efficacy dropped from the 0.70 seen in the pretest to 0.47 for the main study. The square root of the variance shared between computer self-efficacy and its measures improved from 0.74 to 0.79. The highest cross loading of a computer self-efficacy scale item was 0.43 well below its 0.82 loading on computer self-efficacy.

Affect: The revised scale for measuring the short term pleasure or disgust associated with using the new software package showed better convergent and discriminant validity than the scale used in the pretest. The range of individual item loadings improved from 0.26 to 0.86 in the pretest to

0.71 to 0.89 for the main study. The internal consistency for the scale improved from 0.65 to 0.71 bringing it within the acceptable range as defined by Nunnally (1978). Discriminant validity was also acceptable. The highest correlation between affect and another construct was 0.64 with perceived consequences down from the 0.73 seen in the pretest. Comparing the 0.64 correlation to the 0.82 square root of the average variance shared between affect and its measures indicates good discriminant validity. No problems were found with the individual item cross loadings. The highest cross loading of 0.64 was well below the loading of 0.87 for that same item on the affect construct.

This section has established that the measurement model is sufficiently valid and reliable that it can be used to evaluate the proposed underlying theory or structural model. In the next section, the research model and hypotheses are reviewed and the results of the structural model evaluation are presented.

Review of the Research Model and Hypotheses

The research model, based on Triandis' (1980) theory of interpersonal behavior, attempts to explain the use of a software application based on expectations of use and the habits formed from their use of the package being upgraded from. The use expectations in turn are explained by: affect, the short term pleasure or disgust generated while using the new application; computer self-efficacy, the confidence that efforts to use the new software will be successful; norms, the impact of what other people think the user should do on his or her use expectations; social contracts, specific interpersonal

agreements to use or to not use the new software; and perceived consequences, the anticipated benefits and costs to the individual of using the new software. The diagram below shows the hypothesized relationships among these constructs.

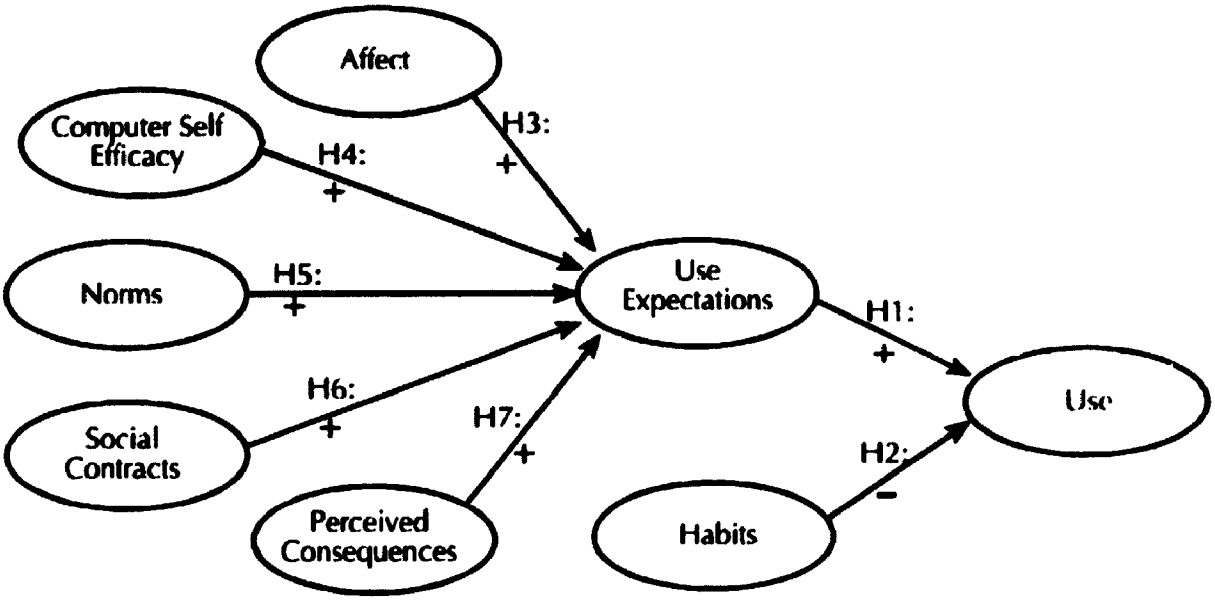

Figure 12 - The Research Model

Evaluating the Structural Model

Having met the necessary condition of having a good measurement model, the explanatory and predictive power of the model was then assessed. Evaluating the explanatory power of the model involved testing how well the observed data fit the hypothesized relations among constructs. This was done by examining the size, sign, and statistical significance of the path

coefficients between constructs in the model. The statistics were generated using a technique called Jackknifing (Fornell and Barclay 1983).

Jackknifing involves the application of PLS modeling to overlapping subsets of the original dataset. Subsets are generated by removing the first 'n' observations from the data set and generating the PLS path coefficients. The second iteration replaces the first 'n' observations and removes the next 'n', and so on until all of the observations have been removed once from the data set. The path coefficients are calculated for each subset and become the elements in a sampling distribution to which t-statistics can be applied. The size of the subsets to be removed determines the sample size used in evaluating the t-statistic. With a subset of n, the resulting number of sub-samples is the number of observations in the original data set divided by n. With a data set of 160, an n of 5 was chosen to yield 32 sub-samples for the calculation of the t-statistic.

The predictive capacity of the model was evaluated by examining the variance explained in the endogenous or dependent constructs. The predictive capacity of the model must be considered when evaluating the tenability of the proposed theory (Barclay, Higgins and Thompson in press). Significant path coefficients, and a substantive variance explained are co-requisites for drawing implications from a theoretical model.

The next section presents and discusses the test statistics for each of the hypotheses in the model. The hypotheses were grouped according to the two endogenous constructs in the model. Those hypotheses relating

constructs directly preceding use are presented first. Then, the posited antecedents of use expectations are explored.

Hypothesis Testing

H1: There will be a positive relationship between use expectations formed during the use of a new system and future usage levels of the system.

The strongest observed relationship found in the model was between use expectations and use (see table 13). As proposed by Triandis, use expectations were significantly positively correlated with future use. Respondents' expectations for their usage level of the new software application in three months time were significantly and substantively correlated with reported use. The path coefficient of 0.668 was significant at the two tailed α level of 0.001 with a t-value of 62.42.

This result further supports the link between use expectations and the adoption or rejection of an information technology innovation established by Moore (1989). It is also consistent with research in Social Psychology linking expectations to use for a variety of social behaviors (Triandis 1980, Ajzen and Fishbein 1980, Warshaw and Davis 1985). The strength of the link observed in this work between use expectations and use indicates that this relationship also applies in the specific context of using software applications.

One factor which may have strengthened the relationship found between Use expectations and Use was the subjects' degree of familiarity

with the new system when their Use expectations were measured. Forty eight percent of the sample reported having more than three months experience with the new system while continuing to use the original system. This would suggest that those people might have more accurately formed use expectations of their future use of the new software than users with less experience. Sample size requirement for PLS did not permit evaluating the influence of Use expectations use across experience levels.

Table 13 - Summary of Significance Levels and Path Coefficients

Hypothesis	Path Coefficient	t-value	α Level
H1: Use expectations → Use	0.668	62.42	$\alpha < 0.001$
H2: Habits → Use	-0.124	-7.49	$\alpha < 0.001$
H3: Affect → Use expectations	0.145	7.31	$\alpha < 0.001$
H4: Perceived Consequences → Use expectations	0.382	19.02	$\alpha < 0.001$
H5: Computer Self-efficacy → Use expectations	0.100	4.60	$\alpha < 0.001$
H6: Subjective Norms → Use expectations	0.050	1.59	$\alpha = 0.127$
H7: Social Contracts → Use expectations	0.230	14.10	$\alpha < 0.001$

H2: Habits associated with using the original system will be inversely related to future usage levels of the new system.

Habits were found to be significantly inversely related to use. The path coefficient between habits and use was significant at an α level of 0.001 (t-value equal -7.49). The path coefficient of -0.124 was also substantive. This indicates that the stronger an individual's habits are with respect to using a particular software application, the less likely they are to voluntarily switch to a new one.

While the importance of habits has been established in other contexts (Sugar 1967, Zand and Sorensen 1975), and the breaking of old habits when considering new behaviors (Lewin 1947), this result serves to point towards the importance of considering old habits when considering the use of new software.

The relationship between use expectations, habits and use posited by Triandis in his model was supported. Much of the variation in use was explained by prior use expectations and the habits associated with using the previous application. The significance of both path coefficients beyond the α level of 0.001, and their magnitude provides strong support for the applicability of this portion of the theory in the IS context.

The model's capacity to predict use was also substantively significant with 50.5% of the observed variation in use being explained by use expectations and habits. This means that in this study just over half of the respondents' variation in use can be predicted by their use expectations and

habits measured three months previously. If prediction of use was Triandis' only goal the rest of the model would not be needed. However, it is the antecedents of use expectations that have the potential to provide insight into the management of those expectations.

Proceeding with the second part of the model, the causal antecedents of use expectations are affect, perceived consequences, computer self-efficacy, subjective norms, and social contracts. All but one of the hypothesized relationships were supported. Only the impact of norms on use expectations was not significant.

H3: Affect related to using the new system will be positively related to use expectations.

Affect was found to be positively related to use expectations. The more pleasure a person derived from using the new software, the greater their expectations of future use. The path coefficient between affect and use expectations was significant at an α level of 0.001 with a t-value of 7.31. It was also substantive at 0.145.

The establishment of affect as a causal antecedent of use expectations provides support for the generally recognized importance of user friendliness to system success (Carrol and Thomas 1988). While the affect associated with using a system is only one of several components of user friendliness (Mead 1985), it does identify one of the mechanisms through which user friendliness impacts system use.

H4: The perceived consequences of using the new system will be directly related to use expectations.

The path coefficient between perceived consequences and use expectations was found to be significant at the α level of 0.001 (t-value equal 19.02). The greater the perceived beneficial outcomes of using the new software, the higher the expectations for future use. The effect of perceived consequences on use expectations was also substantive at 0.382. The results found by Robey (1979), Davis (1989), and Davis, Bagozzi and Warshaw (1989) linking constructs similar to perceived consequences to system use is further supported by this work.

H5: Computer self-efficacy will be positively related to use expectations.

Computer self-efficacy did positively relate to use expectations. The greater an individual's confidence that efforts to learn a new application will be successful, the higher their expectations for future use. The path coefficient of 0.100 was significant at an α level of 0.001 with a t-value of 4.60. This was consistent with Triandis' theory and lends further support to the growing evidence in the IS context of the importance of computer self-efficacy to system use (Hill, Smith and Mann 1987, Igbaria and Parasuraman 1988, Gist et al. 1989, Compeau and Higgins 1991).

H6: Subjective norms towards using the new system will be positively related to use expectations.

The observed relationship between subjective norms and use expectations was not significant. The results suggest that what other groups of people thought the respondents should be doing did not influence their expectations for future use. The t-value of 1.59 corresponds to an α level of 0.13, which led to a failure to reject the null hypothesis that norms do not affect use expectations. Because of the non-significance of the results the path coefficient of 0.05 cannot be interpreted. Two possible explanations for this are presented below.

The nature of the two applications studied is personal. An individual's use of either one may require little interaction with others, and would therefore be less affected by social influences than an application requiring a greater degree of interaction with others. This explanation is consistent with observations made by Davis et al. (1989) on finding that subjective norms in their study did not have a significant effect on behavioral intentions.

It is also possible that the insignificance of subjective norms is due to the context chosen for this research. Recent work by Thompson, Higgins and Howell (1991) suggests that the role of norms in determining use expectations varies with the computer experience of the individual. Novice users are more likely to be influenced by what others think they should be doing than are experienced users. Based on their research, it would appear that the more experience a person has using computers the less they formulate use expectations based on what others think. Presumably people gain confidence in their own ability to make computer-related choices as their experience increases.

While this study did not measure 'computer experience' as used by Thompson, the measure of computer self-efficacy does provide insight into the level of confidence the respondents place in their own computer abilities. Computer self-efficacy was measured on a seven point scale ranging from plus three indicating extremely confident to minus three indicating extremely unsure. The average score was 1.92 indicating that respondents were quite confident in their ability to get results from efforts to use the software. The high score is consistent with the confidence one would expect from a group of people who had voluntarily upgraded to a new software package.

Further analysis was done to test this explanation by breaking respondents into two groups. The first group were those with very high computer self-efficacy scores averaging two or more out of a maximum of three. The other group contained all respondents with scores below two. The research model was run for each of the groups and the results compared. Unfortunately, the path coefficient between norms and use expectations was not significant for either group so further interpretation was impossible. Given the high computer self-efficacy of both groups it is likely that Thompson's explanation that high confidence reduces the effect of norms on behavior continued to account for the lack of a significant influence of subjective norms on the use expectations of respondents.

H7: Social contracts will be positively related to use expectations.

Social contracts were found to be positively related to use expectations. The existence of specific interpersonal agreements to use, or to not use the new software application were significantly related to use expectations. The t-value of 14.10 was significant beyond the two tailed α level of 0.001. The path coefficient was also substantively significant at 0.230. This indicates that the importance of social contracts to other types of behavior (Traindis 1977) also applies to the use of a new software application.

Overall, Triandis' view of the antecedents of use expectations was well supported by this research. A total of 43.9% of the variation in use expectations was explained. Affect, perceived consequences, computer self-efficacy, and social contracts were all positively, significantly, and substantively related to use expectations as posited. Only subjective norms were not found to be significant. As already discussed, the high computer self-efficacy of the sample may account for their independence from the influence of others in forming use expectations. While this part of the model does not add to the capacity to predict use, it does enhance our understanding of those factors influencing the formation of use expectations.

Indirect Effects

The observed indirect effects from the causal antecedents of use expectations are reported in Table 14. The indirect effect coefficients are interpreted in the same way as standardized path coefficients. The

coefficients indicate the expected change in use resulting from a one unit change in the indirect causal antecedent.

Table 14 - Indirect Effect Coefficients

Indirect Effect Between Constructs	Indirect Effect Coefficient
Affect → Use	0.097
Computer Self-efficacy → Use	0.067
Subjective Norms → Use	0.034
Social Contracts → Use	0.154
Perceived Consequences → Use	0.255

Only the indirect effects of social contracts and perceived consequences were substantive, with the coefficient of affect being marginal at 0.097. The large indirect effect of perceived consequences (0.255) indicates that the expected outcomes from using the new software plays a significant role in determining future use. This finding is consistent with work done by Davis, Bagozzi and Warshaw (1989). They found that a construct similar to perceived consequences, labeled usefulness, had a significant impact on use. The indirect effect of Social contracts on use was also substantive (0.154). Perceived consequences also had a substantive indirect effect (0.255) on use through use expectations.

Comparison of Overall Results to Individual Application Results

A comparison was made between the results for Aldus and Borland separately. The purpose of this comparison was to determine whether the relationships identified by the model in the sub-groups were consistent with each other. Care must be taken in interpreting these results as the smaller sample sizes for each group make them less reliable than the complete sample. In particular, the sample of 50 Borland respondents is below the minimum of 60 needed by PLS for this model. The individual analyses presented below will not be identified by company in order to preserve the confidentiality of individual results required by the participating companies.

The results shown in table 15 for the first sub-sample are inconsistent on three paths with the second sub-sample reported in table 16. The main difference is that the path between habits and use in the first sub-sample was substantively significant at -0.356 and statistically significant ($\alpha < 0.001$), while the same path coefficient in the second sub-sample was non-substantive at 0.038 and significant at an α level of 0.099.

Table 15 - Sub-sample 1 Path Coefficients and Significance Levels

Hypothesis	Path Coefficient	α Level
H1: Use expectations → Use	0.417	$\alpha < 0.001$
H2: Habits → Use *	-0.356	$\alpha < 0.001$
H3: Affect → Use expectations *	0.030	$\alpha = 0.271$
H4: Perceived Consequences → Use expectations	0.489	$\alpha < 0.001$
H5: Computer Self-efficacy → Use expectations	0.070	$\alpha = 0.005$
H6: Subjective Norms → Use expectations *	-0.098	$\alpha = 0.531$
H7: Social Contracts → Use expectations	0.224	$\alpha < 0.001$

* indicates a difference from sub-sample 2

Another difference between the two sub-samples is that the path coefficient between affect and use-expectations was statistically insignificant ($\alpha = 0.271$) for the first while being significant for the second at an α level of 0.016. The final difference between the two groups is that the influence of subjective norms on use expectations was insignificant for the first, but was statistically significant ($\alpha < 0.001$) and substantively significant with a path coefficient of 0.174 for the second group.

Table 16 - Sub-sample 2 Path Coefficients and Significance Levels

Hypothesis	Path Coefficient	α Level
H1: Use expectations → Use	0.719	$\alpha < 0.001$
H2: Habits → Use *	0.038	$\alpha = 0.096$
H3: Affect → Use expectations *	0.091	$\alpha = 0.016$
H4: Perceived Consequences → Use expectations	0.317	$\alpha < 0.001$
H5: Computer Self-efficacy → Use expectations	0.136	$\alpha < 0.001$
H6: Subjective Norms → Use expectations *	0.174	$\alpha < 0.001$
H7: Social Contracts → Use expectations	0.325	$\alpha < 0.001$

* indicates a difference from sub-sample 1

Recognizing that the size of the sub-samples make a firm interpretation of the results impossible, there are some tentative observations to be made. The results for both sub-samples largely coincide. However, the difference in sign and magnitude of the path between habits and use, the significance of norms in the second sub-sample, and the insignificance of affect in the first suggests there may be application specific differences in the importance of constructs in the research model for

predicting and explaining use. Habits, for example, may be more or less important depending on the type of application being upgraded.

Discussion

The results of this research support the application of Triandis' model of interpersonal behavior in the context of application software use. The model demonstrated statistical significance for all paths in the model, with the exception of the path between norms and use expectations. All of the significant path coefficients ranged between 0.100 and 0.668 indicating that substantive significance was also achieved. The 50.5% variance explained in the dependent construct use, and the 43.9% variance explained in use expectations also demonstrated the model's strong predictive capacity.

Several previously hypothesized relationships have been reconfirmed. The connection between expectations and behavior presented by Moore (1989) in the context of information technology innovation decisions held in this context as well. The strongest link in the model was between use expectations and use.

The relationship between affect associated with using software and the degree of use was also demonstrated. In the IS field, affect fits as a component of the multidimensional concept of user friendliness. The relationship between affect and use supports the widely recognized importance of user friendliness to system use (Carrol and Thomas 1988).

The importance of perceived consequences to system use was reinforced by this work. The results found by Robey (1979), Davis (1989),

Davis et al. (1989) and Adams et al. (1992) that constructs similar to perceived consequences impact system use was confirmed.

Another relatively new construct to the IS field, computer self-efficacy (Hill Smith and Mann 1987, Igbaria and Parasuraman 1988, Gist et al. 1989, Compeau and Higgins 1991), was demonstrated as being important to usage levels of software applications.

Two new relationships have been introduced to the IS field and tested. The habits associated with using previous software have been shown to significantly and substantively affect use of new software. Social contracts to use or not to use new software were shown to impact an individual's use.

The insignificance of the path between norms and use expectations contributed indirectly to work already done by Thompson et al. (1991). The high computer self-efficacy of the respondents found in this study parallels the higher experience levels cited by Thompson as reducing the user's dependence on what others think.

This research has also served to reinforce the methodological value of using structural equation modeling techniques, in this case Partial Least Squares, to investigate IS phenomenon.

This strength of the results in this study provide support for the recommendations made by Keen (1980) to borrow from referent disciplines to improve the quality and rate of progress in IS research. Triandis' (1980) theory of interpersonal behavior provided a consistent and proven framework within which to investigate the voluntary use of application software. The

relatively clear definitions accompanying the model also facilitated the selection of appropriate existing scales from within the IS literature. The concerns expressed by Swanson (1982) that inconsistent and often contradictory construct definitions have led to conflicting views of the role of attitudes in system use were avoided by selecting scales which fit the theoretical definition of the constructs within the context of the model.

The benefits of using clearly defined constructs, and proven measurement instruments surfaced in the evaluation of the measurement model. The reliability, internal consistency and discriminant validity for all borrowed scales was good. For those scales that had to be developed, the clear theoretical definitions permitted development of acceptable measures with only one pretest.

The strength of the original theory, imported into the IS context was evident in the structural model results. Most of the originally hypothesized relationships, with the exception of the influence of subjective norms on use expectations, were statistically and substantively significant. Even the unanticipated insignificance of subjective norms made sense in retrospect when the high computer self-efficacy of the sample was taken into consideration. Measurement problems with the habits construct accounted for the other unsupported relationship.

An important contribution has been made to IS research independent of the context specific results of this work. The practical viability of implementing the recommendations of Keen (1980) and Swanson (1982) has been demonstrated. Considerable progress can be made by borrowing from

an appropriate referent discipline, clearly defining the constructs used, employing established measurement scales when possible, and applying them in a manner consistent with the original context.

Summary

This chapter presented the evaluation of the main study. The internal reliability and discriminant validity of the measurement model were established first. Then Triandis' model was evaluated based on the data. The results were strongly in support of the theory. Some of the direct implications of the findings were then discussed. The next chapter will present a more detailed discussion of the implications of this research and suggest further avenues of work based on the results.

CHAPTER 5 - CONCLUSIONS

Overview

While organizations may purchase computer systems, ultimately it is people who have to use them before companies can achieve the anticipated benefits from their technology investments. With a view to improving usage levels, understanding how people react to new systems has been a long standing concern of practitioners and IS researchers. Recent research has begun to look to other fields of study to gain insight into how people react to new systems. This research continued in this direction by borrowing a behavior prediction model (Triandis 1980) from Social Psychology and applying it to the problem of understanding the human factors that influence application software usage levels.

As an approach to IS research, drawing from a strong referent discipline has several advantages. The first is that it is much faster to locate and then borrow a good theory than it would be to develop one. When borrowed properly, by paying close attention to the original context and measurement specifications, the IS field receives the full benefits of research already done in the referent field. A high quality, theory grounded IS model results. Borrowing theory and testing it in the IS context also helps to place the work being done in the IS field in a larger context.

In this research, the decision to focus exclusively on people's reaction to computing technology rather than on the technology itself was made for a

very practical reason. Given the rapid pace of change in computing technology any research attempting to predict system use based on the specifics of the technology would be outdated as quickly as the technology itself. Focusing on the people provided an opportunity to make a lasting contribution to the IS theory base which will not be wiped out by the next revolution in computing technology.

A longitudinal study was conducted to permit the making of causal statements about the factors affecting system use. While longitudinal research does take longer to do, and has the problem of attrition in responses between the first and second measures, it is necessary to establish the temporal precedence (Cook and Campbell 1979, 35) of the hypothesized cause over effect.

This remainder of this chapter briefly summarizes the research that was conducted. The findings and contributions to our understanding of how people choose to use new systems are presented from both the academic and managerial perspectives. The strengths and limitations of this work are then discussed. Lastly, the implications for future research are highlighted.

Summary of Research

A longitudinal study was undertaken to test the applicability of Triandis' (1980) behavior prediction model to the context of an individual's voluntary use of an application software upgrade. A measurement model was built by using existing IS scales which fulfilled the requirements established by Triandis, or by modifying existing scales to meet those

requirements. The instrument was pretested longitudinally through a mail survey of 200 people who had voluntarily purchased an application software competitive upgrade. The instrument was refined based on 38 usable responses and then used in the main study.

The main study surveyed 805 individuals who had purchased competitive upgrades switching to either Aldus Persuasion or Quattro Pro. The first survey measured the hypothesized antecedents of use shown in the figure below. A second measure, taken three months after the first, captured the person's use of the new software. Based on a total of 160 usable pairs of responses, the model was largely supported by the data.

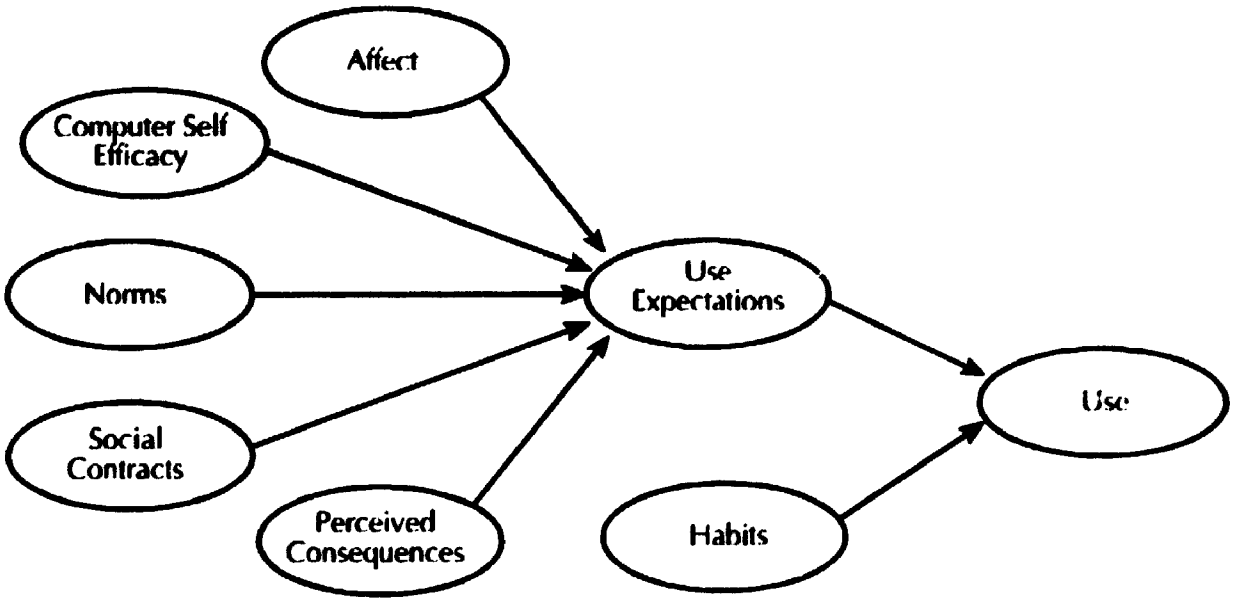

Figure 12 - The Research Model

The findings for each construct in the model are discussed beginning with the immediate antecedents of use and working backwards causally through the model.

Influence of Habits on Use

The habits associated with using the previous software package were found to be inversely related to use of the new software. The longer and more frequently that a respondent had used the previous software package the stronger were habits that had to be overcome before the new application was accepted. Individuals who have considerable past experience with an application may experience greater difficulty in switching to a new application than someone with less experience.

This represents a important contribution to our understanding of the factors influencing system use. Although Thompson et al. (1991) did use habits in their model of personal computer utilization, they encountered discriminant validity problems in the measurement model which led them to drop habits from the analysis. This research has successfully demonstrated the importance of addressing the habits associated with a user's experience with previous systems in predicting how they will react to a new system.

Influence of Use expectations on Use

Use expectations was found to be the strongest predictor of use in the model. While use expectations have been discussed by other IS researchers referencing Social Psychology (Pavri 1988, Thompson 1988, Moore 1989, Thompson, Higgins and Howell 1991), they all chose to drop behavioral

intentions in their research models. This research has demonstrated that use expectations are a good predictor of use. Exploring the factors influencing the formation of use expectations provides an opportunity to influence system use. Several of those factors were included in this study.

The strongest path in the model (0.668) was found between use expectations and use. The strength of the path, together with the fact that only 43.9% of the variation in use expectations were explained by the model, indicates that use expectations are important to the model. The tendency for IS researchers to drop use expectations from models investigating use is strongly counter indicated by this work.

Influence of Affect on Use Expectations

Affect was found to be directly related to the individual's use expectations. The greater the short term pleasure associated with using the new application, the higher the expectations for future use. In addition to being intuitively appealing, these results are consistent with Compeau's (1992) finding that affect is positively related to system use.

The role of affect in determining use expectations, and ultimately system use, is important to IS research. The affect construct represents a substantial piece of the more widely accepted idea that the user-friendliness of a system impacts its use (Carroll and Thomas 1988). While there is no widely accepted definition of user friendliness, Mead's (1985) discussion of the construct suggests that enjoyment of use, or affect, is one of four important dimensions. This has contributed to IS research on the

importance of user-friendliness by isolating an important dimension of the construct. The clear theoretical definition of affect, the high quality measurement instrument used, and the theory describing the mechanism through which affect works, has provided insight into the concept of user-friendliness.

Influence of Computer Self-efficacy on Use Expectations

A person's confidence that his or her efforts to learn a new application would be successful was found to positively influence use expectations. People who are confident that they will be able to master a new system have higher expectations for future use than those with lower computer self-efficacy.

These results support Compeau's (1992) introduction of the important new concept of computer self-efficacy to IS research on system use. Compeau's results, which showed that computer self-efficacy directly influences use, were supported by this study. The impact of computer self-efficacy on use through use expectations supports and extends the role of computer self-efficacy as identified by Compeau. By using Compeau's measurement scale this work also facilitated a further verification of its psychometric properties.

Influence of Norms on Use Expectations

The most surprising result of the study was the statistically insignificant impact of norms on use expectations. This indirectly provides support for recent work by Thompson et al. (1991) suggesting that the impact

of norms is moderated by a user's computer experience. Thompson posits that people with less experience may rely more heavily on others in forming their use expectations, while experienced users may rely on their own judgment. This research provides support for the idea that experienced users are not influenced by norms. The high computer self-efficacy of the sample suggests respondents were very confident in their own computer abilities and did not rely on what others thought in forming use expectations.

Influence of Social Contracts on Use Expectations

Social contracts were found to be positively related to use expectations. The existence of specific interpersonal agreements to use, or to not use the new application influenced future expectations of use. While this relationship has been clearly demonstrated in Social Psychology (Triandis 1977 cites evidence in support of this construct) until now it has not been used in the IS context. IS researchers now have another clearly defined, easily measured, theory backed piece of the puzzle surrounding why people use systems.

Influence of Perceived Consequences on Use Expectations

Intuitively, the positive relationship found between perceived consequences and use expectations is appealing. It is not surprising that the benefits expected from using an application impact use expectations, and ultimately use. These results are consistent with similar work relating the consequences of using a system with use (Robey 1979, Davis 1989, Davis Bagozzi and Warshaw 1989, Adams Nelson and Todd 1992). The main

contribution of this work with respect to perceived consequences was to extend the concept of a system's perceived usefulness as established by Davis (1989) to include an evaluative dimension. It is not just the outcomes of using a system that must be considered. The importance of those outcomes to the potential user must also be taken into account when evaluating the impact of an outcome on the decision to use a system. Once again, an established IS construct has been extended and placed within a strong theoretical framework.

Academic Contribution Summary

A significant portion of this research's contribution to the IS field is in the area of new scale development, extension of existing scales, and refinement of existing scales. Clearly defined constructs, and measures for those constructs, are fundamental building blocks of a research tradition. This study contributed a new construct, social contracts, to the IS field. Social contracts were shown to have a significant impact on use expectations. The new construct was clearly defined and a scale for its measurement was tested.

Several existing scales were extended or adapted for use in this study. Thompson's (1989) measure of personal computer use was modified to make it more generally applicable to measuring different types of computer use. An evaluative component was added to Compeau's (1991) outcome expectations scale to capture the importance of identified outcomes. An item was added to Moore's (1989) subjective norms scale to extend the context of the referent groups from the workplace to include friends as well.

Two scales, Compeau's (1991) affect and computer self-efficacy measures, were re-tested directly. The strong psychometric performance of both scales in this new context further reinforced their validity.

A second major area of contribution of this work was the testing of a theory rich model in the IS field. The strength of the results of this study support Keen's (1980) recommendation that IS researchers borrow rather than invent theory to improve progress in the field. This study, when examined in the context of work by Davis (1989), Davis et al. (1989), Thompson et al. (1991) and Adams et al. (1992), demonstrates the utility of carefully borrowing and implementing relevant theory.

It has been common practice to drop use expectations/intentions as a means of simplifying research models (Pavri 1988, Thompson 1988, Moore 1989, Thompson et al. 1991). In contrast, this study and Davis et al. (1989) point to the utility of use expectations as a predictor of system use.

Four recent IS studies have included a concept similar to Triandis' perceived consequences. These studies include Davis (1989), Davis et al. (1989) and Adams et al. (1992) who employed perceived usefulness, and Thompson et al. (1991) who used long-term consequences of PC use as predictors of system use. In each study perceived consequences were found to be a strong predictor of use expectations or actual use. The collective implication is that perceived consequences are an important determinant of system use.

The importance of the user friendliness concept to system use was indirectly supported by the relationship between affect and use expectations. Affect, a component of the larger concept of user friendliness, was shown to significantly influence use expectations, which in turn influenced use.

The demonstrated importance of computer self-efficacy to the formation of use expectations indirectly supported the work of Hill et al. (1987) who found that self-efficacy partially determined system use.

An encouraging aspect of this study is that non-technologically based factors can be used to predict the use of a system. To explain 50.5% of the variation in voluntary use without resorting to technology specific issues was enlightening. It may be possible to develop an understanding of how people react to new information technology without tying our understanding to the specifics of the technology. For example, studies comparing the utility of batch versus interactive systems have lost much of their relevance as the technology has evolved to permit both types of systems to be implemented simultaneously on a single hardware platform. Technology independent knowledge would outlive the current technological environment and provide a solid base on which to build further research into systems implementation.

The next section will discuss the managerial implications of this work.

Managerial Implications

Perhaps the strongest managerial implication to be drawn from this work is that it is critical for managers to pay close attention to the human side of any voluntary adoption situation. Human factors play a major role in

the use of new application software as evidenced by the 50.5% of variation in system use captured in this study. Attention to those factors can directly influence the voluntary usage levels. An increased return on system investments, smoother transitions between systems, and more positive employee attitudes toward new systems, are all potential benefits to managers of recognizing and managing the human side of systems. The next few paragraphs will explicitly address the managerial issues surrounding each of the relationships in the research model.

The identification of use expectations as a strong predictor of system use has the potential to provide managers with a tool to gauge future voluntary system use. Such a tool could be used when choosing applications to compare relative expected usage levels after exposure to a new system. Organizations could improve their return on technology investments by trying systems and then buying those with higher expected use levels. It might also be used to assist in the identification of potential application failures allowing managers time to take corrective action before a failure occurs.

While use expectations can help to gauge future application use, it is the antecedents of use expectations that provide specific areas to target in order to influence use expectations and ultimately use. The perceived consequences of using an application have the strongest link with use expectations. This has implications for both software vendors and managers. Software vendors may be able to increase use expectations by making

customers aware of the positive perceived consequences of using their application.

Managers overseeing a voluntary application implementation should ensure that the benefits of using a system are demonstrated to the intended user group. The benefits presented should be as specific to the individuals being targeted as possible. This has practical implications for how training programs should be organized. Time spent identifying the benefits that potential users can expect from the system should be included up front as a motivation to learn and use the new system.

The importance of social contracts to the formation of use expectations suggests that software vendors should seek to establish a social contract with upgrade customers. A commitment to try the package as a part of the reduced upgrade price contract could increase usage rates. Within an organization, having change agents establish specific interpersonal agreements with users should be included in the implementation plan. With little extra effort an important commitment to use the system could be established by the project champion.

Knowing that affect is an important antecedent of use expectations has implications for selecting applications. Weighting the affect associated with alternate systems during the selection process could facilitate the selection of an application which generates more positive affect. This in turn may partially compensate for anticipated resistance and could ultimately increase usage levels. The importance of affect also indicates that software companies

should take care to match the characteristics of the user interface with the intended user group to generate more positive affect.

Knowing that computer self-efficacy also affects use expectations suggests a strategy of promoting an application based on how easy it is to learn and use. Lowering the anticipated learning barrier may make the application more accessible to individuals with lower computer self-efficacy.

From an organization's perspective, selecting high computer self-efficacy individuals whenever possible to be the first users of new systems could increase voluntary usage levels. The greater persistence, and higher expected usage levels of high efficacy people make them good choices as first users. The level of self-efficacy also has implications for training. It may be possible to divert some training resources from high computer self-efficacy individuals to those with lower efficacy to improve overall system use.

Strengths and Limitations of Study

The study has two main strengths. The first is that the theoretical model was borrowed from the relevant and well established discipline of Social Psychology. Borrowing Triandis' (1980) model allowed the development of a research model whose construct definitions, and interrelationships were theoretically well established. This facilitated the rapid development of a high quality measurement model, and allowed the theoretical framework to contribute substantially to the meaning of the constructs. The significance and magnitude of the results was due largely to the quality of the theory borrowed from Psychology.

The second major strength is that the research was conducted longitudinally. Establishing the temporal precedence of use expectations and habits to use was critical to making causal statements about the factors hypothesized to influence use. While longitudinal research does take considerably more time and resources to conduct than cross-sectional research, the resulting causal statements are much stronger. This study was able to draw causal implications with more confidence because the study was longitudinal.

Partially offsetting the ability to draw strong causal inferences were the substantially greater costs of doing the research longitudinally. A higher level of commitment was needed from participating companies to conduct the research, making it more difficult to locate willing participants. The data collection phase of the research took substantially longer than a cross-sectional study would have. The cost of collecting a sufficient number of paired responses was high both in dollar terms and clerical time needed to assemble and distribute the questionnaires. It is not surprising that many researchers choose to conduct cross-sectional research when possible.

Other strengths include the fact that the sample used was drawn from people outside of the academic community as opposed to resorting to students. The time and expense of locating and sampling "real" users contributed to the generalizability of the results. Care was also taken to preserve the original context of the research model. Constructs included in the research model were operationalised as specified by Triandis and the change context was strictly voluntary. A deliberate effort was also made to

conduct this research in a way which contributed to the cumulative tradition in IS research. Measurement scales which had appeared in other IS research were employed wherever possible. This made the results more directly comparable with other work and helped to place accepted IS concepts within a strong theoretical framework.

The principal drawback of this work was a direct consequence of attempting to provide a valid test of Triandis' theory in the IS context. The utility of a voluntary model of change, and the conclusions drawn from it have limited applicability to mandatory change situations. While it can be argued that most system use has a voluntary and a mandatory component, further work is needed to determine which, if any, of the constructs from this research apply to forced change situations.

The highly educated nature of respondents may also limit the generalizability of the results. Fully 78.3% of the respondents had at least an undergraduate university degree, with 32.9% reporting having a graduate degree. Extrapolating the results to other contexts where the potential users have less education must be done cautiously.

Despite the test conducted for non-response bias, the potential still exists for non-respondents to differ significantly from respondents. Generalizing the results must be done with this potential in mind.

Finally, the context of personal computer based software applications may or may not generalize to other hardware platforms and system types. Whether the results found here apply to Macintosh versus PC platforms, or

to transaction processing systems on mainframe computers is a question for future research.

Overall the study did accomplish the original objective of testing a close variant of Triandis' model in an IS context. The limitations discussed above are all consequences of providing a valid test of the model. Now that the model has been shown to work in the specific context chosen for this research, future work can address these limitations.

Implications for Future Research

This research has established that factors which influence other types of behavior also influence the behavior of voluntarily using a software application. The implications of this for IS researchers are profound. People are still people even when using systems. We should not be attempting to develop unique IS models of behavior when so much solid research on human behavior has been done in other disciplines. Currently there is more to be gained in less time, at less cost, with higher quality results by borrowing rather than trying to invent IS specific behavior models. Until our referent disciplines have been exhausted of relevant theory our field has much more to gain by borrowing rather than developing its theories. More IS research needs to be done this way.

More specifically, the field of Social Psychology has much to offer in the area of understanding how people react to new systems. This research has shown the importance of use expectations, habits, affect, computer self-efficacy, social contracts, and perceived consequences in predicting and

explaining the voluntary use of personal computer based software applications.

Overall, Triandis' model demonstrated good predictive and explanatory capabilities as implemented in this work. The fact that use expectations were not fully explained by affect, computer self-efficacy, social contracts, and norms suggests that use expectations has the capacity to predict future usage better than the other variables alone. This argues for the retention of use expectations as an important construct contrary to popular practice in the field (Pavri 1988, Thompson 1988, Moore 1989, Thompson, Higgins and Howell 1991).

The 43.9% of use expectations captured in the model points to an opportunity to increase our understanding of the factors influencing use expectations. According to Triandis, the social factor represents an individual's internalization of the referent group's subjective culture. As such it has a potentially unlimited number of components. The three social factors included in this study, computer self-efficacy, norms, and social contracts, should be added to in future work to expand our understanding of this area of the model.

Additional research is also needed to expand the application of this model into the area of non-voluntary system use. A better understanding of how to implement systems in non-voluntary contexts is needed to improve the success rate of these systems. Other contexts will also require the identification of habits and perceived consequences relevant to the user group being studied.

A question raised by this work is how the influence of Use expectations on Use is affected by the time users have spent using a new system. More work is needed to determine at what point in an implementation a user's expectations become a reliable predictor of future use.

Further research is also needed to determine how to influence the factors which determine system use. For example, this study found that the habits relating to the previous software application strongly impacted use of the new system. Knowing how to change those habits would allow IS researchers to provide managerial direction on how to influence usage by changing old habits.

The anteceedents of use expectations also provide a rich area for future research. Identifying the factors which lead to the formation of perceived consequences, affect, and computer self-efficacy would provide the opportunity to influence behavioral expectations and ultimately use.

More research is needed to explain why norms did not have a significant impact on use expectations. A separate study is needed to determine if computer self-efficacy as suggested in this study, or level of computer experience as suggested by Thompson et al. (1991), moderates the impact of norms on use. Answers to these questions would provide insight into overcoming negative group norms toward new system implementations.

Further work is also needed in developing a measure of habits which can be applied to the highly correlated behaviors often found in the information systems field.

Another area for examination is the temporal linkage between use expectations and use. While this study used three months as the time lag, the effect of different lengths of time on the strength of the relationship between expectations and use is not known.

During the test for non-response bias, the possibility was raised that elements in the model might differ in importance depending on the specific application type under investigation. More work is needed to determine if and how the elements in Triandis' model vary by application type.

A question raised by this study is why would people buy software they do not expect to use? The non-response follow-up results indicated that 41% of the people who did not respond to the first mailing did not expect to use the package. What changed their expectations between purchasing the upgrade and filling out the questionnaire?

Conclusions

This study set out to gain a better understanding of the factors influencing the usage level of new systems by using Triandis' (1930) behavior prediction model to predict and explain the voluntary use of a personal computer based software application. The results support the applicability of Triandis' model to the problem of predicting system use levels. Affect, computer self-efficacy, social contracts, and the perceived consequences of using a system were all found to significantly impact a person's expectations for future use of a system. Use expectations and habits relating to the software being replaced were also shown to be good predictors of future use.

Further investigation of the factors influencing the formation of use expectations, and ways to influence those factors is proposed as an important area for further research.

A secondary objective of this work was to evaluate the general approach to IS research of borrowing theory from a relevant reference discipline and importing it into the IS context. The strength of the results support the approach. It is recommended that other IS research adopt this approach until such time as our referent disciplines are exhausted of relevant theory.

APPENDIX A - PRETEST INITIAL MEASURE

Survey on Using

Aldus Persuasion

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SECTION A: SHOULD YOU BE FILLING OUT THIS SURVEY?

These first few questions deal with whether or not you should be filling out this survey. Please **circle** the appropriate answers.

A-1 Have you recently purchased an upgrade from a competitor's product to Aldus Persuasion?

NO - Although your willingness to help in this research is appreciated, only people who have purchased a competitive upgrade to Aldus Persuasion are needed for this study. Please circle the NO response at the left and return your questionnaire in the envelope provided. Thank you.

YES - Please continue.

A-2 Have you tried using Aldus Persuasion yet?

NO - Please wait until you have tried Aldus Persuasion before you continue filling out this survey as many of the questions ask for your opinions about using the package.

YES - Please continue.

A-3 Will you be using Aldus Persuasion for personal or business use?

PERSONAL - Many of the questions ask about using Aldus Persuasion in your job. Please answer these questions as they relate to your personal use of Aldus Persuasion.

BUSINESS - Please Continue.

BOTH - Many of the questions ask about using Aldus Persuasion in your job. Please answer these questions as they relate to the overall usefulness of Aldus Persuasion for your personal and business use.

A-4 What is today's date? _____ DATE (Day-Month-Year)

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SECTION B: WHAT YOU USED BEFORE ALDUS PERSUASION

This set of questions ask about the presentation package you used before purchasing Aldus Persuasion. Where appropriate, please place an X in the slot which best describes your use of the other product.

Example:

B-0 In a single day, what is the most time you have ever used the other product?

6 OR MORE	5 HOURS	4 HOURS	3 HOURS	2 HOURS	1½ HOURS	1 HOUR	½ HOUR	ALMOST NONE
			X					

The most this person has ever used the other product in a single day is three hours

B-1 Which presentation package did you use most before purchasing Aldus Persuasion?

OTHER PRODUCT'S NAME _____

B-2 How long have you been using the other product? _____ MONTHS

B-3 On average, how often did you use the other product?

SEVERAL TIMES A DAY	ONCE A DAY	SEVERAL TIMES A WEEK	ONCE A WEEK	SEVERAL TIMES A MONTH	ONCE A MONTH	ALMOST NEVER	NOT AT ALL

B-4 During an average work week, how much time did you spend using the other product?

_____ HOURS PER WEEK

FUTURE USE OF THE OTHER PRODUCT

B-5 In the next three months will your use of the other product increase or decrease?

INCREASE	HIGHLY	MODERATELY	SLIGHTLY	NEITHER	SLIGHTLY	MODERATELY	HIGHLY	DECREASE

B-6 In three months time, how often do you expect to be using the other product?

SEVERAL TIMES A DAY	ONCE A DAY	SEVERAL TIMES A WEEK	ONCE A WEEK	SEVERAL TIMES A MONTH	ONCE A MONTH	ALMOST NEVER	NOT AT ALL

B-7 In three months time, what do you expect your average weekly use of the other product will be?

_____ HOURS PER WEEK

SECTION C: ALDUS PERSUASION'S USEFULNESS

Based on what you know about Aldus Persuasion, the next set of questions relate to how useful you expect it to be in doing your job. Please place an X in the one slot which best describes how likely or unlikely you think each statement is.

C-1 Using Aldus Persuasion in my job will enable me to accomplish tasks more quickly.

LIKELY							UNLIKELY
EXTREMELY	QUITE	SLIGHTLY	NEITHER	SLIGHTLY	QUITE	EXTREMELY	

C-2 Using Aldus Persuasion will improve my job performance.

LIKELY							UNLIKELY
EXTREMELY	QUITE	SLIGHTLY	NEITHER	SLIGHTLY	QUITE	EXTREMELY	

C-3 Using Aldus Persuasion in my job will increase my productivity.

LIKELY							UNLIKELY
EXTREMELY	QUITE	SLIGHTLY	NEITHER	SLIGHTLY	QUITE	EXTREMELY	

C-4 Using Aldus Persuasion will enhance my effectiveness on the job.

LIKELY							UNLIKELY
EXTREMELY	QUITE	SLIGHTLY	NEITHER	SLIGHTLY	QUITE	EXTREMELY	

C-5 Using Aldus Persuasion will make it easier to do my job.

LIKELY							UNLIKELY
EXTREMELY	QUITE	SLIGHTLY	NEITHER	SLIGHTLY	QUITE	EXTREMELY	

C-6 I will find Aldus Persuasion useful in my job.

LIKELY							UNLIKELY
EXTREMELY	QUITE	SLIGHTLY	NEITHER	SLIGHTLY	QUITE	EXTREMELY	

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SECTION D: OTHER'S EXPECTATIONS

The next set of questions ask whether other people in your organization think you should be using Aldus Persuasion in your job. On the first scale please indicate how likely or unlikely the statement is. Then, on the second scale, indicate how important their opinion on using Aldus Persuasion is to you.

Example:

D-0 My peers in other companies think that I should use Aldus Persuasion in my job

	EXTREMELY	QUITE	SLIGHTLY	NEITHER	SLIGHTLY	QUITE	EXTREMELY	
LIKELY	[ ]	[ ]	[ ]	[ ]	[ ]	[X]	[ ]	UNLIKELY

How important to you is what they think?

	EXTREMELY	QUITE	SLIGHTLY	NEITHER	SLIGHTLY	QUITE	EXTREMELY	
IMPORTANT	[ ]	[ ]	[ ]	[X]	[ ]	[ ]	[ ]	UNIMPORTANT

The above response indicates that this person thinks it is quite unlikely that his or her peers in other companies think he or she should be using Aldus Persuasion. It is also neither important nor unimportant to him or her what they think.

D-1 Most people who are important to me think I should use Aldus Persuasion in my job

	EXTREMELY	QUITE	SLIGHTLY	NEITHER	SLIGHTLY	QUITE	EXTREMELY	
LIKELY	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	UNLIKELY

How important to you is what they think?

	EXTREMELY	QUITE	SLIGHTLY	NEITHER	SLIGHTLY	QUITE	EXTREMELY	
IMPORTANT	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	UNIMPORTANT

D-2 My close friends think I should use Aldus Persuasion in my job.

	EXTREMELY	QUITE	SLIGHTLY	NEITHER	SLIGHTLY	QUITE	EXTREMELY	
LIKELY	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	UNLIKELY

How important to you is what they think?

	EXTREMELY	QUITE	SLIGHTLY	NEITHER	SLIGHTLY	QUITE	EXTREMELY	
IMPORTANT	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	UNIMPORTANT

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D-3 My co-workers (peers) think that I should use Aldus Persuasion in my job.

LIKELY ___ ___ ___ ___ ___ ___ ___ UNLIKELY
EXTREMELY QUITE SLIGHTLY NEITHER SLIGHTLY QUITE EXTREMELY

How important to you is what they think?

IMPORTANT ___ ___ ___ ___ ___ ___ ___ UNIMPORTANT
EXTREMELY QUITE SLIGHTLY NEITHER SLIGHTLY QUITE EXTREMELY

D-4 My immediate superiors think that I should use Aldus Persuasion in my job.

LIKELY ___ ___ ___ ___ ___ ___ ___ UNLIKELY
EXTREMELY QUITE SLIGHTLY NEITHER SLIGHTLY QUITE EXTREMELY

How important to you is what they think?

IMPORTANT ___ ___ ___ ___ ___ ___ ___ UNIMPORTANT
EXTREMELY QUITE SLIGHTLY NEITHER SLIGHTLY QUITE EXTREMELY

D-5 Senior management thinks that I should use Aldus Persuasion in my job.

LIKELY ___ ___ ___ ___ ___ ___ ___ UNLIKELY
EXTREMELY QUITE SLIGHTLY NEITHER SLIGHTLY QUITE EXTREMELY

How important to you is what they think?

IMPORTANT ___ ___ ___ ___ ___ ___ ___ UNIMPORTANT
EXTREMELY QUITE SLIGHTLY NEITHER SLIGHTLY QUITE EXTREMELY

D-6 My subordinates think I should use Aldus Persuasion in my job.

LIKELY ___ ___ ___ ___ ___ ___ ___ UNLIKELY
EXTREMELY QUITE SLIGHTLY NEITHER SLIGHTLY QUITE EXTREMELY

How important to you is what they think?

IMPORTANT ___ ___ ___ ___ ___ ___ ___ UNIMPORTANT
EXTREMELY QUITE SLIGHTLY NEITHER SLIGHTLY QUITE EXTREMELY

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SECTION E: USING ALDUS PERSUASION

Imagine that you have just encountered a task which will require you to use features of Aldus Persuasion that you have never used before. The following questions present various situations in which you need to learn the new features. For each question, please place an X in the one slot which best describes how **confident** you are that you could learn the new features and complete the task.

EVEN IF I HAD NEVER USED THE FEATURE BEFORE, I COULD COMPLETE THE TASK USING ALDUS PERSUASION ...

E-1 ... if there was no one around to tell me what to do as I go.

CONFIDENT								UN CONFIDENT
	EXTREMELY	QUITE	SLIGHTLY	NEITHER	SLIGHTLY	QUITE	EXTREMELY	

E-2 ... if I had only the software manuals for reference.

CONFIDENT								UN CONFIDENT
	EXTREMELY	QUITE	SLIGHTLY	NEITHER	SLIGHTLY	QUITE	EXTREMELY	

E-3 ... if I had seen someone else using it before trying it myself

CONFIDENT								UN CONFIDENT
	EXTREMELY	QUITE	SLIGHTLY	NEITHER	SLIGHTLY	QUITE	EXTREMELY	

E-4 ... if I could call someone for help if I got stuck.

CONFIDENT								UN-CONFIDENT
	EXTREMELY	QUITE	SLIGHTLY	NEITHER	SLIGHTLY	QUITE	EXTREMELY	

E-5 ... if I had a lot of time to complete the job.

CONFIDENT								UN CONFIDENT
	EXTREMELY	QUITE	SLIGHTLY	NEITHER	SLIGHTLY	QUITE	EXTREMELY	

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SECTION F: FEELINGS ABOUT USING ALDUS PERSUASION

The next few statements describe feelings that some people have about using Aldus Persuasion. For each statement, please place an X in the one slot best indicates the extent to which you agree or disagree with the feelings being expressed.

F-1 I like working with Aldus Persuasion.

AGREE							DISAGREE
STRONGLY	MODERATELY	SLIGHTLY	NEITHER	SLIGHTLY	MODERATELY	STRONGLY	

F-2 I look forward to those aspects of my job that require me to use Aldus Persuasion.

AGREE							DISAGREE
STRONGLY	MODERATELY	SLIGHTLY	NEITHER	SLIGHTLY	MODERATELY	STRONGLY	

F 3 Once I start working with Aldus Persuasion, I find it hard to stop.

AGREE							DISAGREE
STRONGLY	MODERATELY	SLIGHTLY	NEITHER	SLIGHTLY	MODERATELY	STRONGLY	

F-4 Using Aldus Persuasion is frustrating for me.

AGREE							DISAGREE
STRONGLY	MODERATELY	SLIGHTLY	NEITHER	SLIGHTLY	MODERATELY	STRONGLY	

F-5 I get bored very quickly when working with Aldus Persuasion.

AGREE							DISAGREE
STRONGLY	MODERATELY	SLIGHTLY	NEITHER	SLIGHTLY	MODERATELY	STRONGLY	

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SECTION G: EASE OF USE

These questions concern how easy you think Aldus Persuasion is to use. Please Place an X in the slot which best describes how likely or unlikely you think each statement is

G-1 Learning to operate Aldus Persuasion is easy for me.

LIKELY ___ ___ ___ ___ ___ ___ ___ UNLIKELY
EXTREMELY QUITE SLIGHTLY NEITHER SLIGHTLY QUITE EXTREMELY

G-2 I find it easy to get Aldus Persuasion to do what I want it to.

LIKELY ___ ___ ___ ___ ___ ___ ___ UNLIKELY
EXTREMELY QUITE SLIGHTLY NEITHER SLIGHTLY QUITE EXTREMELY

G-3 My interaction with Aldus Persuasion is clear and understandable.

LIKELY ___ ___ ___ ___ ___ ___ ___ UNLIKELY
EXTREMELY QUITE SLIGHTLY NEITHER SLIGHTLY QUITE EXTREMELY

G-4 I find Aldus Persuasion to be flexible to interact with.

LIKELY ___ ___ ___ ___ ___ ___ ___ UNLIKELY
EXTREMELY QUITE SLIGHTLY NEITHER SLIGHTLY QUITE EXTREMELY

G-5 It will be easy for me to become skilful at using Aldus Persuasion.

LIKELY ___ ___ ___ ___ ___ ___ ___ UNLIKELY
EXTREMELY QUITE SLIGHTLY NEITHER SLIGHTLY QUITE EXTREMELY

G-6 I find Aldus Persuasion easy to use.

LIKELY ___ ___ ___ ___ ___ ___ ___ UNLIKELY
EXTREMELY QUITE SLIGHTLY NEITHER SLIGHTLY QUITE EXTREMELY

SECTION H: SUPPORT FOR ALDUS PERSUASION

The following questions ask you about the environment in which you use Aldus Persuasion. Please place an X in the slot which best describes how easy or difficult it is for you to get access to the things described.

IT IS EASY OR DIFFICULT FOR ME...

H-1 ... to get access to Aldus Persuasion on a computer?

EASY ___ ___ ___ ___ ___ ___ ___ DIFFICULT
EXTREMELY QUITE SLIGHTLY NEITHER SLIGHTLY QUITE EXTREMELY

H-2 ... to get printed reference materials such as books or manuals about Aldus Persuasion?

EASY ___ ___ ___ ___ ___ ___ ___ DIFFICULT
EXTREMELY QUITE SLIGHTLY NEITHER SLIGHTLY QUITE EXTREMELY

H-3 ... to get help from an expert on Aldus Persuasion?

EASY ___ ___ ___ ___ ___ ___ ___ DIFFICULT
EXTREMELY QUITE SLIGHTLY NEITHER SLIGHTLY QUITE EXTREMELY

H-4 ... to get help from a co-worker on Aldus Persuasion?

EASY ___ ___ ___ ___ ___ ___ ___ DIFFICULT
EXTREMELY QUITE SLIGHTLY NEITHER SLIGHTLY QUITE EXTREMELY

H-5 ... to get training on how to use Aldus Persuasion?

EASY ___ ___ ___ ___ ___ ___ ___ DIFFICULT
EXTREMELY QUITE SLIGHTLY NEITHER SLIGHTLY QUITE EXTREMELY

H-6 ... to transfer work originally done in my previous presentation package into Aldus Persuasion?

EASY ___ ___ ___ ___ ___ ___ ___ DIFFICULT
EXTREMELY QUITE SLIGHTLY NEITHER SLIGHTLY QUITE EXTREMELY

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SECTION I: YOUR EXPECTATIONS

The following statements describe the outcomes that people might expect from using Aldus Persuasion. For each item please indicate on the first scale the likelihood that you will experience that outcome. Then, on the second scale indicate how important that outcome is to you.

Example:

USING Aldus Persuasion ...

I-0 ... will make me more productive in my job.

	EXTREMELY	QUITE	SLIGHTLY	NEITHER	SLIGHTLY	QUITE	EXTREMELY	
LIKELY			X					UNLIKELY

How important to you is being more productive?

	EXTREMELY	QUITE	SLIGHTLY	NEITHER	SLIGHTLY	QUITE	EXTREMELY	
IMPORTANT		X						UNIMPORTANT

The sample response indicates that this person felt using Aldus Persuasion would be slightly likely to increase his or her productivity, and that productivity is a quite important outcome

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USING ALDUS PERSUASION ...

I-1 ... will make me be better organized in my job.

	EXTREMELY	QUITE	SLIGHTLY	NEITHER	SLIGHTLY	QUITE	EXTREMELY	
LIKELY								UNLIKELY

How important to you is being better organized?

	EXTREMELY	QUITE	SLIGHTLY	NEITHER	SLIGHTLY	QUITE	EXTREMELY	
IMPORTANT								UNIMPORTANT

I-2 ... will increase my effectiveness on the job.

	EXTREMELY	QUITE	SLIGHTLY	NEITHER	SLIGHTLY	QUITE	EXTREMELY	
LIKELY								UNLIKELY

How important to you is increasing your effectiveness on the job?

	EXTREMELY	QUITE	SLIGHTLY	NEITHER	SLIGHTLY	QUITE	EXTREMELY	
IMPORTANT								UNIMPORTANT

USING ALDUS PERSUASION ...

I-3 ... will let me spend less time on routine job tasks.

LIKELY ☐ ☐ ☐ ☐ ☐ ☐ ☐ UNLIKELY
EXTREMELY QUITE SLIGHTLY NEITHER SLIGHTLY QUITE EXTREMELY

How important to you is spending less time on routine job tasks?

IMPORTANT ☐ ☐ ☐ ☐ ☐ ☐ ☐ UNIMPORTANT
EXTREMELY QUITE SLIGHTLY NEITHER SLIGHTLY QUITE EXTREMELY

I-4 ... will increase the quality of output of my job.

LIKELY ☐ ☐ ☐ ☐ ☐ ☐ ☐ UNLIKELY
EXTREMELY QUITE SLIGHTLY NEITHER SLIGHTLY QUITE EXTREMELY

How important to you is increasing the quality of output of your job?

IMPORTANT ☐ ☐ ☐ ☐ ☐ ☐ ☐ UNIMPORTANT
EXTREMELY QUITE SLIGHTLY NEITHER SLIGHTLY QUITE EXTREMELY

I-5 ... will increase the quantity of output for the same amount of effort.

LIKELY ☐ ☐ ☐ ☐ ☐ ☐ ☐ UNLIKELY
EXTREMELY QUITE SLIGHTLY NEITHER SLIGHTLY QUITE EXTREMELY

How important to you is increasing the quantity of output for the same amount of effort?

IMPORTANT ☐ ☐ ☐ ☐ ☐ ☐ ☐ UNIMPORTANT
EXTREMELY QUITE SLIGHTLY NEITHER SLIGHTLY QUITE EXTREMELY

I-6 .. will make me less reliant on support staff.

LIKELY ☐ ☐ ☐ ☐ ☐ ☐ ☐ UNLIKELY
EXTREMELY QUITE SLIGHTLY NEITHER SLIGHTLY QUITE EXTREMELY

How important to you is being less relanat on support staff?

IMPORTANT ☐ ☐ ☐ ☐ ☐ ☐ ☐ UNIMPORTANT
EXTREMELY QUITE SLIGHTLY NEITHER SLIGHTLY QUITE EXTREMELY

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SECTION J: AGREEMENTS TO USE OR TO NOT USE ALDUS PERSUASION

The next set of questions ask you about any agreements you may have made with others to use or to not use Aldus Persuasion. Please circle your response.

J-1 Has anyone explicitly encouraged you to use Aldus Persuasion?

YES NO → GO TO QUESTION J-2

If YES, did you imply that you would use the system?

YES NO

Why? _____

_____

_____

_____

J-2 Has anyone explicitly discouraged you from using Aldus Persuasion?

YES NO → GO TO QUESTION K-1

If YES, did you imply that you would use the system?

YES NO

Why? _____

_____

_____

_____

SECTION K: TIME SPENT USING ALDUS PERSUASION

The next set of questions ask you about how often you use Aldus Persuasion and about the time you spend, and expect to spend using it.

K-1 How long have you been using Aldus Persuasion? _____ MONTHS

K-2 On average, how often do you use Aldus Persuasion?

SEVERAL TIMES A DAY	ONCE A DAY	SEVERAL TIMES A WEEK	ONCE A WEEK	SEVERAL TIMES A MONTH	ONCE A MONTH	ALMOST NEVER	NOT AT ALL
☐	☐	☐	☐	☐	☐	☐	☐

K-3 In an average work week, how much time do you spend using Aldus Persuasion?

_____ HOURS PER WEEK

FUTURE USE OF ALDUS PERSUASION

K-4 In the next three months, will your use of Aldus Persuasion to increase or decrease?

INCREASE							DECREASE
	HIGHLY	MODERATELY	SLIGHTLY	NEITHER	SLIGHTLY	MODERATELY	HIGHLY
	☐	☐	☐	☐	☐	☐	☐

K-5 In three months time, how often do you expect to be using Aldus Persuasion?

SEVERAL TIMES A DAY	ONCE A DAY	SEVERAL TIMES A WEEK	ONCE A WEEK	SEVERAL TIMES A MONTH	ONCE A MONTH	ALMOST NEVER	NOT AT ALL
☐	☐	☐	☐	☐	☐	☐	☐

K-6 In three months time, what do you expect your average weekly use of Aldus Persuasion will be?

_____ HOURS PER WEEK

14

SECTION L: DEMOGRAPHICS

This last set of questions ask for information about you. This information will help us to study the way different people react to new software. The format of the questions vary, so please be careful in indicating your response.

L-1 How long have you worked for this organization? _____ YEARS and _____ MONTHS

L-2 What is your Functional Area? (Please circle the appropriate number.)

1 ACCOUNTING
2 ENGINEERING, DESIGN, R&D
3 FINANCE
4 GENERAL MANAGEMENT
5 PRODUCTION
6 MARKETING OR SALES
7 INFORMATION SYSTEMS
8 HUMAN RESOURCES

9 NONE OF THE ABOVE — > Please specify _____

L-3 What is the level of your position? (Circle the appropriate number.)

1 EXECUTIVE
2 MIDDLE MANAGEMENT
3 FIRST LINE MANAGEMENT
4 PROFESSIONAL
5 TECHNICAL
6 SECRETARIAL OR CLERICAL

7 NONE OF THE ABOVE — > Please specify _____

L-4 Do you consider your position to be a line or a staff position? (Circle number)

1 LINE
2 STAFF

L-5 If you decided that you did not like Aldus Persuasion, could you decide not to use it in your job?

1 YES (I could stop)
2 NO (I must use it)

L-6 How many people report directly to you? _____ PEOPLE

L-7 What is your age? _____ YEARS

L-8 What is your sex?

1 FEMALE
2 MALE

15

L-9 What is the **highest** level of education that you have completed? (Circle number)

1 SOME VOCATIONAL OR HIGH SCHOOL
2 COMPLETED VOCATIONAL OR HIGH SCHOOL
3 SOME COLLEGE OR UNIVERSITY
4 COMPLETED COLLEGE OR UNIVERSITY
5 SOME GRADUATE WORK
6 COMPLETED A GRADUATE DEGREE

L-10 What is your primary educational background? (Please circle the appropriate number.)

1 BUSINESS
2 ARTS
3 SCIENCES
4 ENGINEERING
5 COMPUTER SCIENCE
6 SOCIAL SCIENCE

7 NONE OF THE ABOVE - - > Please specify _____

Thank You

Thank you for having taken the time to fill out this survey. Your contribution to the success of this research is greatly appreciated.

You can expect to receive the second half of this survey in about three months. Although your responses on this first half are in themselves quite useful, this half becomes substantially more useful when paired with your responses on the second half. Please, take the time to fill in the second half when it arrives.

Space has been provided on the back cover for any comments you would like to make concerning Aldus Persuasion, this survey, or this type of research. If you would like to talk to me, please feel free to call me at (519) 433-3275.

Sincerely,

YOUR COMMENTS

Please seal your completed survey in the envelope provided and place it in the mail. If, for any reason you would like to contact me, I can be reached at the address below or by calling (519) 433-3275.

Thomas Davies
Software Innovation Project
Western Business School
The University of Western Ontario
London, Ontario, Canada
N6A 3K7

APPENDIX B - PRETEST FOLLOW-UP MEASURE

Survey on Using

Aldus Persuasion

Part Two

Thomas Davies
Software Innovation Project
Western Business School
The University of Western Ontario
London, Ontario, Canada
N6A 3K7

SECTION 2-A: YOUR USE OF THE OTHER PACKAGE

These questions ask about the presentation package you used before purchasing Aldus Persuasion. Where appropriate, please place an X in the slot which best describes your use of the other product. (4 –)

A-1 How often do you currently use the other product?

SEVERAL TIMES A DAY	ONCE A DAY	SEVERAL TIMES A WEEK	ONCE A WEEK	SEVERAL TIMES A MONTH	ONCE A MONTH	ALMOST NEVER	NOT AT ALL
☐	☐	☐	☐	☐	☐	☐	☐

A-2 What is your average weekly use of the other product? _____ HOURS PER WEEK

A-3 In the next three months will your use of the other product increase or decrease?

INCREASE							DECREASE
	HIGHLY	MODERATELY	SLIGHTLY	NEITHER	SLIGHTLY	MODERATELY	HIGHLY
	☐	☐	☐	☐	☐	☐	☐

These next questions ask about your use of ALDUS PERSUASION.

A-4 How often do you currently use Aldus Persuasion?

SEVERAL TIMES A DAY	ONCE A DAY	SEVERAL TIMES A WEEK	ONCE A WEEK	SEVERAL TIMES A MONTH	ONCE A MONTH	ALMOST NEVER	NOT AT ALL
☐	☐	☐	☐	☐	☐	☐	☐

A-5 What is your average weekly use of Aldus Persuasion? _____ HOURS PER WEEK

A-6 In the next three months will your use of Aldus Persuasion increase or decrease?

INCREASE							DECREASE
	HIGHLY	MODERATELY	SLIGHTLY	NEITHER	SLIGHTLY	MODERATELY	HIGHLY
	☐	☐	☐	☐	☐	☐	☐

A-7 What is today's date? _____ DATE (Day-Month-Year)

SECTION 2-B: ALDUS PERSUASION'S USEFULNESS

Based on what you know about Aldus Persuasion, the next set of questions relate to how useful you expect it to be in doing your job. Please place an X in the one slot which best describes how likely or unlikely you think each statement is.

B-1 Using Aldus Persuasion in my job will enable me to accomplish tasks more quickly.

LIKELY							UNLIKELY
EXTREMELY	QUITE	SLIGHTLY	NEITHER	SLIGHTLY	QUITE	EXTREMELY	

B-2 Using Aldus Persuasion will improve my job performance.

LIKELY							UNLIKELY
EXTREMELY	QUITE	SLIGHTLY	NEITHER	SLIGHTLY	QUITE	EXTREMELY	

B-3 Using Aldus Persuasion in my job will increase my productivity.

LIKELY							UNLIKELY
EXTREMELY	QUITE	SLIGHTLY	NEITHER	SLIGHTLY	QUITE	EXTREMELY	

B-4 Using Aldus Persuasion will enhance my effectiveness on the job.

LIKELY							UNLIKELY
EXTREMELY	QUITE	SLIGHTLY	NEITHER	SLIGHTLY	QUITE	EXTREMELY	

B-5 Using Aldus Persuasion will make it easier to do my job.

LIKELY							UNLIKELY
EXTREMELY	QUITE	SLIGHTLY	NEITHER	SLIGHTLY	QUITE	EXTREMELY	

B-6 I will find Aldus Persuasion useful in my job.

LIKELY							UNLIKELY
EXTREMELY	QUITE	SLIGHTLY	NEITHER	SLIGHTLY	QUITE	EXTREMELY	

YOUR COMMENTS

Thank you for filling out the second part of the questionnaire. Please seal your completed survey in the envelope provided and place it in the mail. If, for any reason you would like to contact me, I can be reached at the address below or by calling (506) 453-4869.

Thomas Davies
Software Innovation Project
Faculty of Administration
The University of New Brunswick
Fredericton, New Brunswick, Canada
E3B 5A3

APPENDIX C - PRETEST INITIAL COVER LETTER

The UNIVERSITY *of* WESTERN ONTARIO

Western Business School

Dear 2~:

The old adage which says "the only constant in life is change" applies well to those of us who use computers. It often seems that just as we have begun to master one software application, a new one appears which offers improved features and performance. More and more people are faced with the difficult decision of whether the added features are worth the time and effort it will take to learn the new application.

Researchers from the University of Western Ontario are conducting a study in an effort to determine how to make it easier for people to switch from older applications to new ones. As someone who has recently made the decision to try Aldus Persuasion, your views on this situation are valuable to our study. By filling out the enclosed questionnaire you will be helping us to understand what factors are important to people trying new applications.

The enclosed questionnaire asks your opinion about various issues relating to your use of Aldus Persuasion. It should take less than 30 minutes to answer. Please complete the questionnaire and return it in the envelope provided. The code numbers on the back of the questionnaires are used only to track them. Your responses are strictly confidential.

Aldus is one of two companies whose products are beirg studied. Only summary results for the overall study will be released. Such results should provide valuable insights into how to make the transition from older applications to new ones easier. These results will be available to anyone on request. If you would like to receive a copy of them please return a stamped, self-addressed envelope with your completed survey.

We value your opinion and encourage you to participate in this important study If you would like to contact us directly, please call Tom Davies at (519) 433-3275.

Yours sincerely,

Thomas Davies

London, Ontario • Canada • N6A 3K7 • Telephone (519) 661 3206
Fax (519) 661-3485 • Telex 064-7134 UWO TEL LDN

APPENDIX D - PRETEST FOLLOW-UP COVER LETTER

The UNIVERSITY of WESTERN ONTARIO

Western Business School

3~
4~

Dear 2~:

Thank you for having participated in our research on switching software applications. Your responses have already contributed to the success of this research. The time you spent filling out the first part of questionnaire is appreciated.

Your responses on the first part of the questionnaire will be substantially more useful if you decide to fill out the final part of the questionnaire. As you can see the final part is much shorter than the first. It should take less than five minutes to complete Please, take a few minutes at your earliest convenience to complete it.

If you would like to receive a summary of the results from this study please write your name and address in the comments section on the back of the questionnaire.

Once again, thank you for your help. If you would like to contact me directly, I can be reached at (519) 661-3269.

Yours sincerely,

Tom Davies

London, Ontario • Canada • N6A 3K7 • Telephone (519) 661-3206
Fax (519) 661-3485 • Telex 064-7134 UWO TEL LDN

APPENDIX E - PRETEST REMINDER LETTER

The UNIVERSITY *of* WESTERN ONTARIO

Western Business School

3~
4~

Dear 2~:

Thank you for having participated in my research on switching software applications. Your responses on the first part of the questionnaire have already contributed to the success of my work.

About a month ago you should have received the second part of the survey. Because your responses on the first part are so much more useful when paired with the second part, I would encourage you to take a few minutes to complete it. Whatever your current use of Aldus Persuasion, even if you have stopped using it, please consider filling out the enclosed survey.

This research is not commercial. It has been funded through the University of Western Ontario as part of my Ph.D. program. As one of just a few dozen people who have been asked to complete this part of the survey your response is important. Please take a few minutes to fill it out.

If this letter and your survey have passed each other in the mail, please accept my thanks for your participation in this study. To receive a summary of the results write your name and address in the comments section on the back of the questionnaire.

Once again, thank you for your help. I look forward to receiving your questionnaire. If you would like to contact me directly, I can be reached at (519) 661-3269.

Yours sincerely,

Tom Davies

London Ontario • Canada • N6A 3K7 • Telephone (519) 661 3205
Fax (519) 661-3485 • Telex 064-7134 UWO TEL LDN

APPENDIX F - MAIN STUDY INITIAL MEASURE

Survey on Using

Quattro Pro

Thomas Davies
Software Innovation Project
Western Business School
The University of Western Ontario
London, Ontario, Canada
N6A 3K7

SECTION A: WHEN SHOULD YOU FILL OUT THIS SURVEY?

These first few questions deal with when you should fill out this survey. Please **circle** the appropriate answers.

A-1 Have you tried using Quattro Pro yet?

NO → Please wait until you have tried Quattro Pro before you continue filling out this survey as many of the questions ask for your opinions about using the package.

YES → Please continue.

A-2 Do you intend to use Quattro Pro for personal or business projects?

PERSONAL → Many of the questions ask about using Quattro Pro in your job. Please answer these questions as they relate to your personal use of Quattro Pro.

BUSINESS → Please Continue.

BOTH → Many of the questions ask about using Quattro Pro in your job. Please answer these questions as they relate to the overall usefulness of Quattro Pro for your personal and business use.

A-3 What is today's date? _____ DATE (Day-Month-Year)

A-4 How long have you been using Quattro Pro? _____ MONTHS

A-5 On average, how often do you use Quattro Pro?

SEVERAL TIMES A DAY	ONCE A DAY	SEVERAL TIMES A WEEK	ONCE A WEEK	SEVERAL TIMES A MONTH	ONCE A MONTH	ALMOST NEVER	NOT AT ALL
____	____	____	____	____	____	____	____

A-6 In an average work week, how much time do you spend using Quattro Pro?

_____ HOURS PER WEEK

2

SECTION B: WHAT YOU USED BEFORE QUATTRO PRO

These questions ask about the spreadsheet you used before purchasing Quattro Pro. Where appropriate, please place an X in the slot which best describes your use of the other product.

B-1 Which spreadsheet did you use most before purchasing Quattro Pro?

OTHER PRODUCT'S NAME _____

B-2 How long have you been using the other product? _____ MONTHS

B-3 On average, how often did you use the other product?

SEVERAL TIMES A DAY	ONCE A DAY	SEVERAL TIMES A WEEK	ONCE A WEEK	SEVERAL TIMES A MONTH	ONCE A MONTH	ALMOST NEVER	NOT AT ALL
☐	☐	☐	☐	☐	☐	☐	☐

B-4 During an average work week, how much time did you spend using the other product?

_____ HOURS PER WEEK

FUTURE USE OF THE OTHER PRODUCT

B-5 In the next three months will your use of the other product increase or decrease?

INCREASE							DECREASE
	HIGHLY	MODERATELY	SLIGHTLY	NEITHER	SLIGHTLY	MODERATELY	HIGHLY
	☐	☐	☐	☐	☐	☐	☐

B-6 In three months time, how often do you expect to be using the other product?

SEVERAL TIMES A DAY	ONCE A DAY	SEVERAL TIMES A WEEK	ONCE A WEEK	SEVERAL TIMES A MONTH	ONCE A MONTH	ALMOST NEVER	NOT AT ALL
☐	☐	☐	☐	☐	☐	☐	☐

B-7 In three months time, what do you expect your average weekly use of the other product will be?

_____ HOURS PER WEEK

SECTION C: QUATTRO PRO'S USEFULNESS

The next set of questions relates to how useful you expect Quattro Pro to be in doing your job. Please place an X in the one slot which best describes how likely or unlikely you think each statement is, based on what you currently know about Quattro Pro.

C-1 Using Quattro Pro in my job will enable me to accomplish tasks more quickly.

LIKELY [ ] [ ] [ ] [ ] [ ] [ ] [ ] UNLIKELY
EXTREMELY QUITE SLIGHTLY NEITHER SLIGHTLY QUITE EXTREMELY

C-2 Using Quattro Pro will improve my job performance.

LIKELY [ ] [ ] [ ] [ ] [ ] [ ] [ ] UNLIKELY
EXTREMELY QUITE SLIGHTLY NEITHER SLIGHTLY QUITE EXTREMELY

C-3 Using Quattro Pro in my job will increase my productivity.

LIKELY [ ] [ ] [ ] [ ] [ ] [ ] [ ] UNLIKELY
EXTREMELY QUITE SLIGHTLY NEITHER SLIGHTLY QUITE EXTREMELY

C-4 Using Quattro Pro will enhance my effectiveness on the job.

LIKELY [ ] [ ] [ ] [ ] [ ] [ ] [ ] UNLIKELY
EXTREMELY QUITE SLIGHTLY NEITHER SLIGHTLY QUITE EXTREMELY

C-5 Using Quattro Pro will make it easier to do my job.

LIKELY [ ] [ ] [ ] [ ] [ ] [ ] [ ] UNLIKELY
EXTREMELY QUITE SLIGHTLY NEITHER SLIGHTLY QUITE EXTREMELY

C-6 I will find Quattro Pro useful in my job.

LIKELY [ ] [ ] [ ] [ ] [ ] [ ] [ ] UNLIKELY
EXTREMELY QUITE SLIGHTLY NEITHER SLIGHTLY QUITE EXTREMELY

4

SECTION D: OTHER'S EXPECTATIONS

The next set of questions asks whether other people in your organization think you should be using Quattro Pro in your job. On the first scale please indicate how likely or unlikely the statement is. Then, on the second scale, indicate how important their opinion on using Quattro Pro is to you.

Example:

D-0 My peers in other companies think that I should use Quattro Pro in my job.

LIKELY	[ ]	[ ]	[ ]	[ ]	[ ]	[X]	[ ]	UNLIKELY
	EXTREMELY	QUITE	SLIGHTLY	NEITHER	SLIGHTLY	QUITE	EXTREMELY	

How important to me is what they think?

IMPORTANT	[ ]	[ ]	[ ]	[X]	[ ]	[ ]	[ ]	UNIMPORTANT
	EXTREMELY	QUITE	SLIGHTLY	NEITHER	SLIGHTLY	QUITE	EXTREMELY	

The above response indicates that this person thinks it is quite unlikely that his or her peers in other companies think he or she should be using Quattro Pro. It is also neither important nor unimportant to him or her what they think.

D-1 Most people who are important to me think I should use Quattro Pro in my job.

LIKELY	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	UNLIKELY
	EXTREMELY	QUITE	SLIGHTLY	NEITHER	SLIGHTLY	QUITE	EXTREMELY	

How important to me is what they think?

IMPORTANT	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	UNIMPORTANT
	EXTREMELY	QUITE	SLIGHTLY	NEITHER	SLIGHTLY	QUITE	EXTREMELY	

D-2 My close friends think I should use Quattro Pro in my job.

LIKELY	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	UNLIKELY
	EXTREMELY	QUITE	SLIGHTLY	NEITHER	SLIGHTLY	QUITE	EXTREMELY	

How important to me is what they think?

IMPORTANT	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	UNIMPORTANT
	EXTREMELY	QUITE	SLIGHTLY	NEITHER	SLIGHTLY	QUITE	EXTREMELY	

D-3 My co-workers (peers) think that I should use Quattro Pro in my job

LIKELY ___ ___ ___ ___ ___ ___ ___ UNLIKELY
EXTREMELY QUITE SLIGHTLY NEITHER SLIGHTLY QUITE EXTREMELY

How important to me is what they think?

IMPORTANT ___ ___ ___ ___ ___ ___ ___ UNIMPORTANT
EXTREMELY QUITE SLIGHTLY NEITHER SLIGHTLY QUITE EXTREMELY

D-4 My immediate superiors think that I should use Quattro Pro in my job.

LIKELY ___ ___ ___ ___ ___ ___ ___ UNLIKELY
EXTREMELY QUITE SLIGHTLY NEITHER SLIGHTLY QUITE EXTREMELY

How important to me is what they think?

IMPORTANT ___ ___ ___ ___ ___ ___ ___ UNIMPORTANT
EXTREMELY QUITE SLIGHTLY NEITHER SLIGHTLY QUITE EXTREMELY

D-5 Senior management thinks that I should use Quattro Pro in my job.

LIKELY ___ ___ ___ ___ ___ ___ ___ UNLIKELY
EXTREMELY QUITE SLIGHTLY NEITHER SLIGHTLY QUITE EXTREMELY

How important to me is what they think?

IMPORTANT ___ ___ ___ ___ ___ ___ ___ UNIMPORTANT
EXTREMELY QUITE SLIGHTLY NEITHER SLIGHTLY QUITE EXTREMELY

D-6 My subordinates think that I should use Quattro Pro in my job.

LIKELY ___ ___ ___ ___ ___ ___ ___ UNLIKELY
EXTREMELY QUITE SLIGHTLY NEITHER SLIGHTLY QUITE EXTREMELY

How important to me is what they think?

IMPORTANT ___ ___ ___ ___ ___ ___ ___ UNIMPORTANT
EXTREMELY QUITE SLIGHTLY NEITHER SLIGHTLY QUITE EXTREMELY

6

SECTION E: USING QUATTRO PRO

Imagine that you have just encountered a task which will require you to use features of Quattro Pro that you have never used before. For each situation described below, please place an X in the one slot which best describes how **confident** you are that you could learn the new features and complete the task.

EVEN IF I HAD NEVER USED THE FEATURE BEFORE, I COULD COMPLETE THE TASK USING QUATTRO PRO ...

E-1 ... if there were no one around to tell me what to do as I went.

CONFIDENT							UNSURE
EXTREMELY	QUITE	SLIGHTLY	NEITHER	SLIGHTLY	QUITE	EXTREMELY	

E-2 ... if I had only the software manuals for reference.

CONFIDENT							UNSURE
EXTREMELY	QUITE	SLIGHTLY	NEITHER	SLIGHTLY	QUITE	EXTREMELY	

E-3 ... if I had only the on-line help for reference.

CONFIDENT							UNSURE
EXTREMELY	QUITE	SLIGHTLY	NEITHER	SLIGHTLY	QUITE	EXTREMELY	

E-4 ... if I could call someone for help if I encountered problems.

CONFIDENT							UNSURE
EXTREMELY	QUITE	SLIGHTLY	NEITHER	SLIGHTLY	QUITE	EXTREMELY	

E-5 ... if I had a lot of time to complete the job.

CONFIDENT							UNSURE
EXTREMELY	QUITE	SLIGHTLY	NEITHER	SLIGHTLY	QUITE	EXTREMELY	

E-6 ... if someone showed me how to do it first.

CONFIDENT							UNSURE
EXTREMELY	QUITE	SLIGHTLY	NEITHER	SLIGHTLY	QUITE	EXTREMELY	

7

SECTION F: FEELINGS ABOUT USING QUATTRO PRO

The next few statements describe feelings that some people have about using Quattro Pro. For each statement, please place an X in the one slot which best indicates the extent to which you agree or disagree with the feelings being expressed.

F-1 I like working with Quattro Pro.

AGREE [ ] [ ] [ ] [ ] [ ] [ ] [ ] DISAGREE
STRONGLY MODERATELY SLIGHTLY NEITHER SLIGHTLY MODERATELY STRONGLY

F-2 I look forward to those aspects of my job that require me to use Quattro Pro

AGREE [ ] [ ] [ ] [ ] [ ] [ ] [ ] DISAGREE
STRONGLY MODERATELY SLIGHTLY NEITHER SLIGHTLY MODERATELY STRONGLY

F-3 Once I start working with Quattro Pro, I find it hard to stop.

AGREE [ ] [ ] [ ] [ ] [ ] [ ] [ ] DISAGREE
STRONGLY MODERATELY SLIGHTLY NEITHER SLIGHTLY MODERATELY STRONGLY

F-4 I find Quattro Pro irritating to use.

AGREE [ ] [ ] [ ] [ ] [ ] [ ] [ ] DISAGREE
STRONGLY MODERATELY SLIGHTLY NEITHER SLIGHTLY MODERATELY STRONGLY

F-5 Working with Quattro Pro is boring.

AGREE [ ] [ ] [ ] [ ] [ ] [ ] [ ] DISAGREE
STRONGLY MODERATELY SLIGHTLY NEITHER SLIGHTLY MODERATELY STRONGLY

F-6 Quattro Pro is fun to use.

AGREE [ ] [ ] [ ] [ ] [ ] [ ] [ ] DISAGREE
STRONGLY MODERATELY SLIGHTLY NEITHER SLIGHTLY MODERATELY STRONGLY

8

SECTION G: EASE OF USE

These questions concern how easy you think Quattro Pro is to use. Please place an X in the slot which best describes how likely or unlikely you think each statement is.

G-1 Learning to operate Quattro Pro is easy for me.

LIKELY							UNLIKELY
EXTREMELY	QUITE	SLIGHTLY	NEITHER	SLIGHTLY	QUITE	EXTREMELY	

G-2 I find it easy to get Quattro Pro to do what I want it to.

LIKELY							UNLIKELY
EXTREMELY	QUITE	SLIGHTLY	NEITHER	SLIGHTLY	QUITE	EXTREMELY	

G-3 My interaction with Quattro Pro is clear and understandable.

LIKELY							UNLIKELY
EXTREMELY	QUITE	SLIGHTLY	NEITHER	SLIGHTLY	QUITE	EXTREMELY	

G-4 I find Quattro Pro is flexible to interact with.

LIKELY							UNLIKELY
EXTREMELY	QUITE	SLIGHTLY	NEITHER	SLIGHTLY	QUITE	EXTREMELY	

G-5 It will be easy for me to become skilful at using Quattro Pro.

LIKELY							UNLIKELY
EXTREMELY	QUITE	SLIGHTLY	NEITHER	SLIGHTLY	QUITE	EXTREMELY	

G-6 I find Quattro Pro easy to use.

LIKELY							UNLIKELY
EXTREMELY	QUITE	SLIGHTLY	NEITHER	SLIGHTLY	QUITE	EXTREMELY	

SECTION H: SUPPORT FOR QUATTRO PRO

The following statements investigate how easy or difficult it is for you to access different types of support for Quattro Pro. Please place an X in the slot which best describes how easy or difficult it is for you to get access to the things described.

IT IS EASY OR DIFFICULT FOR ME...

H-1 ... to get access to Quattro Pro on a computer.

EASY [ ] [ ] [ ] [ ] [ ] [ ] [ ] DIFFICULT
EXTREMELY QUITE SLIGHTLY NEITHER SLIGHTLY QUITE EXTREMELY

H-2 ... to get printed reference materials such as books or manuals about Quattro Pro

EASY [ ] [ ] [ ] [ ] [ ] [ ] [ ] DIFFICULT
EXTREMELY QUITE SLIGHTLY NEITHER SLIGHTLY QUITE EXTREMELY

H-3 ... to get help from an expert on Quattro Pro.

EASY [ ] [ ] [ ] [ ] [ ] [ ] [ ] DIFFICULT
EXTREMELY QUITE SLIGHTLY NEITHER SLIGHTLY QUITE EXTREMELY

H-4 ... to get help from a co-worker on Quattro Pro.

EASY [ ] [ ] [ ] [ ] [ ] [ ] [ ] DIFFICULT
EXTREMELY QUITE SLIGHTLY NEITHER SLIGHTLY QUITE EXTREMELY

H-5 ... to get training on how to use Quattro Pro.

EASY [ ] [ ] [ ] [ ] [ ] [ ] [ ] DIFFICULT
EXTREMELY QUITE SLIGHTLY NEITHER SLIGHTLY QUITE EXTREMELY

H-6 ... to transfer work originally done in my previous spreadsheet into Quattro Pro.

EASY [ ] [ ] [ ] [ ] [ ] [ ] [ ] DIFFICULT
EXTREMELY QUITE SLIGHTLY NEITHER SLIGHTLY QUITE EXTREMELY

10

SECTION I: YOUR EXPECTATIONS

The following statements describe the outcomes that people might expect from using Quattro Pro. For each item please indicate on the first scale the likelihood that you will experience that outcome. Then, on the second scale, indicate how important that outcome is to you.

USING QUATTRO PRO ...

I-1 ... will make me be better organized in my job.

LIKELY ☐ ☐ ☐ ☐ ☐ ☐ ☐ UNLIKELY
EXTREMELY QUITE SLIGHTLY NEITHER SLIGHTLY QUITE EXTREMELY

How important to me is being better organized?

IMPORTANT ☐ ☐ ☐ ☐ ☐ ☐ ☐ UNIMPORTANT
EXTREMELY QUITE SLIGHTLY NEITHER SLIGHTLY QUITE EXTREMELY

I-2 ... will increase my effectiveness on the job.

LIKELY ☐ ☐ ☐ ☐ ☐ ☐ ☐ UNLIKELY
EXTREMELY QUITE SLIGHTLY NEITHER SLIGHTLY QUITE EXTREMELY

How important to me is increasing my effectiveness on the job?

IMPORTANT ☐ ☐ ☐ ☐ ☐ ☐ ☐ UNIMPORTANT
EXTREMELY QUITE SLIGHTLY NEITHER SLIGHTLY QUITE EXTREMELY

I-3 ... will let me spend less time on routine job tasks.

LIKELY ☐ ☐ ☐ ☐ ☐ ☐ ☐ UNLIKELY
EXTREMELY QUITE SLIGHTLY NEITHER SLIGHTLY QUITE EXTREMELY

How important to me is spending less time on routine job tasks?

IMPORTANT ☐ ☐ ☐ ☐ ☐ ☐ ☐ UNIMPORTANT
EXTREMELY QUITE SLIGHTLY NEITHER SLIGHTLY QUITE EXTREMELY

USING QUATTRO PRO ...

I-4 ... will increase the quality of output of my job.

LIKELY ☐ ☐ ☐ ☐ ☐ ☐ ☐ UNLIKELY
EXTREMELY QUITE SLIGHTLY NEITHER SLIGHTLY QUITE EXTREMELY

How important to me is increasing the quality of output of my job?

IMPORTANT ☐ ☐ ☐ ☐ ☐ ☐ ☐ UNIMPORTANT
EXTREMELY QUITE SLIGHTLY NEITHER SLIGHTLY QUITE EXTREMELY

I-5 ... will increase the quantity of output for the same amount of effort.

LIKELY ☐ ☐ ☐ ☐ ☐ ☐ ☐ UNLIKELY
EXTREMELY QUITE SLIGHTLY NEITHER SLIGHTLY QUITE EXTREMELY

How important to me is increasing the quantity of output for the same amount of effort?

IMPORTANT ☐ ☐ ☐ ☐ ☐ ☐ ☐ UNIMPORTANT
EXTREMELY QUITE SLIGHTLY NEITHER SLIGHTLY QUITE EXTREMELY

I-6 ... will make me less reliant on support staff.

LIKELY ☐ ☐ ☐ ☐ ☐ ☐ ☐ UNLIKELY
EXTREMELY QUITE SLIGHTLY NEITHER SLIGHTLY QUITE EXTREMELY

How important to me is being less reliant on support staff?

IMPORTANT ☐ ☐ ☐ ☐ ☐ ☐ ☐ UNIMPORTANT
EXTREMELY QUITE SLIGHTLY NEITHER SLIGHTLY QUITE EXTREMELY

12

SECTION J: AGREEMENTS TO USE OR TO NOT USE QUATTRO PRO

These next questions identify people with whom you may have made formal or informal agreements to use or not to use Quattro Pro. Place an X in the slot which best describes how strong an agreement you made. If more than one agreement exists, please pick the strongest one and report on it.

J-1 What type of agreement have you made with someone at work concerning your use of Quattro Pro?

TO USE [ ] [ ] [ ] [ ] [ ] [ ] [ ] NOT TO USE
STRONG AGREEMENT · MODERATE · WEAK · NO AGREEMENT · WEAK · MODERATE · STRONG AGREEMENT

J-2 What type of agreement have you made with a friend (not at work) concerning your use of Quattro Pro?

TO USE [ ] [ ] [ ] [ ] [ ] [ ] [ ] NOT TO USE
STRONG AGREEMENT · MODERATE · WEAK · NO AGREEMENT · WEAK · MODERATE · STRONG AGREEMENT

J-3 What type of agreement have you made with software vendors concerning your use of Quattro Pro?

TO USE [ ] [ ] [ ] [ ] [ ] [ ] [ ] NOT TO USE
STRONG AGREEMENT · MODERATE · WEAK · NO AGREEMENT · WEAK · MODERATE · STRONG AGREEMENT

SECTION K: FUTURE USE OF QUATTRO PRO

K-1 In the next three months, will your use of Quattro Pro increase or decrease?

INCREASE [ ] [ ] [ ] [ ] [ ] [ ] [ ] DECREASE
HIGHLY · MODERATELY · SLIGHTLY · NEITHER · SLIGHTLY · MODERATELY · HIGHLY

K-2 In three months time, how often do you expect to be using Quattro Pro?

[ ] SEVERAL TIMES A DAY
[ ] ONCE A DAY
[ ] SEVERAL TIMES A WEEK
[ ] ONCE A WEEK
[ ] SEVERAL TIMES A MONTH
[ ] ONCE A MONTH
[ ] ALMOST NEVER
[ ] NOT AT ALL

K-3 In three months time, what do you expect your average weekly use of Quattro Pro will be?

_____ HOURS PER WEEK

SECTION L: DEMOGRAPHICS

L-1 How long have you worked for this organization? _____ YEARS and _____ MONTHS

L-2 What is your Functional Area? (Please circle the appropriate number.)

1 ACCOUNTING	4 GENERAL MANAGEMENT	7 INFORMATION SYSTEMS
2 ENGINEERING, DESIGN	5 PRODUCTION	8 HUMAN RESOURCES
3 FINANCE	6 MARKETING/SALES	9 CONSULTING

10 NONE OF THE ABOVE — > Please specify _____

L-3 What is the level of your position? (Circle the appropriate number.)

1 EXECUTIVE	3 FIRST LINE MANAGEMENT	5 TECHNICAL
2 MIDDLE MANAGEMENT	4 PROFESSIONAL	6 SECRETARIAL, CLERICAL

7 NONE OF THE ABOVE — > Please specify _____

L-4 Are you free to stop using Quattro Pro in your job if you don't like it?

1 YES (I could stop) 2 NO (I must use it)

L-5 How many people report directly to you? _____ PEOPLE

L-6 What is your age? _____ YEARS

L-7 Are you? 1 FEMALE or 2 MALE

L-8 What is the **highest** level of education that you have completed? (Circle number)

1 SOME VOCATIONAL OR HIGH SCHOOL	4 COMPLETED COLLEGE OR UNIVERSITY
2 COMPLETED VOCATIONAL OR HIGH SCHOOL	5 SOME GRADUATE WORK
3 SOME COLLEGE OR UNIVERSITY	6 COMPLETED A GRADUATE DEGREE

L-9 What is your primary educational background? (Please circle the appropriate number.)

1 BUSINESS	4 ENGINEERING
2 ARTS	5 COMPUTER SCIENCE
3 SCIENCES	6 SOCIAL SCIENCE

7 NONE OF THE ABOVE — > Please specify _____

APPENDIX G - MAIN STUDY REVISED COVER LETTER

The UNIVERSITY *of* WESTERN ONTARIO

Western Business School

Dear 2~:

The old adage which says "the only constant in life is change" applies well to those of us who use computers. It often seems that just as we have begun to master one software application, a new one appears which offers improved features and performance. More and more people are faced with the difficult decision of whether the added features are worth the time and effort it will take to learn the new application.

As part of my Ph.D. program I am conducting a study in an effort to determine how to make it easier for people to switch from older applications to new ones. As someone who has recently made the decision to try Quattro Pro, your views on this situation are of interest to me. By filling out the enclosed questionnaire you will be helping me to understand what factors are important to people trying new applications.

The enclosed questionnaire asks your opinion about various issues relating to your use of Quattro Pro. It takes about 30 minutes to answer. You do not need to be an expert on Quattro Pro to fill it out. If you have spent two or more hours experimenting with Quattro Pro you are ready to answer the questionnaire. If you have not yet had a chance to try Quattro Pro, please save the questionnaire until you do. All results received within the next six months will be used.

While your individual responses will be held in strict confidence, the overall results from this study will be available to anyone on request. If you would like to receive a copy of them please print your name and address, or attach your business card, to the back of the questionnaire.

This research is not commercial. It is part of my Ph.D program at the University of Western Ontario. As one of only 300 people who will receive this questionnaire your response is important to me. If you would like to contact me directly, please call Tom Davies at (519) 661-3269.

I hope to hear from you soon. Thank you.

Yours sincerely,

Tom Davies

London, Ontario • Canada • N6A 3K7 • Telephone (519) 661-3206
Fax (519) 661-3485 • Telex 064-7134 UWO TEL LDN

APPENDIX H - MAIN STUDY REMINDER LETTER

The UNIVERSITY of WESTERN ONTARIO

Western Business School

{DATE}

Dear 2~:

Last month you should have received a survey asking you what you think about Aldus Persuasion. I am writing to determine the status of your questionnaire as I have not yet received a reply from you. Please take a minute to review the options listed below. I would appreciate it if you would check the one which best describes your intentions, and return this letter in the envelope provided. If this letter and your questionnaire have passed each other in the mail, please accept my thanks and discard this letter.

- ☐ I have saved the questionnaire and will fill it out once I have tried Persuasion.
- ☐ I cannot find the questionnaire. Please send me another one.
- ☐ I did not receive the questionnaire. Please send me one.
- ☐ I do not expect to try using Persuasion. Your questionnaire does not apply to me.
- ☐ I simply do not want to fill out the questionnaire.
- ☐ Other. _____

_____

This research is not commercial. It is part of my Ph.D. degree program at the University of Western Ontario. As one of only 500 people who were sent this questionnaire your response is important to me. However, I respect your privacy and will not be contacting you further unless your response above indicates that I should.

I hope to hear from you soon. Thank you.

Yours sincerely,

Tom Davies

London, Ontario • Canada • N6A 3K7 • Telephone (519) 661-3206
Fax (519) 661-3485 • Telex 064-7134 UWO TEL LDN

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