C. 1

# AN EXAMINATION OF THE IMPLEMENTATION OF INFORMATION TECHNOLOGY FOR END USERS: A DIFFUSION OF INNOVATIONS PERSPECTIVE

By

GARY C. MOORE

B.A. (Honours), The Royal Military College of Canada, 1972

A THESIS SUBMITTED IN PARTIAL FULFILMENT OF

THE REQUIREMENTS FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY

in

THE FACULTY OF GRADUATE STUDIES

Department of Commerce and Business Administration

We accept this thesis as conforming

the required standard

THE UNIVERSITY OF BRITISH COLUMBIA

May, 1989



67

Department of Commerce and Business Administration
The University of British Columbia
1956 Main Mall
Vancouver, British Columbia
Canada
V6T 1Y3

Date: 24 July 1988

**ABSTRACT**

In recent years, the diffusion of end-user oriented Information Technology (IT) within organisations has met with mixed success. The reactions to this technology, which can be considered to be an innovation in the workplace, range from enthusiastic adoption to hostile rejection, and are typical of the reactions to innovations in general. Nevertheless, because this IT is an integral part of many organisations' plans, organisations must have a good understanding of the factors which may influence its use. The purpose of this research is to develop and test a model outlining potential factors and their inter-relationships.

Because personally using IT can be viewed as an innovative behaviour, two areas of prior research were used to develop the research model. First, the <u>Diffusion of Innovations</u> model (Rogers, 1983), postulates that adoption of an innovation is dependent upon several perceptions one has of the innovation. Second, the <u>Theory of Reasoned Action</u> (Fishbein and Ajzen, 1975), posits that behaviour in general is motivated by an individual's attitude towards carrying out the behaviour, and his subjective norms. These norms are based on what one thinks that others expect one to do. These two theories were melded into a general research model to investigate the central research questions:

1. What are the users', and non-users', underlying perceptions of personally using IT?
2. Do any of the above perceptions dominate? If so, which are they, how are they linked, and how do they affect the decision to personally use IT?
3. What are the effects of others' expectations about one's using IT on one's decision to use, or not use, IT?

Items to measure the perceived characteristics of innovating, the subjective norms, and innovative behaviour was developed and administered in a cross-sectional survey to 540 individuals in seven organisations. Three data analysis approaches were used, including a comparison of adopters and non-adopters of IT, regression analysis, and structural equation modelling (LISREL). The analysis results provide support for the general model, and six of the seven specific research hypotheses. Usage of the technology was found to be highly correlated with one's attitudes and subjective norms, and the determinants of attitude were consistent with diffusion theory.

# TABLE OF CONTENTS

CHAPTER FOUR: INSTRUMENT DEVELOPMENT

**Section C: Subjective Norm, Attitude, and Innovativeness Measures**



**Section D: Questionnaire Design**



**Section E: Final Survey - Scale Reliabilities**



**CHAPTER FIVE: DATA COLLECTION AND ANALYSIS**

**Section A: Data Collection and Conditioning**

**APPENDICES**

## LIST OF TABLES

## LIST OF FIGURES

# ACKNOWLEDGEMENTS

The completion of this dissertation required the help, support, and occasional "significant prodding" from many people, to whom I owe a great deal of gratitude. Chief among these is Professor Izak Benbasat, my thesis supervisor, who offerred not only guidance and advice, but patience, tolerance, and personal support. I would also like to thank the other members of my committee, Professors Al Dexter and Craig Pinder for their insightful criticism and encouragement.

I also am very grateful to Professor Malcolm Munro, my "neighbour" at the University of Calgary, who initially motivated me to pursue a Ph.D., and who was crucial in keeping me focussed on the task at hand. Without his backing, this project may not have even been started. In addition, my fellow students at UBC, and the faculty members in the Management Information Systems Area both at UBC and the University of Calgary provided constant encouragement and support.

Finally, I would like to thank those closest to me: Lisa, who helped in overcoming some very trying times; my parents, Jack and Audrey Moore, who supported my efforts throughout my education; and especially my children, Kent and Shannon, who had to do without their Dad for too long while this thesis was being completed.

# CHAPTER ONE

# INTRODUCTION

In technology, anything is possible if
you don't know it isn't available yet.
Anon.

Any problem can be solved given enough
time and money, but you will never be
given enough time and money.
Anon.

## 1.1 THE PROBLEM

In recent years a particular problem within organisations has been having considerable time and money devoted to it. This problem is based on the fact that the proportion of the work force which processes information rather than produces material goods has been rising dramatically. In the U.S., estimates are that it is now over 50%, and will rise to 72% by the end of the century (Barcomb, 1981), while in Canada it is expected to reach 60% by the end of the decade (J. Brown, 1984). At the same time, however, while industrial productivity rose 85% in the U.S. during the 1970's, it is estimated that white collar productivity rose only 4% (Connell, 1979), or may even have remained at a 1960's level (Bowen, 1986). Serious attempts, therefore, are now being made to raise the output of "information workers" through large investments in appropriate computer-based information technology (Curley & Pyburn, 1982; Greenwood & Greenwood, 1984; Quible & Hammer, 1984). This has caused a rapid growth in the use of computers outside the professional computing circles and has created a number of issues and concerns. These concerns started to develop early in the evolution of the use of information technology (IT) by lay users (non-systems professionals). For example, some five years ago, one survey of senior Information Systems (IS) practitioners and academics had already identified among their three top concerns the improvement of IS planning, the facilitation and management of end user computing (EUC), and the integration of data processing, telecommunications and office automation (Dickson et al., 1984). The use of IT by lay users is part of all three concerns, which demonstrated the impact that the diffusion of IT was having in organisations. This has spawned a number of studies into the diffusion of end user IT, all of which have attempted to understand some of the basic forces which underlie this diffusion (see, for example, Brancheau, 1987; Christensen, 1987; Pavri, 1988).

The issues arising out of these concerns are being widely examined, but two different perspectives seem to exist. One is a Management Information Systems (MIS) viewpoint, which concentrates mainly on problems created by the influx into computing of individuals who personally assume many traditional IS functions by acquiring and using their own IT. The other is an office automation (OA) perspective, whose focus deals primarily with attempting to have IT win acceptance by users in organisations. While much has been written about the management of end user IT in both areas, very little has been grounded in theory, which has been a chronic problem in IS research (see Weber, 1985, for some of the recent discussion).

Researchers in OA and MIS have chronicled two significantly different reactions by potential users to IT. At one extreme is unbridled enthusiasm, wherein the user recognises the benefits of using the technology, and adopts it wholeheartedly. The other extreme is overt hostility and resistance wherein users are often forced to adopt the technology against their will. Between these extreme cases lies the complete range of reactions. Indeed, these reactions seem also to be typical of those who are responsible for setting policies with respect to the use of IT within organisations. The president of one company was quoted as saying that user IT was "a snare and a delusion" which ate up resources but produced little in the way of results (Pyburn, 1986, p.49). At the same time, however, a senior MIS executive from a Fortune 500 firm was quoted as saying that user IT is "becoming increasingly like the telephone - everyone should have [it] without being forced to justify it on the basis of measurable cost savings" (Pyburn, 1986, p.50). These reactions seem to typify the responses to user IT across organisations. The purpose, therefore, of this research is to investigate the factors which underlie these reactions, with particular reference to users, and potential users, of IT. As Strassman (1985) put it: "once an economically feasible and technologically efficient electronic system is installed in the work place, there still remains the question: will people use it?". In too many instances, the unfortunate answer has been "No!". Many people are still resisting the technology, or are accepting it only grudgingly.

Although there appear to be no hard quantitative data describing how resistance to IT is affecting its diffusion, some indications do exist. For example, a specialist in the US Office of Personnel Management was quoted as saying that "as many as 40 percent of all functionally sound office automation projects fail to provide the expected benefits because of a lack of cooperation from users" (Freedman, 1983, p.82). More recently, one survey concluded that integrated office systems have not been widely accepted (Canning, 1985a), while a second survey of some 6400 mini/micro-computer sites indicated that only 18% had some form of integrated OA (Verity, 1985). It is unclear how many additional mainframe OA systems exist, but it is clear that use of IT is not growing as expected in some quarters, but is meeting resistance. It seems that the "office of the future" is still in the future in many organisations.

While some researchers have chronicled the resistance to IT by lay users, others have described the rapid growth of **end user computing** (EUC) and the problems that can occur when users enthusiastically take to the technology. EUC was described as "booming" some five years ago (Rockart & Flannery, 1983), with "growth rates of 50 to 100 per cent per year" (Gerrity & Rockart, 1982, p.1). It appears as if this growth in EUC continues today. A recent survey of 295 firms found that 54 per cent had established organisational sub-units (Information Centres) whose roles are specifically to support end users, while another 22 per cent of the firms indicated that they intended to do the same within the next two years. The conclusion reached by the author was that "end user computing will continue to grow" (Hoffman, 1988). To MIS professionals, this growth creates a number of problems.

One of the concerns faced by MIS practitioners is how to control micro-computers (micros). This concern is evidenced in the titles of many articles, including "Managing the Micro Invasion" (Chrysler, 1985), "What To Do With All Those Micros (Keen & Woodman, 1985), and "Controlling the Microcomputer Environment" (Kahn & Garceau, 1984). It appears that, to many observers, EUC is equated to the use of micros, and the attention of many organisations and researchers, therefore, with respect to EUC is directed at this technology (for example, Pavri, 1988, focussed solely on the use of micros by managerial level employees). Furthermore, of the Information Centres in the survey of 295 firms cited above, 90 per cent evaluate microcomputer software for end users, while less than half of that number evaluate mainframe/mini software for end users (Bohl, 1988, p.48). In any event, it seems as if microcomputers are seen in many firms as a problem, but it is a problem of control and integration because of their proliferation, not a problem of getting individuals to use the machines.

Another major concern among the IS community is that many end users are under-educated with respect to computing. This lack of education could have a significant, negative impact on decisions made by these users, and on the overall integrity of their computing. Examples exist of enthusiastic yet ill trained end users making mistakes costing firms tens of thousands of dollars, because they did not test properly their self-developed programmes (G.B. Davis, 1981). End users are also characterised as having "a frequently careless ... attitude toward system operational efficiency" (Guimaraes, 1984). The more users who do their own computing, the more it is felt that the overall information system's efficiency will be degraded. Finally, many writers see end users as creating a threat to the role and future of IS professionals (Laberis, 1983; Guimaraes, 1984; Zink, 1984). One argument is that "personal computers have already made users largely independent of mainframes [and that] future developments in software will enable [them] to be independent of IS departments for software support, as well" (Dearden, 1987). All of these issues and concerns are raised by the large **influx** of end users into computing. None is based on users' resistance to IT. On the other hand, to properly manage the use of IT by these users, organisations need to understand the underlying forces which motivate the users to take to the technology so enthusiastically. Until these forces are understood, addressed, and managed appropriately, many of the attempts to control the diffusion and use of end user IT may be seen as "turf protecting" by the users. Thus, these forces need to be identified.

The question which must be addressed, therefore, is why there exists, on the one hand, a tremendous pull by some users towards using IT, and on the other hand, a resistance to using the technology by many other potential users. If the forces which are at work in either case can be understood, it will provide a tremendous advantage to organisations which are trying to manage the diffusion of IT.

## 1.2 RESEARCH GOALS AND QUESTIONS

The motivation for the present research is twofold. The first is to investigate and validate a theoretical basis for the study and management of the use of IT by laypersons. It does this through the development and testing of a particular model of the process by which potential users decide to adopt or reject personal, hands-on use of information technology. As will be discussed more fully in subsequent chapters, the research is based on two distinct yet theoretically linked bodies of research. These are the **diffusion of innovations** paradigm, and the **attitudes** paradigm. Diffusion theory has developed over the years as a basis for understanding and examining the introduction of innovations. In that the use of information technology by lay users is an innovation within the work place, there should be benefit in using diffusion theory to examine the technology's adoption or rejection by potential users. Attitudes theory has had significant success in predicting behaviour in general, with one of the most successful models being the **Theory of Reasoned Action**, as developed by Fishbein and Ajzen (Fishbein and Ajzen 1975; Ajzen and Fishbein, 1980). This theory should help to gain insight into the forces which underlie the particular behaviour of adoption or rejection of IT.

Both bodies of theory posit that behaviour, in this case personal use of IT, is very much a function of both personal and social factors. In terms used by the **Theory of Reasoned Action**, the personal factor is based on one's **perceptions** about the outcomes of performing the behaviour, which are synthesised into an **Attitude** about the behaviour. The social factor is a function of whether one perceives that others **expect** one to carry out the behaviour, in this case to actually use the technology. This is termed the **Subjective Norm**. Diffusion theory provides considerable insight into the determinants of these two factors with regard to the adoption or rejection of an innovation. This research will draw on both bodies of work to examine the acceptance of information technology by lay users. It will pay particular attention to the perceptions of these users about the **outcomes** of using, or potentially using, the technology, and to their perceptions of whether others **expect** them to adopt or to reject its use.

The second goal of the research, once the theory is tested with respect to the diffusion of IT, is to provide a basis for the derivation of prescriptions and guidelines for addressing, and subsequently managing, the concerns of MIS professionals and managers with respect to the diffusion of user IT. These concerns relate both to the resistance to IT by some potential users, and to its perhaps overly enthusiastic adoption by others. If prescriptions and guidelines can be developed, hopefully both the time and money devoted to this problem should be more wisely spent.

Thus, the major questions underlying the research include:

1. What are the (potential) users' underlying **perceptions** of personally using information technology?

2. Do any of the perceptions of personally using IT predominate? If so, which are they, how are they linked, and how do they affect the decision to personally use IT?

3. What are the effects of others' **expectations** about one's using IT on one's decision to use, or not use, IT?

## 1.3 THE PERSONAL WORK STATION

Because the reaction to information technology seems to be quite general, not dependent on specific instances of the technology, this study will focus on the adoption or rejection of use of "generic IT", termed the **Personal Work Station** (PWS). The PWS is defined as a set of computerised tools designed for personal use by an **individual**, which usually consists of a **personal computer (microcomputer)** with one or more software packages, such as a spreadsheet or word processing programme. A PWS could also be a **computer terminal** that is hooked up to a mainframe computer, again with the appropriate software. The key aspect of a PWS is that it is computer technology used directly by the user, as opposed to through a third party. Secondly, the use of the PWS is generally interactive. This view of a PWS could include a single, on-line system used from a terminal. In this instance, its use would likely be determined by one's job, and thus this aspect of PWS usage will also be investigated.

Some researchers have concentrated specifically on the microcomputer as the basis for studying the use of IT (see, for example, Pavri, 1988). This seems to be overly limiting in that use of either a mainframe terminal, or a microcomputer, are very similar at the level of the individual user. From a functional perspective, both kinds of IT are employed in organisations by lay users to carry out many similar tasks. Moreover, it seems that that the differences between terminals or micros for non-communications applications, while still evident, are becoming increasingly transparent to users. Many "user friendly" **applications** originally developed for micros (e.g. word processing, spreadsheets, etc.) are now offered on mainframes, while some applications originally developed for mainframes (e.g. statistical packages such as SPSS) are now available for micros. The latter development has been made possible because the **performance** of micros, including file storage capacity, processing power and speed, is improving dramatically to close the gap with mainframes. This again tends to reduce the differences between mainframe and micro use. In fact, it has been argued that dumb terminals will become obsolete, and the personal computer and intelligent terminal will eventually merge in "a single box" (Healy, 1987). Finally, the discussion in the various bodies of literature tends to deal not with the reaction of individuals to specific forms of IT, but to IT in general. Therefore, to examine these reactions at an initial macro level, this focus of this research is on the generic **Personal Work Station**, as defined above.

## 1.4 RESEARCH AND DISSERTATION OVERVIEW

This dissertation is organised as follows. The next chapter provides a brief review of some of the work conducted to date with respect to the use of IT by lay persons. In that managing the diffusion of end user IT can be viewed as a specific instance of the implementation of an information system, the chapter also discusses **implementation** research within MIS.

Chapter Three then focuses on the theoretical underpinnings of this research. As was discussed above, this study is based primarily on the **Theory of Reasoned Action** (Fishbein and Ajzen, 1975), which is a generalised theory of behaviour. Diffusion theory is used to couch this general theory in the particular context of adopting or rejecting information technology. It helps to determine the specific perceptions of performing the behaviour which should be salient in forming an overall **Attitude** about adopting PWS usage. The chapter develops and presents the research model which guided the data collection and analysis.

Given the nature of the research questions and the variables to be studied, it was concluded that a **field survey** would be the most appropriate research approach. This required the identification and/or development of a survey instrument with which the data would be gathered. Chapter Four describes these activities, and presents in detail the instrument development process that was carried out.

Chapter Five presents the data collection and analysis activities. It shows that the research model is supported by the data, as, to some degree, are virtually all of the research hypotheses. Analysis of the data shows that adoption of IT is predicated by three major factors: one's **Attitude** about using the technology, the perception that others expect one to use the technology (the **Subjective Norm**), and the perception that one is **required** to use the technology in one's job. The last factor is investigated by determining the degree to which one feels use of the technology is **voluntary**. Furthermore, analysis of the data shows that diffusion theory is most beneficial in defining the variables with which to set the **Theory of Reasoned Action** into context. In particular, the **perceived characteristics of innovations**, as defined in diffusion theory, are significant determinants of one's attitude towards using the innovation, and help explain the different reactions of individuals to using IT.

Finally, Chapter Six discusses the implications and limitations of the study. Particular reference is paid to the research questions as outlined earlier, and to the managerial implications of the outcomes of the data analysis. The Chapter concludes with some suggestions for future research.

# CHAPTER TWO

# THE USE OF INFORMATION TECHNOLOGY BY LAY USERS

The easiest computer to use
is the one you don't have to.
An anonymous survey respondent.

## 2.1 GENERAL

The purpose of this chapter is to briefly outline the key issues that have been identified with respect to managing the use of information technology (IT) by lay users, and to highlight some of the research that has been conducted to date that relates to this phenomenon. In general, this includes research on **end user computing** (EUC), **Office Automation** (OA), information systems **implementation**, and **attitudes** towards use of information systems. The chapter concludes by presenting arguments for viewing use of the PWS as an innovation, and discusses the benefits of using **diffusion of innovations** theory to investigate the acceptance of PWS in organisations.

## 2.2 ISSUES

### 2.2.1 General

As was discussed in Chapter One, the genesis of the motivation for this research was in the issues raised by research into end user computing and office automation. These have been the primary areas where direct investigation of the use of IT by lay users has been carried out. The literature indicates that there seems to be a wide range of distinctly different reactions to use of PWS, from enthusiastic adoption through apathy to hostile rejection. This section will very briefly review some of the work to date in this area.

OA and EUC are discussed together because, although they may have different foci, at the level of the individual adopter they present similar opportunities and hazards. For example, while several definitions of both EUC and OA exist, few help to differentiate between the two phenomena. A typical definition of OA is "the incorporation of appropriate technology to help people manage information" (Barcomb, 1981, p.1; see also Greenwood & Greenwood, 1984; Meyer, 1983; and Vogel & Wetherbe, 1985). EUC is generally seen to be the direct hands-on use of a computer by a non-systems individual (see Henderson & Treacy, 1984; Rockart & Flannery, 1983; Sprague & McNurlin, 1986). The similarity between these definitions is more striking than any difference, which is also true for the specific uses of the PWS that are discussed by writers in each area. For example, within OA some include such functions as data processing, decision support systems, and data base management systems (see Greenwood & Greenwood, 1984), while under EUC others discuss word processing, electronic calendars and electronic mail (see Benson, 1983; Canning, 1985c). Thus, there appears to be no clear distinction between EUC and OA based on either their definitions or their applications. They both can be viewed as the use of IT by non-systems professionals, offering similar benefits and creating similar problems. Therefore, at the level of the individual adopter, managing the use of the PWS should require similar approaches.

### 2.2.2 **Benefits and Problems**

As has been discussed in Chapter One and in the previous section, the issues within OA and EUC tend to revolve around the **usage** of the PWS. Within EUC, the main issue is the rapid growth of PWS usage, and the problems this creates, while in OA the main focus is primarily on the potential users' resistance to the technology. When the benefits of using the technology are indicated, they generally relate to **effectiveness** and **efficiency** concerns. For example, personally using the technology is perceived as being quicker than having to go through an intermediary, and more effective than the user trying to indicate to a third party what his needs are. The user "knows what he wants" and should be allowed to get it for himself. From the Information Services Department's (ISD's) perspective, the benefit of having users responsible for developing their own applications is that it is seen as one way of "breaking the systems development bottleneck" (Alloway & Quillard, 1983; Gremillion & Pyburn, 1983). From the users' perspective, one benefit of PWS usage is that it frees them from dependency on the ISD. These are only a few of the ways in which lay use of IT can be of assistance in organisations. In short, although effectiveness and efficiency can be achieved in many ways, hands-on use of the technology is the vehicle for doing so.

Use of information technology, however, is not always seen as beneficial. In fact, resistance to the use of IS in general has been a fact of life for years. Over twenty years ago, Ackoff (1967) argued that "of those [computerized management information systems he'd] seen implemented, most have not matched expectations and some have been outright failures". This leads to a resistance to be involved with the system. Resistance can also exist, however, to functionally sound systems. For example, Argyris (1970) presented several arguments why managers would resist "rational" management information systems. Among them was the argument that usage of an MIS would put information increasingly under control of senior management, and reveal to it things it had never seen before, thus hemming in middle managers. Furthermore, he argued that usage of an MIS makes a middle manager more accountable for wider ranges of information. By not using the MIS, therefore, the middle manager might be able to continue to avoid these developments. As can be seen, Argyris' arguments were not in the context of actual hands-on use of the system, but simply in the manager's use of its outputs. His ideas were echoed some fourteen years later:

> Unfortunately, information management systems are not panaceas. They are only tools. The technology can make good employees better; it cannot make a poor manager into a good one. Following the implementation of an information management system, information is much more visible and much more widely shared than was true when information systems were limited to a hard copy medium. Consequently, mistakes are much more visible too (Foster & Flynn, 1984).

The potential effect this is having on actual users is best illustrated in the following comment from a practising Chartered Accountant:

> In carrying out a Section 8100 review, I used to do a few ratios and some other work and sign it off. Now, by using a computer to do the analysis, you have to explain 35 ratios instead of 10. The end product is probably of higher quality, but it takes longer and is more expensive. In today's marketplace, this creates a difficult fit (quoted in Hibberd, 1988).

Thus, implementation of information systems has often served to raise expectations about individuals' performance, a factor which could lead to resistance to its usage. This certainly also holds for use of the PWS, of which the above accountant's comments are likely an example. The resistance to PWS, however, goes beyond these concerns. Resistance to PWS also relates to the significant changes within organisations that PWS usage may wreak, and is evidenced in such titles as "The Rocky Road to Office Automation" (Chapter 15 in Sprague & McNurlin, 1986). There are many hypothesised reasons for this resistance, including the fear by many workers that the influx of the technology will result in the loss of their jobs (Canning, 1985b; Quible & Hammer, 1984; Thiel, 1984). This is fueled by the fact that one of the touted advantages of office automation is a reduction in labour costs. For others, there is the simple difficulty of "human adjustment to technology" (Matherly & Matherly, 1985; Uttal, 1982). This phenomenon is not peculiar to computers, but has existed for decades, dating back at least to the industrial revolution. In fact, the word "sabotage" has been traced back to the reaction of weavers to the introduction of mechanical looms in Europe. These workers attempted to wreck the looms by throwing their wooden shoes, called "sabots", into the machinery. Overall, these factors can create a significant negative reaction to IT, termed "technostress", which is the "inability of an individual or organization to adapt to the introduction and operation of new technology" (Brod, 1982, p.754).

The new IT also carries the threat of both deskilling and alienating workers (Blackwell, 1988; Wynne & Otway, 1983; Zuboff, 1982). "Deskilling" includes removing human judgement from decision making, and instead substituting reliance on "computer" direction for actions. "Alienation" is a result of the changing interaction patterns among workers, where the computer becomes the primary focus of interaction, not other people. Both deskilling and alienation are significantly discouraging to the affected employees. Certain systems can also increase the organisation's ability to monitor and control individuals' work (Keen, 1981, Zuboff, 1982). Typists' keystrokes can be analysed, so that typing accuracy and speed can be accurately computed, and degradation in performance quickly identified. For employees dealing with the public, the length of their interaction with clients can be monitored and then compared to the results of the interaction. The author is aware of a major airline which is using such information as the basis for salary adjustments of their ticketing and check-in personnel. Even the time away from terminals can be reported. Finally, indications exist that prolonged exposure to video display terminals (VDT's) may have negative effects on one's health, which is becoming a major concern to many employees, especially women (Debow, 1988; Kirkpatrick, 1988; Susser, 1987). Among the potential problems are severe back pain, eye strain, increased stress, and pregnancy difficulties because of VDT electromagnetic radiation.

These negative aspects of technological change are all becoming well publicised (Thiel, 1984). Apparently, however, many individuals also resist using the PWS simply because they fail to see any of its benefits (Salerno, 1985). This is true among senior levels of the organisation as well. Some executives see PWS usage simply as "executives typing" (Fearon, 1984; Benson, 1983), or as a means of reducing their "human" support. Thus, their personal use of the technology offers no perceived advantage over the their current way of operating, and they reject using the machine. More importantly, however, this lack of perceived benefits may be leading some senior executives to inappropriately prevent others in the organisation from using the technology:

> During a recent systems review for a major hospital, reviewers were astounded to find virtually no personal computers in use. Apparently, the executive had issued an edict that they were not allowed. Instead, all processing was done on an antiquated, centralized-site mainframe. Needless to say, many users were not happy..... Some executives interviewed [in a variety of firms] indicated a lack of appreciation for computer technology. Many questioned how personal computers fit with the existing mainframe technology. They also questioned the much-vaunted productivity gains associated with micro-computers (Gilmore, 1988).

Finally, there is evidence of a generalised resistance to computer technology because of the potentially negative effects it may have on society. Lee (1970) found that computers could be regarded as either "beneficial tools of mankind", or "awesome thinking machines". The latter factor leads to an aversion to computer interaction. Morrison (1983), when attempting to replicate Lee's work, found that his subjects had significant concerns over the possible "disemploying and dehumanizing effects - as well as disquiet over the control computers could exercise over their lives". In that these were attitudes of individuals who were not directly affected at the time by computers, they therefore reflect a more generalised aversion to computers. This in turn could lead to resistance to personally using PWS.

### 2.2.3 **Summary**

In general, the reaction to personal use of IT covers a wide range of behaviours. These reactions raise a number of issues. One major one, however, is how to control the rate of diffusion of the technology, so that the organisational goals for its use can be attained. In some cases, the goal may be to slow the rate of diffusion, while in many others it will be to increase the acceptance of the PWS by potential users so as to increase diffusion. Historically, managing the acceptance and use of IT, and its outputs, have long been concerns among MIS professionals. The next two sections describe some of the work that has been conducted in this area so as to put the use of PWS into the greater context of use of information systems in general.

## 2.3 INFORMATION SYSTEMS IMPLEMENTATION

To some, the introduction of PWS into the work place can be considered a special case of information systems implementation (for example, see Christensen, 1987). Development of the PWS is seen as a step in the continuing evolution of information systems, which has been characterised by continuous reductions in the physical size and cost of computer hardware, commensurate with substantial gains in its performance. The PWS is a result of this evolution, which, simply, has made it possible to put IT into the hands of "end users". Now, they may directly "support" themselves, where previously they had to deal through intermediaries to acquire computer support.

It is a basic axiom that the role of information systems, in general, is to enhance the performance of the decision makers in organisations. How this basic goal is operationalised, however, has been open to debate for decades. Over twenty years ago, Ackoff (1967) identified, what he called five mistaken assumptions that systems designers made. For example, he argued that:

> "most MIS's are designed on the critical assumption that the critical deficiency under which most managers operate is the **lack of relevant information**. I do not deny that most managers lack a good deal of information that they should have, but I do deny that this is the most important informational deficiency from which they suffer. It seems to me that they suffer more from an **over abundance of irrelevant information**.

In spite of such comments, Ackoff did support the notion that an MIS was intended to, and could, improve the performance of managers if developed properly. His criticism was with respect to how information systems were implemented.

Systems professionals, therefore, have long been concerned with how to successfully implement information systems so as to achieve the aim of improving the performance of their clients. Because "improved performance" is such a difficult construct to measure, several surrogates for **success** have been used. One of the most popular has been **usage of the system**. The idea here is that a system cannot be a success if it is not used. Because rational individuals would not use an ineffective system, usage must mean effectiveness. As stated by Ein-Dor, Segev and Steinfeld (1981):

> Given the close relationship between use and success, it is clear that an understanding of the reasons for use and disuse would contribute to the ability to construct successful systems, hence

> the importance of research in this area [e.g.] (Ein-Dor & Segev, 1981; Garrity, 1963; Swanson, 1974).

Later, Ein-Dor and Segev (1982) were to be even more emphatic about the importance of system use:

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

Another approach to assessing implementation success has been that of the **perceived effectiveness** of the system. Briefly, this approach measures effectiveness as perceived by the users, including user satisfaction with the system and its outputs, perceived system quality, and so forth. Ginzberg (1978, 1981b), one of the advocates of this approach, argued that the link between usage of the system and implementation success was tenuous. If the system is viewed as a service designed to enhance the performance of managers, usage measures may be quite misleading as indicators of success. It is obvious that use may not necessarily enhance performance. On the other hand, it was argued that users' perceptions of how effective the system was in enhancing performance could provide a more accurate indication of whether the system was meeting its objectives. Thus, **perceived effectiveness** could provide a better measure of the success of the system's implementation than **system usage**.

Finally, some have argued that both approaches may be appropriate (e.g. Ives, Olson & Baroudi, 1983). Srinivasan (1985), in an empirical study of the two approaches, concluded:

> Researchers have to be extremely cautious about using surrogate measures of system effectiveness. While in certain classes of systems strong positive associations may exist between the two types of measures [system usage, perceived effectiveness], in other classes of systems this relationship may be non-existent. Researchers will have to clearly specify what the exact nature of the dependent variables are. System use and system effectiveness may be indicating two entirely different phenomena.

Srinivasan's finding that the two measures might not be tapping the same phenomenon had been previously identified in a study by Barki and Huff (1984). In this case, they were studying "decision support system success", and specifically examined different measures of success. One of their perceived effectiveness measures was **user information satisfaction**, while **use** was measured by asking respondents to report the frequency that they used the Decision Support System (DSS). One conclusion which Barki and Huff reached was that:

> the relatively small correlation between user information satisfaction and system use (.394), [confirmed] that the two measures, while related, are not measuring the same thing.

Given the foregoing, the question is raised as to what actually constitutes implementation success. Unfortunately, the answer which must be accepted at this point is that the appropriate measure of success is contingent upon the particular situation one is researching. Thus, the thrust of implementation research has been to attempt to identify the most appropriate indicator of success in a particular situation, and then to understand the forces which underlie success for that implementation.

In order to understand research into implementation, however, one should first understand what **implementation** is. Implementation is defined by Nutt (1986) as "a series of steps taken by responsible organizational agents in planned change processes to elicit compliance needed to install changes" (p.230). Within information systems, implementation was defined as:

> an on-going process which includes the entire development of the system from the original suggestion through the feasibility study, systems analysis and design, programming, training, conversion, and installation of the system (Lucas, 1981, p.14).

The common thread in both definitions is the idea of "responsible agents" planning change, or "conversion", from one way of doing things to another. It is seen as a rational process. In fact, Lucas' definition of implementation is a paragon of rationality. Given these characteristics, therefore, it might be argued that the introduction of PWS into organisations is sometimes not necessarily one of planned systems implementation. This is primarily true in the area of EUC, which seems to be a user driven phenomenon. There is not necessarily any **planned** change, because the users react, on their own, to the vagaries of the moment and adopt PWS usage, often by acquiring a microcomputer. Similarly, many IS professionals would argue that often there is no "responsible agent" involved in the acquisition and use of a PWS. Instead, in many cases, there are quite irresponsible agents who do not follow the tried and true rules of system development and implementation. Thus, in this situation, **use** of the PWS is seen by IS professionals as a "failure", not a success.

The foregoing argument with respect to the acquisition and use of a PWS does not intend to imply, however, that all instances of users taking over some systems functions for themselves are negative. Many organisations have recognised the benefits of end users doing their own computing and application development (Davis & Olson, 1985; Gremillion & Pyburn, 1983). Having users take over systems development tasks can help to relieve the shortage of systems development personnel, eliminates the difficult task of the users trying to communicate their information needs to an analyst, and transfers the system implementation process to the users. It is thought that users are more likely to use systems that they have developed than those developed for them by "experts". When users take over these tasks, however, it must be recognised that certain risks exist from potentially poorly developed systems. Policies need to be in place, therefore, with respect to user training, quality control and assurance. In these situations, nevertheless, the use of PWS is encouraged, and hence the situation does become one of planned implementation. Furthermore, while perceived effectiveness and other measures may be indicators of success, **use** is seen as a necessary condition for success. Thus, the focus of most of these implementation efforts is to encourage clients to actually adopt PWS usage.

On the other hand, while the growth of EUC in organisations may or may not be the result of implementation projects, **Office Automation** generally is. This is due to the fact that these projects are typically introduced when an organisation, as opposed to an individual, concludes that gains in productivity can be made from its employees' direct computer usage. Furthermore, **OA** tends to be introduced as an integrated system on an organisation wide basis, requiring that the necessary intra-organisational linkages be identified and developed. More recently, inter-organisational systems have also been developed. All of this requires "planned change by responsible agents". With many of these projects, it generally must be assumed that gains in productivity will occur, because many of the gains are hard to measure. For this reason, system **usage** becomes the measure of implementation success.

Given the above arguments, it becomes clear that in the case of PWS implementation, **use** of the technology is a prime consideration, whether it be to discourage its use in some situations, or to promote its use in others. Thus, an understanding of the forces which motivate use or non-use of the technology becomes a key factor in managing its implementation. This leads to consideration of one's **Attitude** towards using the technology, which has been found to be a primary factor in systems usage. Some of the research into the role of **Attitude** is described below.

## 2.4 ATTITUDE RESEARCH

Within MIS research there have been several studies of the effects of **Attitude** on system use. One of the earlier studies was that of Schewe (1976), who found no relationship between whether individuals used a system and their professed attitude towards the system. Schewe found that while usage covaried with beliefs about MIS capabilities, it did not covary with attitudes towards use.

Many other studies, however, have found that attitudes do influence system usage. Schultz and Slevin (1975) found that four of seven attitudinal factors corresponded highly with the likelihood that the respondent would use the system. Robey (1979) used the Schultz-Slevin instrument and found that an indicator of **perceived worth** of the system correlated highly with two separate measures of system use. Based on his findings, he proposed an attitude research model to investigate usage questions. Based on a series of studies, Lucas (1978) had earlier developed a descriptive model of systems use. This model presented several hypothesised determinants of systems use, including users' attitudes and perceptions, technical quality of the system, situational factors, personal factors, decision style, and top management support for the system. Of these, Lucas found consistent support for his hypothesis that **attitude** influenced use. More importantly, however, he found that attitudes and perceptions play the role of **intervening** variables between use and the other determinants.

More recent studies have also found Attitude to be a primary factor in systems usage, especially with respect to the PWS. Christensen (1987) found that Attitude was a significant determinant both of the **intentions** of managers to use, and of their subsequent use of, a Decision Support System (DSS). Pavri (1988) found Attitude to have a significant effect on the use of micro-computers by managers. Finally, Howard (1986) simply recognised, a priori, the effect of attitudes on managers' use of microcomputers. Starting with this recognition, he then investigated various hypothesised determinants of Attitude.

While this discussion is only a cursory review of the research, it nevertheless indicates the importance of Attitude with respect to system usage. Given Attitude's importance, however, it would seem that some consensus should have been developed about the construct's definition. This is not the case. For example, as noted in a review of the research by Ives, Olson and Baroudi (1983), MIS researchers have failed to distinguish between such basic concepts as **Attitude** and **User Satisfaction**. While these are no doubt correlated, and likely causally linked, they should be treated as conceptually different. However, again as noted by Ives et al., a wide range of constructs have been treated as essentially similar. These include **felt need** (Guthrie, 1974), **system acceptance** (Igersheim,1976), **perceived usefulness** (Larker &

Lessig, 1980), **feelings about the information system** (Maish, 1979), and **MIS appreciation** (Swanson,1974).

As will be discussed in more detail in the next chapter, arguments have been made that Attitude Change and Persuasion theory should be tapped in order to provide a more theoretical underpinning for research into the role of Attitude with respect to PWS usage (Moore, 1987). Specifically, the **Theory of Reasoned Action** (Fishbein & Ajzen, 1975) was proposed as a foundation from which to proceed. Nevertheless, even once the need for clearly defining Attitude based on theory was recognised by researchers, there still have been inconsistencies in its operationalisation, and in identifying its key determinants. Three recent studies have used the Theory of Reasoned Action, as suggested, to study the acceptance of user IT. Davis (1985) examined the use of electronic mail and graphics packages. Christensen (1987) studied acceptance of a DSS, and Pavri (1988) researched the general use of microcomputers by managers. Even though these studies all explicitly recognised the need for a theoretical basis for studying the acceptance of PWS, and in fact used the Theory of Reasoned Action, they showed no consistency in how Attitude was operationalised or in how Attitude's determinants were identified . Their approaches are described below.

Based on a review of the relevant MIS literature, Davis (1985) identified two general constructs, **perceived ease of use** and **perceived usefulness** of the system, as the hypothesised beliefs which determined Attitude. Multiple item scales to measure **ease of use** and **usefulness** were then developed. These included such items as "using electronic mail gives me more control over my work" for **perceived usefulness**, and "learning to operate the electronic mail system is easy for me", for **perceived ease of use**. Attitude was then operationalised using five semantic differential items (e.g. "good-bad"), based on a seven-point scale.

While Davis identified general beliefs based on a literature review, Christensen (1987) followed more closely the method suggested by Fishbein and Ajzen (1975) to identify the relevant beliefs. Before conducting his full study, he circulated an initial questionnaire to a convenient sample in order to **elicit** particular beliefs that his respondents had about the outcomes of using the DSS. As a result he identified fourteen very specific beliefs about using the particular DSS in his study, the Interactive Financial Planning System (IFPS). These included such beliefs as "using the IFPS model implies less calculation and summation work", or "using the IFPS model makes it easy to change the structure of the financial model". These elicited beliefs were then included in the final survey questionnaire, where respondents indicated their degree of agreement with the beliefs (on a seven-point "agree-disagree" scale). These beliefs were next evaluated by the respondent as to whether they were "positive" or "negative" (again on a seven point scale). Each "agreement" statement was multiplied by its evaluation to derive an overall score for the belief. Finally, to operationalise Attitude, Christensen used a semantic differential scale containing seven items similar to those of Davis'.

Using both literature reviews and interviews with managers, Pavri (1988) also identified some very specific beliefs about using microcomputers as the determinants of Attitude. His final instrument included eight beliefs, such as using micros "allows one to be more independent of subordinates and secretaries", or using micros "provides access to higher quality information for better decisions". He, however, did not attempt a more direct measure of Attitude as did the other two researchers. Rather, using a method similar to Christensen, he first multiplied the respondent's agreement with the belief statement (on a 1-7 scale) by the professed desirability with the outcome (again on a 1-7 scale). Attitude was then synthesised from these scales by summing the scores for each belief.

These three studies are marked steps forward within MIS in the study of Attitude, its formulation, and its effects on system usage. However, as can be seen, much still needs to be done to bring some consistency into how Attitude is formulated, and specifically into how the particular beliefs that contribute to its formulation are identified and explicated. In that significant gains have been made by defining Attitude based on theory, rather than being dependent on the contingencies of the particular study, it is recommended that the **beliefs**, which are the basis of the Attitude, also be defined based on theory. In this way Attitude will not simply be a function of beliefs in a particular study. The next section suggests a method for doing this.

## 2.5 THE USE OF THE PWS AS A WORK INNOVATION

As was defined earlier, **implementation** is basically a process of planned changes. As indicated by Nutt (1986), these changes can involve:

1. technical innovations resulting from the application and use of technology;
2. administrative innovations dealing with relationships and promulgating new rules, roles, procedures, or structures within organisations; and
3. adaptation of technology or managerial practices used by competing or cooperating organisations.

As can be seen, **implementation** is very much concerned with innovation in organisations. For a number of reasons, therefore, a **diffusion of innovations** (DOI) framework should provide a basis for studying the implementation, or diffusion, of PWS. First, the PWS is a technical innovation, both in terms of its functions and its hardware. Second, its introduction has required administrative innovations to deal with the changed relationships between users and IS professionals that its use has created. Indeed, **implementation** of information systems in general can be seen as a process of innovation. Nevertheless, with the exception of a very recent increase in interest in diffusion theory, described below, the DOI framework apparently has not been applied to any great extent within published MIS work, either to study the diffusion of PWS, or **systems implementation** in general. In a review by Rogers (1983) of some 3085 publications, no mention is made of MIS nor MS/OR among the several disciplines listed.

One notable exception to the lack of use of DOI within MIS is Perry & Kraemer (1979), who used a DOI framework extensively to examine the effects of policy interventions on the diffusion of computing technology among American local governments. Huff & Munro (1986) also developed an information technology assessment and adoption model, and related it specifically to an earlier DOI model developed by Rogers (1961). Zmud (1982, 1983, 1984) examined the effects of several organisational-level variables on the diffusion of modern software practices. One recent study by Raho, Belohlav and Fiedler (1987) examined and found some evidence to support the descriptive nature of McFarlan's and McKenney's model of "Technology Assimilation" (McKenney & McFarlan, 1982; McFarlan, McKenney and Pyburn, 1983). This model described the various stages of the technology assimilation process based essentially on the degree of institutionalisation of the technology in the organisation. Neither the model, not the study, however, explicitly addressed the underlying forces which motivate an organisation to innovate, nor the process by which an ultimate adoption/rejection decision is reached. Furthermore, all these particular works primarily addressed diffusion at the organisational level, not at the level of individual adopters. Finally, the use of a DOI model was also proposed to study implementation methods, by Ginzberg (1981) with respect to the implementation of MIS, and by Schultz & Slevin (1975) with respect to MS/OR techniques. The latter saw implementation as "a special case of organizational innovation" and a call was made for some rigour in the study of implementation from this perspective.

In spite of these views and suggestions, the vast majority of approaches to the study of MIS implementation, in general, and the diffusion of PWS in particular, remain atheoretical. There have been, however, some suggestions that the use of PWS can be viewed as a DOI phenomenon (see for example Henderson & Treacy, 1986). Nevertheless, when work on this particular research commenced in 1986, the author was not aware of any others who were explicitly applying the DOI model to the study of PWS. As the result, however, of a presentation to a consortium of MIS doctoral students (Moore, 1986), contact was made with two other doctoral students who were also using the theory to investigate IS implementation. These students, whose dissertations are now completed (Brancheau, 1987; Alexander, 1989), had also not identified any other explicit use of DOI theory with MIS. Brancheau primarily investigated the potential adopters' environment (communication channels, organisational actions), while Alexander studied the adoption of an organisational level innovation, **data base machines**. Nevertheless, while these dissertations were concerned with the diffusion of IT, and used diffusion of innovations theory, they are only peripherally related to the current study.

In any event, given the success that the DOI perspective has had in other disciplines, and the new found interest in it among MIS researchers, it seems appropriate to apply DOI theory to the diffusion of PWS, without being accused of adopting a "framework of the month approach" (Keen, 1980). Among other benefits, it allows the identification of generic beliefs which affect **Attitude**, an objective highlighted in the previous section. The next chapter outlines how this was done with respect to this research.

## 2.6 SUMMARY

The personal use of information technology by individuals outside the Information Systems Department is a phenomenon which has received considerable attention in the last few years. To both organisations and individuals, PWS usage has offered many potential advantages, whether it be with respect to end user application development, or to the automation of many office functions. Nevertheless, there are many indications that the acceptance of PWS usage is far from universal, which is creating significant management problems. Resistance to information technology, however, is not a new phenomenon. There has been a reluctance among many to the use of information systems since their inception, with respect not only to hands-on use of the systems, but to use of their outputs as well. This is the basis of the **implementation** problem.

With respect to the diffusion of PWS in organisations, it can be seen that the initial measure of success of its implementation is the appropriate **use** of the machine. In that actual **use** is theoretically predicated by one's

**Attitude** towards use, this chapter reviewed some of the work that has been done with respect to **Attitude** towards use of information systems in general, and use of PWS in particular. It has chronicled some of the attempts, and advances, that have been made to provide a more theoretical basis for the study of the effect of **Attitude** on systems use. Nevertheless, as was discussed, there still is much work to be done in couching this line of research in theoretical terms. One of the suggested ways of doing this is to view the use of PWS in organisations as an **innovation**, and thus to draw upon the body of theory developed in the **diffusion of innovations** research.

It can be seen that there is an **object**, the PWS, which is central to this study. Thus it may seem to some that this research is technology driven, which opens it up to the potential criticisms of some observers:

> Even to the casual observer, it quickly becomes apparent that the IS literature is technology driven. As each wave of new technology occurs, the focus of the literature shifts to the predictable descriptions of the technology, examination of implications, case studies of use, exhortations to adopt, etc. This phenomenon is present in both the professional literature and the research literature; indeed, PhD dissertation topics appear to be a fairly reliable indicator of what technology is "in" each year .... (Weber, 1985).

Although, as mentioned above, the PWS is the central object of this study, it is not the central focus. This is **use** of the technology. Thus, the intent of this chapter has been to show that the current research can be viewed as a continuation of a long standing line of research, information systems **implementation**. The intent of the research is to provide a more theoretical basis for this line of study. This basis will be developed in the next chapter.

# CHAPTER THREE

# THE DIFFUSION OF INNOVATIONS: A THEORETICAL FRAMEWORK

Things do not change; we change.

Thoreau, WALDEN

## SECTION A: THE THEORETICAL MODEL

### 3.1 INTRODUCTION

Throughout their life cycles, individuals and organisations tend to prefer courses of action that continue their current ways of operating over those that represent change (March & Simon, 1958, p. 173). Alternatives which require a change are not normally adopted unless the present course of action is considered to be in some way unsatisfactory. This may result from discovering that the present programme of activities is inadequate, which leads to undertaking a search for a better alternative. It may also result from learning that a superior course of action exists, which makes the present course in comparison seem unsatisfactory. This has been termed discovery of the "performance gap" (Zaltman, Duncan & Holbek, 1973, p.2). Whatever the impetus, according to March and Simon, once consideration of "change" over "persistence" occurs, the process of innovation is started.

> Initiation and innovation are present when change requires the devising and evaluation of new performance programs that have not previously been part of an organization's repertory and cannot be introduced by a simple application of programmed switching rules (March & Simon, 1958, p.175).

### 3.2 INNOVATION

The term **innovation** has been used in a variety of contexts, with a corresponding variety of different meanings. In a review of these contexts by

Zaltman, Duncan, and Holbek (1973), the following definitions of innovation were discussed:

1. a creative process whereby two or more existing concepts or entities are combined in some novel way (p.7);

2. the process whereby an existing innovation becomes part of an adopter's cognitive state and behavioural repertoire (p.8); and

3. the idea, practice or material artifact that has been invented or that is regarded as novel independent of its adoption or non-adoption (p.8).

As a result of their review, Zaltman et al. concluded that the last definition of innovation is the most appropriate. It focuses on why something can be considered an innovation, whereas the first two definitions focus on the processes of invention and adoption respectively. This last definition is close to that offered by Rogers (1983), one of the pioneers in the study of innovations, in the third and latest edition of his now classic book on the diffusion of innovations:

> An innovation is an idea, practice or object that is perceived as new by an individual or other unit of adoption. It matters little, so far as human behaviour is concerned, whether or not an idea is "objectively" new as measured by the lapse of time since its first use or discovery. The perceived newness of the idea for the individual determines his or her reaction to it. If the idea is new to the individual, it is an innovation (Rogers, 1983, p.11).

### 3.3 DIFFUSION

An innovation moves through a population by **diffusion**, which is defined as the "process by which an innovation is communicated through certain channels over time among the members of a social system" (Rogers, 1983, p.5). In many early studies the diffusion of an innovation was compared to the spread of a disease, which from the theory of epidemics follows the classic S-shaped curve (Figure 3-1). Individuals were then categorised depending how early or late they adopted the innovation. Those who adopted early were the innovators, or "early adopters", and individuals who adopted later were laggards. Davies (1979), however, chronicled many of the weaknesses of this model. For example, not all individuals are equally susceptible to a particular disease, as the availability of inoculations could make some initially immune. The inoculation could wear off, however, and thus one's immunity might change. It is difficult, therefore, to forecast the shape the infection curve will take over time. In diffusion, the analogy to immunity would be some predisposition to resist an innovation. In any event, because of the somewhat simplistic approach of the "disease" model, other models of diffusion have been developed with the thrust being to recognise innovation as a change process which is influenced by a variety of factors.

## 3.4 INNOVATIVENESS

At the conceptual level, **innovativeness** is the dependent variable central to many studies of the diffusion of innovations (DOI). As defined by Rogers, **innovativeness** is the "degree to which an individual or other unit of adoption is relatively earlier in adopting new ideas than other members of a system" (1983, p.22). This definition is quite popular among many diffusion researchers, but appears to capture only part of the actual construct. Midgley and Dowling have argued that this particular definition is, in fact, an **operationalisation** of the construct, as it is couched directly in terms of the construct's measurement (time of adoption), not in abstract or conceptual terms. Such a definition is tautological, for "innovativeness is what we measure, and what we measure is innovativeness" (Midgley & Dowling, 1978, pp.230-232). The result of this tautology is that any study of innovativeness using this definition must be innovation specific, which limits the study's generalisability, and makes theory generation suspect at best.

Midgley and Dowling define innovativeness as "the degree to which an individual makes innovation decisions independently of the communicated experience of others" (1978, p.235). This definition reflects their view that innovativeness is essentially a generalised **personality trait** "that all members of society possess to a greater or lesser degree" (p.235). This belief is also held by others. For example, Hurt, Joseph and Cook (1977) argue that innovativeness is a "normally distributed, underlying personality construct, which may be interpreted as a willingness to change" (p.59). There are, however, problems in viewing innovativeness as a general personality trait. As will be discussed below, considerable research exits, as well as anecdotal evidence, that innovativeness is not a general trait, but rather is **relative** to a particular innovation. Examples are legion of those who are very innovative with respect to certain behaviours, such as using high technology products, but are unwilling to change in other areas, such as eating habits.

A second problem with Midgley and Dowling's definition is that although it does include the vital **communications** aspect of the diffusion of innovations, the authors define communicated experience as "information passed verbally between individual consumers [which] is generally based on actual experience with the new product in everyday usage" (p.235). Linking the communicated information to actual usage of the innovation seems to be overly limiting. For example, social norms, which are developed through the communications process, can heavily influence behaviour, including the use of innovations. Such norms can arise without the communicators of the norm ever having experienced the behaviour. One such example is abortion, which in many ways can be viewed as an innovative birth control method. It is probably safe to assume that the behaviour of many anti-abortionists is heavily influenced by the attitudes of others, most of whom will not have experienced an abortion. While the vast majority of innovations do not have the emotional impact of abortion, the point remains that usage is not necessarily required in order for a person to form an opinion about the innovation, nor for the opinion holder to be able to influence others.

Although it has been generally accepted that **interpersonal** communication is likely more effective than other communications media, down playing the influence of other media can create difficulties. An example is provided by a study conducted by Midgley himself (1976). In researching different types of influence on first time purchasers of six various consumer products, he found that "in two cases interpersonal communication was more effective than the media; in one case the effects were equal; and in the remaining three cases marketing influences were more influential" (p.39). Although Midgley admitted to some problems with the model he was attempting to develop, he concluded, whatever the results did or did not demonstrate, that:

> it is no longer possible to emphasize one type of communication at the expense of another. Any theory of innovative behavior must incorporate and relate all channels of communication and influence (p.39).

What seems to be important, therefore, in defining innovativeness is the amount and type of information required by an individual, relative to others, in order to decide to adopt an innovation.

A further difficulty with Midgley's and Dowling's definition is that innovativeness is related essentially to the **independence of decision making,** and not to actual **use of** innovations. It apparently does not matter whether an individual ever adopts an innovation, but rather that any decision is arrived at independently. The independent decisions may always be to reject the innovation. The authors address this apparently fundamental flaw only in passing. They argue that perhaps adding the "degree to which an individual is receptive to new ideas" might strengthen the definition, but that there was no "pressing point to make this added complication" (p.237). Even if the authors are given the benefit of the doubt and their meaning of "innovation decision" is taken to mean a decision to adopt, the exclusion of receptivity to new ideas seems to be quite simply illogical. As a first level definition, it would appear that this receptivity is the essential component of innovativeness.

In spite of some of the problems with the definition of innovativeness offered by Midgley and Dowling, their point is very well taken that the generally accepted definition given by Rogers is conceptually weak. On the other hand, one of the strengths of Rogers' definition is that it shows innovativeness to be a relative construct, an aspect which, for reasons discussed below, should be maintained in any definition. Thus, in order to capture the points made by Midgley and Dowling, as well as the strength of Rogers' definition, **innovativeness** is defined as follows in this study:

> Innovativeness is the degree to which an adopting unit makes novel use of product(s) or process(es), as compared to other members of the referent social system (Moore, 1987).

This definition is conceptually broad in that it taps several dimensions of the innovativeness construct. The first dimension is **adoptive innovativeness**, or time of adoption of an innovation, which is the crux of Rogers' definition. The earlier one adopts an innovation relative to others, the more novel must be the use of the innovation in the referent social system. Thus, an earlier adopter is more innovative than a later adopter.

A second dimension of the construct captured in the definition is **use innovativeness** (Hirschman, 1980, p.288). This is the use of a previously adopted innovation in a novel use domain or to solve a novel problem. It should be noted that the product or process itself might no longer be an innovation as it may already be well entrenched in the social system. It is the novel **type** of use which constitutes use innovativeness. The greater the degree of behaviour change required for the new type of use, the greater would be the innovativeness.

Finally, the third dimension of innovativeness reflected in the definition is the degree to which the innovation is put to use, or **implementation innovativeness**. The relatively more an adopter uses an innovation within a given use domain, the more innovative would he be. Although no studies were identified which examined this dimension, it is considered to be an important part of the construct. It would facilitate, for example, investigations of changing usage patterns over time, or of the differences between early adopters whose use remains constant and later adopters whose use might grow rapidly.

The capturing of post-adoption behaviour is believed to be a strength of the definition. For example, Tornatzky and Klein (1982) called for a measure of innovativeness which would include such behaviour, and suggested developing scales to measure the degree of implementation of the innovation. The definition above calls for such measures. The definition also has other strengths. First, it shows that innovativeness can be a property of adopters other than individuals, such as departments or whole organisations. Secondly, it shows that use of the innovation is required in order for one to be innovative, and implies that the more innovations that an individual uses, the more innovative would he be. Thirdly, by relating innovativeness to the "referent social system", the role that environmental factors can play is acknowledged. Finally, the definition includes the idea of making decisions independently of the communicated experience of others (Midgley's and Dowling's point), simply because novel use would imply that few others would have experience to communicate.

As an example of the interrelation of the three dimensions of innovativeness, consider the adoption of the Personal Work Station (PWS). A user may see the benefits of using electronic spreadsheets to calculate month-end balances, and therefore be among the first to acquire a PWS for that purpose. This is adoptive innovativeness. If the user were then to acquire a different application, such as word processing, use innovativeness would occur. Finally, as the adopter used the spreadsheet relatively more for the same purposes, calculating month-end balances, implementation innovativeness occurs. All three innovativeness dimensions are important when studying the adoption of innovations in general and PWS in particular, as different motivations may underlie the various behaviours.

As was mentioned above, innovativeness is a "relative construct" (Bigoness & Perreault, 1981, p.70). First, one's innovativeness is relative to other members of one's social system. Thus, particular behaviours may vary in relative innovativeness across social systems, or, in other words, across the **reference domain of the innovator** (Bigoness & Perreault, 1981, p.72). What might be innovative in one social setting, such as bankers' wearing short pants during a heat wave in London, is an entrenched behaviour among the banking community in Bermuda. The second domain where innovativeness may vary in relative terms is with respect to the innovations themselves, which is called the **content domain of the innovation** (Bigoness & Perreault, 1981, p.71). Individual innovativeness may vary along a continuum from high product or concept specificity, to being more universal. This means that some adopting units may be quite innovative with respect to certain innovations, and very uninnovative with respect to others. Again, this is illustrated in the example cited earlier of individuals being very innovative with respect to high technology products, but uninnovative with respect to eating habits.

The relativity of innovativeness may introduce confounding variables into attempts to compare results across various studies, or even within studies. This, however, should not be a problem in the current study. First, the content domain was very narrowly bounded to include the PWS itself and its various applications. Secondly, the reference domain (population of interest) was defined as **knowledge workers** in office settings.

## 3.5 THE MARKET PERSPECTIVE

To date, research on the diffusion of innovations has tended to concentrate on either the characteristics of adopters or the characteristics of innovations. The aim has been to attempt to determine what makes some potential adopters more innovative than others, or what makes some innovations more adoptable. These approaches have been termed the **adoption perspective**, in that they concentrate on the **demand** aspects of the process (Brown, 1981, p.5). Brown has argued that the **supply** side should also be considered, which he terms the **market perspective**, in that it explicitly addresses the processes by which an innovation is made available to potential adopters. This perspective takes the view that potential adopters do not act so much out of free will, but rather make choices within a given set of constraints and opportunities. These include the potential adopters' level of **awareness** of, and their **access** to, the innovation. Brown has argued that a "diffusion agency" can affect the rate of diffusion of an innovation by manipulating both of these constraints. For example, access to an innovation is a function of a number of factors, including product affordability and availability, and the adopters' accessibility to the market itself. By manipulating factors such as these, the agency can attempt to affect both the rate and direction that an innovation takes.

The market perspective shows that different rates of diffusion may be found across organisations depending on the way each organisation manipulates the set of constraints within which potential adopters operate. In fact, it has been argued in the DOI literature that diffusion research should shift from focussing on the individual adopter to the organisation (e.g. Baldridge & Burnham, 1975), and models of innovation at the organisational level are being developed (e.g. Amabile, 1988). The thrust behind these arguments has been that, in many studies, differences in organisational context have been better predictors of innovativeness than individual adopter variables (for some examples see Ettlie et al. 1984; Kimberly & Evanisko, 1981; Robertson & Wind, 1980).

Zaltman et al. (1973) propose several independent variables at the organisational level which could affect innovativeness (pp.134-155). They are as follows:

1. **Complexity**: the number of occupational specialties in the organisation, and their professionalism (pp.134-138).
2. **Formalisation**: the emphasis placed on following specific rules and procedures in performing one's job (pp.138-143).
3. **Centralisation**: the degree to which the locus of authority and decision making are higher in the organisation (pp.143-146).
4. **Interpersonal Relations**: the degree of impersonality within the interpersonal relations (pp.146-148).
5. **Ability to Deal with Conflict**: (pp.148-154).

The interaction between these variables and innovativeness are complex. Furthermore, depending on the stage of diffusion, the effects of each variable may change. At the initiation stages (awareness, persuasion and decision) it is expected that lower levels of complexity, formalisation and centralisation will facilitate innovativeness. During the implementation and confirmation stages, however, it is expected that the reverse of this will be the case. Thus, the way an organisation operates and is structured may have to change over time depending on the desired degree of diffusion, the stage of the diffusion process, and the pervasiveness of the innovation. Furthermore, the ability of the organisation to handle conflict will impact on how well and widely the innovation is eventually diffused.

Many of the arguments for focussing on organisational variables make sense when examining inter-organisational differences in the rate of diffusion of certain innovations, and when studying organisational level innovations. One such MIS innovation would be Database Machines, the subject of another DOI study currently underway (Alexander, 1989). These innovations must be adopted by entire organisations as opposed to by individuals. Office Automation (OA) could also be an example of an organisational level innovation, especially if considered as a "whole", as opposed to a collection of individual PWS. Nevertheless, as has been argued earlier, much still remains to be learned at the individual adopter level about the acceptance of PWS. The OA and EUC literature indicate that, even within given organisational, or "market", contexts, significant differences exist in the acceptance of PWS by individual adopters. Furthermore, as will be discussed below, organisational variables would affect diffusion by influencing individual norms and attitudes towards adopting PWS. These facts all support an approach initially concentrating on identifying the salient variables at the individual adopter level which affect adoption of the PWS.

Support for this approach also appears in the research literature. Introduction of PWS in an organisation is an example of a **process** innovation which mainly affects the organisation's **administrative core**. Its primary impact is generally on knowledge workers' work processes, with a much smaller effect on the actual overall **technology** used by the organisation. Differences have been found between innovations which affect the administrative core and those which affect the technology core of organisations (see Aiken et al., 1980; Daft, 1978; Kimberly & Evanisko, 1981; and Zmud, 1982). Specifically, Zmud (1984) found that use of an administrative innovation was largely a function of the manager's knowledge of the innovation, and that organisational receptivity towards change had no significant impact on administrative process innovation (p.736). Kimberly and Evanisko also found that organisational and contextual variables were less effective predictors of administrative innovations than of technological innovations (1981, p.705). These findings all lend support to initially concentrating on PWS adoption at the individual adopter level.

## 3.6 VOLUNTARINESS OF PWS USAGE

When examining the adoption or rejection of innovations, consideration must be given as to how free an individual is to carry out his personal adoption or rejection decision. For example, an individual may decide to adopt an innovation, but may be prevented from doing so. With respect to PWS, an individual may have decided that the PWS would be a definite asset in his job, but may not be able to adopt it because corporate policy prevents it. In this case, because of the favourable attitudes and decision to adopt, "symbolic adoption" has occurred but actual adoption has not. Similarly, of course, "symbolic rejection" may occur. In this case, one would observe an individual using the innovation, but if he had free choice, the innovation would not be used. With respect to PWS, cases exist where some typists did not want to convert to word processing from traditional typing but had no choice, other than to quit their job. Symbolic rejection occurred for those who converted to word processing.

In situations where the required behaviour is contrary to the symbolic decision, **innovation dissonance** occurs (Rogers & Shoemaker, 1971, p.31), a term obviously adapted from "cognitive dissonance" (see Festinger, 1957). As with cognitive dissonance, in order to overcome innovation dissonance an individual can either alter his attitude towards the innovation, or attempt to change the required behaviour. The dissonant rejector, who initially wanted to adopt the innovation but could not, might either develop a lesser opinion of the innovation, or attempt to circumvent organisational dictates and use it anyway. On the other hand, a dissonant adopter, forced to use the innovation, might either develop a positive attitude towards the innovation or actively attempt to avoid using it. In the case of PWS, examples have been described of dissonant rejectors covertly acquiring microcomputers contrary to company policy (Benson, 1983, p.38). On the other hand, dissonant adopters may be the cause of many of the so called "failures" of OA projects. The targeted individuals fail to use or support the projects, and the projects wither on the vine. In even more extreme cases, the targeted adopters may even sabotage such systems. Dowling (1980) reported deliberate staff interference or sabotage in forty-five percent of hospital information systems that he surveyed. These systems were designed to directly address problems in the delivery of medical care to patients. Extreme reports of violence against the technology have also been reported, such as one worker using a shotgun to literally blow away his terminal.

Innovation dissonance is an important consideration in the current research because the use or non-use of a PWS might be mandated by the organisation, and hence not be solely related to the individual's underlying attitude. Furthermore, the degree of voluntariness of PWS use has been found to be a major determinant of actual usage (Kraemer, 1986). Because of these considerations, care was taken in this study to measure the **voluntariness of use** of the PWS. As with most factors, it is not the **actual** degree of voluntariness which will influence behaviour, but rather the **perception** of voluntariness. Thus, for the purposes of this study, **Voluntariness** is defined as follows:

> Voluntariness: the degree to which use of the PWS is perceived as being voluntary, or of free will.

### 3.7 THE STATE OF DIFFUSION THEORY

Whereas diffusion theory has not been used to a great extent within MIS, as was discussed in Chapter Two, its use is quite prevalent in many other disciplines. Downs & Mohr called it "possibly the most fashionable of social science areas" in the decade from 1965-1975 (1976, p.700). Nevertheless, they also questioned the theoretical value of the research in that the findings from various studies showed significant variance. At the same time as criticising the research, however, they also said:

> This popularity [of diffusion research] is not surprising. The investigations by innovation research of the salient behavior of individuals, organizations, and polities can have significant social consequences. The latter imbue even the most obscure piece of research with generalizability that has become rare as social science becomes increasingly specialized (p.700).

Rogers later responded to the opinions of Downs and Mohr, stating that he believes the status of diffusion research to be "impressive" (1983, p.880), and that:

> when the reliability of our present generalizations [are compared] with those in other fields of social science, biological science, and physical science, I do not find them to be less reliable. So if the comparison is relative,

> diffusion generalizations are as reliable as those in other research fields, especially given the diverse range of scientific disciplines, methodologies, and types of innovations and adopting systems involved in diffusion research (1983, p.132).

Given Rogers' stake in diffusion research, it is not surprising that he has a somewhat more positive attitude towards the research than Downs and Mohr. Nevertheless, it does behove us to consider their concerns, and attend to the prescriptions offered in their article for improving the research.

Their first concern is that some inconsistencies in the research findings likely arise because all innovations have been treated as being similar, when they are not. Although an adopter may be innovative with respect to one innovation, this is not necessarily true for all other innovations (Downs & Mohr, 1976, p.702). Downs and Mohr therefore call for a taxonomy of innovations, so that innovativeness can be measured against a **type** of innovation. Bigoness and Perreault, in their attempt to offer a "conceptual paradigm" for the study of innovations, agree: "a single product criterion of innovativeness is appropriate if one is concerned with identifying innovativeness only with respect to that highly specified content area" (1981, p.73). These arguments reflect the discussion earlier about how innovativeness is relative to the **content domain** of the innovation. As mentioned earlier, this study is concerned with innovativeness in a highly specified content domain, in that it is examining the diffusion of a specific innovation, the PWS.

A second concern of Downs and Mohr is that "an innovation is rarely the same thing to two organisations" (1976, p.703). This is based on the fact that innovations have both "primary" and "secondary" attributes. These terms are explained as follows:

> Galileo, Descartes, Locke and others divided the qualities of objects and substances into two classes which Locke designated as primary and secondary. Secondary qualities are those which are perceived by the senses, and so may be differently estimated by different percipients; primary qualities are those which are essential to the object or substance and so are inherent in it whether they are perceived or not (1976, p.702).

Thus, Downs and Mohr call for a division of the attributes of innovations into primary and secondary attributes. As an example of the effect of this division, consider the attribute of **cost**. This is a primary quality if actual **price** only is used, but can be a secondary attribute if price relative to disposable income is used. Thus, what might appear "costly" to one potential adopter, could be "inexpensive" to another, depending on their relative levels of income. It is argued that it is relative **cost** which has the greatest effect on buying behaviour. Downs and Mohr argue that if studies were to be based only on primary qualities, the inconsistency in findings across studies would not be resolvable (1976, p.703). If secondary qualities were used, however, then a more general theory is possible by studying the interaction among **perceptions** of innovations. This is the very approach used in the current research. As will be discussed later in this chapter, one of the hypothesised determinants of the rate of diffusion of innovations are the **perceived characteristics**, or secondary qualities, of the innovation. These characteristics are the focus of this study.

Finally, Downs and Mohr address what they call instability due to differences in the operationalisation of the dependent variable, innovativeness (1976, p.709). They identify three common operationalisations which had been used, which although interrelated may also have tapped different behaviours. These are:

1. time of first use of the innovation,
2. simple adoption versus non-adoption of the innovation, and

3. degree of implementation of the innovation.

For example, Downs and Mohr argue that the first operationalisation allows inferences to be made about "search patterns, communication processes, and reference group behaviour" (p.709), but that the last will not. Whatever the possible inferences, the point is that the dependent variable needs careful explication so that the type of innovativeness being studied is understood. Where different types of innovativeness may be impacted by different sets of independent variables, consideration must be taken to ensure that this is noted in any discussion of research results. This study has addressed these concerns. As was discussed in Section 3.4, the definition of innovativeness used reflects three different dimensions or behaviours. As will be shown in Section 4.14, these three dimensions were explicitly operationalised and measured.

## 3.8 THE INNOVATION DECISION MODEL

### 3.8.1 Stages in the Innovation Decision

Diffusion of an innovation results from the cumulative decisions of individuals to adopt the innovation. Therefore, the process by which a potential adopter makes this decision is a vital element in any diffusion study, and hence a model of this process is required. The purpose of this section is to suggest one such model. Not surprisingly, several models have been developed which typically conceptualise the decision as a stage process (for a review, see Zaltman et al., 1973). The model developed by Rogers (1983, p.165) is appealing because it reflects the stages of the more general model of the decision process, as defined by Simon (1977). The stages in Rogers' model are as follows:

1. **Knowledge**: occurs when a decision maker is exposed to the innovation's existence and gains some understanding of its functions;

2. **Persuasion**: occurs when the decision maker forms an attitude toward the innovation;

3. **Decision**: occurs when the decision maker engages in activities that lead to a choice to adopt or reject the innovation;

4. **Implementation**: occurs when the decision maker puts an innovation to use; and

5. **Confirmation**: occurs when a decision maker seeks reinforcement of an individual decision already made, but may reverse the decision if exposed to conflicting messages.

Figure 3-2 illustrates this model with some modifications. The first is the addition of a **search loop** between the Persuasion and Knowledge stages. This loop reflects the potential adopter's gathering more information as he refines his attitude toward the innovation. The information search can tap a number of sources, including a **trial** of the innovation. While some researchers have set trial as a separate stage (see Klonglan & Coward, 1970; Robertson, 1971), it is included here in the search loop because it is considered to be a method of gaining more information about the innovation. A trial may or may not be actually carried out, and hence it cannot be considered a distinct stage.

The second modification to the model is at Stage IV, to define **implementation** as either **adoption** or **rejection**, not just use of the innovation. This definition had been included in Roger's original depiction of the stage process (Rogers & Shoemaker, 1971), but for some reason was dropped from his latest version. It is considered that explicit inclusion of **rejection**, as a behaviour not just a decision, is necessary for completeness. Finally, a second loop, from **Confirmation** back to **Decision**, has also been added to the model. **Confirmation** in the post-decision environment augments the effects of the initial persuasion "sources", which may in fact still be operative. This loop also highlights the possibility that the decision maker may actually reverse his initial decision.

### 3.8.2 Variables Affecting the Innovation Decision

In Rogers' model, several sets of variables are hypothesised to have effects in the various stages of the innovation decision. One is the adopter's **communications network**, which includes source, message, channel and recipient effects. Recipient factors are also captured in a second set of variables, the adopters' **personal characteristics**. Finally, there are the **perceived characteristics of the innovation**. Because the perceived characteristics are **perceptions**, they could actually change over time. These changes may be caused by cognitive dissonance setting in after a decision is made, or by assessing new information acquired from use of the innovation or from other sources. Thus, while the communications network and personal characteristics of the adopter are independent variables, the PCI are actually intervening variables. They are affected by the adopter's personal characteristics and by communications received about the innovation, as well as by the **objective characteristics** of both the innovation and its precursor (that which the innovation is intended to replace). The objective characteristics of the innovation and its precursor are their **primary qualities**, as defined earlier.

## 3.9 THE PERCEIVED CHARACTERISTICS OF INNOVATIONS

### 3.9.1 General

Based on a review of a number of studies, Rogers (1983) identified five general characteristics of innovations, as perceived by the potential adopters. These were:

> **Relative Advantage**: the degree to which an innovation is perceived as being better than its precursor.
>
> **Compatibility**: the degree to which an innovation is perceived as being consistent with the existing values, needs, and past experiences of potential adopters.
>
> **Complexity**: the degree to which an innovation is perceived as being difficult to use.
>
> **Observability**: the degree to which the results of an innovation are observable to others.
>
> **Trialability**: the degree to which an innovation may be experimented with before adoption.

The comprehensiveness and validity of these five attributes have received substantial support in a number of studies. It should also be noted that the labels for each of these characteristics could be preceded by the qualifier, "perceived". This was not done for ease of reading, but rather is assumed.

The **perceived characteristics** were initially used to study the **adoptability** of innovations, as opposed to the **innovativeness** of adopters. Adoptability and innovativeness are obviously intertwined, however, in that an innovation's adoptability is dependent upon the number of individuals who decide that it is worth adopting. On the other hand, an individual's innovativeness with respect to an innovation will be a function of the individual's perceptions of the innovation's relative advantage, compatibility, and so forth. From either perspective, Rogers' classification of perceived characteristics should be valid and applicable. For example, if one innovation has an apparent advantage over another, it likely will be adopted more quickly and by more people. On the other hand, if one individual can perceive an advantage more readily than another can, he likely will be more innovative. The difference is the point of reference: inter-innovation versus inter-adopter.

For purposes of studying the PWS, both reference points are applicable. If the interest is in why a particular type of PWS hardware or software is more successful than another, then the adoptability perspective should be used. If, however, the interest is in why some individuals adopt PWS whereas others do not, then innovativeness should be the focus.

Each of the perceived characteristics are discussed in the following sections in terms of actually **using** the innovation, and thus are the **perceived characteristics of <u>innovating</u>** (PCI). The reasons for discussing them in this fashion are presented in Section 3.10.2. Each characteristic is covered in turn, with an additional characteristic, **Image**, added to Rogers' list. Furthermore, **Complexity** has been reformulated as **Ease of Use**.

3.9.2 **Relative Advantage**

Relative advantage is defined as the degree to which using an innovation is perceived as being better than using its precursor (Rogers, 1983, p.213). While "advantage" is often couched in economic or social terms, within organisations the relative advantage of innovations is expressed most often in terms of increased profitability, time savings, or labour savings. Thus, it seems to be essentially an effectiveness and efficiency issue. This appears to be the case with respect to PWS usage.

Many individuals within organisations, especially among the professional or managerial ranks, have become dependent on computer services for the accomplishment of their tasks. Increasing demands are being made on the Information Services Department (ISD) for support applications, which has created a significant backlog in application development in the ISD (Alloway &

Quillard, 1983). On the other hand, many later generation computer "packages", such as spreadsheets, database query languages, report generators, and so forth, have now given users the power to commence developing their own "applications". This power, combined with the application backlog in the ISD, is one of the hypothesised causes of the growth of PWS usage (Sprague & McNurlin, 1986, p.288). The user can become "independent" of the ISD, and not be held to the ISD's schedule. Similarly, some users may adopt PWS simply to become more independent of support staff, for example by doing their own word processing. In both cases, PWS users may feel they are more effective, in that they get results closer to what they want by doing their own work, and more efficient, in that the time to complete a task is shorter.

For those whose use of the PWS is part of their "job description", computer assisted work might be seen as both more effective and efficient than previous ways of completing the task (for example, use of word processing rather than typewriters). Nevertheless, there has been some debate on how the average **support worker** perceives using the PWS. The role of support workers is to provide such services as typing, filing, taking and forwarding messages, many of which can be automated. Some observers argue that automation could alleviate much of the boring routine of these tasks, provide job enrichment, and make the worker more efficient. On the other hand, one survey reported that women office workers saw automation resulting in "more of the same boring work, less variety, fewer social contacts, and lower relative pay" (Sprague & McNurlin, 1986, p.483). Furthermore, as discussed in Chapter Two, some analysts feel that introduction of the PWS may eliminate many workers' jobs (e.g. Canning, 1985b), and give the organisation a greater ability to control and monitor workers' performance (Keen, 1981). Added to this are concerns about the potentially adverse health effects of extensive PWS usage (Susser, 1987). All of these issues could likely have a negative effect on one's attitude towards adopting a PWS and cause some individuals to **avoid** using them. In this study, beliefs about the negative effects of PWS usage have been labelled **computer avoidance** beliefs. One of the goals of this study is to assess the strength of these beliefs as compared to the "positive" **relative advantage** beliefs.

### 3.9.3 Image

**Image** is defined as the degree to which use of an innovation is perceived to enhance one's image or status in one's social system. Because **Image** can be considered to be an advantage in adopting an innovation, it has been included by some researchers as an aspect of **Relative Advantage**, where it was placed by Rogers. Nevertheless, according to Rogers, "undoubtedly one of the most important motivations for almost any individual to adopt an innovation is the desire to gain social status" (1983, p.215). In fact, some researchers have found the effect of **Image** to be significant enough or different enough to be considered as a separate factor in the adoption decision. For example, Holloway (1977), in examining the diffusion of a pedagogical innovation in high schools, found that **status** emerged as a distinct factor even though he had expected that it would be a component of **Relative Advantage** (p.61). As a result, he argued that "consideration must be given to the 'status' category when developing innovations to be adopted by bureaucratic organizations" (p.137).

Whether **Image** is considered separately from **Relative Advantage** depends on where the theoretical bounds of "advantage" are set. Evidence exists that there certainly seems to be a significant "image enhancement" component to the acquisition, if not use, of a PWS. It has been argued that because leading business magazines often discuss the advantages of using PWS, "where executives and managers once looked down their noses at keyboard devices, personal computers are now beginning to take on an aura of status symbols" (Sprague & McNurlin, 1986, p.287). In fact, even the term "keyboarding" seems to have been coined to circumvent the negative image of "typing". Thus, because of its potentially significant effects, **Image** was included as a separate perceived characteristic in this study.

### 3.9.4 **Compatibility**

Compatibility is the degree to which use of an innovation is perceived as being consistent with the existing values, past experiences and needs of potential adopters (Rogers, 1983, p.223). People seem to be most comfortable with things or ideas which are familiar. This concept ties to that of **primacy**, which indicates that the way in which an organism first successfully copes with a situation sets a pattern which is usually persistent (Watson, 1972).

Compatibility seems to operate in at least two ways. First, it has been argued that previous experience in the innovation's domain leads to increased ability to recognise its potential advantages (Hirschman, 1980). For example, the "growing familiarity with computers" is one of the hypothesised causes of the growth in PWS usage (Sprague & McNurlin, 1986, p.287). Second is the idea of "technology clusters" (Rogers, 1983, p.226), where similar innovations are often viewed in the same manner, and adoption of one may trigger the adoption of others. This is supported by a study of the adoption of home computers, in which the use of several similar high technology products correlated highly with the decision to buy a home computer (Dickerson & Gentry, 1983).

Experience with computers may be gained through one's work and education. Many individuals have had exposure to computers in school and college. Others, as was discussed earlier, have been receiving computer support in their work for some time, albeit through third parties. Nevertheless, these types of experiences could lead to the idea of using PWS becoming more compatible with one's experiences, values and needs.

### 3.9.5 Ease of Use

Complexity is the degree to which learning to use and actually using an innovation are perceived as being difficult (Rogers, 1983, p.230). This includes both the ideas "contained" in the innovation, and on the ease of implementing the innovation (Zaltman et al., 1973, p.39). The more complex that using an innovation appears to be, the less likely it is that an individual will adopt it. The reverse of this argument is that the easier it appears to learn to use an innovation, the more likely it is to be used. Casting this perceived characteristic as **Ease of Use** simply reverses the orientation of the construct. Because the remainder of the PCI are couched in positive terms, it was decided to use the same orientation for this construct.

**Ease of Use** seems to be a significant factor in the decision to use PWS. It is a perceived characteristic that has received considerable attention in the development of applications for lay users. In fact, one of the selling points on which most developers and vendors concentrate is the "user friendliness" of their products.

### 3.9.6 Observability

Observability is defined as the degree to which the results of using an innovation are perceived as being **visible** and **communicable** to others (Rogers, 1983, p.232). This idea seems to tap two aspects of the more general construct of the tangibility or **demonstrability of results** (Zaltman et al., 1973, p.39). The argument is that the more the results of the innovation can be measured or demonstrated, the more likely the innovation is to be adopted. Tangible results seem less uncertain than intangible results. Because acquisition of PWS within organisations often requires some form of justification, this characteristic may play an important role in the adoption of PWS. Any justification required is much easier if the results of using the PWS are both visible and communicable.

### 3.9.7 Trialability

Trialability is the degree to which an individual feels he may try out an innovation on a limited basis before adopting it (Rogers, 1983, p.231). As discussed earlier, a trial helps increase one's knowledge about the innovation. An innovation that can be tried should be more adoptable than one which cannot. No matter how good an innovation might be, if it cannot be tried out, its adoption carries a degree of risk which inhibits its diffusion. Evidence of application of this principle exists in everyday marketing efforts, where "free samples" of new products are provided unsolicited to allow the consumer a trial of the product. Also tied to the notion of trialability is that of reversibility, which is the ability to reverse one's decision, and divisibility, which is the ability to break down a larger innovation into smaller components which can be adopted piecemeal (Zaltman et al., 1973, p.42). All of these concepts relate to the adopter's ability to return to the pre-adoption situation at minimal cost or risk. Again, this characteristic is expected to play an important role in the adoption of PWS. Organisations have recognised this, and those attempting to foster the growth of personal computing often have a policy of "immediate availability for examination or trial of EUC [End User Computing] hardware and software" (Munro et al., 1987, p.15).

## 3.10 THEORY OF REASONED ACTION

### 3.10.1 General

Because two stages of the innovation decision process involve the formation and/or confirmation of attitudes towards the innovation, the persuasion and attitude change literature was examined to provide further theoretical underpinnings to the study. One theory which has been receiving considerable attention and research support is Fishbein's and Ajzen's (1975) **Theory of Reasoned Action** (for a discussion of research results see Petty & Cacioppo, 1981). This theory specifies the relationships between beliefs, attitudes, and behaviours. Fishbein and Ajzen show Reasoned-Action theory (R-A theory) to be quite similar to other models of attitude change, such as learning theory, expectancy value theory, consistency theory, and attribution theory. R-A theory has been used in a variety of research areas, and recently has been applied within MIS (Davis, 1985).

R-A theory is very applicable in the current research because of its parallels with the innovation decision model (as illustrated in Figure 3-2). It helps define the linkages between the perceptions about using the innovation, communications received about using the innovation, and the eventual adoption or rejection of the innovation. It is based on the proposition that an individual's overt **Behaviour** (B) is determined by his intention to perform that behaviour. As is further explained below, the **Behavioural Intention** (BI) in turn is a function of two factors. The first is the individual's **Attitude** towards performing the behaviour itself, ($A_B$), and the second is his **Subjective Norm** (SN).

### 3.10.2 **Attitude Towards the Behaviour**

R-A theory states that the **attitude** towards the behaviour, $\mathbf{A_B}$, is a function of the individual's **expectation** that the behaviour act will lead to certain outcomes, and a weighted **evaluation** of those outcomes. The formation of $A_B$ then would be determined by the following equation:

$$A_B = \Sigma(b_i e_i)$$

$b_i$ = the expectation of the ith outcome
$e_i$ = the evaluation of the ith outcome

In their early formulations, as well as in those of other researchers, **Attitude** originally was represented as the attitude towards the object of interest ($A_o$), not towards the behaviour ($A_B$). The reformulation occurred because, as argued by Ajzen and Fishbein (1980, p.8), the attitude towards an object can frequently differ from the attitude towards a particular behaviour concerning that object. The example they cite is the potential difference that may exist between an individual's attitude towards "blacks" (the object) and his attitude towards "hiring blacks" (the behaviour). An employer who dislikes blacks may nevertheless believe that hiring blacks will bring more positive than negative results. Thus his attitude towards **hiring** blacks will be positive. Not only have Ajzen and Fishbein (1977) shown that this reformulation including the $\mathbf{A_B}$ has better predictive power than that including the $\mathbf{A_o}$, but it has great intuitive appeal as well. This study, therefore, concentrated on the attitudes towards **using** PWS, not towards PWS per se.

Given that **Attitude** is formed from the various **Beliefs** about the behaviour, one of the major tasks is to identify what the relevant beliefs are. As stated by Ajzen and Fishbein:

> Although a person may hold a large number of beliefs about any given object, it appears that he can attend to only a relatively small number of beliefs, perhaps five to nine, at any given moment. According to our theory, these **salient** beliefs are the immediate determinants of the person's attitude (1980, p.63).

One of the methods they suggest to determine the salient beliefs is to use the free response format of having the subject list the beliefs about the behaviour in question. It is assumed that respondents will tend to list beliefs in the order of relative salience. A problem, however, with this procedure is that one does not know when the respondent switches from salient to non-salient beliefs. Within this study, however, this problem was obviated in that the DOI research has defined these beliefs in the form of the **Perceived Characteristics** of the innovation.

**Beliefs** in the R-A Model, however, are defined with respect to the **outcomes** of actually adopting, not with respect to the innovation itself. Nevertheless, the **Perceived Characteristics** of the innovation can easily be recast in terms of **beliefs** about outcomes. For example, the definition of **Relative Advantage** needs only simple rewording to be couched in terms of beliefs about adopting an innovation. It would then be defined as "the degree to which **using** the innovation is perceived as being better than **using** its precursor". Thus, for the purposes of this study, the perceived characteristics are considered from the perspective of the potential adopters' personal use, trial or observation of the innovation, and were redefined as the **Perceived Characteristics of Innovating.**

### 3.10.3 Subjective Norm

As defined by Ajzen and Fishbein (1980), the **Subjective Norm** (SN) is a function of two components. The first is the individual's "normative beliefs" [$(NB)_j$], which are his **beliefs** about what his "important others", or **salient referents** (the j's), expect him to do with respect to a particular behaviour. The second component is the individual's "motivation to comply" ($MC_j$) with these beliefs. The individual $NB_j$'s are then weighted by their respective $MC_j$'s and combined to form the overall SN. It should be noted that it is the perception of what others expect, not their actual expectations, which is the basis for the SN. For example, an individual may consider working late at the office. For this particular behaviour, he may have two salient referents: his wife and his supervisor. The individual may believe that his wife expects him to come home on time, even though she wants him to work late so she can go shopping. On the other hand, he may think his boss expects him to stay late to finish a task, even though the boss really wants him to go home and rest. In any event, the individual formulates his SN by weighting what he **thinks** each of his referents wishes him to do by the **desire** to go along with each of them. In this two referent system he would follow the stronger MC. In systems with several referents, however, the integration becomes more complex. In any event, the SN can be formulated as follows:

$$SN = \Sigma[(NB)_j(MC)_j]$$

It can be seen from the foregoing that the subjective norm is more narrowly and specifically defined than the general view of norms. As pointed out by Ajzen and Fishbein (1980), sociologists have used the concepts of norms to refer to a broad range of permissible but not necessarily required behaviours. The subjective norm, on the other hand, is an individual's **perception** that an important other expects the performance, or non-performance, of a particular behaviour. Social norms may serve as one of the determinants of the subjective norm, in that an individual might infer from the more general social norms that an important other has a particular expectation. Nevertheless, a particular expectation may also run contrary to the social norm, and thus the two are not interchangeable.

### 3.10.4 Behavioural Intention and Behaviour

The **Behavioural Intention** (BI), as mentioned before, is the weighted evaluation of both the attitude towards the behaviour ($A_B$) and the subjective norm (SN). The actual **Behaviour** (B) then, according to Fishbein and Ajzen (1975) can be predicted according to the following formula:

$$B \equiv BI = W_1(A_B) + W_2(SN)$$

$W_1$ and $W_2$ are the relative weights given each component by the individual. **Behaviour** does not always correspond directly to **Behavioural Intention** in that several external factors may intervene between the intention and the behaviour (Ajzen & Fishbein, 1980, pp.47-51). One such factor is that the individual may be prevented by others from implementing his intention. With respect to PWS usage, this corresponds to the discussion earlier regarding the degree of voluntariness that the individual has in adopting or rejecting the innovation. This provides further impetus for measuring the perceived voluntariness of PWS usage.

### 3.10.5 **Linking Innovation-Diffusion and Reasoned-Action Theory**

Links can be made between diffusion of innovations (DOI) theory and the R-A model. First, it can be seen that the **Behaviour** in the R-A model would be the actual adoption or rejection of an innovation, and the **Behavioural Intention** corresponds to the actual decision to either adopt or reject the innovation (the innovation decision). Next, the process during which the **Intention** is formed corresponds to the Persuasion Stage of the innovation decision. The **Attitude** towards the behaviour is based on the expectations that the **Behaviour** leads to certain outcomes (the $b_i$'s). These correspond to the perceived characteristics of using the innovation (PCI's), such as whether it would be difficult, advantageous, reversible (trialable), and so forth. Finally, the various weightings, evaluations and so forth (the $e_i$'s, MC's, and W's), reflect the adopters' personal characteristics. For example, the MC's would reflect individual differences in complying with different referent groups, such as whether one is more influenced by management or by one's peers. Secondly, the W's capture the individual's tendency to make decisions either independently of norms, or to be influenced by them. Finally, the $e_i$'s could reflect the different experiences individuals have had with respect to similar innovations. Those having previous experience in the domain of the innovation might perceive use of the innovation to be easier, more compatible, and so forth. These are empirical questions which could be tested.

### 3.10.6 **The Innovation Decision Model**

In summary, the study of the diffusion of innovations would be facilitated by the use of a model which captures the underlying decision processes of potential adopters. The brief review above shows that the theory being developed in diffusion research in many ways mirrors that of persuasion research. It is felt, however, that the potential effects of the Subjective Norm, as highlighted in the Reasoned Action model, should be explicitly considered in any DOI study. Thus, the innovation decision model used in this study is an adaptation of the Reasoned Action model. It is illustrated in Figure 3-3.

The model contains the four sets of independent variables as discussed earlier. These include the adopter's communications network, his personal characteristics, and the objective characteristics of both the innovation and its precursor. The perceived characteristics of the innovation (PCI's) are captured within the **Attitude Towards Adopting** (Attitude) as beliefs about innovating. The model as illustrated makes a major deviation from Rogers' decision model, however, in that it explicitly recognizes the influence of **Subjective Norms** in the decision process. Furthermore, it can be seen that both the **SN** and **Attitude** act as intervening variables. The hypothesised interactions among the variables are all illustrated, including the "feedback" effects of actually adopting or rejecting the innovation on both the **SN** and **Attitude**.

**Attitude** is an intervening variable in that it is formed from consideration of the objective characteristics of both the innovation and its precursor, as well as from communications one has received about the innovation. One's personal characteristics, such as previous experience in the domain of the innovation, one's novelty seeking behaviour, and so forth interact with these other variables so that an eventual attitude is formulated. The **SN** is an intervening variable in that it is formed in a similar way. As discussed in Section 3.10.3, it contains two elements, the normative beliefs $[(NB)_j$'s$]$ and the motivation to comply $[(MC)_j$'s$]$ with those beliefs. The normative beliefs are **perceptions** of what one's referents expect, which may be formed in a number of ways, including communications received from the referents or from others, or by observation of the referents' behaviour. One's personal characteristics then play a role in the weightings (MC's) of the various **expectations** (NB's).

### 3.10.7 **Use of R-A Theory in MIS Research**

As discussed in Chapter Two, three previous dissertations were identified which used R-A theory. These include Davis (1985), Christensen (1987), and Pavri (1988). First, Davis (1985) used R-A theory in the development of a **Technology Acceptance Model** (TAM). The thrust of Davis' research is very similar to this study. Although he made no reference to the diffusion of innovations model as a theoretical basis for his research, his goal was to examine the effects of system characteristics on user acceptance of information technology.

Davis initially constructed his model in the context of user **acceptance testing** of software, wherein potential users were introduced to a new software package. Within TAM, Davis specifically examined the **perceived usefulness** and **perceived ease of use** of software as the determinants of an **attitude towards using** the software. Although based explicitly on R-A theory, TAM did not include either the **Subjective Norm** or the **Behavioural Intention**. Davis' rationale for omitting the **SN** was that since the subjects would be seeing a new system (prototype) for the first time, "no information [was] available to subjects pertaining to the expectations of their salient referents regarding their usage of the target system" (1985, p.36). If this is the case, the model must be very technology specific, for within an organisation it is expected that norms or beliefs about using generic software or information technology must exist to some extent.

Davis' rationale for eliminating the **Behavioural Intention** was based on his consideration of the time frame required to form such an intention. He argued that the time span can be significant to reach an important decision such as whether to become a user of the technology (p.38). He decided that in the acceptance testing context, a user would not have the time required to form an such an intention, and thus **Attitude** was used as the predictor for behaviour. This reasoning seems odd, as unless the behaviour is "accidental", it must be based on an intention. Nevertheless, whether a subject has the time to form an intention seems irrelevant as Davis' model is formulated. Intention is based on two components, the **SN** and **Attitude**. If the **SN** is eliminated, as in TAM, then the **Intention** is determined by the **Attitude** only, and thus the linkage between **Attitude** and actual **Behaviour** can be made directly.

Finally, Davis' use of only two perceived characteristics of the information technology seems overly limited. As was discussed, there is considerable evidence within the DOI literature that a number of characteristics influence the decision to use or reject new systems. This study on the diffusion of PWS, therefore, differs significantly from the development of TAM in that it adheres more explicitly to the R-A model, and makes a more exhaustive consideration of the perceived characteristics of using the technology.

Christensen (1987), as discussed in Chapter Two, did not attempt to identify any "generic" beliefs as the basis of **Attitude**. Rather, he followed the prescriptions of Fishbein and Ajzen, and used the belief elicitation technique. To do this, he conducted a preliminary survey which asked the respondents to indicate what they believed would be the outcomes of using a particular DSS. The result was fourteen very specific beliefs which correspond closely to the individual items in Davis' scales. The use of these particular beliefs makes this approach very technology specific. Thus, as has been argued, it is believed the more general approach of identifying beliefs based on DOI theory should provide greater external validity to the current study.

Finally, Pavri (1988) also identified specific beliefs, much in the same way as Christensen. As was indicated in Chapter Two, however, the difference in Pavri's approach was that he did not directly measure **Attitude**, as did Davis and Christensen. Rather, he synthesised **Attitude** by adding the scores to the beliefs scale.

One final study which indirectly used R-A Theory was that of Baroudi, Olson and Ives (1986), who investigated the effect of user involvement in systems development on system usage. In this case, they postulated that "user information satisfaction" was akin to **Attitude**. While, as discussed in Chapter Two, this is a curious assumption, nevertheless, the results of path analysis indicated that it did have an effect on **usage**, which they claim reflects R-A theory.

The use of R-A theory in these previous studies provides validity to the current approach. The major difference in this study is the use of theory to determine the appropriate belief structure. By tapping all of the relevant beliefs, or **perceived characteristics of innovating**, as identified in DOI theory, this study should provide a stronger basis for the study of disparate technologies.

## SECTION B: THE RESEARCH MODEL

### 3.11 GENERAL

The innovation decision model (ID Model) in Figure 3-3 is clearly very general. It specifies four general **sets** of independent variables that are hypothesised to impact on the innovation decision (Behavioural Intention), including the **Communications Network** and **Personal Characteristics** of the Adopter, and the **Objective Characteristics** of both the Innovation and its Precursor. These operate through two intervening variables, the **Subjective Norm** and the **Attitude Towards Adopting**.

It is obvious from the breadth of the propositions that could be developed for each set of variables that attempting to validate or investigate the whole model is a project much beyond the scope of one particular investigation. The initial thrust should be to identify those variables which appear to have a **major** impact on the actual **Behaviour**, which in this study is **Innovativeness**. Because of their role in the decision process, it would appear that the **Attitude Towards Adopting** (Attitude), and the **Subjective Norm** (SN) could have such an impact. Furthermore, **Innovativeness** has been defined in terms of usage of the innovation (see Section 3.4). It may also, therefore, be significantly affected by the degree of **Voluntariness** of usage, as discussed in Sections 3.6 and 3.10.4. Thus, the focus of this study is on the impact that each of these three factors, (SN, Attitude, Voluntariness), has on **Innovativeness**, as illustrated in the Research Model in Figure 3-4. Focussing on these variables allows investigation of the research questions as outlined in Chapter One.

It should be noted that the **Behavioural Intention** is not included in the research design. This was done for several reasons, both pragmatic and theoretical. First, **Innovativeness** as defined in this research is a complex construct reflecting various types of behaviour, both past and present. For example, **Adoptive Innovativeness** is based on time of first use of the innovation. Today, for most respondents, first use will have long since past. Therefore, measuring an **intention** to adopt PWS usage is not possible. Second, **Use Innovativeness** is based on the number of different functions that the adopter uses on the PWS. An **intention** measure for this aspect of **Innovativeness** would require eliciting many intentions, one for each of the various functions one could use on the PWS. This would obviously stretch the bounds of practicality. Third, **Implementation Innovativeness** is based on the number of hours one uses the PWS. Again, for the respondent to indicate an intention with respect to this variable not only would be difficult, but any answer would also likely be quite inaccurate.

Of primary interest in this study is the actual **Behaviour**, and how it is influenced by other variables. The primary role of **Intention** is to illustrate that the effects of the **Subjective Norm** and **Attitude** on **Behaviour** may be mediated by other variables (Ajzen & Fishbein, 1980, p.59). If there were no variables which intervened once an attitude and subjective norm were formed, then **intention** could be dropped from the model without a loss of information. Thus, the ability of the **SN** and **Attitude** to predict **Behaviour** depends on the strength of the **Intention-Behaviour** link, which in turn is affected by the strength and number of other intervening variables. One of the most significant variables which would intervene between an **Intention** and the **Behaviour** in this research is **Voluntariness**, which is included in the research model. Thus, by taking it into account, the role of **Intention** in this study is reduced. Finally, intentions are used to predict behaviour, and therefore to be of value "it is important to measure [them] as close as possible to the behavioral observation" (Ajzen & Fishbein, 1980, p.47). In this study, we are not attempting to **predict** future behaviour. Rather, we are attempting to determine how **current** behaviour is related to **SN**, **Attitude**, and **Voluntariness**. This again reduces the role of **Intention** in the model. For all of these reasons, it was considered that inclusion of **Behavioural Intention** in the model was neither practical nor necessary, and it was therefore omitted.

## 3.12 THE ATTITUDE TOWARDS ADOPTING

### 3.12.1 General

Although the research model developed for this study includes both the **Subjective Norm** and **Attitude Towards Adopting**, there is support in previous research for focussing primarily on **Attitude**. This is because several of the **Perceived Characteristics of Innovating** (PCI), from which **Attitude** is formed, have been found to have a significant impact on adoption decisions. For example, in two different studies on the adoption of new consumer products, Ostlund (1974) discovered that by using the PCI, he could correctly classify 79% of adoption decisions in one study, and 68% in the other. Next, Holloway

(1977) found that the PCI discriminated between adopters and non-adopters of a bureaucratic innovation (a high school pedagogical technique). Finally, Bolton (1981), in a longitudinal study of the adoption of videotext technology in individual's homes, found that **Relative Advantage** and **Compatibility** had more power than several other individual and contextual variables to discriminate between adopters and non-adopters of the technology. Therefore, because the PCI have been found to have a significant influence on adoption of innovations, because they form the basis of **Attitude**, and because **Attitude** is in a strategic position within the model, this part of the model became the primary focus of this research.

In summary, one's **Attitude towards Adopting** a PWS is expected to have a significant effect on one's innovativeness with respect to PWS usage. After the previous discussion, this may appear to be a truism, yet there are many other variables which may result in an individual using the PWS, such as being required to do so in one's job. On the other hand, if one had a significantly negative attitude about PWS usage, yet were compelled to use one, it is likely that one would attempt to find another line of work. Therefore, it is hypothesised that:

H1: One's attitude towards using PWS will influence one's innovativeness with respect to PWS usage.

### 3.12.2 Perceived Characteristics of Adopting an Innovation

As was discussed earlier, one's **Attitude** is formed by evaluating and summing the various beliefs about adopting the innovation. A primary goal, however, of this research was not only to assess the effect of **Attitude** per se, but rather the relative importance of the individual beliefs, or PCI, in the formation of the **Attitude**. This assessment can be made by casting

**Attitude** as a latent, **unobserved** variable formed from the various PCI, and then by analysing it using statistical techniques described in the next chapter. It can also be assessed by regressing the PCI on **Attitude** as measured. Again, this technique was also used.

### 3.12.3 **Evaluation of the Perceived Characteristics**

Fishbein and Ajzen argue that attitudes can be estimated with more precision by including an evaluation term for each belief, rather than by simply considering beliefs alone (1975, p.227). This evaluation term serves to provide relative weights to each of the beliefs (see discussion in Section 3.10.2). Nevertheless, it must be questioned whether doing so is advisable or even necessary for two important reasons. First, Fishbein and Ajzen do allow that if the **evaluation** terms are either all positive or all negative, the **belief** terms alone will produce a measure that is highly correlated with **Attitude**. Thus, because virtually all beliefs can be couched in either positive or negative terms, the use of the evaluation term seems only to serve to integrate oppositely stated beliefs. Within this study, the reorientation of oppositely stated beliefs is accomplished by simply reversing the scales for those items which are couched in negative terms. This reduces the contribution that the evaluation term might make. Thus, it was concluded that use of the evaluation term within this study was not necessary.

### 3.12.4 **Relative Effects - Perceived Characteristics Of Adopting PWS**

While the effects of the various perceptions of using a PWS have been delineated above, their **relative** effects have not been explicitly discussed. It is expected, nevertheless, that **Relative Advantage** will play a major role in one's attitude towards adopting the PWS. Without this perception, it is unlikely that an individual would decide to adopt a PWS, no matter how positive the other perceptions might be. Thus, the following can be hypothesised:

> H2: Relative advantage will have a contribution greater than any other PCI in the formation of one's attitude towards adopting a PWS.

While **Relative Advantage** is expected to have the most significant effect, beliefs about the negative effects of PWS usage, termed **Computer Avoidance,** are expected to have the least effect. This is due to the fact that while there has been some negative publicity about PWS usage, for the most part it appears as if this publicity has not slowed the diffusion of PWS. Therefore it is hypothesised that:

> H3: Computer Avoidance will have a contribution less than any other PCI on one's attitude towards adopting PWS.

### 3.13 SUBJECTIVE NORMS

At the social level, behaviour is often influenced by social norms. These norms are generally considered to be analogous to habits in individuals, which are customary and expected ways of behaviour (Watson, 1972, p.614). Similarly, at the individual level, one of the potential determinants of behaviour is the **Subjective Norm,** as defined in the Theory of Reasoned Action (Fishbein & Ajzen, 1975). As was previously discussed, the **SN** is formed from what one thinks others expect one to do, called Normative Beliefs, which are "weighted" by one's motivation to comply with these expectations.

With respect to PWS usage, there are several potential "referents" who might influence one's behaviour. These include one's co-workers, superiors, senior management, and so forth. Within MIS research, there is considerable evidence that several of these referents have been found to influence use of

Information Systems, or be a factor in the success of IS implementation efforts. For example, a popular nostrum for IS success has been "senior management support" (for some various viewpoints see Doll, 1985; Ginzberg, 1981; Markus, 1981). The presence of a "champion", someone who attempts to motivate others to cooperate has also been linked to eventual success of IS implementation efforts (e.g. Curley & Gremillion, 1983). This person could be a peer, supervisor, or other type of opinion leader. In any event, the expectations of these various individuals that others should use the IS would be subsumed within the **SN**. As the introduction of PWS in an organisation can be seen as a particular form of "IS implementation", it can be expected that such influences will also be operative with respect to the use of PWS. In spite of this, Davis, Bagozzi and Warshaw (1989) found that the **SN** had no significant effect on individuals' intentions to use a particular word processing package. They found the result "surprising". In any event, given the results of the larger body of research, both within and external to MIS, it is hypothesised that:

> H4: The SN will influence one's innovativeness with respect to PWS usage.

Finally, although R-A Theory does not postulate any interaction effects between the **SN** and **Attitude**, previous research has shown that these effects can exist (e.g. Ryan, 1982). Within MIS, one recent study of the adoption of DSS showed that the components of **SN** had a direct effect on one's **Intention**, as well as on one's **Attitude** (Christensen, 1987). This effect can be expected in that, typically, others might expect one to adopt, or reject, an innovation based on whether their own perceptions of using the innovation were positive or negative. If this were the case, then their <u>perceptions</u> would also likely be communicated along with their <u>expectations</u> (or beliefs) that one should adopt the innovation. These communicated perceptions could then influence one's own perceptions, and hence one's **Attitude**. It can, therefore, be hypothesised that:

> H5: SN will influence one's attitude towards adopting the PWS.

### 3.14 VOLUNTARINESS OF PWS USAGE

As has been discussed earlier, in constructing a model of innovativeness with respect to PWS usage in organisations, the degree of **Voluntariness** of use should be considered. R-A Theory indicates that the Behavioural Intention does not correlate perfectly with behaviour, and that other factors may mediate between the intention and actual behaviour. It is in this category of "other factors" that **Voluntariness** falls.

It is expected that **Voluntariness** will have effects on **Innovativeness** in different ways. First, individuals who perceive that they must use the PWS will likely use it more than those who perceive their use to be voluntary. In other words, the more voluntary one's usage of a PWS is, the less one's usage is likely to be. Consequently, because **Innovativeness** is defined in terms of <u>actual use</u> of the innovation, and not in terms of a mental state or predisposition towards using it, it can be hypothesised that:

> H6: Voluntariness is negatively related to one's innovativeness with respect to PWS usage.

As discussed earlier, **Voluntariness** could also have a direct effect on one's **Attitude** towards using the PWS. For example, the effects of **innovation dissonance**, as discussed in Section 3.6, could result in even compulsory users perceiving the PWS in positive terms. The effects of **Voluntariness** would operate in this instance through mental processes. On the other hand, it can also be argued that some of the greatest advantages of PWS usage accrue to those who must use it. Rational organisations would likely not compel individuals to use PWS if there were no benefits to the individuals in carrying out their job. For example, use of PWS for word processing certainly could make support staff more efficient than they were when using typewriters. It could save many boring repetitions of the same task, such as retyping whole documents in order to make simple corrections. After using the PWS, these users could develop a positive view of **Relative Advantage**. The same arguments likely hold for the other PCI. In this situation, **Voluntariness**, (or lack thereof), can affect one's attitude through the experience one gains from compelled behaviour. Thus, because of the effects of both **innovation dissonance** and "forced" learning, it can be expected that even compulsory users will eventually develop positive attitudes towards PWS usage. Therefore, it is hypothesised that:

> H7: Voluntariness will be negatively related to one's attitude towards using PWS.

### 3.15 SUMMARY - THE RESEARCH MODEL

The Research Model is illustrated in Figure 3-4. It includes the four major components of interest, **Subjective Norm**, **Voluntariness**, **Attitude**, and **Innovativeness**. It shows **Innovativeness**, with its various dimensions of **Adoption**, **Use**, and **Implementation**, as the dependent variable, influenced by **Attitude**, **Subjective Norm**, and **Voluntariness**. The model also illustrates the hypothesised effects of **Subjective Norm** and **Voluntariness** on **Attitude**. Finally, the model also indicates those beliefs, or PCI's, which are expected to contribute to the formation of **Attitude**. These include the five PCI identified by Rogers, namely **Relative Advantage**, **Compatibility**, **Ease of Use**,

**Observability**, and **Trialability**. As discussed earlier, and indicated in Figure 3-4, two further PCI, **Image** and **Computer Avoidance** have been added to Rogers' listing.

Conceptually, the relationship between **Attitude** and the PCI can be viewed from two perspectives. One is to view **Attitude** as the product of the various PCI. Another perspective is that, given a particular **Attitude**, one would also expect to observe certain corresponding perceptions **indicating** that the person holds that **Attitude**. For example, one would expect certain beliefs about other races in a person who is a racist. As will be discussed in Chapter 5, this is the primary perspective to be taken when analysing the data, and hence the arrows in Figure 3-4 are oriented from **Attitude** to the PCI. The data analysis technique to be used is **structural equation modelling**, as implemented in **LISREL** (Joreskog & Sorbom, 1984). **Attitude** will be cast as a latent, unobserved variable and the various PCI will serve as its "indicators".

## SECTION C: RESEARCH DESIGN

### 3.16 GENERAL

Several definitions of "research design" exist, most of which differ in the detail they present, or with which perspective they view the research in question. According to Emory (1980), there are at least seven different perspectives from which to view any given study. These include the following (p.84):

1. the degree to which the research focuses on a predetermined objective - exploratory or focussed;
2. the scope (breadth and depth) of the study - case or statistical study;
3. the research environment - field, laboratory or simulation;
4. the time dimension - cross-sectional or longitudinal;

5. the communication mode of data collection - observational or survey;
6. the degree of researcher control of the variables under study - low (ex post facto) or high (experimental);
7. objective of research - descriptive or causal analysis.

The particular design which is chosen for any study is very much a function of the aims of the study. This study was motivated by a desire to examine the effects of particular forces which are hypothesised to influence the adoption and use of PWS in organisations. Thus, it can be classified as a focussed study whose objective is to conduct causal analysis. One of the operational aims for the research was to maintain as high a level of external validity as possible. This led to the decision to conduct a field, statistical, ex post facto study. Furthermore, in that the independent variables are attitudinal, the only method of collecting the relevant data is through asking the subjects. This, combined with the extreme difficulty of measuring PWS usage objectively, led to the decision to conduct a survey. Finally, because the intent was to determine how current attitudes and norms affect current behaviour, the time dimension of the study was cross-sectional.

The focus of this study, as discussed earlier, is on those variables which influence one's use of PWS (see Figure 3-4). Given the chosen research design as described above, the next step in the study was to operationalise the various components in the research model, and to develop survey instruments to measure them. The next chapter describes these activities.

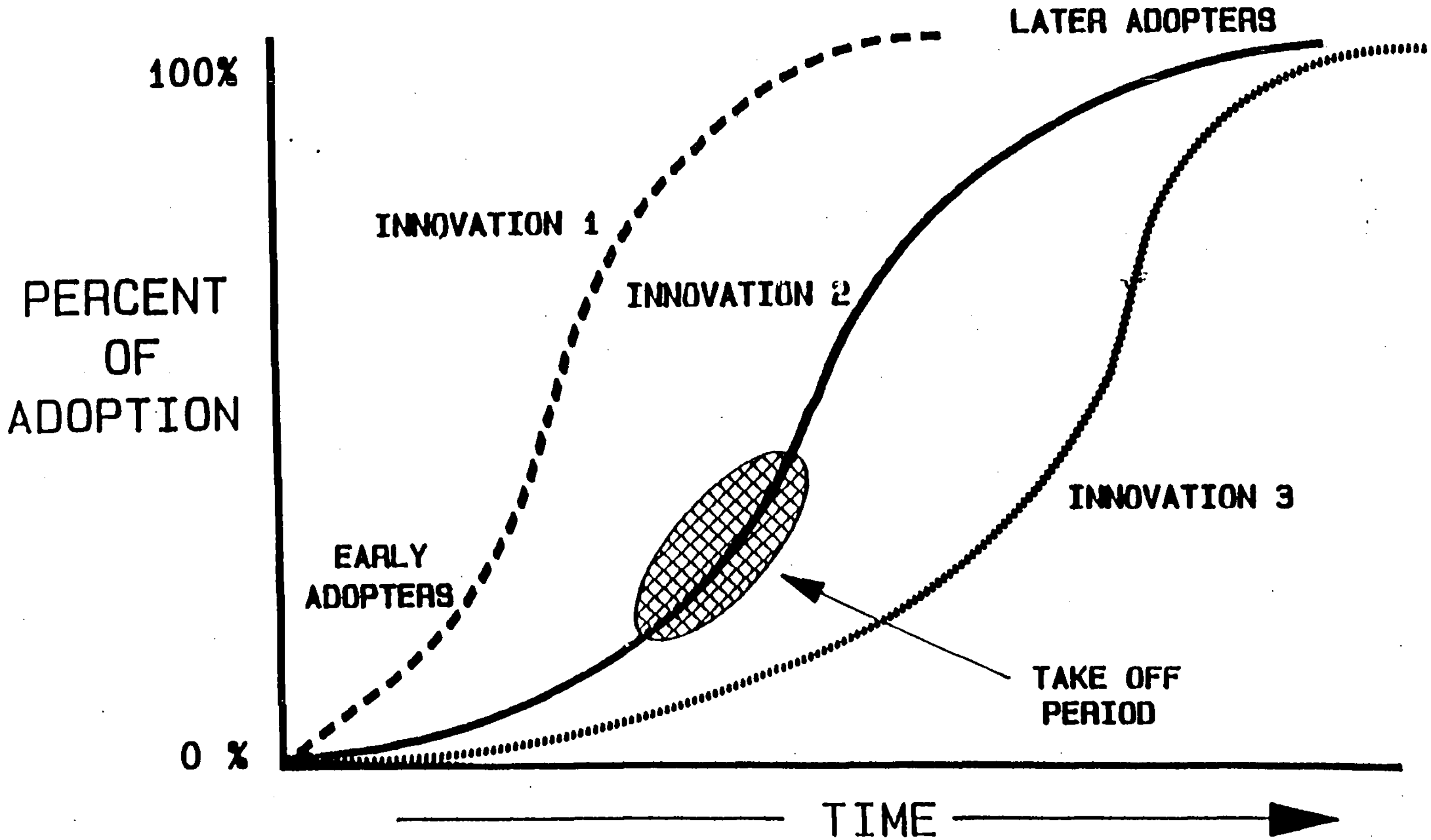


**FIGURE 3-1: DIFFUSION OF INNOVATIONS**

(ROGERS,1983)

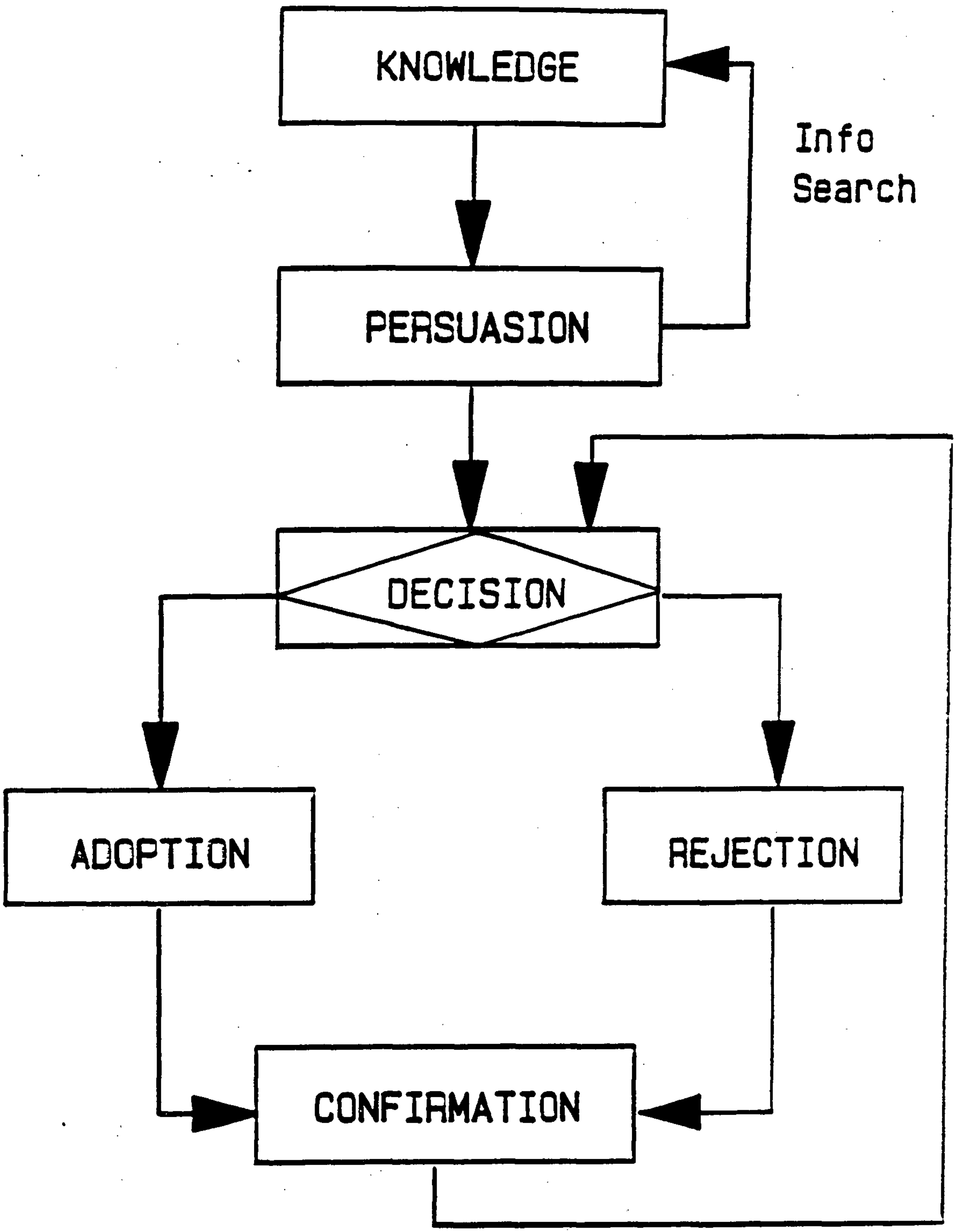


**FIGURE 3–2: STAGES OF THE INNOVATION DECISION PROCESS**

(ADAPTED FROM ROGERS, 1983)

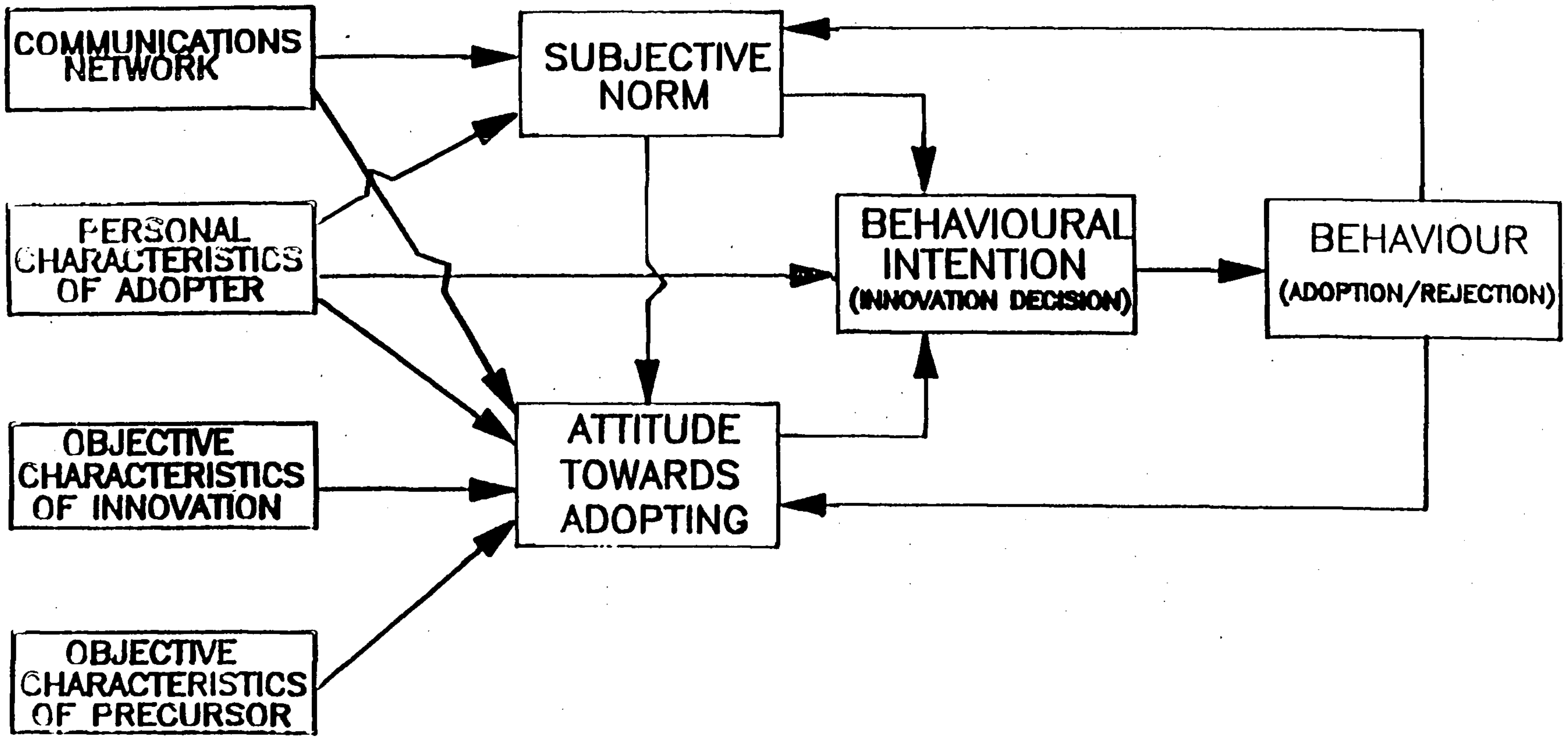


**FIGURE 3–3: INNOVATION DECISION MODEL**
(ADAPTED FROM FISHBEIN & AJZEN, 1975)

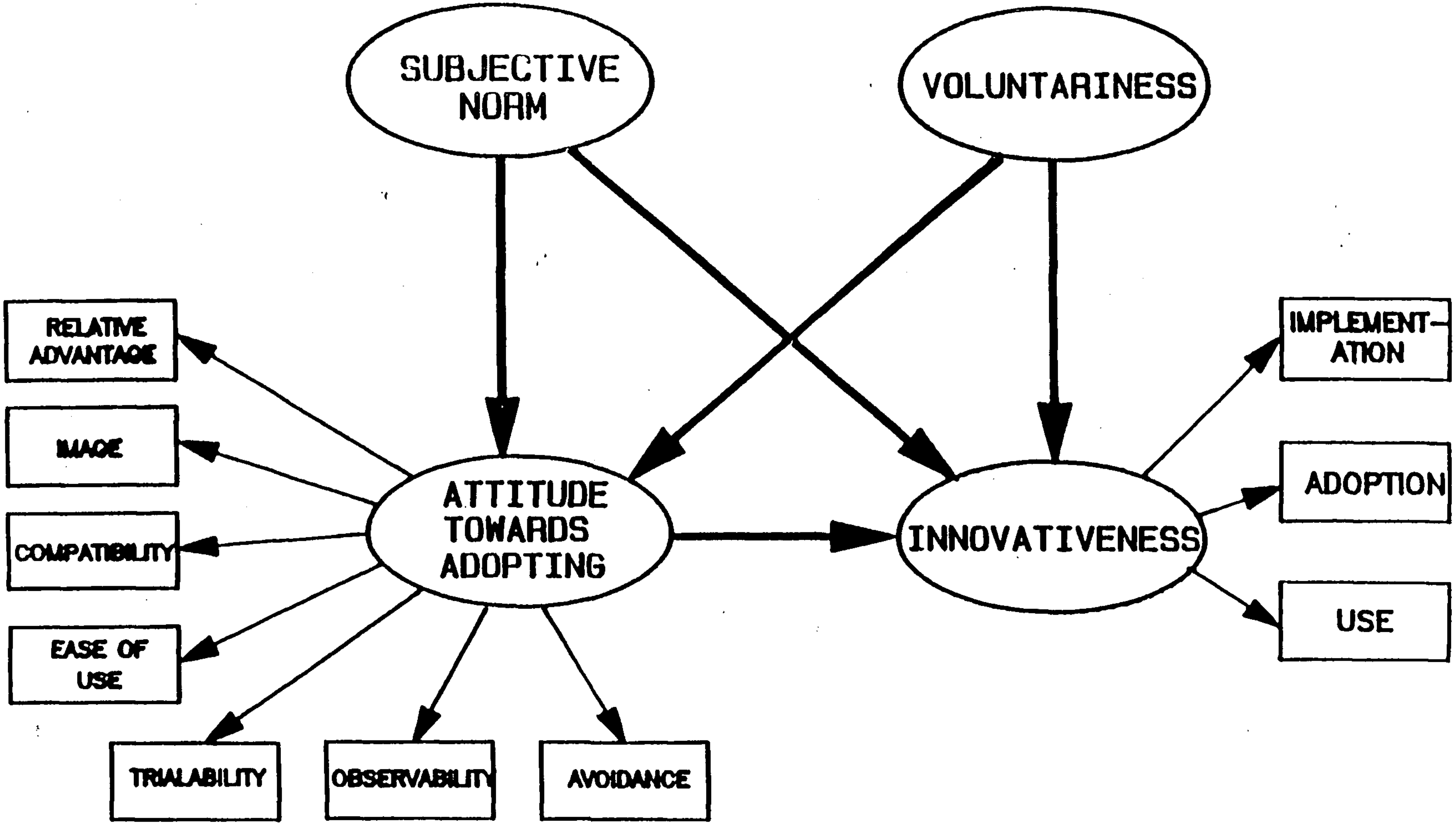


FIGURE 3–4: RESEARCH MODEL

# CHAPTER FOUR
# INSTRUMENT DEVELOPMENT

> Let observation with extensive view,
> Survey mankind from China to Peru.
>
> Johnson, VANITY OF HUMAN WISHES

## SECTION A - INTRODUCTION

### 4.1 GENERAL

The essential ingredient in any field survey is the data collection instrument. The first steps in operationalising this study, therefore, were to identify, evaluate, and select appropriate existing survey instruments to collect the data. The key selection criteria for any instrument are its reliability and validity. These became the basis of the search for, and evaluation of, existing instruments.

**Reliability** is the degree to which a measure is free of error, or the degree to which the observed score reflects the true score (Nunnally, 1978, p.191). The accepted level of reliability depends on the purpose of the research project. For example, Nunnally argued as follows:

> What a satisfactory level of reliability is depends on how a measure is being used. In the early stages of research on predictor tests or hypothesized measures of a construct, one saves time and energy by working with instruments that have only modest reliability, for which purpose reliabilities of .60 or .50 will suffice ... For basic research, it can be argued that increasing reliabilities beyond .80 is often wasteful ... To obtain a higher reliability ... strenuous efforts at standardization in addition to increasing the number of items might be required. Thus the more reliable test might be excessively time consuming to administer and score. (1967, p. 226)

Determination of the appropriate level of reliability for this study was based on Nunnally's suggestions. First, it was considered that the study is in the "earlier" stages of research, in that it extends theory from other domains into MIS research. Much of its intent is exploratory in nature, determining how well these "imported" models help explain usage of Personal Work Stations (PWS), and attempting to determine which of a large set of perceived characteristics of innovating (PCI) influence the decision to adopt the PWS. These observations argued for accepting reliabilities in the .70 range, somewhat higher than Nunnally's minimum level, but not as high as the common target of .80.

A second consideration in determining target reliability levels is based on Nunnally's observation of the resources required to increase reliability of scales. As pointed out by Cronbach (1970), a single observed score "tells us nothing about the error of measurement" (p.157), and therefore multi-item scales should be the basis of the chosen instrument. Furthermore, one of the basic methods of increasing the reliability of a scale is to increase the number of items it contains. Therefore, scales measuring somewhat complex constructs can become rather lengthy in achieving higher levels of reliability. In addition to Nunnally's comments about these tests being excessively time consuming to administer and score, they also make significant demands on the respondents, thus potentially reducing their interest and attention. Because the study was attempting to take a more holistic and comprehensive approach than previous DOI studies, by addressing all the theoretical perceived characteristics of innovating, it was dealing with several complex constructs. All of these could require several items in any measurement scale striving to achieve high degrees of reliability, which in turn could make any instrument excessively long and unwieldy.

For all these reasons, a reliability coefficient of .70 to .80 was set as the target reliability for the final scales. Nevertheless, it was considered that this was a lower bound and that efforts should be made to achieve higher levels of reliability in the final study if possible within the constraints of development time and administration ease.

The second primary criterion in assessing an instrument is **construct validity**, or the degree to which a scale actually measures the theoretical construct that it purports to measure (Cook and Campbell, 1979, p.59). A check on construct validity can be done somewhat by examining the scale's development history to determine how individual items were created. If they were based closely on theory, then the scale's potential validity would be higher. Secondly, a check can be made to see if the items were based on any existing validated instruments, with those that are obviously gaining some validity themselves. Checks can also be made on the tests that were conducted to investigate the validity of the items. These tests include whether evidence of convergent and divergent validity were present (Campbell and Fiske, 1959). In general, scales developed to measure certain theoretical constructs should not correlate systematically with scales developed to measure different constructs, unless there is a causal link. This is divergent validity. Secondly, scales measuring the same or very similar constructs should correlate highly at a statistically significant level, which is convergent validity. In summary, a scale's development history, its link to previous validated scales, and evidence of convergent and divergent validity are all considerations which must be taken into account when assessing or developing scales.

The variables being investigated in the study grouped naturally into what are essentially three separate subject areas:

(1) the perceived characteristics of innovating,

(2) the subjective norms about using PWS, and

(3) the actual use or non-use of the PWS.

Therefore, the search for, and development of, instruments concentrated on these three areas. Each will be discussed in turn, beginning with the **perceived characteristics of innovating** in the next section. Discussion of the scales to measure the remaining variables will follow.

## SECTION B: THE PERCEIVED CHARACTERISTICS OF USING THE PWS

### 4.2 PERCEIVED CHARACTERISTICS OF INNOVATING

As has been described earlier, the perceived characteristics of innovating (PCI) are based on Rogers taxonomy of the perceived characteristics of innovations. The latter were highlighted approximately twenty-five years ago (Rogers, 1962) as a major factor in the innovation decision. Since then, Rogers' taxonomy, with its five categories, has been widely adopted among diffusion researchers and writers, and has achieved a distinct level of face validity. It was considered, therefore, that an instrument to measure the PCI could likely be based on instruments used in previous studies. Surprisingly, however, a literature search indicated that very few studies have explicitly used all five categories as a basis for their research. For those studies identified which actually used the five PCI'S, it was discovered that the instruments used to measure the perceptions were very suspect. They were often lacking in reliability, and also the validity of many of the items in the various scales was doubtful.

Among the first to explicitly use Rogers' taxonomy was Ostlund (1969), who examined the five PCI's for a variety of new consumer goods, including a sixth characteristic, perceived risk. The scales in his study, however, used only two items per perceived characteristic, with no reliability coefficients reported. Work on extending Ostlund's instrument was carried out more recently by Bolton (1981), who examined perceptions of videotext technology. He added a few items to Ostlund's scales, and eventually had approximately five items for each scale. Once again, however, the psychometric properties of the instrument remained essentially below the desired levels, with ALPHA coefficients ranging from a high of .85, to a low of .30. Of 18 ALPHA coefficients from three replications of the survey, only four were above .80. Of these, three were for the same PCI, **Compatibility**, from the three replications. Because of these rather low reliability coefficients, it was concluded that neither Ostlund's instrument, nor Bolton's extension of it, could be adopted without extensive modification for the current project.

One other study which used Rogers' taxonomy was also examined in detail (Holloway, 1977). In this case, Holloway had conducted a considered review of studies on the PCI to that date and then decided to develop his own instrument explicitly for his study. Nevertheless, operationalisation of the constructs within this study still appeared to be inadequate in that subsequent factor analysis revealed that several items which ought to have loaded on different PCI's in fact loaded within the same construct. Therefore, because there appeared to be problems with the construct validity of some of the items, it was again concluded that this particular instrument could not be adopted without modification for the current project.

As a check on the exhaustiveness of the literature search for existing validated instruments, Rogers' office was contacted directly. It was considered that most instruments designed to measure the PCI would be known to this group. It was discovered, however, that very few studies which had explicitly set out to measure the five characteristics as defined by Rogers were known to the group (Rice, 1987). Nevertheless, as a result of this inquiry, one recently developed instrument was identified (Hurt & Hubbard, 1987).

In discussing the development of this latter instrument, its developers argued that the measurement of the PCI to date had been "troublesome" (p.1), and that the "relationships among innovation characteristics and innovativeness have not been systematically investigated" (p.2). Thus, they had attempted to create an instrument to measure the perceived characteristics of microcomputers, based directly on Rogers' classification. Once again, however, the results were disappointing in that Rogers' classification was not supported by factor analysis of the results. First, the constructs of **Trialability** and **Observability** did not emerge as separate factors. The authors considered that either the items written "did not clearly discriminate between the two theoretical attributes" or that "those two allegedly independent characteristics are treated as a single concept by potential adopters" (p.8). An examination of the items used in the instrument did not help determine which of the hypotheses was the more likely. A second interesting finding was that **Relative Advantage** did not emerge as a factor at all. Once again, it must be questioned whether this was an artifact of the instrument development process or a reflection of attitudes about using microcomputers. On the other hand, however, high reliability figures were obtained for **Complexity** and **Compatibility**, with ALPHA's of .93 and .86 respectively.

Within the MIS literature very few instruments were identified which attempted to measure attitudes towards using computers, based on Rogers' or other similar topologies. As discussed in Chapter 3, however, Davis (1985), without citing Rogers or other DOI studies, recently has developed a Technology Acceptance Model (TAM), which in many aspects is quite similar to a DOI model. Two of the constructs within Davis' model are "perceived usefulness" and "perceived ease of use", which he defined as follows (p.82):

> Perceived Usefulness: The degree to which an individual believes that using a particular system would enhance his or her job performance.

> Perceived Ease of Use: The degree to which an individual believes that using a particular system would be free of physical and mental effort.

The similarity between Davis' "perceived usefulness" and the "perceived relative advantage" of the DOI model is obvious, as it is between his "perceived ease of use" and DOI's "perceived complexity". Therefore, any instrument used or developed to measure these two DOI constructs should be able to draw on Davis' work. Furthermore, evidence of the relative paucity of research along a DOI line with respect to computer usage was also provided by Davis. He concluded, after a search for an appropriate instrument, that no validated scales with the desired reliability levels existed for **usefulness** (relative advantage) or **ease of use** (complexity). He therefore undertook an instrument development process resulting in two scales for these constructs with reliabilities in excess of .90 for each. Given this level of reliability, and the similarity of the constructs to those within the DOI model, it was considered that the scales developed by Davis should be directly usable within the context of the proposed research.

In spite of the relative promise of the Davis scales for measuring **Relative Advantage** and **Ease of Use**, and of Hurt's and Hubbard's to measure **Compatibility**, it was concluded that they could not be used without also going through a validation process to ensure that they fit within the context of the current research. Furthermore, no existing valid and reliable scales had been identified to measure **Observability** or **Trialability**. Therefore, it was concluded that a new scale had to be developed for the purposes of the current research.

## 4.3 INSTRUMENT DEVELOPMENT PROCESS

To provide as high a level of reliability and validity as possible for the new instrument, a three "stage", six step instrument development process was carried out. The following briefly describes the stages, while detailed explanations for each stage are given in later sections:

**STAGE I: ITEM CREATION**

Step 1: As many items as possible were identified from existing scales that fit the construct definitions of the current study.

Step 2: So that the item pools would contain as many "quality" items as possible, additional items were generated as necessary based on the theoretical constructs.

**STAGE II: SCALE DEVELOPMENT**

Step 3: Items were were sorted into categories by a panel of judges. This procedure will be discussed in detail below, but the aim was to have the judges first sort the items into separate categories, based on the similarities and differences among items, and then to define the underlying constructs represented by each category of items. Once this procedure was carried out, the items were examined to see how they grouped, and whether any tended to be categorised differently by different judges. This allowed checks to be made for any ambiguous items, which would detract from the internal cohesiveness of any scale based on them. The definitions of the various categories provided by the judges after the sorting procedure were a check on the construct validity of the items and item groupings.

Step 4: A second panel of judges was first provided with the construct definitions and then asked to sort the items into categories based on the definitions. Again, an examination for problematic items was made to attempt to eliminate any inappropriately worded and ambiguous items.

**STAGE IV: SCALE TESTING**

Step 5: **Pre-Pilot**. The instrument was distributed to a small sample of 20 respondents for a further check for any problematic items. Seventeen usable questionnaires were returned and an analysis of the actual responses was conducted to get an an initial indication of the reliability of the scales. Items which did not contribute to the reliability of the scales were then culled prior to the pilot test.

Step 6: **Pilot Test**. A "full scale" pilot test was conducted. Questionnaires were distributed to 80 individuals, with 66 returned for analysis. This larger number of subjects allowed the various statistical tests to be completed with higher levels of confidence so that the scales could be refined for the final survey.

## 4.4 INSTRUMENT DEVELOPMENT - STAGE I: STEP 1 AND STEP 2

As a first step, all the items identified in the instruments discussed in paragraph 4.2 were sorted according to the various constructs (perceived characteristics) which they were originally intended to address. This generated an initial item pool for each of the perceived characteristics, including the "status conferring" characteristic as discussed earlier in Chapter 3. Based on the construct definitions, and on the loading of the items on particular factors for those studies where a factor analysis had been carried out, each item was examined for its applicability in the current research. Due to the different goals of the original studies, some items were judged to be inappropriate for this study because of their focus. For example, use of PWS in organisations likely would involve little personal out-of-pocket cost or monetary benefit to users. Therefore, the following item from Bolton (1981), intended to measure the economic aspects of using an innovation, was dropped from the item pool:

> Channel 2000 [the innovation] would probably cost a lot of money.

Once this was done for all items, **Step 2**, the creation of new items, was carried out to address those perceived characteristics which had potentially too few items, or where it was felt that all aspects of the construct had not been addressed. It was considered that the instrument for the initial tests would require approximately 10 items for each scale. This was based on the similarity of the eventual scales to those developed by Davis, and on his <u>ex post</u> conclusion that ten items per scale were required to achieve the desired reliability levels.

All items were also examined to ensure that they reflected the various **elements of behaviour** as defined in the Theory of Reasoned Action (Ajzen & Fishbein, 1980). These elements include the **actual behaviour** of interest (using a PWS), the **target** at which the behaviour is directed (the PWS), a **context** for the behaviour (in one's job), and a **time frame** (now and into the future). In terms of the current research, it was felt that the latter two elements did not have to be explicitly defined, as the general instructions for completing the eventual questionnaire would make these elements implicit in all items.

Because a scale was also required to measure whether respondents felt their use or non-use of the PWS to be **voluntary**, this scale was included in the general development process. Therefore, an additional item pool was created to reflect this construct. Once this had been completed there remained the following number of items in each of the seven categories (see Appendix 1 for a listing of items by category) for a total of 146 items:

| | |
|---|---|
| Voluntariness: | 6 |
| Image: | 8 |
| Relative Advantage: | 26 |
| Compatibility: | 30 |
| Ease of Use: | 24 |
| Observability: | 21 |
| Trialability: | 31 |

These items were then reevaluated to eliminate those which appeared excessively redundant, or potentially ambiguous (i.e. which would load on more than one factor). For example, under **Relative Advantage** the following items all were felt to deal with the aspect of "saving time":

7. Using the PWS enables me to accomplish tasks more quickly.

10. Using the PWS reduces the time I spend on unproductive activities.

11. Using the PWS saves me time.

24. As a result of using the PWS, I am more timely in completing my work.

Based on the redundancy of these items, it was decided to drop #10 and #11 from the item pool.

Examples of potentially ambiguous items included the following from the **Compatibility** pool:

7. I really need a tool like the PWS.
14. Using a PWS would help me a lot with my work.

For each of the above items, it was felt that they also captured an aspect of **Relative Advantage**. In fact, an examination of the various scales which had been used in previous research, and factor loadings of items within them, indicated that much of the factorial complexity of items designed to measure **Compatibility** may be in its original definition. Rogers (1983) defined **Compatibility** as follows:

> The degree to which the innovation is perceived as compatible with the existing values, past experiences, and <u>**needs**</u> of the potential adopter (p.223).

The inclusion of "needs" as highlighted above is considered to be a source of confounding with **Relative Advantage**, as there certainly can be no advantage to an innovation that does not reflect the needs of the potential adopter. For that reason it was decided to eliminate any reference to "needs" in derivation of items to measure **Compatibility**.

This process of culling left the following number of items (as specified in Appendix 2) in each item pool, for a total of 94 items:

| | |
|---|---|
| Voluntariness: | 6 |
| Image: | 8 |
| Relative Advantage: | 18 |
| Compatibility: | 16 |
| Ease of Use: | 18 |
| Observability: | 14 |
| Trialability: | 14 |

## 4.5 INSTRUMENT DEVELOPMENT - STAGE II: STEPS 3 AND 4

### 4.5.1 General

The goals of Step 3, as discussed above, were twofold: to assess the construct validity of the various scales being developed, and to attempt to identify any particular items which may be problematic because of construct ambiguity. As will be shown below, the first aim was accomplished by having judges assign their own labels to the various categories which they themselves had created from the total item pool. Then, an assessment was made of the congruity of these labels with those of the original constructs. Problematic or ambiguous items were identified as those which were consistently put into different groupings by the various judges. By eliminating these items from the item pool, it was hoped that the internal consistency of the scales would be increased. The general aims of Step 4 were similar to that of Step 3, although in this case the judges were asked to sort the items according to a given set of construct definitions.

The method of sorting items into categories is similar to that carried out by Davis (1985), who was interested in assessing the coverage of the domain of his particular constructs. Thus, his judges were asked to sort items <u>within constructs</u>. By comparing the categories developed, Davis was then able to assess the domain coverage. In Davis' case, the categorisation procedure was a second step, carried out after the judges had rated how well the various items fit the definitions that had been provided. The procedure used in the current research, differed, however, in that two separate rounds were used. Step 4 is similar to Davis' procedure in that definitions were given; however, no attempt was made to differentiate the items within constructs. The major difference with Davis' procedure was the inclusion of Step 3, where the judges were provided with only the total item pool, and were given no idea as to what the underlying constructs might be. Secondly, after sorting the items they were then asked to provide their own definition or label for the constructs, again without knowing what the researcher's intent was. It is felt that these procedures are somewhat more rigourous than Davis', in that it attempted to verify the construct validity of the scales in a significantly different way. This increased the degree of confidence which could be assumed for the construct validity of the scales.

A second indicator of construct validity was provided by examining the convergence and divergence of the categories and the items within each sorting procedure. If an item were consistently placed within a particular group, then it was considered that the item demonstrated **convergent validity** with the related construct, and **discriminant validity** with the others. Secondly, in Step 3, if the number of categories created by the various judges, the labels assigned to them, and the items included in them, were fairly consistent, then scales based on these categories could also be said to demonstrate convergent and discriminant validity. As might be expected, the process of refining the items for the scales required that the procedures of STAGE II be carried in two rounds, with Step 3 and Step 4 included in each round.

It should be noted at this point that one additional method of illustrating convergent and discriminant validity is with the use of the multi-trait-multimethod (MTMM) matrix as developed by Campbell and Fiske (1959). Using this approach, the intercorrelations of the items in the various scales are compared and tested. For convergent validity, item-item correlations within a scale must be significantly different than zero and large enough to warrant further investigation. For discriminant validity, the correlation of an item with other items within its intended scale is compared to the number of times it correlates more highly with the items in a separate scale. Campbell and Fiske suggest that if an item correlates more highly with items in a separate scale in more than half of the potential correlations, then there is a problem with discriminant validity.

Because of the nature of the current research, it was felt that the MTMM approach was neither very necessary nor very feasible. First, as discussed, the only feasible method of gathering data was "self reporting". In this research, this involved use of survey instruments. Although some studies have claimed to be using the multimethod technique by varying the **type** of item within an instrument, this data collection technique is not considered to offer different enough approaches to warrant the multimethod label. It is also doubtful whether even interview techniques vary enough from surveys, in that they also involve self-reporting. Thus, multimethods of data collection were not employed within this study.

Secondly, because there are some hypothesised causal linkages among the various constructs (traits), as well as chance potential correlations, it was expected that many items would correlate highly with items from a separate scale. The only definitive method to show discriminant validity among constructs using a multitrait matrix would be to experimentally manipulate various traits (perceived characteristics) while holding others constant. One would then examine how the subjects' perceptions of these traits changed as they were manipulated, and whether perceptions of any of those traits held "constant" also changed. For eight constructs, a rigorous examination of discriminant validity would have required an excessive number of manipulations and concomitant data collection. It was for this reason that the "sorting" method was chosen to examine construct validity. It did not require extensive data collection, and in fact established the validity of items before any data was collected.

Kerlinger (1978) describes two more techniques to examine construct validity. One is essentially a sub-technique of the MTMM method, in that it examines the item-scale correlations. This approach makes the assumption that the overall scale is valid, and thus the correlation of the item with the scale is an indicator of the construct validity of the item. This measure is calculated by first subtracting the item score from the scale, to avoid a spurious correlation, and then by calculating the correlation between the item and the corrected scale score. This measure was used to examine the validity of items within the current development process, as will be discussed below in Section 5.10.

The second method discussed by Kerlinger is factor analysis. Factor analysis has two basic purposes: "to explore variable areas in order to identify the factors presumably underlying the the variables; and ... to test hypotheses about the relations among variables" (Kerlinger, 1978, p.590). It is the first purpose which contributes to the examination of construct validity. One examines the items loading on a particular factor, and then infers the meaning of the factor. As argued by Nunnally, "factor analysis can be used either to test hypotheses about the existence of constructs, or if no credible hypotheses are at issue, to search for constructs in a group of interesting variables " (1967, p.289).

An argument, however, against using factor analysis is provided by Fornell. As he points out:

> "in traditional exploratory factor analysis, both factor loadings and factor scores are indeterminate; factor loadings can be rotated in numerous ways and the solution is therefore said to be 'non-unique' .... In other words, many different models may fit the data equally well" (1983, pp 444-445).

Therefore, he argues, data analysis where possible ought to be grounded in strong **a priori** notions, which fits with the approach in this research. The constructs of interest are based on a substantial body of prior research and have been explicated prior to any development of items. This follows Cook's and Campbell's (1979, p.64) suggestion that items be **developed** to fit the construct's conceptual meaning as a method of ensuring construct validity. This contrasts to the method of inferring underlying constructs based on how items "group" in factor analysis. Nunnally (1978, p.258) also argued that the validity of measures should be planned for, rather than tested after they have been constructed. This, in fact, was the basis of the instrument development procedure in this research. Finally, one very pragmatic point which argued against factor analysis was the number of responses required to properly use the technique. Kerlinger (1978, p.594) suggests that ten subjects for each item is a "good rule of thumb". For an item pool of 80-90 items this would have required 800-900 respondents for a proper analysis. This was considered infeasible within the context and aims of the current study. For all these reasons, factor analysis was not used in the development of the scales.

### 4.5.2 Inter-Rater Reliability

To assess the reliability of the sorting conducted by the judges, three different measures were made. For each pair of judges in each sorting step, two measures were taken of the **level of agreement** in categorising items. Thus, for example, for four judges there were six different pairs or computations, and for five judges there were ten pairs. There was a separate agreement measure for each pair, and by examining the distribution of the various measures an assessment of the reliability of the classification procedure was made. The final measure assessed the **overall** correct "placement" of items by the judges as a group for each round. Each measure is described more fully below.

The first and most basic measure was the simple raw proportion of agreement on item classification within each pair of judges. This was calculated as follows:

$$Po = \frac{\text{Number of items classified identically}}{\text{Total Number of items to be classified}}$$

A second, and more sophisticated measure of the agreement between judges, was that developed by Cohen (Cohen's Kappa) which considers the likelihood that some of the agreement will be simply due to chance (Cohen, 1960). Kappa thus takes the raw proportion of agreement and adjusts it by taking into account the joint marginal probability that both judges would randomly place the same item in the same construct. Thus, the measure of "chance agreement", Pe, is defined as follows:

$$Pe = \Sigma \left[ \frac{[Ni(\text{Judge 1}) * Ni(\text{Judge 2})]}{[\text{Total number of items classified}]^2} \right]$$

where Ni is the number of items assigned to construct "i" by each judge.

The measure of chance agreement is used to adjust the proportion of raw agreement, and thus Kappa is calculated as follows:

$$\text{Kappa} = \frac{Po - Pe}{1 - Pe}$$

The following is an example of this procedure for a simple two construct classification scheme with 20 items.

| | | **JUDGE 1** | | |
|---|---|---|---|---|
| | Construct | A | B | Total |
| **JUDGE 2** | A | 7 | 3 | 10 |
| | B | 1 | 9 | 10 |
| | Total | 8 | 12 | 20 |

In the above example, each judge classified 20 items. By examining the columns, it can be seen that Judge 1 placed eight items in construct A, and twelve in construct B. Of the eight items placed in construct A, seven were in agreement with Judge 2, but the eighth was classified by Judge 2 as being in construct B. Of the 12 items placed by Judge 1 in construct B, nine in agreement with Judge 2 as being in that construct, but three were classified by Judge 2 as being in construct A. Likewise, by examining the rows, the same analysis can be carried out for Judge 2. The scores on the diagonal indicate the number of items about which the judges agreed. Thus, the raw proportion of agreement can be calculated by summing the diagonal and dividing by the total number of items as follows:

$$Po = \frac{7 + 9}{20} = .80$$

The "chance agreement" score (Pe) would be calculated as illustrated below where:

$N_A$ (Judge 1) = 8
$N_A$ (Judge 2) = 10
$N_B$ (Judge 1) = 12
$N_B$ (Judge 2) = 10

Therefore, $$Pe = \frac{(8 * 10)}{20 * 20} + \frac{(12 * 10)}{20 * 20} = .50$$

Finally, the value for Kappa would be calculated as follows:

$$Kappa = \frac{Po - Pe}{1 - Pe} = \frac{.80 - .50}{1 - .50} = .60$$

Once the Kappa's were calculated within each sorting round, the scores were examined for all possible pairs of judges, and an assessment made of the overall level of agreement on the item classification. For Kappa, scores greater than .65 were considered acceptable (Jarvenpaa, 1987).

A third measure of the both reliability of the classification scheme and the validity of the items was developed for this research. The method is simply to see how many of the items were classified by the panel of judges for each round as being within the "target" construct. In other words, because each item was included in the pool explicitly to measure a particular underlying construct, a measurement can be taken of the overall frequency with which judges placed items within their intended theoretical construct. The higher the percentage of items placed in the target construct, the higher the degree of inter-judge agreement across the panel which must have occurred. Secondly, scales based on categories which have a high degree of "correct" placement of items within them can be considered to have a high degree of construct validity, with a high potential for good reliability scores.

As an example of how this measure could be used, consider the simple case of three theoretical constructs with ten items developed for each construct. With a panel of four judges, a theoretical total of 40 placements (4 judges times 10 items) can be made within each construct. Thus a **THEORETICAL** versus **ACTUAL** matrix of item placements could be created as follows (including an **ACTUAL** 'Not Applicable' column where judges could place items which they felt fit none of the categories):

| | | **ACTUAL** | | | | | |
|---|---|---|---|---|---|---|---|
| Constructs | | A | B | C | N/A | Total | % Hits |
| | A | 36 | 2 | 1 | 1 | 40 | 90 |
| **THEORETICAL** | B | 12 | 24 | 4 | 0 | 40 | 60 |
| | C | 0 | 0 | 40 | 0 | 40 | 100 |

Item Placements: 120 Hits: 100 Overall "hit" ratio: 80%

Examination of the actual-theoretical <u>diagonal</u> of the above matrix shows that with a theoretical maximum of 120 target placements (three constructs at 40 placements per construct), a total of 100 "hits" were achieved, for an overall "hit ratio" of 80%. A judgement must be made whether this is an acceptable level. Secondly, and more importantly, examination of each <u>row</u> shows how the items created to tap the particular constructs are actually being classified. For example, Row C above shows that all 40 item placements were within the target construct, but that in Row B, only 24/40, or 60%, were within the target. In the latter case, 12 of the placements were made in Construct A, which might indicate that the items underlying these placements are not differentiated enough from the items created for Construct A. This would lead one to have confidence in a scale based on Row C, but be hesitant about accepting any scale based on Row B. Finally, examination of the off-diagonal entries indicates how factorially complex any construct might be. Actual constructs based on columns with a high number of entries in the off-diagonal might be considered to be too ambiguous. Likewise, the items themselves in the off-diagonals might be ambiguous, so any consistent pattern of item mis-classification should be examined. It must be emphasised that this procedure is more a qualitative analysis than a rigourous quantitative procedure. There are no established guidelines for determining "good" levels of placement, but the matrix can be used to highlight any possible problem areas.

### 4.5.3 **Sorting Procedures**

Each of the items were hand printed onto 3X5 inch index cards, with each card containing only one item. Care was also taken to ensure that all items were printed as similarly as possible. The cards were then shuffled into random order for presentation to the judges. Each judge sorted the cards into categories and labelled the categories of items independently and separately from the other judges. Judges were asked not to discuss the procedure with anyone prior to the researcher finishing the procedure with all judges.

Prior to sorting the cards, the judges were read a standard set of instructions (Appendix 3). The instructions were tested with a separate judge prior to the first sorting round to ensure their comprehensiveness and comprehensibility. The aim of written instructions was not only to standardise the instructions, but also to ensure that no points were left out. Judges were allowed to ask as many questions as necessary to ensure they understood the procedure.

Before carrying out the categorisation procedure, a trial was done by each judge on ten sample items unrelated to the constructs of the study. In this case ten statements were written about various aspects of an automobile. Some of the items were deliberately constructed to be ambiguous. Judges were asked to sort the "test" cards, following the instructions they had just received. Any misunderstandings resulting from the instructions became obvious and were clarified. For example, the researcher was able to point out that items reflecting opposite viewpoints of the same construct **could** nevertheless be grouped together. Furthermore, after the judges had sorted the ten items, and labelled the categories, the researcher was then able to take the ambiguous cards and resort them to create different construct categories. This was done to ensure that the judges understood the idea of attempting to sort the items based on an **underlying construct** for each category, and to place items in categories which best reflected the underlying construct. It also cued the judges to be more aware of ambiguous or unclear items. In virtually all cases, the judges reported that they found the trial sort to be a very helpful exercise.

## 4.6 STEP THREE - ROUND ONE

### 4.6.1 Judges

The judges for the initial round of Step 3 were drawn from the Faculty of Management at the University of Calgary. It was felt that in order for the panel to be unbiased, it should be fairly diverse. Thus, four judges were used, including a professor, lecturer, graduate student, and a member of the Faculty support staff.

### 4.6.2 **Results**

The results of the first sorting round are shown in Appendix 5, with labels in Appendix 6. Of the four judges, two identified seven categories, or constructs, and the other two identified six. The theoretical number had been seven. Furthermore, there appeared to be a high level of agreement among the judges, and thus the results could be presented in a factor matrix format, and analysed in such a fashion.

As shown in Appendix 8, Table 1, the initial overall placement of items within the target constructs was 78%. Examination of the off-diagonal entries reveals two significant clusters, which reflect those judges who had only six categories. Nevertheless, because the off-diagonals showed clustering, rather than a scattering of items, it can be seen that the items not placed within the target constructs still tended to be grouped together. This augured well for any potential internal consistency measurements.

Following the sorting and labelling procedure the four judges were assembled together to discuss the results. In examining the "factor structure" resulting from the sorts, the first point addressed was the creation of only six categories by two judges. As can be seen from Appendix 5, Judge B differed from the others in that items 82-94 were grouped together with items 1-6, and labelled "access or barriers" to the PWS. The other judges had consistently created two categories out of these items (1-6 and 82-94), with labels reflecting the theoretical constructs of **Voluntariness** and **Trialability** respectively. In the discussion of the categories, Judge B quickly agreed that there could in fact be two groupings and separated her original group into two separate ones.

Judge P also had only six categories, but in this case had created a category called "value" into which he had put all the **Relative Advantage** items, as well as those items intended to reflect **Observability**. Judge B had also grouped the items similarly, although not quite to the same extent. Thus, the observability items were included with relative advantage for two judges, and put into a separate category by two others. In the discussion that followed, Judges B and P allowed that there could be two separate categories, but that the differences were "subtle". This indicated that the observability items needed to be reexamined.

Following this discussion, those items that one or more judges had not included in the "predominating" category were examined. As indicated in Appendix 5, those judges for whom an asterisk is included (*), quickly agreed with minimal discussion that the item was likely a better fit in the "main" category. It was emphasised that the goal was to identify ambiguous items, and that no judge was to feel pressured to "move" an item to simply make it "fit" with the other judges' groupings. This would simply defeat the intent of the procedure. Also, no attempt was made to reconcile any item which originally was put into more than two groupings, as it was considered to be inherently too ambiguous. Eventually all items were discussed, and it was agreed that several were too ambiguous, or simply did not fit in any category. As is indicated in Appendix 4, these included items 34, 35, 37, 43, and 44 from **Compatibility**, #60 from **Ease of Use**, #68 and #72 from **Observability**, and #81 and #93 from **Trialability**. These were dropped from the item pool for the next step.

This process of culling left the following number of items in each item pool, for a total of 84 items:

| | |
|---|---|
| Voluntariness: | 6 |
| Image: | 8 |
| Relative Advantage: | 18 |
| Compatibility: | 11 |
| Ease of Use: | 17 |
| Observability: | 11 |
| Trialability: | 13 |

The inter-judge level of agreement for this sorting round was quite high. As shown in Appendix 7, after the discussion had been carried out, the raw agreement scores ranged from .74 to .90, with an average of .83. Cohen's Kappa had a low of .70, well above the desired minimum of .65, and a high of .89. The average was a respectable score of .80. Furthermore, the percentage of items placed within the target constructs rose to 85% (Appendix 8, Table 2). This is in spite of the fact that **Observability** only had a placement ratio of 43% because of one significant off-diagonal clustering. Because these items did cluster, however, they were retained for the next sorting round to see what the effect of providing construct definitions would be on item placement.

After the various categorisations had been reconciled, the group of judges were asked to label and define each of the categories. Each judge had already independently carried this out, and this step examined the level of agreement among judges as to what each category represented. As can be seen in Appendix 6, the definitions supplied by the panel of judges very closely matched the intent of the researcher. **Observability**, however, was defined differently enough from the original intention to indicate that there may have been some problem with its operationalisation.

## 4.7 STEP FOUR - ROUND ONE

### 4.7.1 Judges

The judges for this round were also selected from the Faculty of Management at the University of Calgary. Again, attempts were made to have a diverse panel, and hence the judges included a professor, a lecturer, a graduate student and a member of the Faculty support staff.

### 4.7.2 Results

For this round, the judges were supplied the construct definitions on 3X5 index cards and asked to sort the remaining items based on the definitions. Problematic items which had been identified in the first round were dropped for this step. A "too ambiguous/ doesn't fit" definition card was also included to ensure that the judges did not "force fit" any item into a particular category.

Again the results of this sort were very encouraging. An examination of the factor structure (Appendix 5) shows very high agreement among the judges, with the exception of **Observability**. The raw agreement scores ranged from .82 to .88 with an average of .86 (Appendix 7). Cohen's Kappa scores were similarly high, ranging from .79 to .86, with an average of .83. The overall placement of items within target constructs was 92%, with all constructs at or above 90% except for **Observability** which was at 73% (Appendix 8, Table 3). This indicated that items were generally being consistently placed as they were intended. Thus, it was concluded that the development process had resulted in scales which demonstrated construct validity, with a high potential for very good reliability coefficients. Nevertheless, because some **Observability** items still loaded on other theoretical constructs, it was decided to reexamine this scale.

#### 4.7.3 Scale Refinement

An examination of the how the items from the **Observability** pool were sorted indicated that the original construct as defined by Rogers (1983) was too complex, as was discussed earlier in Chapter 3. It was defined as the degree to which the **results** of an innovation are **visible** and **communicable** to others (1983, p.232). The items included in the pool for this study attempted to tap both these constructs, and had been drawn mainly from other studies. Because of this, it was expected that their construct validity, and internal cohesiveness, would be high. This was not the case, however, as from this group, items 67, 68 and 72 had not clustered with the others in Step 3, and hence had been dropped. Although item 71 had been placed into three separate categories during the sorting procedure, it was retained after Step 3 because it seemed to be very congruent with the theoretical construct. Therefore, it was decided to see how it would be placed once a construct definition had been provided. In Step 4, however, it was again placed into three different categories, and therefore was dropped from the pool. Items 69, 74, and 79 also were problematic, in that they were placed into other categories by at least two of the judges, and hence had to be dropped. In fact, 25% of the placements of **Observability** items in Step 4 were in the **Relative Advantage** category, even though the construct definitions had been provided. For this reason, it was decided to eliminate any items which might be confounded with **Relative Advantage**.

As a result of the above process, it was decided to concentrate on the **tangibility** of the results, which would include their **Observability** and **Communicability**. It was concluded that the construct would be more aptly labelled **Result Demonstrability**. This ties back to the term used by Zaltman et al. (1973) who indicated that the more "amenable to **demonstration** the innovation is, the more visible its advantages are, ... the more likely it is to be adopted" (p.39). In keeping with the idea of result demonstrability or tangibility, items were kept which reflected the ability to measure, observe, and communicate the results of using a PWS. This meant that item 70 was dropped from the pool. Item 68, which had been deleted, was reworded to try to more accurately capture the construct and put back into the pool. The result of this culling process meant that only seven items (68, 73, 75, 76, 77, 78, and 80) of the original pool were left. All items were reworded to drop any references to "benefits" or "advantages" in order to concentrate on the "results" aspect of the construct, as is shown in the listing in Appendix 2. Finally, two additional items were written, 80-2 and 80-3, to increase the coverage of the item pool.

In re-examining **Observability**, it was discovered that Rogers alluded to yet another dimension of the construct, that of the **Visibility** of the innovation itself. This is the degree to which the innovation is apparent to the sense of sight. Rogers raised this issue when comparing the hardware and software components of a technology. He indicated that software dominant innovations have "less observability and usually have slower rates of adoption" than other types (1983, p.232). If results were the only focus, it would matter little whether they were related to software or hardware. Software, however, is less visible than hardware. Thus, it appears that the more a potential adopter can see an innovation, the more likely he is to adopt it. This seems to be an important consideration, in that research has shown that "mere exposure [to objects] is capable of making an individual's attitude toward these objects more positive" (Zajonc & Markus, 1982). Because of the seeming lack of strength of the tangibility of results items, and the apparent theoretical importance of visibility, it was decided to create an item pool to measure the actual visibility of the PWS. For this reason an additional nine items were written and added to the overall pool for the next round of sorting (Appendix 2, items 95-103).

## 4.8 STEP 3 - ROUND TWO

### 4.8.1 Judges

The judges for the second round of Step 3 were drawn from the Faculty of Commerce and Business Administration at the University of British Columbia (UBC). Again the panel was kept diverse, with five members, and included a professor, two graduate students, a research assistant, and a member of the Faculty support staff. Having shifted the locale to UBC enabled the panel to be composed of individuals who would not have been aware of the first sorting rounds, and who might bring a different perspective. This increased the potential for highlighting any problem areas with the items.

### 4.8.2 Results

The results of the second round of Step 3 are shown in Appendix 5. A quick visual examination of the placement of the various items reveals that most items were categorised as intended, although there were some clusters in categories other than the target. This is confirmed by Table 4, Appendix 8, which shows that overall 86% of the items were placed within the target constructs, but that within the individual constructs, the percentages had a wider range than in previous sorts. The major problem areas seemed to be **Image**, **Compatibility**, and **Visibility**.

In examining **Image**, with a placement ratio of 72%, it can be seen in Appendix 5 that Judge D placed seven of the eight items within a group including the **Voluntariness** items. This overall group was labelled "external pressure to use PWS" (Appendix 6). In that **Voluntariness** and **Image** both might reflect such an overall construct, the grouping is not surprising, and thus the construct validity of the items was not severely threatened. Also, the internal consistency of the image items remained high, and if Judge D's group of items were included within the target construct, the placement ratio would rise to 90%.

**Compatibility** also appeared to have problems as some items were placed into several different categories, resulting in a placement ratio of 53%. Nevertheless, only Judge D failed to group a majority of the items together. Judge N did group eight items together but outside the target (with the **Ease of Use** items). These facts augured well for the internal consistency of the items, in that if Judge N's items were included within the target, the placement ratio would rise to 67%. Nevertheless, it was difficult to determine if the results of this sorting round for **Compatibility** were an anomaly, or a reflection of problems with the items. It was therefore decided to leave the items essentially as they were, because of the success in earlier sorts, and to see how they were placed when construct definitions were provided to the judges in the next sorting round.

The final problem category was **Visibility** with a placement ratio of 73%. Once again, however, Judge M had grouped all of the items together with **Trialability** (Appendix 5) and labelled this category "exposure" (Appendix 6). Again, visibility of the PWS, as well as opportunity for trial, might be considered to be sub-aspects of a construct called "exposure", and therefore the construct validity of the items remained high. Furthermore, because the items grouped together, although outside the target construct, meant they did not detract significantly from the internal cohesiveness of the overall

**Visibility** group of items. Finally, if these items were added to the overall group, the placement ratio would rise to 93%.

Because of the several groupings outside the target constructs, the inter-judge agreement scores showed a wide range. As can be seen in Appendix 7, the proportion of raw agreement ranged from a low of .60 to a high of .94, with an average of .75. Cohen's Kappa also showed a wide range from .58 to .94, but the average of .71 remained well above the target of .65. In fact, despite the groupings outside the targets, only three of the ten scores fell below the .65 threshold, at .53, .58, and .64 respectively.

### 4.8.3 Scale Refinement

In examining the placement of various individual items in Appendix 5, it can be seen that a few were placed in several categories. It was therefore decided to eliminate any items for which there had been a fairly consistent pattern of placement outside the target construct in all the sorts. This resulted in five items being dropped from the pool before the next round, including items 3, 7, 80-3, 81, and 92. This assessment was not made based on any simple algorithm, but was largely subjective and in part was also based on the number of items in each construct's item pool. Constructs with larger pools were more likely to have items dropped at this stage than those with smaller pools. The aim was to try to keep approximately ten items for each of the more complex constructs.

## 4.9 STEP 4 - ROUND TWO

### 4.9.1 Judges

Judges for this round were again from the Faculty of Commerce and

Business Administration at UBC. Four judges were recruited, including a professor and three graduate students.

### 4.9.2 Results

The placement of items is again shown in Appendix 5. A visual examination shows a fairly simple "factor structure", with only one significant off-target cluster. This is for Judge J who placed seven of the eleven **Trialability** items within the **Voluntariness** construct. Again, this is not surprising in that the perception of **Voluntariness**, as discussed in Chapter 3, should also contribute to the perception of **Trialability**.

The inter-judge raw agreement scores (Appendix 7) reflect the simple factor structure. Except for Judge J, the agreement among the pairs of judges was above .90. Even for Judge J, with the off-target **Trialability** items, the agreement scores are in the 75% range. Cohen's Kappa scores are also correspondingly high, with an average of .82. They range from a low group of .70, .72, and .74, to a high of .96. The three low scores are all for the pairs including Judge J.

The placement of items within the target constructs also show that a high degree of construct validity and potential reliability had been achieved. The overall placement of items within the target construct is 92%, with the lowest score for an individual construct being **Trialability** at 84% (Appendix 8, Table 5). Shifting the off-target cluster raises this group to 100%. The only other construct with a ratio below 90% is **Relative Advantage**, at 87%. This was not considered problematic in that in previous sorts the ratios had been well in excess of 90%.

### 4.9.3 Scale Refinement

The final step of this round was to reduce the number of items for the various scales to approximately ten each. Again, this number was based on the analysis conducted by Davis (1985) who estimated that a ten item scale would provide the desired levels of reliability.

The scales for **Voluntariness** and **Image** were already within the target number and hence were included for the next development stage as they were. **Relative Advantage** on the other hand, had 18 items remaining after the various sorting rounds. It was therefore decided to keep the items developed by Davis (1985) for his "perceived usefulness" construct, because of the success he had with this particular scale (#'s 15 -24, Appendix 2). As shown in Appendix 4, it had survived the sorting rounds intact, which demonstrated its construct validity with respect to **Relative Advantage**. It was also decided to keep four items from two other sources (#'s 25-28, Appendix 2) to provide a potentially different perspective. Thus the scale for the next stage was composed of 14 items, reflecting the rather complex nature of the construct.

As is indicated in Appendix 4, it was decided to keep all eleven items left for **Compatibility** because of the sometimes inconsistent categorisation of the items which had occurred during Steps 3 and 4. Although the construct was not as complex as **Relative Advantage**, this sorting inconsistency did not augur well for a potentially high reliability coefficient. Secondly, this new scale was not based on any existing one. Therefore, it was hoped that by keeping a relatively larger number of items at this stage, there would be more opportunity to eventually develop a better scale for the final questionnaire.

Again as indicated in Appendix 4, ten items were retained for the **Ease of Use** scale. These were all taken directly from the Davis scale for "perceived ease of use". They had passed through the validation rounds unaltered, and again because of the success realised by Davis, it was considered that they should provide a valid and reliable scale. The other items from other sources which had remained after the sorting rounds were dropped.

Eight items remained for **Result Demonstrability** after the sorting rounds. It was decided to retain all for the next stage. Nevertheless, it was considered that this particular construct was perhaps too factorially complex for a proper scale to be developed, and in the context of the current study was perhaps somewhat irrelevant. This was based on a couple of considerations. First, as was discussed earlier, items from this category tended to be grouped with those of **Relative Advantage**. Thus, it might be argued that the strength of the perception of **Relative Advantage** in fact captures the tangibility, or demonstrability, of the results of using a PWS. Certainly, the more intangible, or less amenable to demonstration, the results of using a PWS are, the less advantage will be perceived in using one. The second consideration is that in an organisational context, where PWS are provided without a significant requirement for justifying their acquisition, the impact of having to demonstrate the benefits of using a PWS will be less. Both of these considerations indicated that perhaps this scale could be dropped from the final instrument. Nevertheless, it was decided to retain it for the next stage to see what the results of the initial test of the scale would reveal.

It was decided to retain all nine items which remained for **Visibility**. Like **Result Demonstrability**, it was considered that this aspect of Rogers' **Observability** construct might not have a significant impact within organisations. This is due to the fact that even though a significant number of individuals are not yet using PWS, the machines are fairly widespread, and hence likely quite "visible". Finally, as indicated in Appendix 4, it was also decided to keep ten of the twelve items which remained for **Trialability**. These items had had been grouped together rather consistently during the sorting rounds, but again as they were to be part of a new scale it was thought better to retain ten items to allow for flexibility in culling items after the next stage.

It was also decided to add six new items which did not specifically fit within the general scales developed to this point. Most items developed to date had a general focus, and could be used to measure perceptions of most innovations. As discussed in Chapter 2, however, computer usage has certain specific <u>negative</u> aspects which have received rather prominent attention. These include the capability which PWS potentially provide management to monitor users, as well as the health, deskilling and job elimination concerns of some PWS users. Six items were developed to measure users' perceptions of these concepts (Appendix 2, #'s 104-109). It should be noted that these items do not necessarily constitute a new cohesive scale, as there is no reason to expect that they should correlate with one another. For example, the health issue is distinctly separate from the monitoring issue, as it is from the others. Therefore, the new items constitute essentially single item measures of very specific perceptions, with a two item measure for the control and monitoring issue (#'s 104-105).

The final refinement to the scales for the Pre-Pilot test was to reword items as necessary for users and non-users of the PWS. This essentially involved a slight change in tense and mood for the items, as illustrated by the underlined words in the following example:

User: Using a PWS <u>is not</u> similar to anything that I've done before.

Non-User: Using a PWS <u>would not be</u> similar to anything that I've done before.

The re-wording created two sets of items which were grouped in two different sections of the questionnaire. Respondents were directed to the appropriate sections depending on whether they used the PWS or not.

## 4.10 PRE-PILOT TEST

### 4.10.1 General

The next stage of the instrument development process was to conduct a pre-pilot test, so-called because the size of the sample was kept intentionally small. The primary aim of this test was to ensure that the mechanics of compiling the questionnaire had been adequate. This was accomplished by having respondents first complete the questionnaire, and then comment on its length, wording, and the instructions that were included (Appendix 11). These comments, plus a scanning of the questionnaires to see if any difficulties were encountered, served the purpose of ensuring that respondents would encounter a minimum of difficulty completing the questionnaire.

The analysis of the reliability of the scales was also important in this test, but because of the test's first aim it was considered that a large sample size would be inappropriate. The purpose of the discussion in this section, however, is to comment on the test's impact on the development of the various scales measuring the perceived characteristics of using the PWS.

### 4.10.2 **Sample**

Questionnaires were distributed to a convenience sample of 20 users and non-users taken from the business faculties at the University of Calgary and University of British Columbia. This sample included both voluntary users of the PWS, primarily faculty members, and non-voluntary users, primarily secretaries. Seventeen usable questionnaires were returned.

### 4.10.3 **Results**

While all aims of the pre-pilot were met, only the scales measuring the perceived characteristics were statistically analysed. The intent was to check on the internal consistency of the eight scales which had been developed, and to see how many of the items, if any, could be eliminated. It was considered that 81 items were simply too many for this type of instrument, and that it should be reduced as much as possible while retaining desired reliability levels.

The scales were analysed using the SPSS-X **Reliability** routine, calling for the six measures of reliability discussed by Guttman (1945). Of the six measures, Guttman argued that the one with the lowest rating establishes the lower bound on the true reliability of the scale. Cronbach's ALPHA, one of the six measures discussed by Guttman (Lambda 3), was also examined as has become fairly standard in most discussions of reliability. The correlation matrix of items in each scale (henceforth item-item), the "corrected item-to-total correlations" (henceforth item-scale), the "ALPHA if deleted" score, and the item standard deviation scores were also used to determine which items were candidates for deletion from the scale. Items with low inter-item and item-scale correlations, which would raise ALPHA if deleted, or which showed low variance (and hence would have low explanatory power in any model) were all candidates for elimination. Two analysis rounds were conducted, one to show the initial results and one to determine the statistics after items had been deleted from the scales. It is recognised that the second analysis round lacks some validity in that items have been deleted. Nevertheless, it was felt that the insight gained from examining these statistics would be most valuable in refining the scales. The results of these analysis rounds are given in Table 4-1.

As is shown at Appendix 4, five items were included in the scale to measure **Voluntariness** (questionnaire items 5, 14, 23, 31, and 38; henceforth all item numbers refer to their number on the questionnaire). As summarised in Table 4-1 the results for this scale (labelled VOL) were very encouraging. Guttman's lower bound (henceforth GLB) was .95, with ALPHA at .93. One item (#14) with the lowest corrected item-scale correlation would actually raise the ALPHA if deleted score. Once deleted, GLB rose to .96 and ALPHA to .94. Because of the relative homogeneity of the items, it was decided that item 14 could be dropped from the scale for the next round.

Seven items were included in the **Image** scale (labelled IMG). The initial GLB for this scale was .89, with ALPHA at .71. Two items (36 and 49), however, showed poor correlation with the scale, and would significantly raise ALPHA if deleted. After dropping them, GLB dropped slightly to .88 but ALPHA rose to .84. It was also concluded that eliminating the items would not affect coverage of the domain of the construct, and hence they were dropped for the next round of testing.

Fourteen items were originally included in the **Relative Advantage** scale (labelled RA), and hence it was hoped that the analysis would reveal several items which would be candidates for elimination. The initial GLB for this scale was .98, with ALPHA at .89. It was decided that several items could be deleted while still remaining within the target range for reliability. Items with low inter-item and item-scale correlations, combined with low variance were first examined to see if dropping any of them would cut down on the coverage of the domain of the construct. Based on this analysis, five items were identified as candidates for deletion (16, 25, 37, 72, 81). After deletion, ALPHA remained at .89, while GLB decreased slightly to .97. It was concluded, therefore, that the scale could be reduced to nine items with good domain coverage and excellent reliability.

The scale for **Compatibility** (labelled CPAT) originally contained eleven items. The statistics for this scale showed some surprising negative item-item and item-scale correlations (items 01, 52, 54, and 71). Examination of the item content did not reveal why this might be the case, but they significantly lowered ALPHA (.52), although GLB was somewhat higher (.86). Nevertheless, because the negative correlations would make any scale based on these items hard to interpret, and eliminating them would not negatively affect the coverage of the domain of the construct, it was decided that these items could be deleted from the scale. Furthermore, examination of the results revealed that there were two or three additional items which had low item-scale correlations. The content of these items was examined and again it was felt that three could be dropped without adversely affecting domain coverage (items 20, 28 and 69). Once this overall deletion of seven items was carried out ALPHA rose to .89 and GLB to .93. Thus, it was concluded that the revised scale of four items demonstrated good potential for reliability in the final instrument, and was sufficiently parsimonious without detracting from domain coverage.

The original scale for **Ease of Use** (labelled EOU) included ten items. Within this scale one item had a negative item-scale correlation (#59) and two others had low item-scale correlations (#06 and #19). As a result the score for ALPHA was relatively low at .79 with GLB at .91. The content of the latter two items was examined, and it was decided that #19 could be dropped as well as #59 without affecting domain coverage. The resulting ALPHA was .83 with GLB at .92. The reduced scale therefore demonstrated slightly higher reliability coefficients without reduced domain coverage and was used in the pilot test.

The scale developed for **Result Demonstrability** (labelled RD) contained eight items. Analysis of the results of the pre-pilot test showed very poor item-item and item-scale correlations. Four items had negative item-scale correlations (24, 35, 39, and 40) and one was near zero (75). Even items which were expected to correlate highly as they were designed to tap the same part of the construct domain had surprisingly low item-item correlations. An example are the two items (39 and 70) intended to measure the observability of results whose item-item correlation was -.35. Once again, therefore, it was questioned whether this construct was applicable in the context of the current research, if even within the general DOI framework. Nevertheless, it was decided to keep the items with positive item-scale correlations for the pilot test, including #75. The ALPHA for this four item scale was .62 with GLB at .72.

The scale developed for **Trialability** (labelled TRIAL) originally contained eleven fairly homogeneous items; hence, it was expected that this scale should be able to be reduced significantly. With eleven items it had an ALPHA of .77, and GLB of .94. Once again, therefore, items were examined to see which could be deleted which might increase reliability levels, while still maintaining domain coverage. Four items (17, 21, 51 and 73) with item-scale correlations below .40 were identified based on these criteria. Four others (8, 15, 27 and 33) were also noted with item-scale correlations below .50. Several combinations of deletions of items were analysed, and a final five item scale was determined with adequate domain coverage, an ALPHA of .81, and GLB at .84. The remaining items in the scale for use in the pilot test included 27, 33, 45, 62, and 77. One final refinement to the items for the Pilot Test was the slight rewording of the **Trialability** items. It was noted by one respondent that the items could be perceived to require dichotomous responses, not a gradation of opinions. Thus qualifiers were added to the necessary items as in the following example, (with the added qualifier underlined):

U-45: A PWS was available to me to <u>adequately</u> test run various applications.

The **Visibility** scale was composed of nine items, which because of the nature of the construct were fairly homogeneous. ALPHA for the nine item scale was .83, with GLB of .95. Examination of the item-scale and item-item correlations revealed several candidates for deletion. Once again, because of the simplicity of the construct, it was felt that most of the items with an item-scale correlation of less than .65 could be eliminated without affecting domain coverage. Thus five items were dropped (29, 55, 63, 66, and 76). The resulting four item scale to be used in the pilot test showed an ALPHA of .94, and GLB of .95.

The remaining six items in the instrument dealing with the negative aspects of computer usage were put through the same analysis as a group labelled **Computer Avoidance** (CA). As stated earlier, however, it was not expected that there would be a significant degree of correlation among the various items, and this proved to be the case. The highest correlation was between items 12 and 58, which addressed the control and monitoring aspects of PWS usage. As suspected, therefore, there did not materialise from this initial test any particular computer avoidance type construct.

## 4.11 PILOT TEST

### 4.11.1 General

The final stage of the instrument development process was to conduct a "full scale" pilot test of the questionnaire using respondents whose background would be similar to the target population of the final study. The primary aim of the pilot test was to ensure that the various scales demonstrated the appropriate levels of reliability. Secondary aims were to again check for any difficulties or ambiguities that respondents might face in completing the questionnaire.

### 4.11.2 Sample

The sample population for the pilot test was drawn from the head office of a utility company. It included a variety of individuals, both users and non-users of PWS, from a variety of levels and departments,. Questionnaires were distributed to 75 individuals, with 66 usable questionnaires returned.

### 4.11.3 Results

The scales were again analysed using the SPSS-X **Reliability** routine, calling for the six measures of reliability discussed by Guttman (1945). Furthermore, the same analysis was conducted as for the pre-pilot test, focussing on the item-item and item-scale correlations. (Table 4-2 summarises the results for all scales developed, including the four **Innovativeness** measures discussed in Section 4.15.)

The **Voluntariness** scale consisted of four items. As shown in Table 4-2 the reliability scores were slightly lower than for the pre-pilot test, but certainly at a very acceptable level. Guttman's lower bound (GLB) was .88, and Cronbach's ALPHA .87. One item (#14) with the lowest item-scale correlation would raise ALPHA very slightly if deleted (to .88). Nevertheless, it was decided to retain this item in the final scale.

Five items had been retained for the **Image** scale. Reliability for this scale was very similar to the pre-pilot, with a GLB of .88, and ALPHA of .84. Any item if deleted would result in a lowered ALPHA, and thus all five were retained for the final scale.

Nine items had been included in the **Relative Advantage** scale. Again, reliability for this scale was high with both GLB and ALPHA at .90. One item (#26) would raise ALPHA slightly to .92 if deleted. Examination of this item indicated that it might be improved by emphasising its "reversed" direction, which was done by underlining the word "disadvantage". All nine were therefore retained for the final scale.

Four items were incorporated in the **Compatibility** scale, whose reliability in this instance had decreased somewhat from the pre-pilot. Nevertheless, it was still in the acceptable range, with GLB at .82, and ALPHA at .81. All items were retained for the final scale.

The **Ease of Use** scale consisted of eight items, which again demonstrated an acceptable level of reliability, with a GLB of .85 and ALPHA of .83. The statistics indicated that two items (#23 and #24) would result in a slight increase in ALPHA if they were deleted. Examination of the wording of these items revealed that the word "interaction" might be causing some of the problems, and that changing it to "using" might improve the scores. This was done and all items were then retained for the final scale.

The **Result Demonstrability** scale of eight items demonstrated a narrower range of reliability scores than in the pre-pilot, although they were still in the lower range of acceptability. GLB was .74 and ALPHA was .72. Removal of any item would decrease ALPHA, and hence all were retained for the final scale.

Five items had been retained for the **Trialability** scale. Again the resulting reliability scores were in the lower range, with GLB at .73 and ALPHA at .72. There appeared to be problems with one item (#16) as ALPHA would increase slightly if it were to be deleted. Examination of the item indicated that it contained a "complex" wording which might be tapping two constructs ("opportunity to try and work"). Therefore, it was simplified by dropping "and work", and retained with the other four items for the final scale.

The **Visibility** scale of four items demonstrated significantly reduced reliability from the pre-pilot test, dropping to a GLB of .46 and ALPHA of .37. Although this construct was of lesser importance in the study when compared to other constructs, it was decided to attempt to "improve" the final scale's potential reliability score by reworking some of the items. Item 17 was dropped from the scale, and replaced by item 76 from the pre-pilot. The word "not" in item 36 was emphasised in the final scale by underlining it, and item 55 from the pre-pilot was reworded slightly and added. The result was that the final scale included five items.

The final "scale" was that attempting to measure **"Computer Avoidance"**. As discussed for the pre-pilot test, it was not expected that the various items would be very highly correlated, although the reliability scores for the pilot test did improve somewhat. GLB was at .62, and ALPHA was .60. The same six items were retained•for the final instrument.

## 4.12 SUMMARY OF DEVELOPMENT OF PCI SCALES

The creation of the final survey instrument to measure the perceived characteristics included surveying existing instruments, choosing appropriate items from them, creating new items as necessary, and then undertaking an extensive scale development process. The result was a fifty item instrument, comprising nine scales, all with acceptable levels of reliability. Although some scales demonstrated reliabilities at the lower bound, based on comments received from respondents in both the pre-pilot and pilot tests, it was concluded that 50 items was the maximum feasible length for this instrument. Since any attempt to increase reliabilities would certainly involve adding items, the instrument was accepted. Nevertheless, those constructs considered to be of higher relative importance in the study (such as **Relative Advantage** and **Ease of Use**) were allocated a higher percentage of the items in order to maximise their potential reliability scores in the study.

# SECTION C: SUBJECTIVE NORM, ATTITUDE, AND INNOVATIVENESS MEASURES

## 4.13 SUBJECTIVE NORM

### 4.13.1 General

The **Subjective Norm** (SN) as described in Chapter 3 forms one major component of the Theory of Reasoned Action. Nevertheless, as was discussed, it was not the intent of the current study to attempt to rigorously apply this model. Rather, the major aim was to examine the effects, if any, of the **Perceived Characteristics** of adopting the PWS on the decision to adopt or reject PWS usage. Nevertheless, it was decided that some examination of the effects of the SN should be undertaken, and therefore an instrument was created for this purpose.

### 4.13.2 Scale Development

As discussed in Chapter 3, the SN is defined as follows:

$$SN = \Sigma(NB_j)(MC_j)$$

where $NB_j$ = the belief that the performance of a specific behaviour is expected by the jth referent; and

$MC_j$ = the motivation to comply (or not) with the jth referent.

To calculate the SN, therefore, one needs to measure both the NB's and MC's which are relevant to the particular behaviour. Scales for doing this have been outlined by Ajzen and Fishbein (1980, Appendices A and B), which are basically of the Likert or semantic differential type. Numeric values are assigned to the responses, and then the respective $NB_j$'s and $MC_j$'s are multiplied together and summed for all referents to calculate the overall SN.

The NB and MC for each referent are measured by single items. While the use of single items contrasts with earlier discussion about reliabilities, this procedure has been fairly standard in the measurement of the SN. For example, in one application of the Theory of Reasoned Action, Ryan (1982) constructed multiple-item scales to measure beliefs about the outcomes (similar to PCI's) of actually using a product. For the SN, however, he used only single-item scales to measure the various NB's and MC's. Therefore, because investigation of the SN was a sub-goal of the current research, it was not intended to alter this accepted practice and develop multi-item scales.

Different approaches have been taken in assigning values to the various responses. Bipolar scoring, with positive and negative values centered on a midpoint of zero, has often been used for NB's. This appears to be a valid method for this study in that the meaning attached to such scores make sense. For example, the possible responses to the belief

"Referent A thinks I should use a PWS"

range from "extremely likely" through "neither likely nor unlikely" to "extremely unlikely". If a respondent thought that a referent had no opinion ("neither likely nor unlikely") about his using a PWS, then the respective NB should have no effect on the SN. Therefore, scoring this response as a zero is appropriate. "Unlikely" responses should tend to have a negative effect on the SN, and assigning negative values to these responses also makes sense. The same argument holds for assigning positive values to the "likely" responses. Hence, it was decided that scores for NB's would be based on a bi-polar scale, ranging from -3 to +3 for the seven points, with zero (0) as the mid-point.

Problems appeared, however, in determining values for MC. Ajzen and Fishbein (1980) once suggested that the MC is unipolar, "in that people are unlikely to be motivated to do the opposite of what their salient referents think they should do" (p.75). This runs contrary to an earlier argument by Fishbein that bipolar scaling is in fact correct, and that modifications such as "I want to do the opposite of ... " should be used (Fishbein, 1976). In fact, as pointed out by Ryan (1982), the operationalisation of the MC is still not settled. Indeed, within one publication Ajzen and Fishbein provided examples of two different seven point scales to measure the MC (1980, Appendix A). In one example, their response categories to the question:

How much do you want to do what your parents want you to do?

ranged from "not at all" to "very much". It would be assumed that the scoring in this case would range from 0 to +7, consistent with the unipolar view. In the second example (1980, Appendix B), their response categories ranged from "extremely likely" to "extremely unlikely" to the statement:

I want to do what most members of my family think I should do.

It is not clear how the responses for items of this type would be scored. Whether an "extremely unlikely" response indicates a 0 or -3 on a seven point scale is debatable.

Within the context of the current study, however, it was decided to use unipolar scoring for the MC. First, it was thought unlikely that individuals in organisations would consciously act counter to the prevailing norms. Thus, having possible negative scores did not make sense. Second, if a bi-polar scale were used, multiplying a negative NB times a negative MC would result in the same score as if they were both positive. It is unlikely from a semantic or conceptual point of view that these two situations should be treated as having an equal effect on the SN. Finally, from an arithmetic point of view, having a bipolar NB scale (-3 to +3), and a unipolar MC scale (1 to 7), results in a better theoretical distribution of scores than if both were unipolar. For one referent only, with unipolar values, the "neutral" score would be 16 [(NB=4)*(MC=4)]. The poles would then be 1 (1*1) and 49 (7*7). Thus, the value for the semantic midpoint (16) would lie well below the value of the numeric midpoint (24.5). This would obviously create interpretation problems. On the other hand, having one unipolar scale and one bi-polar scale results in having the potential numeric responses distributed evenly about a midpoint of zero. Therefore, because of both conceptual and arithmetic considerations, it was decided to use this scoring technique.

The construction of actual items was fairly simple, with only the identification of the referent groups being required. This was accomplished by asking five different individuals (two junior support staff, two middle level managers, and a senior level manager) who their referents in the workplace were. This resulted in the obvious groups being identified:

Co-workers (peers)
Immediate superiors
Senior Management
Subordinates (if applicable)

Items were then constructed based on the format suggested by Ajzen and Fishbein (1980). One item was written for the NB and MC for each of the above referent groups. An overall item for the NB was created as suggested by Ajzen and Fishbein (1980), as well as the inclusion of "friends" as referents. It was decided to include both of these latter referents to provide flexibility later in the analysis of results. They could be included or deleted as the situation warranted. The final result was a 12 item instrument to measure the SN. Examples of the items are as follows:

NB: My co-workers (peers) think that I should use the PWS in my job.

MC: Generally speaking, I want to do what my co-workers think I should do.

NB (Overall): Most people who are important to me think I should use the PWS in my job.

### 4.13.3 Reliability

No assessment of the reliability of this instrument could be made because each NB and MC item asked about a different "referent". In order to assess reliability a multi-item scale would have been required. As discussed earlier, using single items to measure SN is normal practice and hence had been adopted for this study. It also helped keep the overall length of the questionnaire within reasonable limits.

## 4.14 ATTITUDE

### 4.14.1 General

In the early stages of development of this research, it was not intended to directly measure **Attitude**. Rather, the intention was to synthesise **Attitude** from the beliefs about PWS usage in accordance with the **Theory of Reasoned Action**, as discussed in Chapter 3. For that reason, no scale to measure **Attitude** had been included in the pilot test. Nevertheless, one was created for the final survey.

### 4.14.2 Development of Attitude Scale

In that several studies had investigated the effect of **Attitude** on system usage, as well as the fact that Ajzen and Fishbein (1980) had suggested a particular format, the development of a scale to measure **Attitude** was not particularly problematic. In particular, both Davis (1985) and Christensen (1987) had used such a scale with good results. The approach is to construct a semantic differential rating scale, using a series of adjective pairs. Davis used a total of five items, and achieved an overall reliability of .96 for his scale. Given the already somewhat lengthy nature of the current instrument, it was decided to construct a four item scale for this research. As a result, four pairs of adjectives from Davis's set of five were selected. These were used to respond to the following statement on a seven point scale:

Overall, my using a PWS in my job is:

The adjective pairs included Good-Bad, Harmful-Beneficial, Wise-Foolish, and Negative-Positive. The orientation of each subsequent pair was reversed as a further check on the reliability of the overall instrument.

## 4.15 INNOVATIVENESS

### 4.15.1 General

The dependent variables in the current study are all based on various aspects of actual innovative behaviour. In review, **Adoptive Innovativeness** reflects the degree to which an individual is relatively early in adopting an innovation. **Use Innovativeness** is the degree to which an individual who has adopted the innovation uses that innovation to solve novel problems, or in a new use domain. Finally, **Implementation Innovativeness** reflects the degree to which an individual puts an innovation to use, or implements it, within a given use domain. Thus the measures used within the study had to capture all these different forms of behaviour with regards to PWS usage.

Of all the variables being measured in the current study, it would have been most feasible to derive objective measures for determining **Innovativeness**. Nevertheless, it was felt that this was not practical, and that such measures might be even more unreliable than self-reported ones. For example, for **Adoptive Innovativeness**, a measure might be based on documentary evidence available within an organisation indicating when the individual received a terminal or micro, or was given official access to one. Nevertheless, it is possible that individuals might have been using a PWS before they "officially" had access to or received one. On the other hand, some individuals may not have started using the PWS until well after they had received access. The same argument holds for the other dimensions of **Innovativeness**. Therefore, it was decided that self-reports should again be used to collect data on these variables.

The three types of innovativeness all revolve around use of the PWS, which in the MIS domain is akin to **System Usage**. This has been a fairly common measure within MIS research (for some examples see F. Davis, 1985; Ginzberg, 1981b; Lee, 1986; and Robey, 1979). Typically these measures have used only one or two items to capture the use of the system. While this may create a degree of unreliability, it is not as serious a problem for dependent variables as for independent variables. For example, Davis (1985, p.97), basing his discussion on Pindyck and Rubinfeld (1981), argued that while unreliability in <u>independent</u> variables introduces bias and inconsistency into any regression coefficients, error in the <u>dependent</u> variable side of the equation is taken into the error term. While this may increase the estimate of error variance, any tests and confidence intervals will still be valid. For this reason, it was decided that only one or two items will be used to measure use of the PWS, as most other researchers have done when examining system usage. The various measures are described in the following sections. For ease of reference, item numbers refer to the final questionnaire, although initially the discussion will focus on the pilot test.

### 4.15.2 Adoptive Innovativeness

**Adoptive Innovativeness** was operationalised as the date of first use of a PWS. Three items were developed to capture this aspect. The first item asked for the month and year of first use as follows (B-3):

> Approximately when (month and year) did you first start using the PWS beyond any trial of it you may have carried out?

The second item simply asked for the length of time the user had been using the PWS (B-11):

> I have been using the PWS for:

The responses to this item were based on a seven point scale with each point indicating a bracket of time since adoption. The low anchor point was "less than one month", with the high anchor being "more than 24 months". The anchors were set at these particular levels as it was felt that differences in attitudes would be minimal for users with more (high anchor) or less (low anchor) experience than the anchors. The use of the seven point scale, rather than a raw number of months, was intended to offer a variation of the type of item being used for this measure.

Finally, a third item was included asking the respondent to indicate how long ("in months") they had been regularly using any of a variety of PWS functions (B-9). The longest used function should correlate highly with the date of first use of the PWS. It is possible that an individual may no longer be using the function that precipitated first use of the PWS, but it was concluded that these cases should be few in number, and hence the item should provide a fairly accurate indicator of the date of first PWS use.

A scale for measuring **Adoptive Innovativeness** was constructed from these three items. This required first converting the "Month-Year" response in B-3 into a number of months, and selecting the longest used function from the list of used functions in B-9. These were then distributed on a seven point scale commensurate with that in B-11.

The reliability of the measures was assessed after the Pilot Test, and found to be very high (ALPHA and GLB at .94). It was noted, however, that the many of the responses fell beyond the upper limit of the seven point scale. Because the reliability of the overall scale did not fall if B-11 were removed, it was decided that the other two items could be used to form the scale for the final instrument. This also allowed for a wider and more detailed response set, which, it was expected, should facilitate the eventual analysis.

### 4.15.3 Implementation Innovativeness

As operationalised, **Implementation Innovativeness** is the number of hours which the adopter uses the PWS. While this does not provide an accurate assessment of the **potential** use which the individual may make of the PWS, it was considered that there was no feasible method with which to measure "potential use". Self-reported measures of potential would be unreliable as an assessment would be very much dependent on an individual's training, general knowledge, experience, and other such factors. Thus, it was decided to simply measure for the average number of hours of actual usage per week for each function (B-8). The total number of hours of use per week could then be computed as the sum of these responses.

Measures of the frequency of use were also included (B-5, B-7), in keeping with other studies of computer usage (for example Davis, 1985). Item B-5 provided an indication of overall PWS usage, while B-7 indicated the frequency of use of individual functions.

Because only one question had tapped the **hours of use**, no reliability assessment could be made of this construct. Therefore, it was to add a second question for the final questionnaire. This item (B-4) simply asked the more general question of overall use, as follows:

Overall, how many hours per week do you use a PWS?

The reliability of the frequency measures in the Pilot Test was .86 for both GLB and ALPHA. Although this was fairly high, the difficulty was recognised of trying to compare frequency of use of individual functions, with a general overall usage measure. Therefore, although both items were retained for the final questionnaire, it was decided that the item dealing with frequency of use of individual functions (B-7) would be the primary measure. A "frequency" score could be computed by summing the response values to each individual function. It is recognised that this certainly does not constitute an interval scale, but it was concluded that the response set would be wider and more detailed than a simple seven-point scale, and hence more amenable to analysis. The idea of asking respondents for a "raw number" indicating the overall frequency of use was rejected as likely being too difficult to answer.

Secondly it was considered that any response to such an item would likely be more unreliable than one received in checking function by function.

#### 4.15.4 Use Innovativeness

**Use Innovativeness** was operationalised in this study as the number of **different functions** that an adopter uses on the PWS, which addresses the different "use domains" aspect of the construct (see Section 3.4). No attempt was made to measure the use of the PWS to solve "novel" problems within the same use domain. This was done for two reasons, one of which was pragmatic. It would be very difficult to determine with much degree of reliability or validity what constituted "novel" problems. Secondly, however, the application of the PWS in a novel use domain would most likely require a greater degree of change than using it within the same domain. Therefore, using it in novel domains would demonstrate a greater degree of innovativeness. It was for these reasons that this study concentrated on this aspect of **use innovativeness**.

No direct items had to be created to measure this aspect of PWS usage, in that several others were already tapping the construct. The actual functions included in these items were based on awareness what is available, as well as discussions with users. Opportunity was also provided to allow respondents to write in any function not listed.

The first items which could be used were the "frequency of use" (B-7) and "number of hours of use" (B-8), from **Implementation Innovativeness**, and "months of use" (B-9) from **Adoptive Innovativeness**. Each had a function by function component. Two other items were included in the Pilot Test which also could be used. One asked whether the functions were used on the mainframe or micro (B-6), and the second for the sequence with which various functions were adopted (not included in final questionnaire). In total this provided five different items to measure this construct.

In order to calculate an overall **Use Innovativeness** score, a count was made of the number of functions indicated as "used" in each item, and then an average taken. The reliability of the scores was very high, with both ALPHA and GLB at .99. For this reason, the question dealing with sequence of adoption was dropped, in that it did not contribute significantly to the aims of the study, would not detract from the reliability of the scale, and would help shorten the overall questionnaire.

## SECTION D: QUESTIONNAIRE DESIGN

### 4.16 GENERAL

In general, once the specific items had been developed, the overall questionnaire was designed using the **Total Design Method** as advocated by Dillman (1978). Dillman claimed very high response rates for surveys following his methods, which were apparently refined in collaboration with a number of researchers in more than 50 surveys. The guidelines all have face validity, and hence were followed whenever possible. The discussion that follows is based both on Dillman's recommendations and on personal experience in administering and answering questionnaires. After the questionnaire had been assembled, it was tested in two separate rounds, as has been discussed earlier. The Pre-Pilot Test's two main aims were to test the formatting of the questionnaire and examine the development of the items to measure the **Perceived Characteristics**. The Pilot test also was used to do this but to a lesser degree, as most of the problems had already been identified and addressed.

## 4.17 FORMAT

### 4.17.1 Booklet

First, potential respondents are apt to debate whether even answering a questionnaire is important. Because the respondents' first impression of the questionnaire is very likely to affect whether and how they respond, care was taken to have as professional a "package" assembled as possible. Thus, the appearance was intended to indicate to the respondent that a great deal of time, energy, and expense was put into the questionnaire. The higher these perceptions, the more important the questionnaire is likely to be considered, and the greater should be the incentive to respond to it. For this reason, the booklet format was chosen, with features such as high quality covers and paper. Respondents are also likely to be concerned about what will be done with their responses, especially those dealing with personal details or impressions of their organisation. For this reason the cover included the logo of the university, and the covering letter emphasised the confidentiality of the responses. The logo hopefully also contributed to the impressions of the questionnaire's importance and that it was not a "sales gimmick".

Booklet style questionnaires might be perceived to be lengthy. For this reason the covering letter emphasised that the completion time was relatively short. In addition, the use of different coloured pages for the different sections allowed a "visual" reference to be made to the sections. This facilitated the covering letter's explanation that respondents would be skipping one of the sections, which it was believed would help reduce any concerns about the questionnaire's length.

The use of coloured pages also served two other purposes. One was the simple enhancement of the overall appearance of the booklet. More importantly, however, the different coloured sections aided the direction of respondents from one section to another. By making reference to colour rather than page numbers, respondents should have been able to move more quickly and accurately from one section to another.

Finally, the inside cover page included a cartoon related to the topic. Again, the purpose of the cartoon was twofold. First, it should have help reduce the impressions of some respondents that academic research (and academics) are "stuffy". Second, it hopefully put respondents in a positive frame of mind with which to approach answering the items.

4.17.2 **Question Layout**

Questions were formatted with three principles in mind. First, answers were vertically oriented, whenever possible, to achieve a vertical flow through the questionnaire. This allowed respondents to move quickly down the page, achieving a sense of accomplishment and progress. Secondly, respondents placed answers to the left of the categories rather than on the right. This typically allowed responses to be stacked without regard to the length of the category description. Finally, the answer categories were typed in UPPER CASE to distinguish them from the actual questions.

Instructions for answering the questions were consistently placed throughout the questionnaire, as well as at the beginning in a set of general instructions. Although this may seem to have been redundant, the Pre-Pilot test indicated that questions which lacked these instructions were often answered in a manner other than that desired.

### 4.17.3 Covering Letter

The covering letter was intended to sell the idea of completing the questionnaire to the potential respondent. For this reason, the covering letter was designed following standard sales techniques. The first paragraph was designed to catch the respondents' attention, indicate what the goals of the study were and how meeting them would be of benefit to the respondent. Once this was established, then the costs to the respondent were introduced, which was answering the questions. As with most sales "pitches", the costs were minimised, which meant emphasising the short completion time and the high confidentiality of the responses. Finally, the benefits of responding were re-stated, and a commitment sought from the respondent.

As can be seen from Appendix 9, the wording of the covering letter followed very carefully the wording of most sales letters. It did not ask for favours, as is the case with many questionnaire covering letters. For example, there was no plea to help a struggling doctoral student finish his dissertation. Finally, both general benefits (understanding the impact of computer proliferation on our jobs) and specific rewards (receiving a copy of the findings) were offered.

## 4.18 TESTING

The Pre-Pilot Test was primarily a check on the formatting of the questionnaire, and on its overall length. Respondents were made aware of this at the beginning, and were asked to monitor the length of time required to complete all of the items. Secondly, they were asked to indicate whether any of the instructions were ambiguous, difficult to understand, and so forth. Finally, they were also asked to make any comments they felt appropriate about the wording of any of the items which would help improve the overall questionnaire.

In general the questionnaire was well received. Most of the comments have been discussed in the item development sections. Any negative comments primarily reflected the length of the Sections dealing with the **Perceived Characteristics** of the PWS. The average length of time required to complete all sections was 20-25 minutes. A few items were answered either inappropriately or missed, although none of these were consistent. Nevertheless, attempts were made to ensure that this would not occur in future administrations of the questionnaire by rewording or making more explicit the instructions. Finally, both the pre-pilot and Pilot tests helped identify some of the typographical errors which had escaped detection to that point.

## SECTION E: FINAL SURVEY - SCALE RELIABILITIES

### 4.19 GENERAL

Although full details of the study results are provided in Chapter 5, Table 4-3 indicates the reliabilities that were achieved in the full survey for the various scales that were developed. The reliabilities for scales measuring the PCI's are based on the full sample of 540 respondents. For the scales measuring the various forms of innovativeness, which revolve around use of the PWS, the reliabilities are based only on those respondents who actually use the PWS (418 respondents). The final form of the questionnaire is provided in Appendix 10.

### 4.20 RESULTS

As shown in Table 4-3, the reliabilities of all scales are above the minimum target of .70 initially set for the study. In fact, the majority of the scales are at or well above the .80 level, with only three near the .70 lower bound. These are **Trialability** (ALPHA=.72, GLB=.73), **Visibility** (ALPHA=.70, GLB=.76), and **Computer Avoidance** (ALPHA=.71, GLB=.75). The newly developed scale for **Attitude** also showed excellent reliability (ALPHA=.91, GLB=.92).

The above results indicate that amendments made to the scales following the **Pilot Test** succeeded in raising the reliabilities of the problematic scales to the desired levels. Furthermore, those scales which were considered to be more important from a theoretical perspective, such as **Relative Advantage**, **Compatibility**, and **Ease of Use**, all have excellent reliabilities. Given these results, it can be concluded that the instrument development process achieved its aim, and that the scales can be used with confidence in the study of the diffusion of PWS.

## TABLE 4-1

## RELIABILITY COEFFICIENTS: PRE-PILOT TEST

| | INITIAL VARIABLE SET | | | FINAL VARIABLE SET | | |
|---|---|---|---|---|---|---|
| VARIABLE NAME | # ITEMS | CRONBACH'S ALPHA | GUTTMAN'S LOWER BOUND | # ITEMS | CRONBACH'S ALPHA | GUTTMAN'S LOWER BOUND |
| VOL | 5 | .93 | .96 | 4 | .94 | .96 |
| IMG | 7 | .71 | .89 | 5 | .84 | .88 |
| RA | 14 | .89 | .98 | 9 | .89 | .97 |
| CPAT | 11 | .52 | .86 | 4 | .89 | .93 |
| EOU | 10 | .79 | .91 | 8 | .83 | .92 |
| RD | 8 | .20 | .64 | 4 | .62 | .72 |
| TRIAL | 11 | .77 | .94 | 5 | .81 | .84 |
| VIS | 9 | .83 | .96 | 4 | .94 | .95 |
| CA | 6 | .59 | .73 | 6 | NO CHANGE | |
| TOTAL | 81 | | | 49 | | |

## TABLE 4-2

## RELIABILITY COEFFICIENTS: PILOT TEST

| NAME | ITEMS | ALPHA | LOWER BOUND |
|---|---|---|---|
| VOLUNTARINESS | 4 | .87 | .88 |
| IMAGE | 5 | .84 | .88 |
| RELATIVE ADV | 9 | .90 | .91 |
| COMPATIBILITY | 4 | .81 | .82 |
| EASE OF USE | 8 | .83 | .85 |
| RESULT DEMON | 4 | .72 | .74 |
| TRIALABILITY | 5 | .72 | .73 |
| VISIBILITY | 4 | .37 | .46 |
| COMPUTER AVOID | 6 | .60 | .62 |
| MONTHS OF USE | 3 | .94 | .94 |
| NUMBER OF USES | 5 | .99 | .99 |
| USE FREQUENCY | 2 | .86 | .86 |
| HOURS OF USE | 1 | ---- | ---- |

## TABLE 4-3

## RELIABILITY COEFFICIENTS: FINAL SURVEY

| NAME | ITEMS | ALPHA | LOWER BOUND |
|---|---|---|---|
| VOLUNTARINESS | 4 | .84 | .85 |
| IMAGE | 5 | .80 | .80 |
| RELATIVE ADV | 9 | .93 | .94 |
| COMPATIBILITY | 4 | .86 | .86 |
| EASE OF USE | 8 | .82 | .82 |
| RESULT DEMON | 4 | .79 | .79 |
| TRIALABILITY | 5 | .72 | .73 |
| VISIBILITY | 5 | .70 | .76 |
| COMPUTER AVOID | 6 | .71 | .75 |
| MONTHS OF USE | 2 | .90 | .90 |
| NUMBER OF USES | 4 | .98 | .98 |
| USE FREQUENCY | 1 | ---- | ---- |
| HOURS OF USE | 2 | .88 | .88 |
| ATTITUDE | 4 | .91 | .92 |

# CHAPTER FIVE

# DATA COLLECTION AND ANALYSIS

There are three kinds of lies: lies, damned lies, and statistics.
Benjamin Disraeli

Statistics are like alienists - they will testify for either side.
F.H. La Guardia

## SECTION A: DATA COLLECTION AND CONDITIONING

### 5.1 INTRODUCTION

This chapter will present the data collection and analysis activities carried out in this study. As discussed in Chapter Three, a field survey was chosen as the particular research design for this study. Chapter Four then outlined the various steps taken to operationalise the constructs of interest and to develop the instruments to be used for data collection in the survey. Chapter Four also presented the reliabilities that were achieved in the survey for the final scales used to measure the constructs. This chapter now describes the data collection activities, and presents the analysis of the data. It first outlines the various checks that were made with respect to the integrity of the data, and then presents various descriptive statistics. Finally, the results of both regression analysis and structural equation modelling are given.

It should be noted that much of the analysis in this chapter speaks in "causal" terms, in line with the theory developed earlier. It is recognised, however, that because this study was cross-sectional and non-experimental, **determination** of causality is not possible. As a result, discussion of causes and effects is, in a **strict** sense, not appropriate. The better approach would be to discuss the results in terms of correlations and associations. Nevertheless, in that the research model is based on theory which posits various causes and effects, the discussion will often be couched in causal terms, based on **inference** from the data. This applies especially to the analysis using structural equation modelling. As put by Hayduk (1987):

> As long as social scientists find it useful to think of one thing as influencing, bringing about, effecting, determining or causing another, there is no reason to abandon causal statements. Despite the philosopher's unease with statements of causation and the statistician's insistence that there is nothing causal about equations, social scientists are free to judge the usefulness of thinking causally about their data sets and to exploit the consistencies between structural equations and causal thinking.

## 5.2 SURVEY SAMPLE

### 5.2.1 Survey Sites

Given the aim of attempting to have as high a degree of external validity as possible, several decisions were made as to the nature of the desired sample for the survey. As discussed in Chapter Two, there appears to be a range of significantly different reactions by individuals to Information Technology (IT), from hostility and rejection to enthusiastic adoption. Furthermore, while not downplaying the effects of **organisational variables**, it appears as if the full range of reactions can occur within a **given** organisational context. Therefore, conducting a study within a given context should provide valuable insights into the diffusion of PWS. In spite of this, to increase the external validity of the study, it was decided to include individuals employed in a variety of contexts within the sample. This in turn led to the decision to approach several firms representing a variety of industries. Nevertheless, it must be emphasised that the **individual adopter** is the unit of analysis in this study, not the organisation.

The specific industries and firms targeted for the survey were based on geographical convenience. After discussion with several organisations, seven eventually agreed to participate in the survey. These included two different government departments, one whose primary role is planning and one which has primarily a service orientation. Two private sector utilities, a telephone company and an electric power supplier, were also included. Two resource based industries were represented, including a petroleum exploration and production company, and a pulp and paper manufacturer. The final firm in the study was a natural grains (wheat, barley, etc) marketing and farm supply agency. As can be seen, these firms, as well as representing diverse industries, also cover the range of private to public sector organisations.

Within the firms, several different departments were targeted for inclusion in the survey. The decision on which departments to target was based on the researcher's experience and intuition, and on discussion with the firms' representatives, with respect to the different "computing" cultures that might exist within the firm. It was hoped to target departments which would cover the range of familiarity and experience with computers and computer support. For example, computers generally were first introduced into organisations to support those departments whose activities were quite structured and "computationally intense", such as accounting and engineering. Other departments, such as administration, have typically only relatively recently started to receive computer support. It was expected that if differences with respect to acceptance of computers were to exist among departments, such differences would likely be manifested by choosing departments with potentially different computing histories. By including respondents from these departments, the generalisability of the study would be improved. For this reason the departments listed below, all in the head offices of the participating firms, were chosen as sites for the survey (not all departments were represented in each firm).

| Departments | Number of Respondents |
|---|---|
| Human Resources/ Administration/ Legal | 216 |
| Marketing/ Sales/ Public Affairs | 67 |
| Engineering/ Finance/ Accounting | 168 |
| Other | 88 |

### 5.2.2 Response Rates

The participating organisations agreed to distribute questionnaires to all employees within the targeted departments, and to serve as the collection agencies for the completed questionnaires. A total of 810 questionnaires were distributed, with 540 usable ones returned, for a response rate of 67%. The response rate was consistent across all firms, ranging from a low of 58% to a high of 69%. This return was judged to be quite acceptable. No "reminders" were sent out to attempt to raise the response rate for two reasons. First, because some items included within the questionnaire were of a confidential nature, respondents had to be assured that their responses would be completely anonymous. For this reason, no provisions were included to identify individuals with particular questionnaires, and hence a targeted reminder to those who did not return the questionnaire was impossible. Secondly, as many of the firms had recently seen a spate of surveys, they generally requested that the survey be "low key", without the potential of respondents perceiving coercion to complete the questionnaire. Thus, it was felt that the cooperation of the firms might be threatened if extra prodding of respondents were used to increase the response rate.

### 5.2.3 Demographic Statistics of Survey Sample

A few basic demographic statistics were collected on the sample to assess how well it represented the population of employees within the firms.

In general, examination of the results in Table 5-1 indicates that the sample should be fairly representative of the overall population. The departments in which the respondents are employed are grouped in Table 5-1 to reflect the perceived potential differences in computing culture which may exist among them. As can be seen, no one group overly dominates the sample. With respect to position in the organisational hierarchy, the education, and age of the respondents, again the sample seems to have adequate representation across all levels. While no specific data is available, conversation with the company representatives indicated that the proportion of respondents in each category generally reflected the overall proportions in the organisations. The only category in the sample which might seem to be somewhat non-representative is that of SEX, in that only 38% of the sample are female. It is believed that this is a little lower than the actual proportion of females in the organisations, but how much it differs is not known. Nevertheless, the difference is not considered to be crucial to the study.

## 5.3 CONDITIONING THE DATA

### 5.3.1 General

Several issues had to be considered before analysing the data, including checking the accuracy of the input data, dealing with missing data, and identifying and treating outliers, skewness, non-linearity and heteroscedasticity (Tabachnik & Fidell, 1983). Treatment of these issues is described below.

### 5.3.2 Accuracy of Input Data

To verify the accuracy of the input data, two key steps were taken. First, a data entry programme was specifically written to correspond to the survey questionnaire. This programme presented data entry "screens" which clearly indicated each item by question number and a key word. In addition, values which were outside the acceptable range for an item were not accepted by the programme, and were indicated to the person entering the data as being "out of range", allowing immediate correction. Finally, the programme automatically created a data file formatted for later data analysis.

Having created the data entry programme, the next step was to enter each questionnaire twice, once each by two different entry operators. To relieve boredom, and thereby attempt to increase the accuracy of the keypunching, a total of five individuals were used for the data entry task. Once two complete data files had been created, a second programme was written to compare the two files. All differences in the two files were reported by questionnaire and item number. This allowed the researcher to visually check each questionnaire for the correct response and enter it into the final data file.

Once the final step had been carried out, the accuracy of the data file was considered to be very high. The only inaccuracies which may have remained undetected would be those where the different keypunchers entered the same <u>valid</u> (within the acceptable range) yet inaccurate response. In this situation the file comparison programme would not be able to detect the inaccuracy. Nevertheless, because the detected error rate was so low (292 errors in 90,508 entries, or 0.32%), it was considered that such inaccuracies would be very infrequent.

### 5.3.3 **Missing Data**

The next step was to deal with missing data. For multi-item scales, <u>if only one item in the scale had a missing value</u>, the scale mean was inserted for the missing value for the particular item. If more than one item had a missing value in any particular scale, the items were left as "missing". As a result of this procedure, 18 cases (six percent of the questionnaires) had scale means inserted for missing values. Fourteen cases were left with missing values, of which 13 were for the Subjective Norm items. It seemed as if these respondents either considered the Subjective Norm items to be irrelevant or perhaps "too personal" as they simply skipped over this section of the questionnaire. It should also be noted that the reliabilities reported for the various scales in the previous chapter, and the descriptive statistics reported in the next section, are based only on those cases which had complete responses for each scale. That is, no cases which had the scale means inserted for missing values were used for these statistics.

5.3.4 **Outliers and Skewness**

Outliers are cases which have extreme values on one particular variable (univariate outlier) or in a combination of variables (multivariate outlier). Outliers are important considerations in that they can influence the choice of a regression line to fit the data, and hence unduly influence the analysis. Typically univariate outliers are easy to detect by simply investigating descriptive statistics, for example by looking for very deviant standardised scores. Multivariate outliers are typically more difficult to detect and normally require more sophisticated investigation than univariate outliers. One technique is to run various regression analyses and then investigate the standardised residuals or Mahalanobis distance scores. Extreme scores indicate that the case is an outlier.

Outliers can affect shape of the distribution of data points, and lead to violations of the assumption of normality required for analysis. As discussed by Tabachnik and Fidell (1983), the link between multivariate and univariate normality is complicated:

> Most inferential statistics in multivariate analyses assume that the variables have a multivariate normal distribution. The assumption of multivariate normality is difficult to describe .... and difficult, if not impossible to test if several variables are involved.
>
> The relationship between univariate normality and multivariate normality is complicated. If a set of variables has a multivariate normal distribution, then the individual variables are univariate normal, but the reverse is not true: If variables are each univariate normal, they do not necessarily have a multivariate normal distribution (p.79).

Because of the inter-relationship between the existence of outliers, both univariate and multivariate, and potential violations of normality, the following steps were taken to investigate the data. First, individual variables were examined for the existence of univariate outliers. Then, they were checked for skewness, and those which were highly skewed were transformed using an appropriate transformation. Finally, all the independent variables were regressed on the dependent variables and the standardised residuals investigated for extreme cases. The results are described below (the steps carried out and the discussion below are based on the guidelines suggested by Tabachnik & Fidell, 1983).

The first step was fairly straightforward. The descriptive statistics were analysed and no univariate outliers were identified. Several of the variables, however, demonstrated large degrees of skewness, which is a large number of scores in one tail of a distribution of scores, and a thinly spaced distribution in the other tail. Consideration of skewness is important in that it may may cause distortion of Type 1 error rate as well as instability in estimation of regression coefficients. Tests of whether the reported skewness is excessive can be conducted by comparing it against the standard error for skewness. The standard error for skewness is calculated as follows:

$$s_S=(6/N)^{\frac{1}{2}}$$

where N is the number of cases. The probability of obtaining a particular level of skewness can then be estimated using the z-distribution, where the z-score is calculated as follows:

$$z = \frac{S - 0}{s_S}$$

and S is the reported skewness value. Given this formula, a critical S value can be calculated for a given probability level. For example, rejecting the assumption of normality at $p \leq .01$ would be based on a z-score whose absolute value was greater than 2.58. For the current sample of 540, the value for the standard error for skewness is the square root of (6/540) or .105. Solving for S with z equal to 2.58 gives a critical value of .272. Thus, any absolute value greater than .272 would indicate a significant level of skewness.

Once a variable is determined to be overly skewed, one might consider carrying out a transformation of the data to try to reduce the skewness. There are several arguments for and against data transformations. From a theoretical perspective, a transformation can create a more normal distribution of the data and reduce the influence of outliers, both of which are important in data analysis. On the other hand, the interpretation of results must be based on the transformed data, and this often becomes difficult if the original scales had some meaningful basis. In this study, the **dependent** variables all were behaviourally based, and thus had meaning attached to them. Transforming them would reduce the interpretability of the results. Also, as will be shown, the various **independent** variables (the **Perceived Characteristics**) had significantly different degrees of skewness and required different transformations to achieve the desired results. Thus, although the scales for the Perceived Characteristics were initially arbitrary, they were all the same, and transforming them in different ways would make interpretation and comparison of effects most difficult. These facts argued against transformation. In any event, it was decided that there would be some benefit in carrying out the transformations before conducting the different regression analyses for the purpose of identifying potential multivariate outliers. If a case were determined to be an outlier even after transformation, it certainly would be a candidate for deletion or modification in some way.

Two basic transformations were used, both of which require that the skewness be positive. For **moderate** skewness, the square root transformation was used, while a logarithmic transformation was employed for **severe** skewness. Many of the variables requiring transformation, however, were negatively skewed (higher number of scores in the right hand tail, or at the higher values), which meant that they first had to be re-oriented to create positive skew. All the variables requiring reorientation were among the **Perceived Characteristics**, whose initial scale orientations were arbitrarily chosen. This meant that to create positive skew, the scoring for the scales simply had to be switched. Table 5-2 indicates the skewness scores before and after transformation, and the transformation that was used. For all variables except one, the transformation resulted in acceptable levels of skewness. The one variable which did not respond was **Ease of Use**, where the result after the transformation was literally the same degree of skewness, only in the opposite direction. Therefore, this scale was not transformed, although it was reoriented so that its direction remained consistent with the other scales.

Once the variables had been transformed to correct for skewness, the next step was to regress the independent variables on the four dependent variables and check for outliers. This was done using SPSS "New Regression", which identifies all standardised residuals whose values are greater than 3 standard deviations. Checks were made both on the size of the individual residuals, and whether a particular case had a large residual in more than one of the regressions. As a result of this analysis, eight cases were identified as being problematic. The demographic statistics were then checked for this group, which indicated that there appeared to be no consistent underlying pattern. Given the small number of cases involved (1.5% of the sample), and the lack of any clear reason for maintaining them in the sample, it was decided to drop these cases from further analysis. This meant the final sample to be used in the analysis contained 532 respondents.

### 5.3.5 Non-Linearity and Heteroscedasticity

Two further assumptions required in multivariate statistics were examined. The first, **linearity**, is that the relationship between two variables can be described using a straight line. The second, **homoscedasticity**, is that the variability in scores are roughly equivalent for all values of the two variables. In both cases, tests can be made by examining bivariate scattergram plots of the variables. In general, if the plots are oval shaped then both assumptions hold. Bivariate scattergrams were created for all the variables of interest, analysis of which detected no significant violations of these two assumptions.

### 5.3.6 Summary

In summary, the data appeared to be very well conditioned for analysis. The accuracy of input was very high, and there were few missing data. For items with missing data in multi-item scales, the scale mean was available to "correct" for the missing data point. This was done for six per cent of the cases. There were also only eight identified outliers (1.5%), but given the potential influence they may have had on the analysis, they were deleted from the sample. There also did not appear to be a problem with non-linearity and heteroscedasticity. On the other hand, several of the variables were significantly skewed, and thus were transformed to correct for the skewness. The effects of the transformation on the data analysis are discussed in subsequent sections.

## SECTION B: DESCRIPTIVE STATISTICS

### 5.4 GENERAL

Before analysing the data in terms of the Research Model, several general descriptive statistics were computed for each of the research variables, including the mean, standard deviation, and maximum and minimum reported values. These are provided in Table 5-3, which also indicates the **Number of Items** from which the variable scores are derived. In Table 5-4 the variable means are provided for a split sample of **users** versus **non-users**, along with the z-scores from the Mann-Whitney **U** test which compares the results for these two populations. The results are discussed below, including the initial indications of whether these statistics support the various research hypotheses. These are "initial" indications in that they are based only on **adoption** versus **non-adoption** of PWS. A more detailed analysis of the data will be presented in a later section of this chapter. Furthermore, a summary of the results of the tests of each individual hypothesis are presented in Section 5.22.

## 5.5 ATTITUDE TOWARDS INNOVATING

Table 5-3 indicates that, with an overall average of 5.9 on a seven point scale, attitudes are in general quite positive with respect to PWS usage. Table 5-4, however, indicates that although both **users** and **non-users** have positive attitudes towards PWS usage, a difference exists between the attitudes in the two groups. In order to check the significance of the difference, the **Mann-Whitney U** test was used. This test is useful when we wish to avoid the assumptions of the **t-test** (such as normal distribution) or when the measurement scales are weaker than interval scaling but have at least ordinal properties (Siegel, 1956). It is a conservative test of whether two independent groups are drawn from the same population, in that it generally (but not always) is less powerful in detecting differences between populations than its equivalent parametric test. The statistics reported in Table 5-4 include the **z-score** computed from **U**, and its level of significance. For **attitude**, we can see that with an average of 6.1, the score for **users** is higher than the 5.3 of **non-users** at the $p<.001$ level of significance. This provides initial support for the first hypothesis of interest, **H1**, that one's attitude towards using PWS will influence one's innovativeness with respect to PWS usage (see Appendix 11 for an inventory of hypotheses).

## 5.6 PERCEIVED CHARACTERISTICS OF INNOVATING

In general, the higher the score reported for a particular perceived characteristic, the more the individual agrees with the perception pertaining to that variable. The range of possible scores was from "1", indicating that the respondent <u>strongly disagreed</u> with the perception, through "4" indicating a <u>neutral</u> opinion, to "7", indicating <u>strong agreement</u> with the perception. In most cases, the higher the score, the more "positive" is the perception. The exception to this rule is **Computer Avoidance**, which is "negatively" oriented. That is, the higher the score on **Computer Avoidance**, the more the individual perceives that there may be negative aspects to computer usage.

As can be seen from Table 5-3, the various perceptions of using PWS are generally quite positive. On average, use of PWS is considered to be quite **advantageous** (5.6/7.0) with highly **demonstrable results** (5.6/7.0), as well as quite **compatible** (5.4/7.0) with one's work style. The **ease of PWS use** is not rated quite as highly (5.0/7.0). Likewise, the perceived ability to **try out** or experiment with the PWS is again slightly less positive (4.5/7.0), while the **image** enhancing effects of PWS usage are perceived in almost a neutral way (4.2/7.0). The potentially **negative effects** of PWS usage do not seem to be perceived by the respondents (2.0/7.0), which might indicate either a lack of knowledge about the potential adverse effects of usage, or disagreement with the perception. Use of PWS on average was also perceived to be slightly **compulsory** (3.7/7.0). Finally, PWS seem to have been widely diffused within the organisations as their perceived **visibility** is quite high (5.8/7.0).

While the statistics in Table 5-3 indicate that the critical perceptions with respect to PWS usage are all positive, Table 5-4, however, again shows that there are statistically significant differences between adopters and non-adopters. The Mann-Whitney **U** test indicates that there is a difference in perceptions between the two groups at the $p \leq .001$ significance level (two tailed test) for every characteristic except **Trialability** and **Computer Avoidance**. The difference in **Trialability**, nevertheless, is still significant at the $p < .03$ level indicating that the two groups do differ with respect to this perception. For **Computer Avoidance**, however, there is virtually no difference between the two groups.

These results provide indirect support for two of the research hypotheses. The first is **H2**, that **Relative Advantage** will have a contribution greater than any other PCI in the formation of one's attitude towards adopting PWS. The second is **H3**, that **Computer Avoidance** will have a contribution less than any other PCI on one's attitude towards adopting PWS. The support is "indirect" in that this analysis is not directly linked to **Attitude**, but rather to the use or non-use of PWS. It is **assumed** at this point that **Attitude** will motivate use or non-use of PWS.

**H2** is "moderately" supported in that it has the second highest **U-test** z-score, only slightly less than **Compatibility**. This indicates that the adopter and non-adopter groups differ more on these two variables than any other, and hence these two variables may have the most influence on **Attitude**. **H3** is indirectly supported in that there is no difference between adopters and non-adopters on this dimension, which provides an indication that it likely has little effect on one's **Attitude**. It is recognised that these tests are not rigourous, but more qualitatively oriented. Nevertheless, examination of the data does provide an initial indication of the potential effects of these variables.

Finally, **H6**, that **Voluntariness** is negatively related to one's innovativeness with respect to PWS usage is supported in that **users** have a significantly lower score on this variable than **non-users**.

## 5.7 SUBJECTIVE NORMS

Table 5-3 indicates the average values calculated for the Subjective Norms for each of the respondent's referents. As discussed in Chapter 4, the

**Subjective Norm** is calculated by multiplying the response to the Normative Belief for a particular referent (on a "1" to "7" scale) by the Motivation to Comply with that particular referent (ranging from "-3" for extreme lack of motivation to "+3" for extremely high motivation to comply). Thus, the range of possible scores for each **Subjective Norm** is -21 to +21. As can be seen the overall norms are positive, but when the split sample of users versus non-users is examined in Table 5-4, once again differences at the p<.001 level of significance are apparent for all Subjective Norms. First, non-users report neutral to slightly negative norms, whereas users report significantly more positive norms. For non-users, the various norms differ very little, whereas there is a much wider range of scores for the different norms for users. In this group, the strongest "pressure" to use the PWS comes from their immediate **supervisors** (9.4) and **senior management** (8.8), with slightly less pressure from **peers** (6.1) and **subordinates** (5.3). For users, **Friends** (2.5) appear to be the least influential, whereas for non-users **friends** appear to be the most influential (-1.4). The negative sign would indicate that any potential influence would be against using the PWS. In general, the differences in the various **Subjective Norms** provide initial support to **H4**, that the overall **Subjective Norm** will influence one's innovativeness with respect to PWS usage.

## 5.8 INNOVATIVENESS MEASURES

As discussed in Chapter 4, **Innovativeness** was measured by having respondents report their actual usage of the PWS. There were four such measures: **months** elapsed since initial adoption of PWS use, **frequency** of use, **hours** of use per week, and number of different **functions** used. The descriptive statistics for the total sample are provided in Table 5-3. All the measures are fairly self-explanatory except for **frequency**. In this instance, the score was calculated by summing the responses to questions about usage of

12 different functions. The response set for each function ranged from "1", indicating that the function was not used, through "4" indicating it was used about once per week, to "7" indicating that it was used more than once per day. Thus, the possible range of values for this variable was from 12 for non-users (12 functions with no usage or 12x1), to 84 for an individual who used all functions more than once per day (12x7).

Because the values in Table 5-3 include the responses of non-users, the average values for those who **actually use** the PWS are somewhat higher. This can be seen by checking the results in Table 5-4 for users, who, overall, comprised 77% of the sample. Part I of Table 5-4 provides the breakdown by organisational level of users and non-users. Perhaps a little surprisingly, the ratio of users to non-users is fairly consistent across all organisation levels, ranging from a low of 69% of senior executives having adopted PWS usage, to 80% of clerical staff. Although it was expected that the adoption rate of PWS among senior executives would be less than for other levels, the differences in the rate across the various levels were expected to be somewhat larger than they are. On the other hand, the size of the senior executive sample, while proportionate across the total sample to the overall population, is too small to draw any definitive conclusions.

Adopters of PWS use an average of approximately six of the listed 12 functions, for an average of approximately 16 hours per week. To put this latter figure in context, it is only two hours less than half of a standard 37.5 hour work week. The average **frequency** of use score is 35. This "over-all" score is more interpretable when the its average value (35) is divided by the average number of uses (6) reported by adopters. The result (5.8) would indicate that the "average" adopter uses each adopted function about once per day. This is based on the fact that a score of "6" on the individual frequency scales indicates that a function is used once per day.

The average time elapsed since initial adoption of PWS in this survey is 40 months (with the median being 33 months, reflecting the skewness of the distribution). Diffusion theory has posited that if the cumulative number of adopters is plotted over time, the curve will have an S-shape (see discussion, and Figure 3-1, in Chapter 3). Figure 5-1 has been constructed to illustrate the distribution for this study. By reversing the scale for **months elapsed** since initial adoption and putting the largest value at the origin, the X-axis reflects the passage of time since PWS were first adopted (approximately 11-12 years ago). The cumulative adoption percentage is plotted on the Y-axis. As can be seen from Figure 5-1, the plot approximates the lower half of an S-curve. The initial years saw a slower rate of adoption, with the rate increasing significantly approximately 50-60 months prior to the survey being taken (1982-1983), about the time organisations and researchers started to concentrate extensively on end-user computing. The fact that the graph has not started to flatten indicates that the diffusion rate has not yet slowed, and that there likely is penetration of PWS into organisations still to occur. The fact that approximately 25% of the respondents to this survey are non-adopters also provides evidence of this interpretation.

Table 5-5 indicates the percentage of users who reported using various functions. Part I provides an breakdown based on the sample of **users**, with functions listed in decreasing levels of adoption, or "popularity", while Part II provides an indication of adoption by organisational level of the users. As can be seen in Part I, simple **retrieval of information** was the most frequently used function, with 87% of adopters using this function, with the adoption rate being fairly consistent across all organisational levels (Part II). 82% of all users reported using **electronic mail**, providing an indication of the significant diffusion of this office automation function, while only 39% reported using **calendaring**. Part II of the table, however, shows that adopters in the two senior levels of the organisation use these two functions much more than those at other levels. The differences are most marked for **calendaring**, with 78% of senior executives but only 28% of clerical staff using the function. **Word processing** and **report generation** packages were the next most overall used, with close to three quarters of all adopters using these functions. Of interest is that the two lowest levels in the organisation reported using **word processing** the least, with the adoption rate greatest among the senior executives. This certainly is counter-intuitive. Surprisingly, only 61% of adopters reported using **spreadsheets**. This runs contrary to some of the common wisdom that spreadsheets were the impetus behind the growth of use of PWS, and is a contrast to a recent finding by Pavri (1988) who found that 84% of respondents in a survey on micro-computer use had adopted spreadsheets. Pavri, however, was surveying "managers", and examination of Part II shows that the popularity of **spreadsheets** is directly proportional to the organisational level of the users. The adoption rate for executives (78%) is close to Pavri's finding, although it drops to 70% for middle management. This is still somewhat less than what Pavri found. Approximately forty to fifty percent of all respondents used **database, graphics, modelling systems**, and **statistical analysis** packages. Again, the differences across organisational levels are interesting. For example, **modelling systems** were much more popular at the senior levels, being adopted by 67% of executives but only 15% of clerical workers . The same is true for **graphics** packages, although the differences are not as marked, with the adoption rate ranging from 56% for senior executives to 21% for clerical workers. **Statistical analysis** packages were most popular at the middle levels (39%-49% adoption rate), with the senior executives at 33% and clerical levels at 25% reporting the lowest adoption rate. **Fourth generation languages** were the least adopted functions at 12%, a finding which again parallels that of Pavri (1988) who found that 10% of his sample used this function.

## SECTION C: REGRESSION ANALYSIS

### 5.9 GENERAL

The research hypotheses and model were investigated using two different techniques. The first approach was to use multiple regression to examine the effects of the different independent variables on each of the innovativeness, or usage, measures independently. This section describes the results of this analysis. The second technique used was **structural equation modelling**, as implemented in **LISREL**, which is described in the following section of this chapter.

One of the concerns to be addressed was the effect of transforming the data for some of the variables in order to reduce the skewness of the responses. Ideally, using the untransformed data would be preferred because of interpretation problems with the transformed data. On the other hand, as was discussed earlier, skewness may introduce problems in estimating correlation coefficients. The approach taken was to conduct various regressions using both sets of data, transformed and untransformed, and then to compare the results. As will be shown, the results did not differ substantially, which justified using the untransformed data for investigation of the research hypotheses.

## 5.10 REGRESSION OF PERCEIVED CHARACTERISTICS ON ATTITUDE

The first equation which was analysed included the eight **Perceived Characteristics of Innovating** (PCI) and **Voluntariness**. These were regressed on **Attitude**, which was computed from the responses to four items (using a seven point scale). These included the following semantic differential pairs: good-bad, harmful-beneficial, wise-foolish, and negative-positive. The initial approach was to run a **stepwise** regression using the transformed data with the probability of the **F**-value for entry of a variable set at $p<.05$, and F value to remove a variable once in the equation set at $p>.10$. This resulted in the first six variables listed in Table 5-6 being entered into the equation. The next step was to conduct a regression where all variables were sequentially forced into the equation, with the first six being entered in the same sequence as in the stepwise regression. This was done for both the transformed and untransformed data sets, with the results indicated in Part I of Table 5-6. The end result after all variables were in the equation is the same as having conducted standard multiple regression starting with all variables in the equation. By having stepped entry, however, the relative contributions of the variables to $R^2$ could be directly assessed.

As can be seen in Table 5-6 both regressions had very similar results. The different $R^2$ were very similar at each step, as were the F-values for the equations and the Beta weights for the variables on entry into the equation. Part II to Table 5-6 lists the statistics for the variables in the final equation. Once again, examination shows that the values for Beta are fairly similar for each data set, as are the significance levels for each variable (the F values listed are for **B**, the unstandardised regression coefficient). Examination of the standardised residuals for both regressions also revealed that there were no differences in their **patterns**. Furthermore, although the standardised residuals indicated that there were no outliers for the transformed data set, there were only four cases using the untransformed data whose standardised residuals were greater than 3.0, with the maximum being 3.8. In all these cases the predicted value of **Attitude** was greater than the actual value. Given the sample size, it was not felt that these cases would unduly influence the results. The plot of predicted versus actual values of the residuals also indicate a good fit to the model for the untransformed data set. Given the above, it was decided that no cases needed to be deleted from the data set based on this regression.

Finally, a check was made for **suppressor** variables, which are variables that are "heavily weighted not because they directly predict the [dependent variable] but because they suppress irrelevant variance in other [independent variables]" (Tabachnik & Fidell, 1983, p.107). Conditions indicating the presence of suppressor variables include the situation where the absolute value of the simple correlation between the independent variable and dependent variable is considerably smaller than the **Beta** for the independent variable, or when the simple correlation and Beta have opposite signs. In both cases Beta would have to be significantly different from zero. Neither of these conditions were evident in the results for the untransformed data. This, plus all of the facts above, argue for being able to use the untransformed data for analysis and interpretation. The discussion below, therefore, will concentrate only on the results of regression using the untransformed data set.

With an adjusted $R^2$ of .677, the regression indicates that the **Perceived Characteristics of Innovating (PCI)** play a significant role in the formation of one's **Attitude** towards using the PWS. Although, as discussed in the previous section, there were significant differences between adopters and non-adopters of PWS with respect to <u>all</u> of the PCI except **Computer Avoidance**, the regression analysis indicates that the various **PCI** have different effects with respect to **Attitude**. First, neither **Trialability** (p=.74) nor **Visibility** (p=.75) are significant, and their inclusion in the regression equation does not improve $R^2$. Furthermore, **Image** (p=.06) and **Result Demonstrability** (p=.09) are somewhat less significant than the remaining PCI, and their inclusion in the regression equation contributes only marginally to an increase in $R^2$.

The results would indicate that four of the **PCI**, (**Relative Advantage**, **Compatibility**, **Computer Avoidance**, **Ease of Use**), have a significant effect on **Attitude**. **Relative Advantage** is by far the most significant, which supports **H2**, that **Relative Advantage** will have a contribution greater than any other PCI in the formation of one's attitude towards adopting a PWS. On the other hand, **H3**, that **Computer Avoidance** will have a contribution to **Attitude** less than any other PCI, is not supported. In the regression analysis, four other PCI had lesser effects than **Avoidance**. This result contradicts those from the examination of the variable means for **adopters** and **non-adopters**, where there were no differences at all in the scores for **Avoidance**, but significant differences for all other PCI. The inclusion of **Voluntariness** in the equation supports **H7**, that it will be negatively related to **Attitude**.

Once the effects of the PCI on **Attitude** were examined by themselves, a further regression was conducted including the **Subjective Norm** in order to examine the effect of this variable. The overall **Subjective Norm** (SN) used in this case was computed by summing the scores of the individual Subjective Norms for the various referents.

The result of a standard multiple regression entering all PCI's and **SN** at once are given in Table 5-7. As can be seen, **SN** is statistically significant in the equation. Furthermore, while the Beta weights and significance levels of most PCI's have not changed to a large degree, **SN** is the second most important variable in the expanded equation. It has taken on this significance at the expense of **Voluntariness**, whose Beta weight dropped considerably to a non-significant level. Examination of the correlation matrix reveals that **SN** and **Voluntariness** have a .45 correlation, which might be expected given the definitions of the two constructs. The **Subjective Norm** deals with the **expectations** of several referents and one's motivation to comply with these expectations. **Voluntariness**, however, reflects the degree to which use of the PWS is perceived to be **voluntary** or **compulsory** based on the nature of one's job. Usage may be very **voluntary**, yet the **expectations** that one should use the PWS could be quite high. This indicates that the two constructs have a different basis, yet it is obvious that they nevertheless might be correlated. Furthermore, when the dependent variable is **Attitude**, not usage of the PWS, it might be expected that the **Subjective Norm** will have a more significant effect than **Voluntariness**. First, **SN** captures some of the aspects of **Voluntariness**, as just discussed. Second, however, it also includes the idea of **norms**, which could have effects beyond **compulsion**. As was discussed in Chapter 3, the process of communicating or diffusing the norms might itself influence **Attitude**. The extra dimension in **SN** beyond "compulsion" is reflected by the much larger Beta attached to it in the expanded equation than that for **Voluntariness** in the equation without **SN**. Thus, **H3**, that the **Subjective Norm** will influence one's attitude towards adopting PWS, is supported. On the other hand, **H7**, that **Voluntariness** will be negatively related to **Attitude**, is not supported when **SN** is in the equation. (A summary of the results of testing the various hypotheses using regression analysis is provided in Table 5-12, along with the results from using the other analytical techniques).

The results of regressing the PCI and SN on **Attitude** as directly measured raise a question about the operationalisation of **Attitude**. While several PCI are **statistically** significant in the regression equation, only **Relative Advantage** has obvious practical significance. It has by far the highest Beta weight, and by itself provides an $R^2$ of .64. With all variables in the equation, $R^2$ is only raised to .70. This would indicate that perhaps the construct validity of **Attitude** is questionable, as it seems to capture primarily **Relative Advantage**, and not the more general theoretical definition of attitude from the **Theory of Reasoned Action**, as discussed in Chapter 3. As will be shown below, this conclusion is supported by further analyses.

## 5.11 REGRESSIONS ON INNOVATIVENESS

### 5.11.1 General

The next stage of analysis was to examine the relationships of the different independent variables to the innovativeness, or usage, variables. The first analysis used **Attitude, SN,** and **Voluntariness** as the independent variables, in accordance with the research model (See Figure 3-4). Following this analysis, the **direct** relationships between the innovativeness variables and the various PCI, and the Subjective Norm for each referent group were examined, without using **Attitude** and the <u>overall</u> **Subjective Norm** as intervening variables. Again, as the response sets for three of the dependent variables, **Frequency of Use, Months Since First Adopted,** and **Hours of Use per Week**, were skewed, the regressions were run using both transformed and untransformed data to see whether the untransformed data could validly be used for analysis.

### 5.11.2 Attitude, SN and Voluntariness on Innovativeness

Table 5-8 indicates the results of regressing **Attitude, Voluntariness,** and the overall **Subjective Norm** on the different **Innovativeness** variables. Standard multiple regression was used with all variables entering the equation at once. Again, as was the case with the regression of the **PCI** on **Attitude,** the results of using the two different data sets do not differ substantially for this regression. Nevertheless, the F values of the overall equation using the transformed data are a little higher than for the untransformed data, as are the $R^2$ (all F values are significant at the $p \leq .001$ level). Furthermore, the Beta weights are very similar for each variable in the two data sets. (The signs for **Attitude** and **Voluntariness** are reversed for the transformed data results as the original scales had been transposed in order to create positive skew for the transformation). All in all, the various checks once again indicated that the untransformed data could legitimately be used for analysis.

As can be seen in Table 5-8, the adjusted $R^2$ ranges from a low of .15 for **Months** of Use, to a high of .39 for Number of **Hours** of Use per Week, with middle-range values of $R^2$ for **Frequency** of Use ($R^2$=.29), and Number of **Functions** Used ($R^2$=.23). It is obvious, therefore, that the independent variables capture significantly different degrees of the variance in the different forms of innovativeness.

**Subjective Norm** is not significant at the $p \leq .05$ in any of the equations, and has a Beta weight much lower than the other independent variables. Thus, **H4**, that the **Subjective Norm** will influence one's innovativeness, is not supported. On the other hand, **Voluntariness**, with a negative Beta, and **Attitude**, with a positive Beta, are significant in all equations. Therefore, both **H1**, that one's attitude towards using PWS will influence one's innovativeness, and **H6**, that **Voluntariness** will be negatively related to one's innovativeness, are supported.

Although the general hypotheses about the effects of **Attitude** and **Voluntariness** are supported, their relative Beta weights vary in each equation. The Beta weight of **Attitude** is approximately twice that of **Voluntariness** with respect to **Functions**, and slightly less than twice that of **Voluntariness** with respect to **Frequency**. For **Months**, the weights of **Attitude** and **Voluntariness** are approximately equal. For **Hours**, however, the roles are reversed as the Beta weight for **Voluntariness** is approximately 1½ times that of **Attitude**. Thus, by examining the differences across **Functions**, **Months**, **Frequency** and **Hours**, one can see that the independent variables have different relationships with the various forms of innovativeness. It can be seen that those users who use the PWS longer (more **Hours**), likely do so primarily because they <u>must</u> use it (low **Voluntariness**). On the other hand, those who adopt several **functions** of the PWS, probably do so more because of a positive **Attitude** than because of any compulsion to adopt the functions. The results for **Frequency**, which is related to **Functions** in that its score is calculated by summing the frequency scores for the individual functions, parallel those for **Functions**. This further supports the above conclusion that while **implementation innovativeness** seems to be affected very much by a perceived compulsion to use PWS, **use innovativeness** is probably more affected by one's **attitude**. For **adoptive innovativeness**, however, **Voluntariness** and **Attitude** seem to have equal effects. Again, as stated at the beginning of the chapter, it must be emphasised that these "effects" have not been shown, but rather have been inferred based on the theory and the observed relationships among the variables.

### 5.11.3 PCI, SN, and Voluntariness on Innovativeness

Because other researchers have found that the **PCI** can have direct effects on behaviour (e.g Davis, 1985; Davis et al., 1989), in addition to their effects through the intervening variable, **Attitude**, it was decided to examine the magnitude of their direct effects in this study. Thus, the next stage of analysis was to regress the individual **PCI** and the individual **Subjective Norms** on the dependent variables. Because the different **PCI** and **SN** were expected to have different significance levels and effects, **stepwise** regression was used, with the probability to enter a particular variable into the equation set at $p\leq.05$. Once again, the regressions were conducted using both the transformed and untransformed data, with the results supporting using the untransformed data for analysis. The variables and the Beta weights in the final equations were all similar (see Table 5-9). In three of the four cases, however, the $R^2$ were higher for the transformed data, while for **Functions** they were virtually the same.

The $R^2$ in all regressions indicate that the direct effects of the PCI and individual SN's explain significantly more of the variance in the dependent variables than do the intervening variables, **Attitude** and the overall **Subjective Norm**. When the direct effects are allowed, the increase in $R^2$ ranges from .07, for **Months**, to .13 for **Functions**. This parallels the results in Davis (1985), which indicated that **perceived usefulness** (or **relative advantage**), had a direct effect on system usage beyond that of **Attitude**. While Davis argued in favour of a direct link between cognitions (perceptions) and behaviour, a second interpretation of the existence of the direct link is that **Attitude** as operationalised does not totally reflect the theoretical construct. For example, Fishbein (1980) argued that:

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

Several factors in this study support Fishbein's observation that "indirect measures" may be more reliable than direct measures. First, as was discussed in the previous section, the regression of the PCI on **Attitude** <u>as directly measured</u> (by the four items listed in Section 5.10, henceforth $\mathbf{A_m}$), indicated that only **Relative Advantage** has any practical significance in the equation. Second, in the regression of the various **PCI** and **SN** on **Innovativeness**, the direct effects of the **PCI** and individual **SN**'s result in a greater $R^2$ than using $\mathbf{A_m}$ or **Subjective Norm** alone. The theoretical definition of **Attitude** is that it is synthesised from a variety of salient beliefs about the outcomes of the performing the behaviour (see Chapter 3). In this study, these beliefs are represented by the **PCI**. Thus, given the relative lack of effect of the **PCI** on $\mathbf{A_m}$, but the significance of their direct effects on the actual behaviours, it would seem that $\mathbf{A_m}$ does not totally reflect the theoretical definition of **Attitude**. This then argues for using analytical methods which formulate **Attitude** from the responses to the individual components, rather than by measuring it "directly". This is the approach to be taken in the next section.

**Voluntariness** is significant in all equations, has a negative relationship, and in terms of Beta weight ranks either first or second among the different variables. This again supports **H6**, that **Voluntariness** is negatively related to one's innovativeness. Those PCI which are significant in all equations include **Result Demonstrability**, **Trialability**, and **Compatibility**.

**Relative Advantage** appears in only one equation, **Months**, which indicates that perhaps **Result Demonstrability** may have captured some of the **advantageous** aspects of PWS usage in the innovativeness equations. A second surprising effect is that of **Avoidance** with respect to **Hours**. Instead of having a negative relationship, the higher the **Avoidance** score, the more **Hours** of PWS usage is reported. On the other hand, **Voluntariness** has a significant negative relationship with respect to **Hours**. This might indicate that those who must use the PWS, use it longer, and as a result are more concerned with the negative aspects of PWS usage.

Finally, only the **Subjective Norm** for **Subordinates** was significant in any of the equations. It was the last variable to enter the equations for **Functions** and **Frequency**. In that **Voluntariness** may capture part of the **SN** for supervisors and senior management, the inclusion of **SN** for subordinates serves to include a third referent group. Overall, however, **H4**, that the **Subjective Norm** will influence one's innovativeness, is not supported. A summary of the hypothesis tests from this section is provided in Table 5-12.

## SECTION D: STRUCTURAL EQUATION MODELLING

### 5.12 GENERAL

The analysis and discussion in the previous section indicated several problems with using regression analysis to investigate the various hypotheses. One problem not discussed, however, was that the dependent variable, **Innovativeness**, had to be analysed in terms of its individual components. Given the different methods of collecting data on the different **Innovativeness** dimensions, there was no method within regression to create an overall **Innovativeness** construct on the dependent side of the equation. Furthermore, the various paths in the complete research model as depicted in Figure 3-4 could not be investigated simultaneously. Finally, as discussed in the previous section, the regression analysis indicated that the intervening variables **Attitude** and **Subjective Norm** did not account for as much of the variance in the dependent variables as did their individual components when regressed directly on the dependent variables. This argued for a method of constructing **Attitude** and **Subjective Norm** from their individual components. The solution to these various difficulties is to use a second generation multivariate analysis technique, **structural equation modelling**. Use of this technique helps to overcome all of these problems. It should again be highlighted that while structural equation modelling is clearly stated in "cause" and "effect" terms, the data for this research was gathered in a cross-sectional study, and hence causality cannot be demonstrated. Thus the reader should be cautious in interpreting any of the results.

## 5.13 LISREL

In this section the basics of **structural equation modelling**, as implemented in **LISREL**, are discussed. The results of using the technique are presented in the next section. A strength of **structural equation modelling** is that it allows certain variables to be cast as latent, or unobserved, variables. The structural equation model specifies the hypothesised causal relationships among the latent variables and is used to describe the causal effects and amount of unexplained variance (Joreskog & Sorbom, 1984). **LISREL** is the "most general program that is widely available for estimating structural equation models" (Hayduk, 1987) and is the method used in this study. Basically, the technique works by having the programme compare the **actual** covariances among the **observed** (measured) indicators, with those **implied** by the model postulated by the researcher.

> The **model-implied variances and covariances of the observed indicators** ... can be compared to the variances and covariances calculated from the data on the observed indicators. Comparison of the model's predictions with the observed reality (the actual observed covariances) provides the fundamental basis for testing a model's adequacy ... and for obtaining reasonable estimates of the model's coefficients ... (Hayduk, 1987).

**LISREL** also integrates measurement concerns within the structural equation model by including both the latent (unobserved) variables and the measured variables within a single equation model. Variables are further classified as **exogenous** or **endogenous** depending on whether they are postulated as causes or effects. If a variable is never an **"effect"**, and is always a **"cause"**, then it is exogenous. If a variable is "caused" or influenced by any other variable in the model, it is endogenous. The basic equation which captures the direct effects among constructs is as follows:

$$\boldsymbol{\eta} = \mathbf{B}\boldsymbol{\eta} + \boldsymbol{\Gamma}\boldsymbol{\xi} + \boldsymbol{\zeta}$$

The components of the equation are defined as follows:

- **$\eta$** : a vector (m x 1) of **endogenous latent variables** (the "effects") where m is the number of endogenous constructs
- **B** : a matrix (m x m) of structural coefficients indicating the effects of **endogenous** constructs (the $\eta$'s) **on** other **endogenous** constructs. The coefficients in the matrix ($\beta_{ij}$'s) correspond directly to the direct paths from one particular endogenous concept ($\eta_i$) to another endogenous concept ($\eta_j$). For example, $\beta_{12}$ corresponds to the path from the first to the second endogenous construct.
- **$\Gamma$** : a matrix (m x n) of structural coefficients indicating the effects of **exogenous** constructs (the causes) **on endogenous** constructs. The coefficients in the matrix ($\gamma_{ij}$'s) correspond directly to the paths from an exogenous construct ($\xi_i$) to an endogenous construct ($\eta_j$). For example, $\gamma_{11}$ corresponds to the path from first exogenous construct to the first endogenous construct.
- **$\xi$** : a vector of (n x 1) of **exogenous constructs**, where n is the number of exogenous constructs.
- **$\zeta$** : a vector (m x 1) of "errors" (residuals) in the **conceptual** model.

Two other basic LISREL equations link the **conceptual** variables (constructs) to their **observed** indicators (the scores on the measurement scales). These are the measurement equations. The first of these links the **endogenous** indicators to the **endogenous** constructs. It is specified as follows:

$$\mathbf{Y} = \mathbf{\Lambda_y}\boldsymbol{\eta} + \boldsymbol{\varepsilon}$$

The components of the equation are defined as follows:

**Y** : a vector (p x 1) of **observed** endogenous **indicators** (**y** variables) where p is the number of indicators, and $p \geq m$.

$\mathbf{\Lambda_y}$: a matrix (p x m) of structural coefficients ($\lambda_{ij}$'s) linking the observed indicators to the endogenous constructs.

$\boldsymbol{\eta}$ : the vector (m x 1) of endogenous constructs.

$\boldsymbol{\varepsilon}$ : a vector (p x 1) of "errors" in the **measurement** model.

The second measurement equation links the **exogenous indicators** to **exogenous constructs** as follows:

$$\mathbf{X} = \mathbf{\Lambda_x}\boldsymbol{\xi} + \boldsymbol{\delta}$$

The components of the equation are defined as follows:

**X** : a vector (q x 1) of **observed** exogenous **indicators** (**x** variables) where q is the number of indicators, and $q \geq n$.

$\mathbf{\Lambda_x}$: a matrix (q x n) of structural coefficients ($\lambda_{ij}$'s) linking the observed indicators to the exogenous constructs.

$\boldsymbol{\xi}$ : the vector (n x 1) of exogenous constructs.

$\boldsymbol{\delta}$ : a vector (q x 1) of "errors" in the **measurement** model.

The **LISREL** model has the following basic assumptions (Joreskog & Sorbom, 1984):

1. $\zeta$ is uncorrelated with $\xi$ (the errors in the structural equation are independent of the exogenous constructs);

2. $\varepsilon$ is uncorrelated with $\eta$ (the measurement errors in observed y's are independent of the endogenous constructs);

3. $\delta$ is uncorrelated with $\xi$ (the measurement errors in the observed x's are independent of the exogenous constructs);

4. $\zeta$, $\varepsilon$, and $\delta$ are mutually uncorrelated (all the error terms are independent);

5. B has zeroes in the diagonal and I - B is non-singular; and
6. the observed variables have multivariate normality.

Perhaps the most important aspect in applying **LISREL** in this study is assessing the fit of the model. Joreskog and Sorbom (1984) suggest that the user pays careful attention to the following quantities:

1. **Parameter estimates** which have negative variances or are correlated very highly;
2. **Standard errors** which are extremely large;
3. **Squared multiple correlations** (SMC's) which are negative; and
4. **Coefficients of determination** which are negative.

If any of the above has an unreasonable value, it is an indication that the model is wrong. The programme gives **SMC's** for each structural equation and coefficients of determination for all structural equations jointly. These are analogous to $R^2$ in regression analysis.

The programme also provides SMC's for each observed variable separately, which is the reliability of the variable, and **coefficients of determination** for all the observed variables jointly, which is a generalised measure of reliability for the measurement model. These measurements are based on classical test theory where the reliability of a single measurement Y is defined as follows (Dillon & Goldstein, 1984):

$$\rho = \frac{\text{var}(T)}{\text{var}(T) + \text{var}(\varepsilon)} = 1 - \frac{\text{var}(\varepsilon)}{\text{var}(Y)}$$

where **T** is the true underlying score and $\varepsilon$ is the error of measurement.

Thus, the reliability (SMC) for the ith observed variable is defined as $1 - \theta_{ii}/s_{ii}$, where $\theta_{ii}$ is the error variance and $s_{ii}$ is the observed variance of the ith variable (Joreskog & Sorbom, 1984). Similarly, the coefficient of determination for all observed variables jointly is defined as $1 - |\Theta|/|S|$, where $|\Theta|$ is the determinant of the matrix of error terms in the measurement model, and $|S|$ is the determinant of the covariance matrix of the observed variables.

Once these statistics have been evaluated, the next step is to assess the actual fit of the model. **LISREL** supplies several measures to do this. The first is the Chi-Square ($\chi^2$) measure. In **LISREL**, the $\chi^2$ measure is the likelihood ratio statistic for testing the specified, constrained model against the alternative that the model is unconstrained. The probability associated with the $\chi^2$ is the probability of obtaining another $\chi^2$ larger than the value actually obtained, under the hypothesis that the model specified is a reflection of reality. Small probability values indicate that the model is not confirmed by the data. Thus, unlike traditional statistical tests, large $\chi^2$ and low p-values, are undesirable. The problem with this statistic is that it is very susceptible to sample size. With large sample sizes even small differences tend to be detectable as being more than sample fluctuations, and hence significant. On the other hand, large samples are required for the **LISREL** algorithm to perform properly. Thus, $\chi^2$ is likely always to be significant. Because of this, several authors, including Joreskog and Sorbom, have suggested that $\chi^2$ not be used as a test statistic, but a general indicator best used for assessing the fit of competing models. By comparing the differences in $\chi^2$ and the respective degrees of freedom for competing models, one can assess whether one model is a better fit than another (for a discussion about the role of $\chi^2$ see Hayduk, 1987). This is the approach taken in this research.

A second measure to assess the fit of the model is the "Goodness of Fit" index (GFI). This is a measure of the relative amount of variances and covariances jointly accounted for by the model. It is independent of sample size and relatively robust against departures from normality, but, unfortunately, its statistical properties are unknown, so there is no standard against which to compare it (Joreskog & Sorbom, 1984). The programme also provides a GFI adjusted for degrees of freedom (AGFI). Both of these measures can be used to compare competing models. Finally, one can also use the root-mean-square residual (RMR), which is a measure of the average of the residuals and can only be interpreted in relation to the sizes of the observed variances and covariances in the observed data matrix. Again, the RMR can be used to compare the fit of two different models to the same data.

## 5.14 THE STRUCTURAL EQUATION MODEL

The initial step in using **LISREL** is to establish the various components (constructs) to be included in the model, and linkages among them. This is primarily theory driven, but in some instances simplification of the theoretical model is required. According to Hayduk, "it is not uncommon for novices to create huge models that ultimately require simplification... Eliminating unnecessary concepts and eliminating all but the best one or two indicators for the remaining concepts usually reduces the model to manageable size... " (1987, p.150). The structural equation model for this study is indicated in Figure 5-2. As can be seen it reflects the general research model as illustrated in Figure 3-4, but, as will be discussed below, in keeping with Hayduk's advice, the model has been simplified to a small degree. The four major constructs in Figure 3-4 are represented, two as exogenous latent variables ($\xi$'s), and two as endogenous latent variables ($\eta$'s).

The two exogenous variables are **Subjective Norm** and **Voluntariness**. The observed indicators for **SN** are the scores for all of the individual referents, except **Friends**. Regression analysis had indicated that **Friends** was the least influential of all the individual **SN**'s, and as this referent group was external to the organisation it was deleted for the sake of simplification. It should also be noted that using the individual **SN** to synthesise the overall **Subjective Norm** is substantively different from that of simply summing the scores for the various respondents to create an overall **SN**. It is somewhat more sophisticated as it allows the components to have different loadings (weights) on the overall **SN** depending on how they fit the model.

The observed indicator for **Voluntariness** is the score on the **Perceived Voluntariness** scale. **Perceived Voluntariness** was also allowed to load on (be an indicator for) **SN** for two reasons. First, the regression analysis indicated that there may be interaction among these variables, which as was discussed earlier also makes sense theoretically. Moreover, an initial **LISREL** run showed that having **Perceived Voluntariness** load on **SN** would reduce $\chi^2$ significantly. Thus, the model was amended to reflect this interaction.

The two endogenous variables in the model are **Attitude** and **Innovativeness**. As was discussed earlier, regression analysis revealed that the direct effects of the various **PCI** on **Innovativeness** were greater than that of **Attitude** (as calculated from the items in the questionnaire, $\mathbf{A_m}$). This indicated that $\mathbf{A_m}$ might not reflect the theoretical basis of the construct, and thus it was decided not to use it as the indicator of **Attitude**, the latent variable in the structural equation model. Rather, it was decided to follow the prescriptions of the theory and <u>synthesise</u> **Attitude** from the various **PCI**. To do this, the responses to the various **Perceived Characteristics** (PCI) scales become the observed indicators for **Attitude**. Also, as is indicated in Figure

5-2, the PCI included in the model reflect the division of **Observability** into two constructs, **Result Demonstrability** and **Visibility**.

The observed indicators for **Innovativeness** are the scales for **Hours**, **Months**, and **Functions**, each of which was developed to reflect one of the dimensions of **Innovativeness**. One of the benefits of using **LISREL** is the ability to synthesise the latent variable from its disparate indicators. As discussed earlier, there is no single method to operationalise **Innovativeness** given its different dimensions, and thus being able to combine the various scores in a meaningful way, especially on the dependent variable side of the equation is a major advantage. The indicator, **Frequency of Use**, was not used as an indicator for **Innovativeness** for two reasons. First, as was discussed earlier, because of the way it was operationalised, it was difficult to interpret. More importantly, however, the similarity of the results for the regression equations for **Frequency** and **Functions** indicated that these variables are likely tapping the same dimension of innovativeness. As was discussed earlier, the overall **Frequency** score is computed from the responses to the frequency of use for individual functions, and thus is directly related to the **Functions** score. Because of its similarity to **Functions**, and the relative difficulty in interpreting its scores, it was decided to simplify the model by not including **Frequency** in the structural equation model.

The various effect paths are illustrated in Figure 5-2. The $\beta$ and the various $\gamma$'s have been included to indicate the **LISREL** notation for these paths. Not indicated in the figure are the labels for the paths from the latent variable to the observed indicators. These are labelled in **LISREL** as $\lambda$'s.

## 5.15 GOODNESS OF FIT

The first step in assessing the model was to check the parameter estimates, standard errors, squared multiple correlations, and coefficients of determination for unreasonable values. All values seemed reasonable and thus the reliability of the various components were then examined. This is done by examining the coefficients of determination, which act as generalised measures of reliability for all the observed variables jointly. The values for both the x-variables (.973) and y-variables (.920) were very reasonable, confirming that the data collection scales could be used with some confidence.

The next step was to examine the various goodness of fit indices. The $\chi^2$ was 802 with 99 degrees of freedom. As discussed earlier, this index is very sensitive to sample size, and thus the fact that $\chi^2$ was very significant was not surprising. Of concern, however, was its magnitude in relation to the degrees of freedom. Wheaton et al. (1977) suggest that a $\chi^2$ five times greater than the degrees of freedom is acceptable, but the smaller the ratio the better. For this model, however, $\chi^2$/d.f. is approximately 8.1. On the other hand, the goodness of fit index (GFI) at .819, and adjusted GFI (AGFI) at .751, indicate reasonable fits of the model to the data. Although, as discussed earlier, there is no standard against which to judge these values, they can be used to compare competing models. This was done to examine models which eliminated **Voluntariness** and **SN** in one instance, and just **Voluntariness** in the second case. For the model which eliminated **Voluntariness** the $\chi^2$/df ratio was basically unchanged (8.2), as was the AGFI (.749). This indicated that the reduced model fit the data no better than the full model, while other measures such as the coefficients of determination worsened for the reduced model. The same results were true of the model which eliminated both **SN** and **Voluntariness**. The $\chi^2$/df ratio worsened to 10.3, while the AGFI remained very close to the full model at .775. Again, other indices such as the coefficient of determination also were lower, which indicated that the model containing all constructs was the better than any which eliminated a particular construct.

One other diagnostic was also checked. This was the root mean square residual (RMR), which like the other diagnostics, can only be used in relative terms, in this case with respect to the variances and covariances in the observed data matrix. For the observed matrix, the values ranged from several less than 1.0 to several well above 10.0, with some much larger. The value of the RMR was 4.2, which seemed reasonable given the overall range of values in the variance-covariance matrix. It was also roughly equivalent to the values for the reduced models described above, again indicating that these models offered no gains in overall fit of the model to the data.

Finally, one further "reduced" model was examined. Analysis of the loadings of some of the PCI on **Attitude**, and the size of their residuals, indicated that inclusion of some of the PCI might be detracting from the overall fit of the model. Therefore, a model was constructed which eliminated **Trialability**, **Visibility**, **Image**, and **Avoidance**. As a result, the coefficient of determination for the y-variables improved from .92 to .96, which indicated a slightly better fit. The AGFI improved to .81 from .75, again indicating a better overall fit. On the other hand, the RMR increased to 5.5, and the $\chi^2$/df ratio worsened to 8.5 from 8.1. Furthermore, the SMC's for the structural equations also deteriorated very slightly to .67 from .68 for **Innovativeness**, and to .30 from .31 for **Attitude**. Given these mixed results, and the lack of any theoretical reason for eliminating these variables, it was decided to use the full model the data analysis. The "fit" indices for the various models are summarised in Table 5-10.

The next stage was to examine the individual components of the overall model, and their linkages. Table 5-11 and Figure 5-3 provide the general results of the modelling, with all the values indicated in Figure 5-3 being significant at the $p \leq .001$ level. These are discussed below.

## 5.16 ATTITUDE - CAUSES AND EFFECTS

The first component of the model examined was **Attitude**. Again, it should be emphasised that **Attitude** in this analysis was <u>**synthesised**</u> from the various **PCI**, and is not directly comparable to **Attitude** as directly measured ($A_m$). Table 5-11 indicates the factor loadings of the various **PCI** on **Attitude**, their significance, standard errors, and standardised values. If individuals actually synthesise an **Attitude** from the various **PCI**, as indicated by the theory and as defined in the model, one would expect the various observed indicators of the **PCI** to share variance and thus load on the latent variable. The results indicate that all **PCI**, except **Avoidance**, have significant loadings which supports the theory in general. It also indicates that **Avoidance** has little effect on **Attitude** as synthesised. This in turn supports **H3**, that **Avoidance** will have a contribution less than any other **PCI** in the formation of one's **Attitude** towards adopting PWS.

The standardised solution allows the effect sizes of the different **PCI** to be compared (see Figure 5-3). A visual inspection (qualitative analysis) of the standardised loadings indicate that the **PCI** <u>probably</u> fit into three tiers of influence, with the most influential tier including **Compatibility** ($\lambda$=1.12) and **Relative Advantage** ($\lambda$=1.00). The second tier includes **Result**

**Demonstrability** ($\lambda$=.70) and **Ease of Use** ($\lambda$=.64), with **Trialability** ($\lambda$=.41), **Image** ($\lambda$=.39) and **Visibility** ($\lambda$=.37) in the third tier. These results do not support **H2**, that **Relative Advantage** will have a contribution greater than any other **PCI** in the formation of **Attitude**. Nevertheless, it does appear to play a major role, with an effect very slightly less than that of **Compatibility**.

As illustrated in Figure 5-3, **SN** has a significant effect on **Attitude** ($\gamma$=.53). This supports **H5**, that **SN** will influence one's **Attitude** towards adopting PWS. Furthermore, **Voluntariness** also has a direct negative effect ($\gamma$=-.15), which supports **H7**, that it is negatively related to one's attitude. Thus, the results of structural modelling confirm the results of the regression analysis. Furthermore, although the influences of external variables on **Attitude** was not a focus of this research, the squared multiple correlation for the **Attitude** equations is .307. This indicates that **SN** and **Voluntariness** account for approximately 31% of the variance in **Attitude**.

Finally, as the Table 5-11 and Figure 5-3 show, **Attitude** has a significant effect on **Innovativeness** ($\beta$=.56). This supports **H1**, that **Attitude** will influence one's innovativeness with respect to PWS usage. Furthermore, **Attitude** has the greatest direct effect of the three constructs hypothesised to affect **Innovativeness**.

## 5.17 SUBJECTIVE NORM - CAUSES AND EFFECTS

As indicated in Table 5-11, the various **SN**'s for the specific referents all loaded significantly on the latent variable, **Subjective Norm**. In addition, as was discussed earlier, the perceived **Voluntariness** indicator also loaded on **Subjective Norm**, although as indicated in the standardised solution, its weight ($\lambda$=-1.1) was much less than the other components. As with

**Attitude**, there appear to be three tiers of influence among the various indicators. The most influential includes **Supervisor** ($\lambda$=8.6) and **Senior Management** ($\lambda$=8.3), while **Peers** ($\lambda$=5.5) and **Subordinates** ($\lambda$=4.9) are in the second tier. **Voluntariness** is the only variable in the third tier. As indicated, its magnitude is much less than the other indicators, as well as being reversed in sign. This relates to its definition, in that the higher the score on this variable, the more voluntary is PWS usage. On the other hand, the higher the **SN** scores, the greater is the pressure from one's referents to use PWS.

As is portrayed in Figure 5-3, **SN** has significant effects on both **Attitude**, (**H5**, as discussed above), and on **Innovativeness**. Thus, **H4**, that **SN** will affect one's **Innovativeness** is also supported. A result not expected from the theory, however, is the fact that the effect of **SN** on **Innovativeness** ($\gamma$=.21) is approximately only 40% of its effect on **Attitude** ($\gamma$=.53). Although this is not posited by **Reasoned Action** theory, as discussed in Chapter Three, it does parallel the findings of Christensen (1987), who found that the effect of **SN** on one's **Intention** to use a Decision Support System ($\gamma$=.25), was approximately 54% of its effect on **Attitude** ($\gamma$=.46). Thus, **SN** has both direct and indirect effects on **Innovativeness**. The total effect (T.E.) can be calculated as the sum of the direct effect and the product of the path coefficient to **Attitude** and from **Attitude** to **Innovativeness**. That is:

$$\begin{aligned} \text{Total Effect (T.E.)} &= \gamma_{11} + (\gamma_{21} \times \beta_{12}) \\ &= .21 + (.53 \times .56) \\ &= .51 \end{aligned}$$

As can be seen from the above result, the overall effect of **SN** (T.E.=.51) on **Innovativeness** approaches the effect of **Attitude** on **Innovativeness** ($\beta$=.56).

## 5.18 VOLUNTARINESS - CAUSES AND EFFECTS

There is only one indicator for **Voluntariness**, the scale composed of the various perceived **Voluntariness** items. Thus, the loading of the indicator was fixed at 1.0 for the structural equation model. Figure 5-3 illustrates that **Voluntariness** has significant effects on both **Attitude** ($\gamma$=-.15), supporting **H6** as discussed above, and on **Innovativeness** ($\gamma$=-.37), which supports **H7**, that it is negatively related to **Attitude**. Further, its direct effect on **Innovativeness** is roughly 2½ times greater than on **Attitude**. As with **SN**, however, **Voluntariness** also has an indirect effect on **Innovativeness**. Once again, the total effects can be calculated as follows:

$$\begin{aligned}\text{Total Effect} &= \gamma_{12} + (\gamma_{22} \times \beta_{12}) \\ &= -.37 + (-.15 \times .56) \\ &= -.45\end{aligned}$$

The above result indicates if all paths are considered, the total effects of **Voluntariness** on **Innovativeness** (T.E.= -.45) approach those of both **SN** (T.E.=.51) and **Attitude** ($\beta$=.56).

## 5.19 INNOVATIVENESS

**Innovativeness** was synthesised from three indicators, **Hours** of PWS use per week, **Months** since PWS first adopted, and number of PWS **Functions** used. As shown in Figure 5-3, the three indicators had quite different contributions, although all loaded significantly on **Innovativeness**. The most significant was **Months** ($\lambda$=17.9), which reflects the traditional perspective of **Innovativeness**, early adoption. The second most influential indicator, **Functions** ($\lambda$=9.7), again reflects the idea of adopting something new, in this case different uses to which the PWS can be put. Finally, **Hours**, was the least influential ($\lambda$=2.6). This makes sense when the effect of **Voluntariness**, which compels usage, is considered. If left to one's own choice, one might be less "innovative". Thus, the ranking of influence of the various indicators makes theoretical sense.

As was discussed earlier, **Innovativeness** is significantly affected by all other latent variables in the model. The total effects of the three "independent" variables on **Innovativeness**, summarised below, indicate that there is not a very large difference in the overall effects of the three variables:

| Variable | Total Effects |
|---|---|
| **Attitude** | .56 |
| **Subjective Norm** | .51 |
| **Voluntariness** | -.45 |

In total, approximately 68% of the variance in **Innovativeness** is accounted for by these three variables. The squared multiple correlation for the innovativeness structural equation, equivalent to $R^2$, is .675. This provides good support for the model as developed.

## 5.20 SUMMARY OF RESULTS: STRUCTURAL EQUATION MODELLING

In general, the research model as developed in Chapter 3 was supported by the **LISREL** analysis. The various goodness of fit indices indicated that the model adequately fit the data. Two reduced models, which eliminated **SN** and **Voluntariness**, provided worse fits. The various PCI loaded significantly on **Attitude**, with the exception of **Avoidance**. The same holds true for the various components of **SN** and **Innovativeness**, each of which loaded significantly on their respective latent variables. The hypothesised paths among the variables were all significant, and the effects were in the right direction. Thus, the hypotheses reflected in the research model are supported. Finally, although the direct effects on innovativeness of the three "independent" latent variables differed somewhat, their total effects were quite similar, indicating that they play fairly equal roles in determining one's innovativeness with respect to PWS usage.

## SECTION E: SUMMARY OF DATA ANALYSIS

### 5.21 GENERAL

Three separate techniques were used to analyse the data. The first approach was to compare the descriptive statistics for **adopters** and **non-adopters** of PWS. As discussed earlier, **adoption** or **non-adoption** can be considered a crucial test of **innovativeness**, and therefore any differences between these two groups should provide insight into the effects of the independent variables. Following that, **regression analysis** was used to examine the different relationships between the various independent variables and the three dimensions of innovativeness, **adoptive**, **implementation**, and **use**. By necessity, the relationships had to be examined for each dimension of innovativeness independently. Finally, **structural equation modelling** was used to analyse the research model as a whole, including the simultaneous assessment of the various effect paths in the model. In general, the overall results provided clear support for the research model. The results to tests of the research hypotheses using the different analytical approaches are summarised below. First, however, a brief summary of the descriptive statistics is provided.

### 5.22 SUMMARY OF DESCRIPTIVE STATISTICS

In general, use of PWS was viewed quite favourably across the entire sample. While there were significant differences between them, both **adopters** and **non-adopters** of PWS had positive overall attitudes towards PWS usage, and positive perceptions of the outcomes of personally using PWS. There appeared to be no significant concerns about the potentially negative aspects of PWS usage among either group. The results show that PWS have made a considerable penetration into the workplace, in that approximately 77% of the sample had adopted PWS usage. The penetration levels for this sample were fairly uniform across all organisational levels, including senior executives. In spite of the already significant penetration, however, the results also show that the adoption rate has not slowed, which indicates that there is penetration likely still to occur, and that the saturation point may approach almost the entire organisation.

In general, adopters of PWS use the machine for approximately six different functions during about half of their working hours. Straight information retrieval and electronic mail were consistently the most widely used functions, with fourth generation programming languages (4GL's) being consistently the least widely adopted. Among the other functions, some are more "popular" at different levels of the organisation. For example, some of the more "specialised" functions such as graphics, modelling systems, and database systems had adoption rates which varied across the organisation. One interesting finding was that the adoption level of word processing was higher among senior executives (78%) than among clerical workers (72%).

## 5.23 SUMMARY OF HYPOTHESIS TESTING

### 5.23.1 Hypothesis One

One's **attitude** towards using PWS will influence one's actual **innovativeness** with respect to PWS usage.

This hypothesis was supported by all three analyses. First, **adopters** had a significantly more positive **Attitude** (as directly measured, $A_m$) than **non-adopters** of PWS. Secondly, when regressed with **Subjective Norm** and **Voluntariness** on the various dimensions of **Innovativeness**, $A_m$ was the most significant variable for all dimensions except **implementation** (operationalised as **Hours** of use per week), where it was the second most significant variable. Finally, in using **LISREL**, when **Attitude** is synthesised from its theoretical components, it has the strongest direct, and overall, effect of the three "independent" variables. In conclusion, the results strongly support the hypothesised role of **Attitude**, whichever way it is operationalised, with respect to **Innovativeness**.

5.23.2 **Hypothesis Two**

> **Relative Advantage** will have a contribution greater than any other PCI in the formation of one's **attitude** towards adopting PWS.

This hypothesis was supported only in the regression analysis of the various PCI on **Attitude** as directly measured ($A_m$). The Beta weight of **Relative Advantage** was three times larger than the next most significant PCI. Nevertheless, as has been discussed it is likely that $A_m$ does not reflect the theoretical construct, and thus the results of this analysis are suspect. When **Attitude** was synthesised in the **LISREL** analysis, the loading of **Relative Advantage** on **Attitude** was second to that of **Compatibility**. Furthermore, when the means of the various PCI were compared between **adopters** and **non-adopters**, **Relative Advantage** had only the second highest difference, once again coming after **Compatibility**. While the differences between **Compatibility** and **Relative Advantage** are not large, and likely of no practical significance, the fact remains that the effects of **Relative Advantage** do not dominate the others as was expected. Finally, when the PCI were individually regressed on the **Innovativeness** measures, **Relative Advantage** entered only the equation for **adoptive** innovativeness, operationalised as **Months** elapsed since the PWS was first adopted. Thus, **H2**, was generally not supported.

### 5.23.3 Hypothesis Three

> **Computer avoidance** will have a contribution less than any other PCI in the formation of one's **attitude** towards adopting PWS.

This hypothesis was supported by two of the analyses, with the exception being the regression of the PCI on **Attitude**. In this regression, **Avoidance** was the fourth most significant PCI, after **Relative Advantage**, **Ease of Use**, and **Compatibility**. On the other hand, there was no difference between **adopters** and **non-adopters** with respect to **Avoidance**, and **Avoidance** did not load at all on **Attitude** as synthesised in the **LISREL** analysis.

### 5.23.4 Hypothesis Four

> The **subjective norm** will influence one's **innovativeness** with respect to PWS usage.

This hypothesis was also supported by two of the analyses, again with the exception being the regression analysis. The overall **SN**, when calculated as the sum of the various referent level SN, was not significant when regressed with **Voluntariness** and **Attitude** ($\mathbf{A_m}$) on the **Innovativeness** dimensions. Furthermore, when the individual PCI and referent level SN were regressed on the various **Innovativeness** dimensions, the only statistically significant SN was that for **subordinates** with respect to **use innovativeness**. On the other hand, there were significant differences between **adopters** and **non-adopters** for all the referent level SN. The most telling indication of the potential influence of **SN**, however, was the **LISREL** analysis which synthesised **SN** from its individual components. In this case, not only did **SN** have a significant direct effect on **Innovativeness**, its total effect was close to that of **Attitude**.

### 5.23.5 **Hypothesis Five**

> The **Subjective Norm** will influence one's **Attitude** with respect to PWS usage.

This hypothesis was well supported. First, when regressed with the PCI on **Attitude** as directly measured ($A_m$), **Subjective Norm** had the second largest Beta weight. This was replicated in the **LISREL** analysis, which indicated that it had a relatively large effect on the latent variable, **Attitude**. These results reflect the findings of others (see for example Ryan, 1982; Christensen, 1987), and argue for adding to the **Reasoned Action** model the path from **SN** to **Attitude**.

### 5.23.6 **Hypothesis Six**

> **Voluntariness** is negatively related to one's **Innovativeness** with respect to PWS usage.

This hypothesis was supported by all analysis approaches. First, there was a significant difference between **adopters** and **non-adopters** with respect to this variable, with **adopters** reporting a much lower level of **Voluntariness**. Secondly, **Voluntariness** was significant in all regression equations, with negative Beta weights. Finally, the path from **Voluntariness** to **Innovativeness** was significant in the **LISREL** analysis, with the value of the structural coefficient being negative ($\gamma_{12} = -.37$).

### 5.23.7 Hypothesis Seven

**Voluntariness** is negatively related to one's **Attitude** towards using PWS.

This hypothesis was also supported in the two analyses which investigated it. First, when regressed on **Attitude** as directly measured ($A_m$), **Voluntariness** was significant and had a negative Beta weight. Secondly, in the **LISREL** analysis, the path between **Voluntariness** and **Attitude** as synthesised was significant, with a negative path coefficient ($\gamma_{22}$= -.15).

## 5.24 GENERAL SUMMARY OF RESULTS

Overall, as has been indicated, the various analyses support the research model as it was developed, including which constructs are in the model, and the linkages that exist among them. In general, as is summarised in Table 5-12, the specific hypotheses that were developed were supported, although some received only mixed support. None of these hypotheses was critical to the overall model. Finally, it is believed that the **LISREL** analysis should be considered the most accurate of the various approaches. As has been discussed, it overcomes several inadequacies in the other approaches. Furthermore, it did not support any particular hypothesis that was not also supported by at least one of the other analytical approaches. These results indicate that the **LISREL** analysis should be considered the dominant approach. The implications of these analyses for research and management are discussed in the next chapter.

## TABLE 5-1

## DEMOGRAPHIC BACKGROUND OF SURVEY RESPONDENTS

| | Number | Relative Frequency | Adjusted Frequency |
|---|---|---|---|
| **DEPARTMENT OF EMPLOY** | | | |
| Marketing/ Sales/ Public Affairs | 62 | 11.5% | 12.4% |
| Administration/ Human Resources/ Legal | 212 | 39.3% | 42.4% |
| Finance/ Accounting/ Engineering | 169 | 31.3% | 33.8% |
| Other | 57 | 10.6% | 11.4% |
| Missing | 40 | 7.4% | |
| Total | 540 | 100.0% | 100.0% |
| **ORGANISATION LEVEL** | | | |
| Executive | 13 | 2.4% | 2.5% |
| Middle Management | 98 | 18.1% | 18.8% |
| Supervisory | 130 | 24.1% | 24.9% |
| Professional (Exempt) | 124 | 23.0% | 23.8% |
| Technical (Non Exempt) | 59 | 10.9% | 11.3% |
| Clerical / Support | 98 | 18.1% | 18.8% |
| Missing | 18 | 3.3% | |
| Total | 540 | 100.0% | 100.0% |
| **EDUCATION** | | | |
| Some High School | 5 | 0.9% | 1.0% |
| High School Graduate | 60 | 11.1% | 11.5% |
| Some Technical College | 37 | 6.9% | 7.1% |
| Technical College Graduate | 61 | 11.3% | 11.7% |
| Some Community College | 29 | 5.4% | 5.5% |
| Community College Graduate | 21 | 3.9% | 4.0% |
| Some University | 82 | 15.2% | 15.7% |
| University Graduate | 134 | 24.8% | 25.6% |
| University Postgraduate | 94 | 17.4% | 18.0% |
| Missing | 17 | 3.1% | |
| Total | 540 | 100.0% | 100.0% |
| **AGE** | | | |
| Less than 30 years old | 82 | 15.2% | 16.1% |
| 30 to 39 years old | 229 | 42.4% | 44.9% |
| 40 to 49 years old | 138 | 25.6% | 27.1% |
| 50 years old and older | 61 | 11.3% | 12.0% |
| Missing | 30 | 5.6% | |
| Total | 540 | 100.0% | 100.0% |
| **SEX** | | | |
| Male | 325 | 60.2% | 62.6% |
| Female | 194 | 35.9% | 37.4% |
| Missing | 21 | 3.9% | |
| Total | 540 | 100.0% | 100.0% |

# TABLE 5-2

## CORRECTIONS FOR SKEWNESS: RESULTS OF DATA TRANSFORMATION

| VARIABLE | Skewness Scores Untransformed | Skewness Scores Transformed(1) | Transformation Used |
|---|---|---|---|
| Voluntariness | +.04 | | Nil |
| Image | -.28 (2) | -.55 | Square Root |
| Relative Advantage | -1.13 | +.01 | Logarithmic |
| Compatibility | -1.07 | +.01 | Logarithmic |
| Ease of Use | -.50 (2) | -.50 | Square Root |
| Result Demonstrability | -.92 | -.06 | Logarithmic |
| Trialability | -.37 | -.08 | Square Root |
| Visibility | -1.19 | +.23 | Logarithmic |
| Avoidance | -.23 | | Nil |
| Subjective Norm | -.15 | | Nil |
| Functions Used | +.08 | | Nil |
| Frequency of Use | +.42 | -.21 | Square Root |
| Months since adopted | +1.04 | +.19 | Square Root |
| Hours of Use per Week | +.98 | +.28 | Square Root |
| Attitude | -1.30 | +.02 | Logarithmic |

Notes:

1. Variables with negative skew first had their scales transposed to create positive skew. As a result, some transformations again resulted in negative skew as the transformation over compensated for the original skewness.

2. For **Image** and **Ease of Use**, even the mild square root transformation resulted in excessive skewness, and as a result the original untransformed data was used.

## TABLE 5-3

## SURVEY VARIABLES - DESCRIPTIVE STATISTICS

| | # SCALE ITEMS | MEAN SCORE | STANDARD DEVIATION | MAXIMUM REPORTED SCORE | MINIMUM REPORTED SCORE |
|---|---|---|---|---|---|
| **PERCEIVED CHARACTERISTICS** (Scale Range: 1 to 7) | | | | | |
| Voluntariness | 4 | 3.69 | 1.71 | 7.00 | 1.00 |
| Image | 5 | 4.19 | 1.11 | 6.80 | 1.00 |
| Relative Advantage | 9 | 5.62 | 1.09 | 7.00 | 1.00 |
| Compatibility | 4 | 5.42 | 1.26 | 7.00 | 1.00 |
| Ease of Use | 8 | 4.96 | 1.02 | 7.00 | 1.38 |
| Result Demonstrability | 4 | 5.57 | 1.08 | 7.00 | 1.00 |
| Trialability | 5 | 4.52 | 1.30 | 7.00 | 1.00 |
| Visibility | 5 | 5.80 | 1.01 | 7.00 | 1.80 |
| Computer Avoidance | 6 | 2.00 | 1.02 | 6.83 | 1.00 |
| **ATTITUDE** (Scale Range: 1 to 7) | 4 | 5.88 | 0.87 | 7.00 | 1.50 |
| **SUBJECTIVE NORMS** (Scale Range: -21 to +21) | | | | | |
| Friends | 1 | 1.67 | 6.26 | 21.0 | -18.0 |
| Peers | 1 | 4.77 | 6.95 | 21.0 | -18.0 |
| Supervisors | 1 | 7.33 | 9.11 | 21.0 | -21.0 |
| Senior Management | 1 | 6.78 | 9.01 | 21.0 | -18.0 |
| Subordinates | 1 | 3.98 | 6.97 | 21.0 | -21.0 |
| **INNOVATIVENESS MEASURES** | | | | | |
| **Frequency of Use** (Scale range: 12 to 84) | 1 | 29.6 | 13.9 | 68.0 | 12.0 |
| **Months Since First Use** (Scale range: 0 to 999) | 2 | 31.3 | 30.9 | 131.2 | 0.0 |
| **Hours of Use per Week** (Scale range: 0 to 99) | 2 | 12.4 | 12.4 | 61.3 | 0.0 |
| **Number of Functions Used** (Scale range: 0 to 12) | 4 | 4.6 | 3.5 | 11.3 | 0.0 |

# TABLE 5-4

## USERS VERSUS NON-USERS

### I. PROPORTION OF USERS VERSUS NON-USERS IN SAMPLE

| | USERS | | NON-USERS | | TOTAL | |
|---|---|---|---|---|---|---|
| Org Level | # | % of level | # | % of level | # | % of Sample |
| Executive | 9 | 69% | 4 | 31% | 13 | 3% |
| Middle Management | 73 | 74% | 25 | 26% | 98 | 19% |
| Supervisory | 101 | 78% | 29 | 22% | 130 | 25% |
| Professional | 95 | 77% | 29 | 23% | 124 | 24% |
| Technical | 45 | 76% | 14 | 24% | 59 | 11% |
| Clerical | 78 | 80% | 20 | 20% | 98 | 19% |
| Total | 418 | | 122 | | 540 | |
| Percent of Sample | | 77% | | 23% | | 100% |

### II. VARIABLE MEANS AND TESTS FOR DIFFERENCES

| | USERS | NON-USERS | U-TEST Z-SCORE | SIGNIF |
|---|---|---|---|---|
| **PERCEIVED CHARACTERISTICS** | | | | |
| Voluntariness | 3.3 | 5.0 | -10.01 | .0000 |
| Image | 4.3 | 3.9 | -3.08 | .0021 |
| Relative Advantage | 5.9 | 4.8 | -9.39 | .0000 |
| Compatibility | 5.7 | 4.4 | -9.68 | .0000 |
| Ease of Use | 5.1 | 4.5 | -5.54 | .0000 |
| Result Demonstrability | 5.8 | 4.9 | -7.81 | .0000 |
| Trialability | 4.6 | 4.3 | -2.23 | .0257 |
| Visibility | 5.9 | 5.3 | -5.13 | .0000 |
| Computer Avoidance | 2.1 | 2.1 | - .04 | .9681 |
| **ATTITUDE** | 6.1 | 5.3 | -8.95 | .0000 |
| **SUBJECTIVE NORMS** | | | | |
| Friends | 2.52 | -1.38 | -6.06 | .0000 |
| Peers | 6.10 | .11 | -8.07 | .0000 |
| Supervisors | 9.39 | .08 | -9.06 | .0000 |
| Senior Management | 8.75 | -.16 | -9.06 | .0000 |
| Subordinates | 5.26 | -.53 | -7.78 | .0000 |
| **INNOVATIVENESS MEASURES** | | | | |
| Months elapsed since adoption | 40.3 | | | |
| Hours of use per week | 15.9 | | | |
| Frequency of Use | 34.6 | | | |
| Number of functions used | 5.9 | | | |

# TABLE 5-5

## USE OF PWS FUNCTIONS

### I. PERCENTAGE OF USERS USING SPECIFIC FUNCTIONS

| | **Mainframe** % | **Micro** % | **Both** % | **Total** % |
|---|---|---|---|---|
| Information Retrieval | 51 | 12 | 24 | 87 |
| Electronic Mail | 68 | 8 | 6 | 82 |
| Text/Word Processing | 32 | 25 | 16 | 73 |
| Report Generation | 35 | 16 | 21 | 72 |
| Spreadsheet packages | 20 | 31 | 10 | 61 |
| Database packages | 29 | 11 | 12 | 52 |
| Graphics | 12 | 28 | 6 | 46 |
| Modelling Systems | 14 | 18 | 8 | 40 |
| Statistical Analysis | 19 | 15 | 6 | 40 |
| Calendaring | 32 | 5 | 2 | 39 |
| 4GL's | 12 | 5 | 5 | 22 |

### II. USE OF PWS FUNCTIONS BY ORGANISATIONAL LEVEL

| | Executive n=9 | Middle Mgmt n=73 | Supervisory n=101 | Professional n=95 | Technical n=45 | Clerical n=71 |
|---|---|---|---|---|---|---|
| Information Retrieval | 89 | 86 | 91 | 85 | 91 | 85 |
| Electronic Mail | 100 | 95 | 82 | 82 | 67 | 76 |
| Text/Word Processing | 78 | 75 | 73 | 76 | 69 | 72 |
| Report Generation | 56 | 73 | 79 | 81 | 65 | 65 |
| Spreadsheet packages | 78 | 70 | 67 | 67 | 58 | 40 |
| Database packages | 33 | 56 | 66 | 56 | 49 | 30 |
| Graphics | 56 | 55 | 51 | 54 | 40 | 21 |
| Modelling Systems | 67 | 55 | 46 | 47 | 29 | 15 |
| Statistical Analysis | 33 | 39 | 45 | 44 | 49 | 25 |
| Calendaring | 78 | 58 | 30 | 36 | 42 | 28 |
| 4GL's | 12 | 21 | 24 | 31 | 22 | 12 |

Note 1: Above figures are percentages based on <u>**actual users**</u> of the PWS.

Note 2: In the questionnaire, the **Professional** and **Technical** levels were distinguished by describing each level as "exempt" and "non-exempt" respectively. In discussion with company representatives it was concluded that the labels would differentiate between these groups, both of whom may have technically oriented tasks but who are at different levels in the organisational hierarchy. These "exempt/-non-exempt" labels refer to whether the employee would be covered by any union agreements, with the more senior employees being salaried and hence classified as "exempt". Professional level employees are more senior individuals who are not in supervisory or managerial positions, such as engineers, accountants, and so forth. At the non-exempt level there can be both "technical" and "clerical" employees, depending on the nature of their tasks.

# TABLE 5-6

# REGRESSION RESULTS

# PERCEIVED CHARACTERISTICS ON ATTITUDE

## I. SUMMARY OF STEPPED FORCED ENTRY OF VARIABLES

| | | UNTRANSFORMED DATA | | | | TRANSFORMED DATA | | | |
|---|---|---|---|---|---|---|---|---|---|
| Step | VARIABLE IN | BETA IN | $R^2$ | F (EQN) | SIG F | BETA IN | $R^2$ | F (EQN) | SIG F |
| 1 | Relative Adv | .799 | .639 | 936 | .000 | .793 | .629 | 899 | .000 |
| 2 | Ease of Use | .151 | .655 | 501 | .000 | .153 | .645 | 481 | .000 |
| 3 | Compatibility | .181 | .665 | 349 | .000 | .247 | .664 | 348 | .000 |
| 4 | Avoidance | -.093 | .673 | 272 | .000 | -.081 | .671 | 268 | .000 |
| 5 | Voluntariness | -.087 | .678* | 222 | .000 | -.100 | .678* | 221 | .000 |
| 6 | Image | -.051 | .681* | 186 | .000 | -.058 | .680 | 186 | .000 |
| 7 | Result Demo | .057 | .683** | 161 | .000 | .098 | .685** | 163 | .000 |
| 8 | Trialability | -.008 | .683** | 140 | .000 | -.004 | .685** | 142 | .000 |
| 9 | Visibility | .009 | .683 | 125 | .000 | .007 | .685 | 126 | .000 |

NOTE: All changes in $R^2$ significant at the p<.00 level unless otherwise indicated as follows:
* = p<.1
** = change not significant p>.5

## II. STATISTICS FOR VARIABLES IN THE FINAL EQUATION

| | UNTRANSFORMED VARIABLES | | | | TRANSFORMED VARIABLES | | | |
|---|---|---|---|---|---|---|---|---|
| VARIABLE | BETA | STD ERR BETA | F (B) | SIG F | BETA | STD ERR BETA | F (B) | SIG F |
| Relative Adv | .555 | .047 | 137 | .000 | .481 | .048 | 101.8 | .000 |
| Ease of Use | .077 | .033 | 5.5 | .020 | .062 | .032 | 3.5 | .059 |
| Compatibility | .180 | .046 | 15.5 | .000 | .235 | .046 | 26.5 | .000 |
| Avoidance | -.105 | .028 | 14.4 | .000 | -.088 | .028 | 9.8 | .002 |
| Voluntariness | -.092 | .029 | 9.8 | .002 | -.108 | .029 | 13.2 | .000 |
| Image | -.052 | .028 | 3.5 | .061 | -.061 | .028 | 4.7 | .030 |
| Result Demo | .058 | .035 | 2.8 | .094 | .098 | .035 | 7.4 | .010 |
| Trialability | -.010 | .029 | .12 | .734 | -.006 | .029 | .04 | .835 |
| Visibility | .009 | .028 | .10 | .747 | .007 | .028 | .07 | .789 |
| Variance Expl | Adjusted $R^2$ = .677 | | | | Adjusted $R^2$ = .680 | | | |

## TABLE 5-7

## REGRESSION RESULTS

## PCI'S AND SN ON ATTITUDE

| **Equation** | **PCI Only** | | **PCI and SN** | |
|---|---|---|---|---|
| Beta Weights | Beta | Sig | Beta | Sig |
| Relative Advantage | .555 | .000 | .525 | .000 |
| Subjective Norm | | | .164 | .000 |
| Compatibility | .181 | .000 | .161 | .000 |
| Avoidance | -.105 | .000 | -.112 | .000 |
| Voluntariness | -.092 | .002 | -.021 | .524 |
| Ease of Use | .077 | .020 | .089 | .006 |
| Result Demo | .058 | .094 | .054 | .111 |
| Image | -.052 | .061 | -.073 | .009 |
| Trialability | -.010 | .734 | -.012 | .664 |
| Visibility | .009 | .747 | -.004 | .898 |
| Variance Explained | $R^2$ = .683<br>Adj $R^2$ = .677 | | $R^2$ = .699<br>Adj $R^2$ = .693 | |

# TABLE 5-8

## REGRESSION RESULTS

## ATTITUDE, SN, AND VOLUNTARINESS ON INNOVATIVENESS

| VARIABLES | | UNTRANSFORMED DATA | | | | TRANSFORMED DATA | | | |
|---|---|---|---|---|---|---|---|---|---|
| DEPENDENT | INDEPENDENT | Beta | Sig | Adj $R^2$ | F | Beta | Sig | Adj $R^2$ | F |
| **NUMBER OF FUNCTIONS USED** | Voluntariness | -.163 | .001 | | | .154 | .002 | | |
| | Attitude | .335 | .000 | | | -.321 | .000 | | |
| | Subjective Norm | .085 | .102 | .23 | 50 | .097 | .064 | .22 | 50 |
| **FREQUENCY OF USE** | Voluntariness | -.213 | .000 | | | .219 | .000 | | |
| | Attitude | .360 | .000 | | | -.358 | .000 | | |
| | Subjective Norm | .075 | .138 | .28 | 68 | .093 | .060 | .30 | 76 |
| **MONTHS SINCE ADOPTED** | Voluntariness | -.261 | .000 | | | .293 | .000 | | |
| | Attitude | .279 | .000 | | | -.287 | .000 | | |
| | Subjective Norm | -.078 | .152 | .15 | 33 | -.007 | .884 | .23 | 51 |
| **HOURS OF USE PER WEEK** | Voluntariness | -.479 | .000 | | | .458 | .000 | | |
| | Attitude | .304 | .000 | | | -.342 | .000 | | |
| | Subjective Norm | -.046 | .324 | .39 | 110 | -.005 | .910 | .44 | 138 |

Note: All F values significant at the $p \leq .000$ level.

# TABLE 5-9

## REGRESSION RESULTS
## PCI AND SUBJECTIVE NORMS ON INNOVATIVENESS

**EQUATION 1: DEPENDENT VARIABLE - NUMBER OF FUNCTIONS USED**

| | UNTRANSFORMED DATA | | | | | TRANSFORMED DATA | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Entry Step | Independent Variable | Final Beta | Sig | Adj $R^2$ | F | Independent Variable | Final Beta | Sig | Adj $R^2$ | F |
| 1 | Result Demo | .32 | .00 | | | Result Demo | -.32 | .00 | | |
| 2 | Voluntariness | -.18 | .00 | | | Voluntariness | .19 | .00 | | |
| 3 | Trialability | .15 | .00 | | | Trialability | -.14 | .00 | | |
| 4 | Compatibility | .13 | .00 | | | SN Subord | .10 | .01 | | |
| 5 | SN Subord | .10 | .02 | .36 | 58 | Compatibility | -.11 | .02 | .35 | 57 |

**EQUATION 2: DEPENDENT VARIABLE - FREQUENCY OF USE**

| | UNTRANSFORMED DATA | | | | | TRANSFORMED DATA | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Entry Step | Independent Variable | Final Beta | Sig | Adj $R^2$ | F | Independent Variable | Final Beta | Sig | Adj $R^2$ | F |
| 1 | Result Demo | .33 | .00 | | | Result Demo | -.33 | .00 | | |
| 2 | Voluntariness | -.25 | .00 | | | Voluntariness | .25 | .00 | | |
| 3 | Compatibility | .18 | .00 | | | Compatibility | -.16 | .00 | | |
| 4 | Trialability | .12 | .00 | | | Trialability | -.09 | .02 | | |
| 5 | SN Subord | .07 | .06 | .39 | 83 | SN Subord | .09 | .02 | .41 | 73 |

**EQUATION 3: DEPENDENT VARIABLE - HOURS OF USE PER WEEK**

| | UNTRANSFORMED DATA | | | | | TRANSFORMED DATA | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Entry Step | Independent Variable | Final Beta | Sig | Adj $R^2$ | F | Independent Variable | Final Beta | Sig | Adj $R^2$ | F |
| 1 | Voluntariness | -.39 | .00 | | | Compatibility | -.36 | .00 | | |
| 2 | Compatibility | .30 | .00 | | | Voluntariness | .38 | .00 | | |
| 3 | Result Demo | .17 | .00 | | | Result Demo | -.21 | .00 | | |
| 4 | Avoidance | .17 | .00 | | | Avoidance | -.11 | .00 | | |
| 5 | Image | -.12 | .00 | | | Image | .10 | .00 | | |
| 6 | Trialability | .08 | .03 | .47 | 77 | | | | .54 | 122 |

**EQUATION 4: DEPENDENT VARIABLE - MONTHS SINCE PWS FIRST ADOPTED**

| | UNTRANSFORMED DATA | | | | | TRANSFORMED DATA | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Entry Step | Independent Variable | Final Beta | Sig | Adj $R^2$ | F | Independent Variable | Final Beta | Sig | Adj $R^2$ | F |
| 1 | Relative Adv | .22 | .00 | | | Relative Adv | -.23 | .00 | | |
| 2 | Voluntariness | -.24 | .00 | | | Voluntariness | .29 | .00 | | |
| 3 | Result Demo | .12 | .00 | | | Result Demo | -.16 | .00 | | |
| 4 | Image | -.16 | .00 | | | Image | .11 | .00 | | |
| 5 | Trialability | .13 | .00 | .22 | 30 | Visibility | -.11 | .01 | .30 | 46 |
| 6 | Visibility | .07 | .09 | | | Trialability | -.07 | .10 | | |

# TABLE 5-10

## GENERAL STATISTICS FOR TESTED MODELS

| **ASSESSMENT INDICES** | **FULL MODEL** | **LESS VOL-UNTARINESS** (Note 1) | **LESS 4 PCI** (Note 2) |
|---|---|---|---|
| CHI-SQUARE ($\chi^2$) | 802 | 825 | 417 |
| DEGREES OF FREEDOM | 99 | 101 | 49 |
| $\chi^2$/(DEGRESS OF FREEDOM) | 8.1 | 8.2 | 8.5 |
| GOODNESS OF FIT | .819 | .814 | .879 |
| ADJUSTED GFI | .751 | .749 | .808 |
| ROOT MEAN SQUARE RESIDUAL | 4.20 | 4.12 | 5.48 |
| COEFFICIENTS OF DETERMINATION: | | | |
| X-VARIABLES | .973 | .903 | .973 |
| Y-VARIABLES | .920 | .929 | .956 |
| STRUCTURAL EQUATIONS | .526 | .332 | .524 |
| SQUARED MULTIPLE CORRELATIONS: | | | |
| INNOVATIVENESS EQUATIONS | .675 | .505 | .667 |
| ATTITUDE EQUATIONS | .307 | .302 | .303 |

<u>Notes</u>

1. Full model less **Voluntariness**.

2. Full model less indicators **Trialability**, **Visibility**, **Image** and **Avoidance**.

## TABLE 5-11

## STRUCTURAL EQUATION MODELLING

## FACTOR LOADINGS AND STRUCTURAL COEFFICIENTS

| VARIABLES | LAMBDA (Note 1) | STANDARD ERROR | T-VALUES (Note 2) | STANDARDISED VALUES (Note 3) |
|---|---|---|---|---|
| IMAGE | 1.000 | .000 | .000 | .388 |
| RELATIVE ADVANTAGE | 2.570 | .324 | 7.938 | .997 |
| COMPATIBILITY | 2.879 | .363 | 7.920 | 1.116 |
| EASE OF USE | 1.651 | .226 | 7.320 | .640 |
| RESULT DEMONSTRABILITY | 1.806 | .244 | 7.394 | .701 |
| TRIALABILITY | 1.058 | .196 | 5.405 | .410 |
| VISIBILITY | .958 | .163 | 5.868 | .371 |
| COMPUTER AVOIDANCE | -.021 | .110 | -.193 | -.008 |
| SN PEER | 5.516 | .259 | 21.32 | 5.516 |
| SN SUPERVISOR | 8.616 | .305 | 28.23 | 8.616 |
| SN SR MGMT | 8.303 | .308 | 27.00 | 8.303 |
| SN SUBORDINATES | 4.930 | .272 | 18.14 | 4.930 |
| VOLUNTARINESS | -1.129 | .068 | -16.65 | -1.129 |
| FUNCTIONS USED | 1.000 | .000 | 0.000 | 2.557 |
| MONTHS | 7.009 | .594 | 11.79 | 17.923 |
| HOURS OF USE PER WEEK | 3.791 | .247 | 15.32 | 9.693 |
| **MODEL PATH** (See Figure 5-2) | **COEFF VALUES** | **STANDARD ERROR** | **T-VALUES** | **STANDARDISED SOLUTION** |
| $\beta_{12}$ Attitude -> Innov | 3.684 | .579 | 6.367 | .559 |
| $\gamma_{11}$ SN -> Innov | .526 | .128 | 4.120 | .206 |
| $\gamma_{21}$ SN -> Attitude | .207 | .031 | 6.746 | .533 |
| $\gamma_{12}$ Vol -> Innov | -.940 | .146 | -6.425 | -.368 |
| $\gamma_{22}$ Vol -> Attitude | -.059 | .022 | -2.691 | -.152 |

Notes 1. Lambda ($\lambda$) is the loading of the indicator variable on the latent construct. The loading of one $\lambda$ per concept is typically fixed at 1.0 to set the scale for the loadings of the remaining indicators. In this case, the loadings for **Image** and **Functions** were fixed and hence their standard error and significance cannot be computed.

2. The T-Value (**LISREL** nomenclature) is calculated by dividing the parameter estimate by its standard error, and hence its significance is calculated from the normal probability table. Values greater than $\pm$ 2.6 have probability $p \leq .01$.

3. The "standardised" solution in **LISREL** is a rescaling such that all concepts are given a variance of 1.0, but indicators remain in their original scales.

## TABLE 5-12

## RESULTS OF HYPOTHESIS TESTING

| HYPOTHESES | ADOPTERS VS. NON-ADOPTERS | REGRESSION ANALYSIS | LISREL ANALYSIS |
|---|---|---|---|
| H1: ATTITUDE -> INNOVATIVENESS | SUPPORTED | SUPPORTED | SUPPORTED |
| H2: RELATIVE ADV > OTHER PCI | NOT SUPPORTED | SUPPORTED | NOT SUPPORTED |
| H3: AVOIDANCE < OTHER PCI | SUPPORTED | NOT SUPPORTED | SUPPORTED |
| H4: SN -> INNOVATIVENESS | SUPPORTED | NOT SUPPORTED | SUPPORTED |
| H5: SN -> ATTITUDE | N/A | SUPPORTED | SUPPORTED |
| H6: VOLUNTARY ->INNOVATIVENESS | SUPPORTED | SUPPORTED | SUPPORTED |
| H7: VOLUNTARY -> ATTITUDE | N/A | SUPPORTED | SUPPORTED |

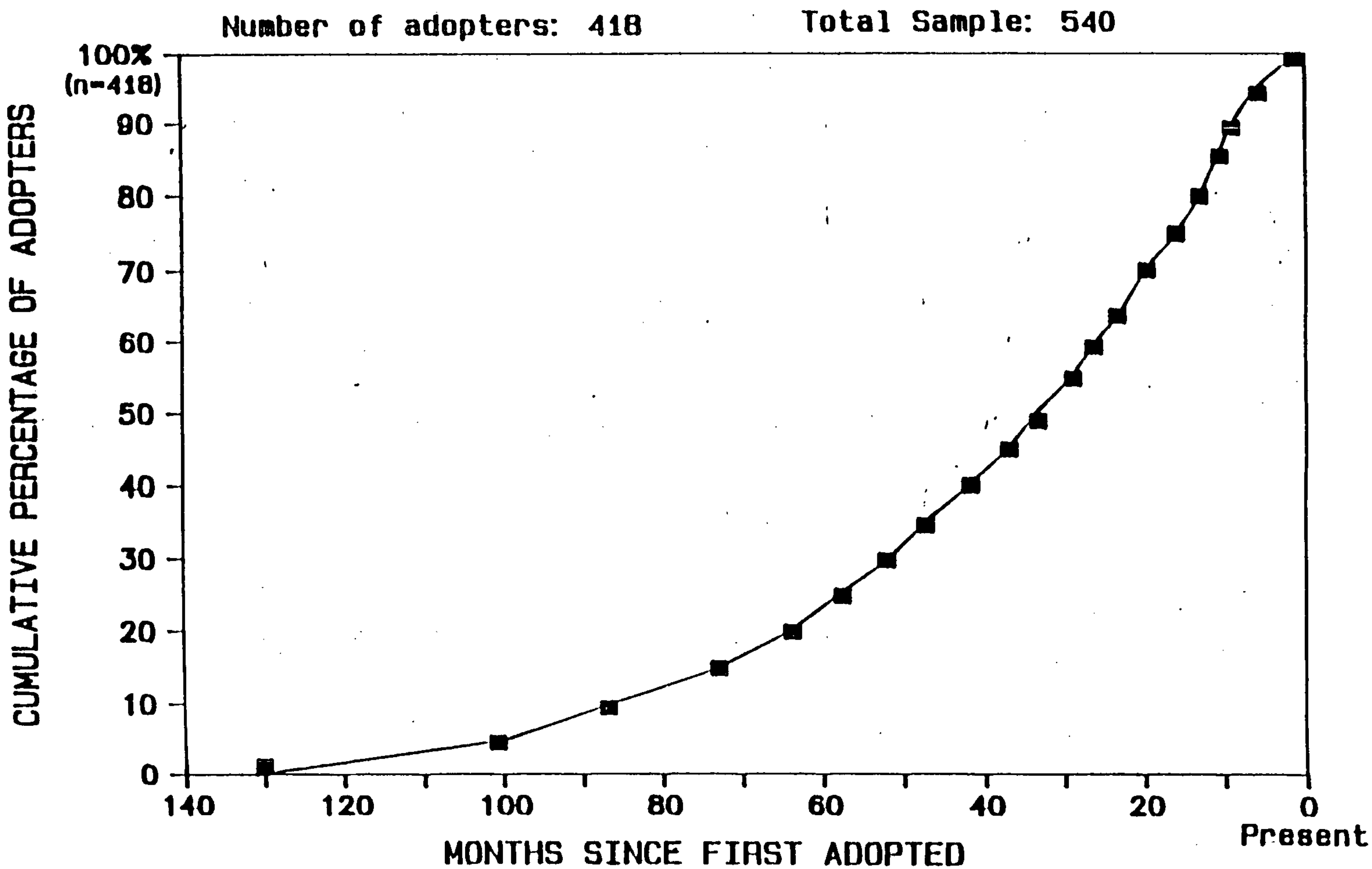


**FIGURE 5-1: DIFFUSION RATE OF PWS TO DATE**

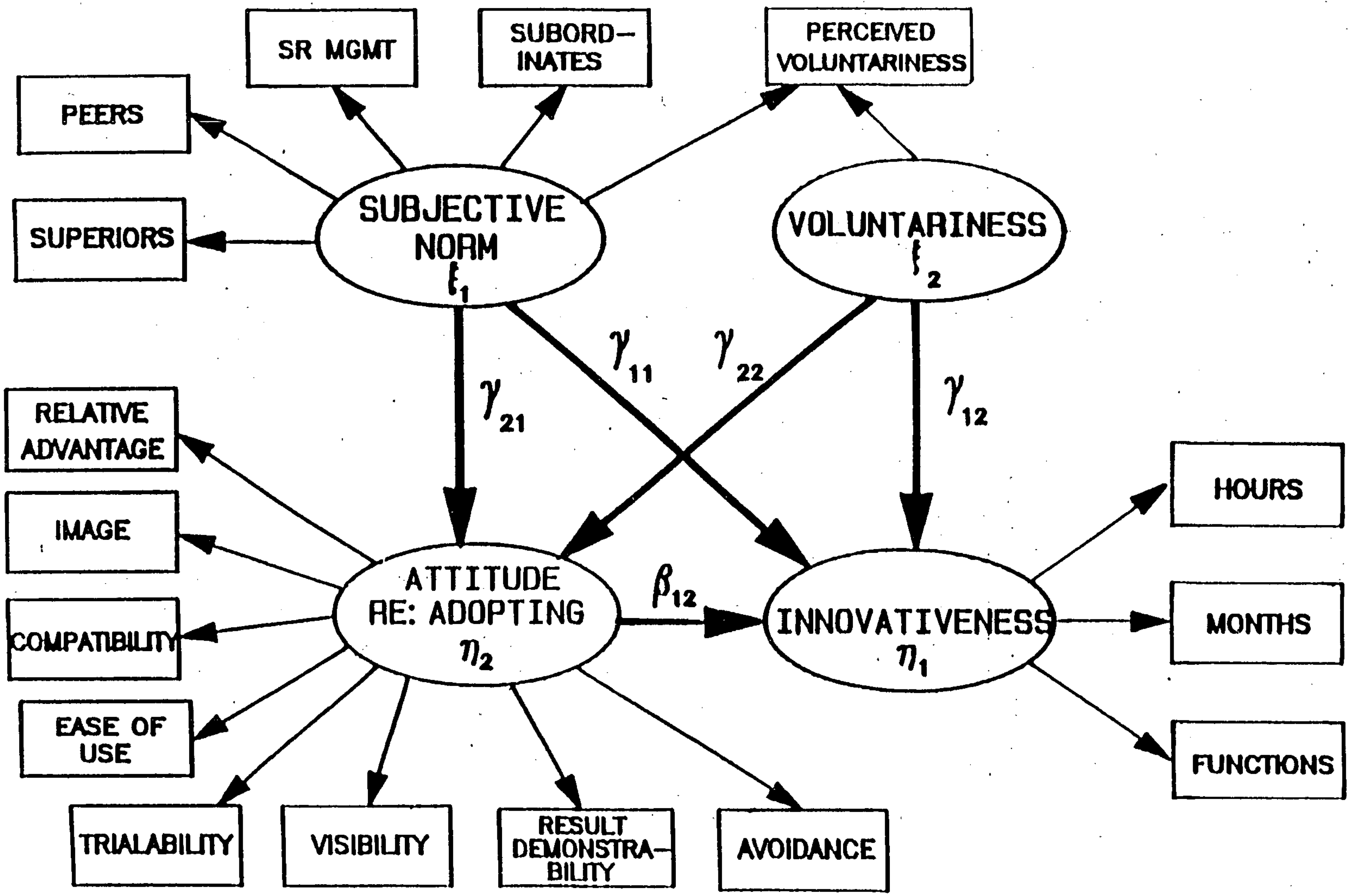


FIGURE 5-2: STRUCTURAL EQUATION MODEL

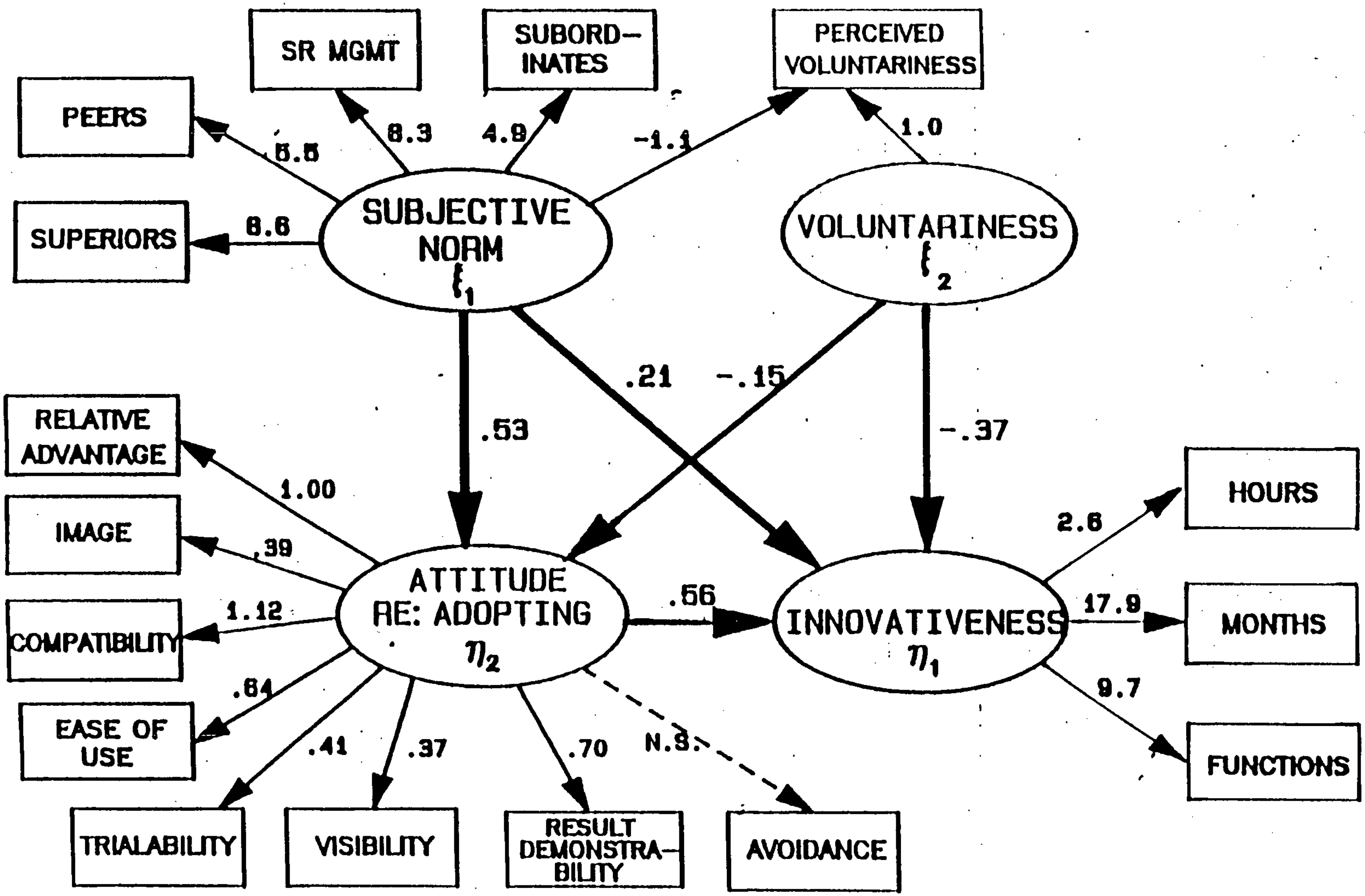


FIGURE 5-3: LISREL STANDARDISED SOLUTION

# CHAPTER SIX

# CONTRIBUTIONS, IMPLICATIONS AND LIMITATIONS

> External causes are the condition of change and internal causes are the basis of change ... external causes become operative through internal causes. In a suitable temperature an egg changes into a chicken, but no temperature can change a stone into a chicken, because each has a different basis.
>
> Mao (quoted in Kimberly, 1981, p.84)

## 6.1 INTRODUCTION

Professionals within the Information Systems community have long been concerned with the management of change. This is due to the fact that the basic role of many IS professionals is the **implementation** of information systems. Implementation, in turn, is primarily a change process. In fact, because the user most often has to carry out new behaviours in order to realise the benefits of the system, systems **implementation** is, to a large extent, a process of managing a particular kind of change, that of **innovation**. Nevertheless, it appears as if very little of the work in the area of systems implementation has been based on innovation theory. Work that has been done has focussed primarily on the "external" factors influencing change, such as top management support, organisational commitment to change, and so forth (Ginzberg, 1981). The goal of this research was to focus on the "internal" causes of change, or innovativeness. To do so, it drew upon previous work in both IS and other disciplines using **Attitude** and **Innovation** theory, in order to examine the implementation of PWS usage in organisations. Thereby, it was intended to extend the theoretical bases for managing IS **implementation** in general.

Even though this research did not investigate an innovation within the domain of rural sociology, Mao's metaphor above does show that when managing change, we have to understand the basis, or motivation, for the change. Within organisations, this is a complex undertaking, as "some members are selling heating systems, some protecting stones, others laying eggs, and still others looking for chickens" (Kimberly, 1981, p.84). This certainly appears to be the case for the implementation of PWS usage. Nevertheless, it is believed that this research should provide those investigating and managing the diffusion of information technology with some insight into this process. As will be discussed later, more research is direly needed in this area. First, however, this chapter will provide a brief summary of the process of this research, and address the research questions. Following that, it will discuss the contributions this study has made, the managerial implications of its findings, and its limitations.

In the discussion that follows, many of the findings will once again be described in terms of causes and effects. As was discussed in Chapter 5, and as will be further addressed below, it is recognised that due to the cross-sectional methodology employed in this research, it cannot be unequivocally stated that changes in one variable "cause" changes in another. Nevertheless, in that the tested theory is framed in cause and effect terms, the discussion that follows uses causal terminology.

## 6.2 SUMMARY OF THE RESEARCH PROCESS

This study was motivated by the wide range of reactions of non-systems professionals to the introduction of the **Personal Work Station** (PWS), which is an innovation in the work place. To be of benefit, the PWS must be directly used by the adopter. There is, however, not only enthusiastic adoption of use of the technology, but there is also considerable evidence of its hostile rejection. The different behaviours which were observed generated the specific research questions identified in Chapter 1. They were:

1. What are the users', and non-users', underlying **perceptions** of personally using IT?

2. Do any of the above perceptions predominate? If so, which are they, how are they linked, and how do they affect the decision to personally use IT?

3. What are the effects of others' expectations about one's using IT on one's decision to use, or not use, IT?

To investigate these questions, the diffusion of the PWS was first put into the context of information systems implementation, which has been an area of research within MIS for years. As was discussed in Chapter 2, there has been some debate as to what constitutes successful implementation. In the context of PWS implementation, however, it can be seen that a necessary condition for success is the appropriate **use** of the technology. Getting individuals to use the PWS, then, can be seen to be a major goal for those implementing these systems.

Because **usage** is a "behaviour", and is a "new" behaviour for most adopters, an investigation of the theory relating to the influences on individual behaviour was undertaken. Two particular bodies of theory were then identified as being appropriate bases for the research. As discussed in Chapter 3, these were the **Theory of Reasoned Action** (Fishbein and Ajzen, 1975), which deals with behaviour in general, and **innovation diffusion** theory (Rogers, 1983), with respect to "new" or innovative behaviour. These were melded into a **theoretical model** which hypothesised how eventual behaviour, in this case **Innovativeness**, is determined. From this theoretical model, the particular **research model** for this study was derived as a basis for investigating innovativeness with respect to PWS usage.

It is recognised that "external causes" are the conditions of change, but the **Theory of Reasoned Action** (and Mao) posit that they become operative through internal causes. That is, contextual or environmental variables are operative through processes internal to the actual adopter. Therefore, in order to gain an initial understanding of **Innovativeness** with respect to the use of PWS, the focus of this research is on the "internal causes" of change. In this study, these were identified as one's **Attitude** towards adopting the PWS, and one's **Subjective Norm** with respect to PWS usage. It is recognised that external variables may influence these internal variables, but investigation of external variables was beyond the scope of this study.

Based on the components of the research model, it was decided that a field **survey** would be the most effective research methodology to investigate the research questions. This required the identification and development of survey instruments with which to collect the data. Because of the paucity of validated and reliable instruments in the field, an extensive **instrument development** process was carried out. This resulted in several reliable scales which were put together into a questionnaire, and distributed to some 800 individuals in seven companies. 540 usable questionnaires were returned.

The data were analysed using three different techniques. Differences between a split sample of **adopters** and **non-adopters** were first investigated. This was followed by both **regression analyses** and **structural equation modelling** for the entire sample. Results of the data analysis showed strong support for the research model and the research hypotheses.

## 6.3 THE RESEARCH QUESTIONS ANSWERED

### 6.3.1 Question One

What are the users', and non-users', underlying perceptions of personally using IT?

On average, most respondents viewed personal use of the PWS as a positive undertaking. The average responses to **Attitude towards using the PWS** and to all the **Perceived Characteristics of Innovating** (PCI) were positive. In general, the PWS is viewed as:

1. providing an advantage over previous ways of doing work;
2. compatible with existing values, and ways of working;
3. easy to use;
4. easy to experiment with, or try out;
5. providing tangible, communicable results;
6. generally visible in the organisation; and
7. <u>not</u> a threat to users' health, jobs or independence on the job.

Even though the perceptions of PWS usage are all positive, there are statistically significant differences between those who actually use the technology and those who do not. **Non-adopters** of the PWS had less positive perceptions of PWS usage than did **adopters**, except for **Computer Avoidance**, for which there was no difference between the two groups. As will be discussed later, the finding with respect to **Avoidance** was considered to be somewhat surprising.

### 6.3.2 Question Two

Do any of the perceptions of personally using IT predominate? If so which are they, how are they linked, and how do they affect the decision to personally use IT?

Investigation of the results shows that there definitely appear to be different tiers of influence among the perceptions. For example, the differences in responses between **adopters** and **non-adopters** for **Compatibility** and **Relative Advantage** were approximately one standard deviation ($1\sigma$), which is much larger than the differences between the two groups for the other PCI. In addition, within the final structural equation model, these two PCI had much larger loadings on **Attitude** than did the other PCI. Furthermore, given the absolute size of the differences for these two variables between users and non-users, it would also appear that they are of practical significance in the decision to use or not to use the PWS. On the other hand, while the differences between the two groups with respect to **Ease of Use** (0.6σ), **Visibility** (0.6σ), and **Trialability** (0.25σ), were all statistically significant, it is difficult to conclude whether they are also of practical significance.

The perception which likely has the least influence on PWS usage was **Computer Avoidance**. There was no difference between **adopters** and **non-adopters** on this dimension, and it did not load on **Attitude** in the **LISREL** analysis. The research did not answer, however, why the potentially negative outcomes of PWS usage, as captured in **Avoidance**, have no apparent relationship with usage. It could be that the respondents discount the touted negative effects, that they are mostly unaware of the effects, or that, for reasons unknown, the results are an artifact of this particular study. The results of the study, however, indicate that the likely answer is the first possibility. This is due to the fact that the average score for the **Avoidance** construct (2.0) indicates that the respondents typically "quite disagree" with the supposed negative consequences of their personally using the PWS. In any event, investigation of the effects of **Avoidance**, if any, is an issue which should be addressed in further research.

**Trialability**, **Image**, and **Visibility** also had relatively lower associations with usage than did the other PCI. These results, however, again may be an artifact of this survey in that it was conducted within a particular environment, organisations where PCI are relatively well distributed (77% of the respondents used the PWS). Common sense, and the results for these variables, indicate that these particular **PCI** are likely more affected by the environment of the adopter (including contextual and organisational variables) than perhaps are the perceptions of **Relative Advantage**, **Compatibility**, and so forth. Therefore, given that the survey was conducted within a given context, where the environmental variables should be fairly constant, it might be expected that **Trialability**, **Image**, and **Visibility** would explain a lesser proportion of the overall variance in the innovativeness measures than would the other PCI. This, in fact, is reflected in the scores for **Visibility**, which had the highest average score (5.8/7.0), and lowest standard deviation (1.01), of the all the perceived characteristics. Thus, most respondents in the survey likely had similar opportunities to see the machines. The potential effects of the given context on **Trialability** and **Visibility** are discussed below.

As discussed in Chapter 3, **Trialability** is expected to have an effect on Innovativeness by reducing the perceived risks of adopting the innovation. For most innovations, the risks associated with adoption are borne by the adopter, including making the necessary financial investment. With respect to the use of IT in organisations, however, it is the organisation, the supplier of the technology, which bears many of the traditional risks. This reduces the risks for the actual adopter of the PWS, which in turn could reduce the impact of **Trialability**. This argument holds primarily for the initial adoption (**adoptive innovativeness**) of the technology, in that the organisation typically supplies the hardware and software required to use a particular set of initial functions. On the other hand, one would expect that the lower the perceived trialability, the fewer the number of functions that would be adopted in addition to the initial set. This in fact appears to be the case, as is evidenced in the regression analyses of the various **PCI** on the different Innovativeness measures. **Trialability** was not significant when regressed on **Months** (measuring adoptive innovativeness) and was of no practical significance when regressed on **Hours** of use per week (implementation innovativeness). On the other hand it was significant with respect to the number of **Functions** used (use innovativeness). Thus, it might be concluded that **Trialability** in the context of this research reflects to some extent the degree of **access** that the respondent has to the various functions. Put another way, **Trialability** may reflect the degree to which the organisation makes **available** the software for the various functions. The organisation may supply the hardware and software for a narrow range of functions, but may not necessarily provide the software and training support for the full range of functions for which the hardware can be used.

The increasing diffusion of the PWS also likely means that its usage has become less **image enhancing** than it might have been when the PWS was first introduced. Status effects usually operate when only a small proportion of the population is able to use, or possess, the object in question. For example, during the 1988 Olympics in Calgary, certain lapel pins (given out by various organisations) became status symbols among pin collectors because of their relative scarcity. Collectors were willing to pay hundreds of dollars for pins whose original cost was the same as the more ubiquitous, and hence less "valuable", pins. Thus, the more diffused use of the PWS becomes, the less its adoption will enhance the image of the user. Similarly, **Image** likely operates through **appearances** of use, not necessarily actual use. Thus, if one is motivated primarily by image effects, then one probably is only a marginal user. As discussed in Chapter 2, just having a PWS on one's desk becomes sufficient. It might be expected, therefore, that those who adopted the PWS earlier, who use it more often, and for more things, would report lesser **image** effects than their counterparts. The regression analyses support this line of reasoning. **Image** had no effect on the number of **Functions** used, and was **negatively** associated with the number of **Months** since PWS usage was adopted, and with the number of **Hours** the PWS is used per week.

A question which was not addressed in the study was whether the image of those who do not use the PWS is lowered. The items in the survey reflected only the image enhancing effects of PWS usage, not the image decrementing effects of non-usage. This is a question which could be investigated in future research.

The theorised effects of the various PCI on **Innovativeness** are linked in that they all apparently contribute to the formation of an overall **Attitude** towards using the PWS. The **LISREL** analysis indicated that the fit of the model would not be enhanced by allowing the PCI to have a **direct** effect on **Innovativeness**, in addition to their effects through **Attitude**. This indicates that **Attitude** appears to act as an intervening variable (Lucas, 1978), and seems to capture all the effects of the PCI. This contradicts the findings of Davis (1985) and Davis et al. (1989). These two studies found that beliefs had a direct effect on use, in addition to their effect on **Attitude**, a finding which runs contrary to the **Theory of Reasoned Action** (Fishbein & Ajzen, 1975). Reasoned Action theory, which was supported by this research and by Christensen (1987), postulates that all effects are channeled through **Attitude**. As discussed in Chapter Five, it is believed that the existence of direct effects, as found by Davis and as indicated in part by the regression analysis in this study, may in fact be an artifact of the operationalisation of

**Attitude**. Examination was made of the items in the semantic differential scales used to operationalise **Attitude**, which revealed that many of the items in the scales reflect primarily the "advantageous" aspects of PWS usage. Thus, they do not contain all of the various components of **Attitude** as defined in the theory.

Finally, to address the last component of **Question 2**, the various perceptions apparently play a significant role with respect to use of the PWS, as was indicated above in the answer to **Question 1**. Those with the more positive perceptions adopted PWS usage earlier. Because this study was cross-sectional, it is not possible to determine whether the more positive perceptions are the result of actual usage, or whether the more positive perceptions existed before usage was adopted. Intuition, and the theoretical model developed in Chapter 3, indicate that there is very likely an interaction between usage and attitude. Those with more positive perceptions are likely to adopt earlier. Then, these positive perceptions are reinforced by actual usage, which would imply that the usage was itself positive. Those with more positive perceptions also tend to use the PWS for more hours per week, and for more functions.

### 6.3.3 Question Three

> What are the effects of others' expectations about one's using IT on one's decision to use, or not use, IT?

The effects of others' expectations were operationalised in two ways in this research, the **Subjective Norm** and the perceived **Voluntariness** of PWS usage. The latter construct captured the idea of compulsion (an enforceable expectation). The results show that both factors have a significant association with usage. First, the differences between **adopters** and **non-adopters** were significant on both dimensions, including all the referent level **SN**. Second, **LISREL** analysis showed that not only do these variables have a direct effect on **Innovativeness**, but that they also have an indirect effect through **Attitude**. In short, the potential user tends to meet others' expectations with respect to using the technology.

## 6.4 CONTRIBUTIONS TO THEORY

### 6.4.1 General

As has been discussed at some length, a primary goal of this research was to extend the use of **reasoned action** and **diffusion of innovations** (DOI) theory explicitly into the MIS domain. There has been a significant call for having more theory based research within MIS, and it has been argued that both DOI theory (Brancheau, 1987; Moore, 1987) and reasoned action theory (Davis, 1985; Christensen, 1987; Pavri, 1988) could help do that. Furthermore, although much of MIS practice is innovative, using constantly changing technologies which require changes in behaviour patterns, there is a paucity of MIS research based on either of these bodies of theory. Thus, a validated model would not not only increase the generalisability of these theories, but it would also help establish a theoretical basis for further MIS research. By eventually extending the proposed model beyond the study of the diffusion of PWS, it eventually could help researchers understand and investigate many other MIS implementations. Finally, the development and validation of several scales with which to measure the **PCI** are also considered to be contributions to theory and research. All these various potential contributions will be discussed below.

### 6.4.2 **Theory of Reasoned Action**

To achieve the goal of extending **reasoned action** and **DOI** theory into MIS, the two bodies of theory first were melded into one model of behaviour. To do this, Chapter Three illustrated the correspondence between the two theories, and then developed a theoretical model which used DOI theory to flesh out the **Attitude** component of the reasoned action model. The goal was to enhance the work using the **Theory of Reasoned Action** that had been carried out to date with respect to the lay person's use of information technology. As was discussed, although previous studies had used **reasoned action** theory in this area, none was identified which had used theory to define the particular belief structure which formed the basis of **Attitude**. Instead, the beliefs which had been used were very specific to the particular studies. As a result, a goal of this research was to develop a more theoretical basis for establishing the salient belief structure of **Attitude**.

It is believed that the goal of extending the theoretical base for studying **implementation** has been achieved. The research model as developed was strongly supported in that the various hypothesised components all played significant roles. Furthermore, the belief structure as defined by diffusion theory was shown to form the basis of **Attitude**. First, adopters and non-adopters differed on all dimensions. Second, all **perceived characteristics of innovating** (PCI) loaded significantly on **Attitude**, which in turn had a significant correlation with on **Innovativeness**. The theoretical implication of this finding is that diffusion theory can be used to extend the **reasoned action** model with respect to innovative behaviour by helping to define the salient belief structure.

This research also provides further support to the **Theory of Reasoned Action** in general. It showed that **Attitude** and **Subjective Norm** do have a direct effect on **Behaviour**, and that **SN** has an effect on **Attitude**. This contradicts the finding of Davis et al. (1989), who found that **SN** had no significant effect on **Behaviour**. To support their finding, they argued that the lack of significance was perhaps due to the "fairly personal and individual" nature of the application they were studying, which might be driven less than other behaviours by social influences. The current study, however, shows that **SN** does have an effect on the use of "personal" level applications, in line with the theory. Furthermore, while the link between **Attitude** and **SN** is not postulated in the general theory, this finding parallels those of other researchers, especially Christensen (1987) with respect to the use of IT.

An indirect contribution of this study to the **Theory of Reasoned Action** is in its method of operationalising **Attitude**. As with many previous studies, this study initially used a semantic differential scale to directly measure **Attitude** (referred to earlier as $\mathbf{A_m}$). Nevertheless, analysis of the results of regressing the PCI (the theorised contributors to **Attitude**) on $\mathbf{A_m}$ indicated that the scale appeared to be somewhat unidimensional because only **Relative Advantage** seemed to have any explanatory power. Furthermore, regression of all the various PCI directly on the **Innovativeness** measures resulted in higher $R^2$ and Beta weights than the regression of $\mathbf{A_m}$ on **Innovativeness**. This appears initially to indicate that **Attitude** does not capture all the effects of the various perceptions or beliefs about performing the behaviour, and thus its role is less than that postulated by the **Theory of Reasoned Action**, a conclusion also reached by other researchers (e.g. Davis, 1985).

When **Attitude** was cast as a latent variable, however, and synthesised from all the PCI in the **LISREL** analysis, all PCI were significant in its formation. (It should be noted that this is simply a second approach to capturing the construct, and that at the conceptual level **Attitude** as synthesised and **Attitude** as directly measured, $\mathbf{A_m}$, are the same.) Furthermore, **Attitude** itself had a higher association with the **Innovativeness** measures than $\mathbf{A_m}$ in the regression analysis. In addition, the **LISREL** analysis indicated that allowing any of the PCI to have a direct effect on **Innovativeness** beyond their impact through **Attitude** would not improve the fit of the model to the data. All these results support the **Theory of Reasoned Action**. They indicate that **Attitude** is formulated from a variety of beliefs, and that it does capture all the effects of these beliefs. Thus, future studies should carefully consider how **Attitude** is defined and operationalised. If its definition is based on the theory used in this research, then scales used to measure it directly must attempt to have a more holistic orientation, and not simply tap only a few of the underlying beliefs.

### 6.4.3 Diffusion of Innovations Theory

This research also continues the extension of the use of DOI theory into MIS, and adds to the understanding of basic DOI theory. First, as has been discussed above, the diffusion of PWS to date was shown to follow the initial stages of an S-shaped curve over time, in line with diffusion theory. Second, the research demonstrated that the **PCI** do provide a basis for understanding the diffusion of innovations. This replicates the findings of various other studies. As far as is known, however, this is the first study which explicitly considered and measured **all PCI**, as defined by Rogers (1983), simultaneously. As a result, the research showed that the individual PCI can have relatively different correlations with **Innovativeness**, depending on the dimension that is being considered. Furthermore, the instrument development process revealed that some of the traditional definitions of the PCI were weakly, or imprecisely, explicated. This may have caused some of the inconsistent findings in earlier studies. As a result, both **Compatibility** and **Observability** were redefined. In the first instance, the "degree to which the innovation meets one's needs" was dropped from Rogers' definition of **Compatibility**, as it tended to reflect the concept of **Relative Advantage**. Secondly, **Observability** was split into two constructs, **Result Demonstrability** and **Visibility**. These were shown to be different constructs in the scale development process, and both were significant in the study.

Perhaps, however, a more significant contribution of this research to DOI theory is the refinement of the concept of **Innovativeness**. As was developed in Chapter 3, **innovativeness** is most likely a multidimensional concept, although it traditionally has been defined in a unidimensional way. Its definition has tended to be in terms of **earliness** of adoption of an innovation (e.g. Rogers, 1962, 1983), which has been the focus of most DOI studies. The problems with this singular focus were discussed in Chapter 3, and it was argued that innovative behaviour can be manifested in ways other than just early adoption. As a result, three innovativeness dimensions (**adoptive, use,** and **implementation**) were defined, operationalised, and studied. **Adoptive Innovativeness** reflects the traditional definition of innovativeness. The results of this study show that the all three dimensions do share a significant amount of variance, and hence can be considered to reflect a deeper underlying concept, defined as **Innovativeness**. The convergence of these three dimensions thus helps to validate arguments presented earlier with respect to how the construct is conceptualised (e.g. Moore, 1987). On the other hand, the results also show that there are large enough differences among the dimensions that all three should be considered when studying diffusion, and that particular reference should be made as to which dimension of innovativeness one is considering.

Finally, this research differs from two other dissertations recently completed in MIS using DOI theory, and hence helps to broaden our knowledge base in this area. For example, while this study investigated the "internal causes" of innovativeness, Brancheau (1987) focussed more on "external causes", including such aspects as the potential adopter's communications channels, and the actions and context of the organisation in which the adopter is employed. Furthermore, the current study also differs from Alexander (1989), in that this one focussed on individual level adoption. Alexander investigated the diffusion of an organisational level innovation, **data base machines**. Thus, this study can be seen to be complementary to these two other projects, thereby broadening the base of DOI research in MIS.

### 6.4.4 Instrument Development

A further contribution of this study to research, and to theory in general, is with respect to instrument development. It helped to refine the actual instrument development process, and secondly, it actually developed several scales with which to measure the **perceived characteristics of innovating**. As was discussed in Chapter 3, considerable investigation of the literature and interviews with prominent researchers in the field had revealed that there existed very few validated, reliable instruments with which to measure the PCI. As a result a lengthy instrument development process was undertaken, which it is believed made several contributions.

First, the development process provided further evidence of construct validity for the two scales developed by Davis (1985) to measure **relative advantage** and **ease of use**. Both scales were re-examined during the instrument development process and shown to reflect these two dimensions. Six more scales were then developed to measure the following perceived characteristics: **Voluntariness**, **Image**, **Compatibility**, **Result Demonstrability**, **Visibility**, and **Trialability**. As was discussed earlier, this process also served to clarify and refine the definitions of the constructs. All of the final scales showed acceptable to very good reliabilities in the full survey.

Finally, the study also helped to further refine the actual instrument development process. A pool of items to measure the various constructs was first generated from previous questionnaires, literature reviews, and interviews. This has been a fairly standard procedure in instrument development. In this study, however, two additional steps were added. The first included the use of iterative rounds of "card (item) sorting" to separate the underlying constructs represented by the items in the pool. The second step was the elicitation of construct definitions from the participants. Thus, the instrument development process used here took the method used by Davis (1985), to identify **within construct** domain coverage, and extended it to actually identify and define the constructs. This helped to achieve the goal set by Cook and Campbell (1979) of having items developed to fit a construct, as opposed to the inferring of a construct based on the groupings of items in factor analysis.

The study also added to the methodology of assessing the results of the above process. For example, it employed **Cohen's Kappa** as a method of assessing the degree of the judges' agreement with respect to the placement of items within a particular construct. This is a statistic used to measure inter-rater agreement in other research areas, such as protocol analysis. The study also developed a second measure to assess the final scales, that of the degree of placement of items within their targeted categories. The combination of both measures serves to provide greater insight when assessing the validity of the final scales.

It is believed that this study provides a contribution to instrument development in two separate ways. The first is to the general process of instrument development, by defining the various steps and the measures with which to assess the outcomes. The second contribution is the actual product of the process, which were several reliable, validated instruments with which to measure the various **perceived characteristics of innovating**.

### 6.4.5 MIS Implementation Research

As was discussed in Chapter 2, there has been a long line of studies with respect to **implementation** of MIS. Integral to these studies has been the issue of how to measure the **success** of the implementation. There have been various approaches to this issue, but these can generally be categorised as focussing either on **use** of the system, or on the users' **perceived effectiveness** of the system. This study clearly shows the linkage between these two approaches, and builds upon the work of Davis (1985), Christensen (1987), and Pavri (1988). The **Theory of Reasoned Action** offers a way of integrating the various methods and approaches of earlier research with respect to **implementation**. It demonstrates the role of **Attitude** as an intervening variable, reflecting the model suggested by Lucas (1978), and shows how the various **factors** (Ginzberg, 1981) have their effect through **Attitude**.

It is also virtually a cliché within information systems research and management that **top management support** is vital in implementation efforts. Research into this factor dates back over twenty years (e.g. Rubenstein et al., 1967; Bean et al., 1975). The current project shows how this concept fits into the overall process, by highlighting the role of the **Subjective Norm**. This "internal" determinant of behaviour is formulated from the individual's perceptions of whether senior management, superiors, peers, and subordinates expect one to perform the behaviour. When the results for **adopters** and **non-adopters** were compared, the differences with respect to the various **SN** were greatest for **supervisors** and **senior management**. These two factors also had the highest loadings on the overall **Subjective Norm** in the **LISREL** analysis. This reflects the idea of management support as indicated above. The **SN** also demonstrates, however, the general effects of **norms** within the organisation on PWS usage. For example, in addition to the previous two referents, it is clear that the expectations of **peers** and **subordinates** also are highly correlated with eventual use of the system.

Finally, as far as is known, this is the only study that clearly investigated the role of **perceived Voluntariness** of systems usage with respect to implementation efforts. For example, Christensen (1987), who used **reasoned action** theory in his study, stated that:

> "we have no simple method of assuring that actual use .... as reported in the questionnaire forms in fact is discretionary use and not committed use. This is a measurement issue to be addressed in future research.... (p.213).

Davis, Bagozzi, and Warshaw (1989) also raise the issue, pointing out that "although it is generally thought that computer use by managers and professionals is mostly voluntary (DeSanctis, 1983; Robey, 1979; Swanson, 1987), in some cases people may use a system in order to comply with mandates from their superiors, rather than due to their own feelings and beliefs about using it". This research explicitly addresses these issues as it clearly identified and investigated the effects of **Voluntariness**. The research showed that this factor was significantly correlated with the usage of information technology. As has been discussed above, in the **LISREL** analysis it had both a direct effect on **Innovativeness**, and an indirect effect through **Attitude**. Of interest is the fact that even though usage may be compelled, the compulsion eventually seems to create more positive attitudes. One explanation for this is that **cognitive dissonance** factors may be at work (Festinger, 1957), whereby attitudes are brought into line with required behaviour. Another explanation is that actual use, even though compelled, reveals the various benefits, ease of use, and so forth of the system. This in turn could serve to create a more positive attitude towards using the system. Of course, the reverse effect could potentially occur, where usage has negative aspects, but the results suggest that this would occur for only a small proportion of users. The results for this characteristics illustrate the need to study the non-recursive effects between usage and attitude.

Finally, the fact that **Voluntariness** was not operationalised as a dichotomous variable is also considered to be a strength of this research. While usage may be mandated in many instances, with no discretion, common sense and experience indicate that there tend to be degrees of compulsion, or voluntariness, with respect to behaviour in organisations. The responses to the **Voluntariness** scale support this, in that the scores were fairly well distributed across the range and were not bipolar. Thus the assumptions that many studies make that they have chosen "voluntary users" may be unfounded, in that many users may **feel** compelled, to a degree, to use the system, even though it is not part of their job description.

In summary, the research model as developed provides a further step in the evolution of a model with which to investigate MIS **implementation**. It clearly indicates the role of external factors, and how they would operate either through the **Subjective Norm** or through **Attitude**. It also provides a more theoretical basis from which to define the determinants of **Attitude**. Finally, it also identifies a major influence on system usage which could mediate the effects of **Attitude** and the **Subjective Norm** on actual **behaviour**. This is the perceived **Voluntariness** of system use.

## 6.5 LIMITATIONS OF THE STUDY

### 6.5.1 General

As with any study, there are limitations to this research. Some of these must be accepted, as little can be done to overcome them. Others may be addressable in future research. These various limitations are discussed below.

### 6.5.2 Data Collection

This research used only one data collection method, a survey questionnaire. This may have created common method variance (Campbell & Fiske, 1959). In addition, respondents may knowingly have given untrue or misleading answers (Emory, 1980). Self-reporting, however, is the only method to gather the data on several of the variables, such as the subjects' **perceptions** and **attitudes** with respect to system usage. Nevertheless, use of elicitation techniques other than a survey questionnaire may be employable to capture this data. These techniques could include open-ended or structured **interviewing**.

While perceptions and attitudes generally require self-reporting, other variables in this study were behaviourally oriented, and thus there may be more direct methods available with which to capture the relevant data. For example, date of first adoption of the technology might be confirmed by documentary evidence, such as the date of issuing computer accounts or delivering microcomputers. As was discussed in Chapter 4, however, problems also exist with this form of data collection. For example, there is no assurance that the PWS was actually used when delivered or when the account was opened, or that the subject had not been using a PWS prior to personally acquiring a microcomputer or a computer account. Nevertheless, some combination of the data collection techniques might be beneficial in future studies.

### 6.5.3 Survey Scales

As was discussed in Chapter 5, many of the statistical methods employed in this study assumed certain properties of the data. These were explicitly addressed, including skewness, non-linearity, and heteroscedasticity. Most statistical techniques, however, also assume interval scales, whereas in a strict sense much of the data in this study were ordinal. However, given that there were several data points within the scales, and that the final values used were **averages** of several scores, which increases yet again the number of intervals on the scales, some of this problem is alleviated (Johnson & Creech, 1983). Nevertheless, while the approach used in this study is consistent with that of most studies using similar scales, the format of the scales should be recognised as a possible limitation to the results.

While most of the scales underwent a significant development process as outlined in Chapter 4, the scale for **Computer Avoidance** was not developed in as rigorous a fashion. The six items which compromise the scale did group together, and thus the scale had acceptable reliability as indicated in Chapter 4 (GLB=.75). Nevertheless, **Avoidance** as used in this study does tap such disparate dimensions as **health** and **work monitoring** concerns. For this reason, the specific results of this study with respect to **Avoidance** should be interpreted with caution, and further work is required to more fully develop these scales.

6.5.4 **Sample**

The test of satisfactoriness of a sample is the degree to which it represents the characteristics of the population it is used to represent. This study was concerned with **Innovativeness** at the individual adopter level, and thus could have been conducted within a single organisation, as has been done in other similar studies (e.g. Davis, 1985). Nevertheless, it attempted to provide a more representative sample of the overall population of potential and actual PWS users in organisations by including respondents from several organisations. As described in Chapter 5, seven different organisations from a variety of industries were included in the survey. Within these organisations, a variety of departments were selected for inclusion in the study. The aim was to achieve as wide as possible range of computer experience and exposure. The departments actually selected were based on the researcher's experience and intuition, as well as on the recommendations of company representatives. The inclusion of a range of companies and departments should serve both to increase the external validity of the study, as well as to dilute potential company and department related factors.

The survey had very good sample size for this type of study. Because there are no accurate descriptors available of the overall population, however, it is not known to what degree representativeness of the overall population was actually achieved. Nevertheless, the demographic statistics do indicate that the sample has some face validity in this regard. Furthermore, although participating organisations distributed questionnaires to all employees in targeted departments, it is not known how much response bias may have been introduced by the non-response of approximately 30% of the targeted population.

### 6.5.5 **Generalisability**

The nature of the sample also suggests that one should extrapolate only with caution from some of the specific results of the study. For example, as has been discussed, **Trialability**, **Image**, and **Visibility** had lower associations than the other PCI with system usage. It was suggested that this finding might be an artifact of the environment of the study, where **Trialability** and **Visibility** of the PWS may be fairly consistent within the organisations. This increasing diffusion of the PWS may also be lessening the influence of **Image**. Thus, one is cautioned about drawing inferences about the relative effects of the PCI in general. For many other innovations, especially in their early stages of diffusion, these factors should be quite important. In any event, the study was testing a particular body of theory, and in that the hypothesised effects were observed, the theory has not been refuted.

### 6.5.6 **Causality**

For reasons discussed earlier, much of the analysis in this study was described in causal terms. This was done to simplify discussion of the results. Nevertheless, it is recognised that in order to demonstrate that two variables are causally related, the following three criteria need to be satisfied (Babbie, 1983):

1. the cause precedes the effect in time;
2. there is an empirical correlation between them; and
3. the relationship is not found to be the result of the effects of some third variable on each of the two initially observed.

In this study only the second criterion is actually met. First, the study was cross-sectional, and thus the first criterion above cannot be satisfied. In order to meet this criterion, a longitudinal study is required. Secondly, in that the study was set in the field, with no control over extraneous variables, the third criterion above also cannot be met. Both of these facts argue for further research explicitly addressing these issues. First, a longitudinal study should address the time dimension, and some sort of experimental study, either field or laboratory, could be conducted to help rule out the effects of extraneous variables. For example, in the latter case, one could attempt to manipulate the perceived characteristics of innovating to study their effects on attitude.

Along with the need for longitudinal research to correctly infer causality, longitudinal research would also help investigate the effects of actual system **usage** on **Attitude**. Indications about their potential interrelationship include the fact that compulsory use had a positive effect on attitude, and those who had used the PWS longer had more positive perceptions. A fuller understanding of this relationship would certainly aid in the formulation of **implementation** strategies. In any event, this research was testing a given theory. Thus, there are prior indications that the variables and the relationships being tested were the appropriate ones. The theory was supported by the results of the research, which helps to ameliorate the situation with respect to the third criterion for demonstrating causality described above.

### 6.5.7 **Implementation Success**

This study has its roots in the MIS **implementation** research. As was discussed in Chapter 2, many such studies employ **use** of the system as the measure of success of the system's implementation. With respect to the PWS, a necessary condition for its successful implementation is use of the machine. This requires the user to demonstrate **Innovativeness**, which became the dependent variable in the study. No effort, however, was undertaken to determine whether the innovativeness (PWS usage) as reported was, in fact, **appropriate** use of the PWS. There is significant evidence in the literature, as was discussed in Chapter 2, that some use of the PWS might not be appropriate. Therefore, again, caution must be urged in assuming that **systems use** is equivalent to success. This study only provides insight into how innovativeness with respect to PWS usage is motivated.

## 6.6 MANAGERIAL IMPLICATIONS

### 6.6.1 General

There are many potential contributions of this study to managerial practice. In general it should help to identify those factors that influence successful implementation. For example, it can be seen that the **Subjective Norm**, **Attitude**, and **Voluntariness** all are associated with use of the PWS. Thus, **assuming** that a causal relationship exists as posited by the theory, those implementing systems can attempt to "manage" these influences. These factors can also be managed by considering their determinants. This approach is discussed below.

### 6.6.2 Attitude

This study shows that **Attitude** is significantly correlated with the use of IT, and that it should be carefully considered in any implementation project. This is not news. More important is the identification of those underlying factors which contribute to **Attitude**. By specifically addressing the "generic" **PCI** which contribute to **Attitude**, managers should be better able to take measures to influence the attitude of the target adopters. It shows, for example, that demonstration of the **relative advantage** of using IT, over previous methods of carrying out the task, is very important, as is making use of the IT **compatible** with workers' values and style. By taking measures to raise these perceptions, those in charge of implementing IT should have more success in creating positive attitudes towards IT usage. One practical example is having a co-worker provide testimonials of how the IT has helped him or her personally. This should not only enhance the perception of **Relative Advantage**, but it should increase **Compatibility**, as the target adopter may likely identify with the values and style of the individual giving the testimonial. Providing training courses, good user manuals, and pledges of post-adoption support should help increase the perceived **Ease of Use** of the technology. It can be seen that similar examples of actions specifically targeted at the remaining perceptions are also easy to derive.

The above measures should all help to increase the use of the technology. In some instances, however, the intent may be to **reduce** the amount of usage. In this latter case, an understanding of the perceptions which motivate adoption is also important if one wants to understand why the adopters are moving away from the "preferred" method of computing, such as using the IS department's resources.

An understanding of the various perceptions which motivate, or discourage, use of the technology can be employed in several ways. It can be used to influence the behaviour of the adopters in the direction desired, which may be either to use, or not to use, the system. As an example of how the theory can be used to explain certain observed phenomena, consider again the issue of information systems **implementation**. **User involvement** in systems development has long been considered a significant factor in implementation success (Ginzberg, 1981). The theory supported in this research helps explain why this may be so, in that involvement could affect the users' perceptions of relative advantage, ease of use, and so forth. Furthermore, being involved during the project means that users are familiar with the system, and thus adopting its use is a less radical change than if they had to adopt a finished system with which they had had no previous involvement. In short, their perceptions of **Compatibility** are greater as a result of their involvement. User involvement, therefore, could affect the users' attitudes towards the system. All of these potential relationships could be investigated in further research.

### 6.6.3 Subjective Norm

The influence of the **SN**, and its link to **senior management support** were described earlier. Thus, the results of this study reinforce, for those managing implementation, the importance of having perceivable support for their efforts from senior managers. Furthermore, the significant contribution of the perceived expectations of all the various referents to the overall **SN** also indicates that members of the organisation other than management can influence systems use. While the most significant referent group in this study were the respondents' immediate supervisors, the expectations of one's peers and subordinates also appeared to influence the adoption decision. These referents have not necessarily received attention or been cultivated in the past from those managing systems implementation. The influence of the norms in general also indicates that attempting to instill the appropriate organisational culture with respect to the personal computing is likely a very important undertaking. This "culture" may highlight the importance of good computing practices. As was discussed earlier, not all **Innovativeness** with respect to usage of the PWS may be appropriate. Thus, norms can help to generate the **appropriate** form of innovativeness with respect to use of the system, which is the ultimate test of implementation **success**.

### 6.6.4 Voluntariness

Finally, the results of the study suggest that if an organisation wishes to increase use of the technology, increasing the perceptions that it should be used as part of the job is one way to do so. While compulsion often is perceived as a negative way of influencing behaviour, the results suggest that perhaps the long term negative effects of at least "gentle persuasion" are not as significant as one might expect. This is an area which invites further research.

## 6.7 SUGGESTIONS FOR FURTHER RESEARCH

Throughout the discussion in the previous chapters, several statements have been made with respect to further research suggested by this study. One of the most basic motivations for such research is that the causal relationships among the variables, while inferred, have not been conclusively demonstrated. As was discussed, demonstration of causality would necessitate the use of longitudinal surveys and experiments. Both of these methodologies should contribute considerably to our understanding of the relationships among the variables, including the potentially non-recursive effects between innovativeness and attitude.

A second motivation for further research is that much of the variance in use of the PWS is still to be explained. There are very likely many other variables beyond those considered in this study which could have an effect on systems use. For example, while the participating organisations indicated that the respondents all had access to the technology, the **degree of access** which the respondents had was not investigated. Many of those with positive attitudes may have been limited in their use of the technology because of relatively restricted access to it. The degree of access may be yet another significant variable which intervenes between **Attitude**, **Subjective Norm**, and **Innovativeness**.

This study specifically investigated the relationship between **Innovativeness** and one's **Attitude** and one's **Subjective Norm**. The initial theoretical model used for this study (Figure 3-4), however, also suggested several factors which are hypothesised to impact in turn on **Subjective Norm** and **Attitude**. These are certainly areas for further investigation. As an example, there are many experiential variables which might contribute systematically to the formation of one's perceptions. These would include experience with other high technology products (e.g Dickerson & Gentry, 1983), education with respect to use of computers (e.g. Davis, 1985; Davis et al., 1989), and experience in dealing with information systems personnel (Moore, 1987). In addition, investigation of a variety of contextual and organisational level variables should be fruitful in furthering our understanding of **Innovativeness**. Examples include the interconnectedness of adopters with respect to communication channels, and the formal actions of organisations to expand and control the innovation process (Brancheau, 1987). Furthermore, there may be specific personal characteristics of adopters which systematically affect whether information technology is used or not used. As discussed in Chapter 3, research has shown that innovativeness is typically relative to the particular domain of the innovation. Insight into the management of the diffusion of information technology in particular, and perhaps "high technology" in general, might be gained by investigating whether there are any systematic differences between adopters and non-adopters of these particular innovations. In short, much still needs to be done to move the research further out the hypothesised causal chain. This research would investigate the determinants of both the **Subjective Norm** and **Attitude**.

A few quite specific questions were also raised with respect to some of the results of this study. For example, the lack of influence of the **Computer Avoidance** factor on systems usage is quite curious, especially given its increasing prominence in the both the popular and academic literature. Thus, research could be undertaken investigating whether respondents are discounting the potentially negative effects of computer usage, whether they are essentially unaware of these effects, or whether for some reason this result is an artifact of this study. Similarly, while many writers have suggested that use of the technology is potentially **Image** enhancing, the results of this study do not support this. Part of the problem may be in how the construct was oriented, in that it measured the image **enhancing** effects of actual use. It did not capture the image **decrementing** effects of non-use of the technology. This is a further empirical question.

## 6.8 CONCLUSIONS

In summary, the stage of this research in terms of the development of a theory of innovativeness with respect to systems usage in general, and to PWS implementation in particular, is a relatively early one. This research was oriented towards "variable identification" and the "determination of the relationships among the variables" (Gordon, MacEachron, and Fisher, 1974, p.193). It identified particular variables which had significant covariance with innovativeness in use of the PWS. Previous **diffusion** and **implementation** research provided a guide, but not all the answers for understanding the diffusion of PWS. By using the general perceptions of innovations identified in earlier research, and by employing them to tailor the **Theory of Reasoned Action** towards **Innovative** behaviour, a basis for investigating the use of PWS was developed.

The contribution of this study to MIS research in general is, hopefully, a better understanding of the variables which can impact on the **implementation of information systems**, on the **diffusion of innovations** in the MIS domain, and of how they are related. Thus, answers to many of the questions implicit in the hypotheses developed earlier should lead to a better understanding, and hence, hopefully, to more effective management of the diffusion of PWS in particular, and of the implementation of systems in general. Recalling Mao, it should help bring together the various interest groups with their heating systems, eggs, stones, and chickens.

## BIBLIOGRAPHY


Ackoff, Russel L. "Management Misinformation Systems", Management Science, Vol. 14, No 4, December 1967, pp. B147-B156.

Aiken, M.S., Bacharach, S.B., and French, J.L. "Organizational Structure, Work Processes, and Proposal Making in Administrative Bureaucracies", Academy of Management Journal, Vol. 23, 1980, pp.631-652.

Ajzen, Icek, and Fishbein, Martin. "Attitude-Behavior Relations: A Theoretical Analysis and Review of Empirical Research", Psychological Bulletin, 1977, pp. 888-918.

Ajzen, Icek, and Fishbein, Martin. Understanding Attitudes and Predicting Behavior, Prentice-Hall Inc., Englewood Cliffs, NJ, 1980.

Alexander, Mary. "The Adoption and Implementation of Computer Technology in Organizations: The Example of Database Machines", unpublished Doctoral Dissertation, Indiana University, 1989.

Alloway, Robert M., and Quillard, Judith A. "User Manager's Systems Needs", MIS Quarterly, June 1983, pp. 27-41.

Amabile, Teresa M. "A Model of Creativity and Innovation in Organizations", Research in Organizational Behavior, Vol. 10, JAI Press Inc., 1988, pp. 123-167.

Argyris, Chris. "Resistance to Rational Management Systems", Innovation, No. 10, 1970, pp. 28-35.

Babbie, Earl. The Practice of Social Research, Third Edition, Wadsworth Publishing Co., Belmont, Ca., 1983.

Bagozzzi, Richard P. "Evaluating Structural Equation Models with Unobservable Variables and Measurement Error: A Comment", Journal of Marketing Research, Vol. 18, August 1981, pp. 375-381.

Baker, Norman N., and Freeland, James R. "Structuring Information Flow to Enhance Innovation", Management Science, Vol. 19, No. 1, September 1972, pp. 105-116.

Baldridge, J. Victor, and Burnham, Robert A. "Organizational Innovation: Individual, Organizational and Environmental Impacts", Administrative Science Quarterly, Vol. 20, June 1975, pp.165-176.

Barcomb, David. Office Automation: A Survey of Tools and Technology. Digital Press, Bedford, Mass, 1981.

Barki, Henri, and Huff, Sid L. "Measuring Decision Support System Success", Proceedings 1984, of the Twelfth Annual Conference of the Administrative Sciences Association of Canada, Guelph, Ont., May 28-29, 1984, pp. 1-10.

Baroudi, Jack J., Olson, Margrethe H., and Ives, Blake. "An Empirical Study of the Impact of User Involvement on System Usage and Information Satisfaction", Communications of the ACM, Vol. 29, No. 3, March 1986, pp. 232-238.

Bean, A.S., Neal, R.D., Radnor, M., and Tansik, D.A. "Structural and Behavioral Correlates of Implementation in U.S. Business Organizations", in R.L. Schultz and D.P. Slevin, eds., Implementing Operations Research/ Management Science, American Elsevier, New York, N.Y., 1975, pp. 77-132.

Benson, David H. "A Field Study of End User Computing: Findings and Issues", MIS Quarterly, December 1983, pp. 35-45.

Berlo, David K. The Process of Communication: An Introduction to Theory and Practice; Holt, Rinehart and Winston, New York, 1960.

Blackwell, Gerry. "Automation Blues", Canadian Business, August 1988, pp. 73-80.

Bigoness, William J., and Perreault, William D. "A Conceptual Paradigm and Approach for the Study of Innovators", Academy of Management Journal, Vol. 24, No.1, March 1981, pp. 68-82.

Bolton, William T. "The Perception and Potential Adoption of Channel 2000: Implications for Diffusion Theory and Videotext Technology", Unpublished Doctoral Dissertation, Ohio State University, 1981.

Bowen, William. "The Puny Payoff From Office Computers", Fortune, May 26, 1986, pp. 20-24.

Bracy, Marilyn. "Info Center Success 'Centers' around the DP Manager", Data Management, February 1984, pp. 34-45.

Brancheau, James C. "The Diffusion of Information Technology: Testing and Extending Innovation Diffusion Theory in the Context of End-User Computing", unpublished Doctoral Dissertation, University of Minnesota, 1987.

Brod, Craig. "Managing Technostress: Optimizing the Use of Computer Technology", Personnel Journal, October 1982, pp. 753-757.

Brown, Jim. "Office Productivity: A People Challenge not a Technology Solution", Business Quarterly, Vol. 49, No. 2, Summer 84, pp. 55-58.

Brown, Lawrence A. Innovation Diffusion - A New Perspective. Methuen & Co., Ltd, New York, 1981.

Campbell, D.T., and Fiske, D.W. "Convergent and Discriminant Validation by the Multitrait-Multimethod Matrix", Psychological Bulletin, Vol. 56, 1959, pp.81-105.

Canning, Robert G. "Making Office Systems Pay Off", EDP ANALYZER, Vol. 23, No. 2, February 1985a.

Canning, Robert G. "Overcoming Employee Concerns", EDP ANALYZER, Vol. 23, No. 3, March 1985b.

Canning, Robert G. "Expanding End User Support", EDP ANALYZER, Vol. 23, No. 6, June 1985c.

Carey, Elizabeth M., and Young, Philip K.Y. "Incorporating the PC into the Workplace", Journal of Systems Management, April 1985, pp.34-37.

Christensen, Gunnar E. "Successful Implementation of Decision Support Systems: An Empirical Investigation of Usage Intentions and Behavior", unpublished Doctoral Dissertation, University of California at Los Angeles, 1987.

Chrysler, Earl. "Managing the Micro Invasion", Journal of Systems Management, January 1985, pp.34-36.

Cirillo, David J. "Helping Middle Managers Manage Office Technology", Personnel, November-December 1984, pp. 6-12.

Cohen, J.A. "A Coefficient of Agreement for Nominal Scales", Educational and Psychological Measurement, Vol. 20, 1960, pp.37-46.

Coleman, James, Katz, Elihu, and Menzel, Herbert. Medical Innovation: A Diffusion Study, Bobbs-Merrill, New York, 1966.

Collins, Frank, and Moores, Tom. "Microprocessors in the Office: A Study of Resistance to Change", Journal of Systems Management, November 1983, pp. 17-21.

Connell, John. "The Office of the Future", Journal of Systems Management, February 6, 1979, p. 6.

Cook, T.D., and Campbell, D.T. Quasi-Experimentation: Design and Analysis Issues for Field Settings, Houghton Mifflin, Boston, 1979.

Cronbach, Lee J. Essentials of Psychological Testing, Third Edition, Harper and Row, New York, 1970.

Curley, Kathleen F., and Pyburn, Philip J. "Intellectual Technologies: The Key to Improving White Collar Productivity", Sloan Management Review, Vol. 24, No. 1, Fall 1982, pp. 31-39.

Curley, Kathleen F., and Gremillion, Lee L. "The Role of the Champion in DSS Implementation", Information and Management, Vol. 6, 1983, pp. 203-209.

Cyert, Richard M., and March, James G. A Behavioral Theory of the Firm, Prentice-Hall, Englewood Cliffs, NJ, 1963.

Daft, R.L. "A Dual Core Model of Organizational Innovation", Academy of Management Journal, Vol. 21, 1978, pp.193-210.

Davies, Stephen. The Diffusion of Process Innovations, Cambridge University Press, Cambridge U.K., 1979.

Davis, David. "SMR Forum: Computers and Top Management", Sloan Management Review, Spring 1984, pp. 63-67.

Davis, Fred D. "A Technology Acceptance Model for Empirically Testing New End User Information Systems: Theory and Results", Unpublished Doctoral Dissertation, Massachusetts Institute of Technology, 1985.

Davis, Fred D., Bagozzi, Richard P., and Warshaw, Paul R. "User Acceptance of Computer Technology, Management Science, 1989, in press.

Davis, Gordon B. "Caution: User Developed Decision Support Systems Can Be Dangerous to Your Organization", MISRC-WP-82-04, University of Minnesota, October, 1981.

Davis, Gordon B., and Olson, Margrethe H. Management Information Systems: Conceptual Foundations, Structure and Development, Second Edition, McGraw-Hill, New York, 1985.

Dearden, John. "SMR Forum: Will the Computer Change the Job of Top Management", Sloan Management Review, Fall 1983, pp. 57-60.

Dearden, John. "The Withering Away of the IS Organization", Sloan Management Review, Summer 1987, pp. 87-91.

Debow, Yvette. "Just How Dangerous are VDT's", Management Review, August 1988, pp. 44-46.

DeSanctis, G. "Expectancy Theory as an Explanation of Voluntary Use of a Decision Support System", Psychological Reports, Vol. 52, 1983, pp. 247-260.

Dickerson, Mary Dee, and Gentry, James W. "Characteristics of Adopters and Non-Adopters of Home Computers", Journal of Consumer Research, Vol. 10, September 1983, pp.225-234.

Dickie, R. James. "Implementation Demands a Personal Approach", Data Management, February 1984, pp. 28-29.

Dickson, Gary W., Leitheiser, Robert C., Wetherbe, James C., and Nethis, Mal. "Key Information Systems Issues for the '80's", MIS Quarterly, Vol. 8, No. 3, September 1984, pp. 135-160.

Dillman, Don A. Mail and Telephone Surveys: The Total Design Method, Wiley and Sons, New York, 1978.

Dillon, William and Goldstein, Matthew. Multivariate Analysis, Methods and Applications, Wiley and Sons, New York, NY, 1984.

Doll, William J. "Avenues for Top Management Involvement in Successful MIS development", MIS Quarterly, Vol. 9, No. 3, September 1983, pp. 33-46.

Downs, George W. Jr., and Mohr, Lawrence B. "Conceptual Issues in the Study of Innovation", Adminstrative Science Quarterly, Vol. 21, December 1976, pp. 700-714.

Dubin, Robert. Theory Building, The Free Press, New York, 1969.

Edwards, Jeri Lynn. "Information Systems Deliver", Computerworld, Vol. 18, No. 7A, July 23, 1984, pp. 57-59.

Ein-Dor, Phillip, Segev, Eli, and Steinfeld, Abraham. "Use of Information Systems: An Empirical Study", in Proceedings, Second Annual International Conference on Information Systems, December 1981, pp. 215-228.

Ein-Dor, Phillip, and Segev, Eli. A Paradigm for Management Information Systems, Praeger, New York, NY, 1981.

Emory, C. William. Business Research Methods, Richard D. Irwin Inc., Homewood, Illinois, 1980.

Ettlie, John E., Bridges, William P., and O'Keefe, Robert D. "Organizational Strategy and Structural Differences for Radical Versus Incremental Innovation", Management Science, Vol. 30, No. 6, June 1984, pp.682-695.

Fearon, Vincent W. "The 'No Surprises' Approach to OA", Office Equipment and Methods, October 1984, pp. 47-51.

Festinger, L. A Theory of Cognitive Dissonance, Stanford University Press, Stanford, CA., 1957.

Fishbein, Martin, and Ajzen, Icek. Belief, Attitude, Intention, and Behavior: An Introduction to Theory and Research, Addison-Wesley, Reading, 1975.

Fishbein, Martin. "Extending the Extended Model: Some Comments", in Beverlee B. Anderson, ed., Advances in Consumer Research, Vol. 3., The Association for Consumer Research, Cincinnati, 1976, pp. 491-497.

Flavell, R.B. "Management and the Micro", Omega, Vol. 12, No. 5, 1984, pp. 419-284.

Fornell, Claes, and Larcker, David F. "Evaluating Structural Equation Models with Unobservable Variables and Measurement Error", Journal of Marketing Research, Vol. 18, February 1981, pp. 39-50.

Fornell, Claes. "Issues in the Application of Covariance Structure Analysis: A Comment", Journal of Consumer Research, Vol. 9, March 1983, pp. 443-448.

Foster, Lawrence W., and Flynn, David M. "Management Information Technology: Its Effects on Form and Function", MIS Quarterly, Vol. 8, No. 4, December 1984, pp. 229-236.

Freedman, David. H. "Team Up to Plan Office Automation", Infosystems, February 1984, pp. 82-84.

Garrity, J.T. "Top Management and Computer Profits", Harvard Business Review, Vol. 41, July-August 1963, pp. 6-12, 172-174.

Gatignon, Hubert, and Robertson, Thomas S. "A Propositional Inventory for New Diffusion Research", Journal of Consumer Research, Vol. 11, March 1985, pp.849-867.

Gerrity, Thomas P., and Rockart, John F. "Managing End User Computing in the Information Era", CISR WP #120, Center for Information Systems Research, Massachusetts Institute of Technology, October 1982.

Gilmore, Ron V. "Why executives are sour on computers", The Globe and Mail, Monday, June 13, 1988, p. A7.

Ginzberg, Michael J. "Key Recurrent Issues in the MIS Implementation Process", MIS Quarterly, June 1981, pp. 47-59.

Ginzberg, Michael J. "Early Diagnosis of MIS Implementation Failure": Promising Results and Unanswered Questions", Management Science, Vol. 27, 1981b, pp. 459-478.

Gordon, G., MacEachron, A.E., and Fisher, G.L. "A Contingency Model for the Design of Problem-Solving Research Problems: A Perspective on Diffusion Research", Milbank Memorial Fund Quarterly/ Health and Society, Vol. 52, Spring 1974, pp. 185-220.

Goren, Gabriel. "An Exploratory Study of Organizational Procurement Policies for Personal Computers", Proceedings of the 5th International Conference on Information Systems, November 28-30, 1984, pp. 63-71.

Greenwood, Frank, and Greenwood, Mary M. "Principles of Office Automation", Journal of Systems Management, February 1984, pp. 13-17.

Gremillion, Lee L., and Pyburn, Philip. "Breaking the Systems Development Bottleneck", Harvard Business Review, March-April 1983, pp. 130-137.

Guimaraes, Tor. "The Benefits and Problems of User Computing", Journal of Information Systems Management, Fall 1984, pp. 3-9.

Guthrie, A.A. "Attitudes of User-Managers Towards MIS", Management Informatics, Vol. 3, No. 5, October 1974, pp. 230-239.

Guttman, L. "A Basis for Analyzing Test-Retest Reliability", Psychometrika, Vol. 10, No. 4, December 1945, pp.255-282.

Hayduk, Leslie A. Structural Equation Modelling with LISREL: Essentials and Advances, John Hopkins University Press, Baltimore, Md., 1987.

Head, Robert V. "Information Resource Center: A New Force in End-User Computing", Journal of Systems Management, February 1985, pp. 24-29.

Healey, Martin. "What is a Workstation", Datamation, January 15, 1987, pp. 55- 57.

Henderson, John C., and Treacy, Michael E. "Managing End User Computing for Competitive Advantage", Sloan Management Review, Winter 1986, pp. 3-14.

Henderson, John C., and Treacy, Michael E. "Managing End User Computing", CISR WP # 114, Center for Information Systems Research, Massachusetts Institute of Technology, May 1984.

Hibbard, Robin. "Our Love/Hate Relationship with Technology", CA Magazine, August 1988, pp. 40-51.

Hickson, D.J., Hinings, C.R., Lee, C.A., Schneck, R.E., and Pennings, J.M. "A Strategic Contingencies' Theory of Intraorganizational Power", Administrative Science Quarterly, Vol. 16, No. 2, June 1971, pp. 216-229.

Higgins, Christopher A., Irving, Richard H., and Rinaldi, Saverio M. "Small Business and Office Automation", Canadian Journal Of Administrative Science, Vol. 2, No. 2, December 1985, pp. 375-381.

Hinings, C.R., Hickson, D.J., Pennings, J.M., and Schneck, R.E. "Structural Conditions of Intraorganizational Power", Administrative Science Quarterly, Vol. 19, No. 1, March 1974, pp. 22-44.

Hirschman, Elizabeth C. "Innovativeness, Novelty Seeking, and Consumer Creativity", Journal of Consumer Research, Vol. 7, December 1980, pp. 283-295.

Hoffman, Gerald M. "Departmental Computing and the Organization", in Gerald M. Hoffman, ed., The AMA Report on End-User and Departmental Computing, 1988, pp. 5-9.

Holloway, Robert E. "Perceptions of an Innovation: Syracuse University Project Advance", Unpublished Doctoral Dissertation, Syracuse University, 1977.

Huff, Sid L., and Munro, Malcolm C. "Information Technology Assessment and Adoption: A Field Study", MIS Quarterly, Vol.9, No. 4, December 1985, pp. 327-340.

Hughes, Marie Adele, Price, R. Leon, and Marrs, Daniel W. "Linking Theory Construction and Theory Testing: Models with Multiple Indicators of Latent Variables", Academy of Management Review, Vol. 11, No. 1, 1986, pp. 128-144.

Hurt, H. Thomas, Joseph, Katherine, and Cook, Chester D. "Scales for the Measurement of Innovativeness", Human Communication Research, Vol. 4, No.1, Fall 1977, pp. 58-65.

Hurt, H. Thomas, and Hubbard, Rob. "The Systematic Measurement of the Perceived Characteristics of Information Technologies 1: Microcomputers as Innovations", presented at the ICA Annual Conference, Montreal, May 1987.

Hurt, H. Thomas. Personal Communication, 1987.

Igersheim, R.H. "Managerial Response to an Information System", in Winkler, S., (ed.) Proceedings of the AFIPS National Computing Conference, Vol. 45, New York, N.Y., 1976, pp. 877-882.

Ives, Blake, Olson, Margrethe H., and Baroudi, Jack J. "The Measurement of User Information Satisfaction", Communications of the ACM, Vol. 26, No. 10, October 1983, pp. 785-793.

Jarvenpaa, Sirkka. "The Effect of Task and Graphical Format Congruence on Information Processing Strategies and Decision Making", Unpublished Working Paper, University of Texas (Austin), February, 1987.

Johnson, David R., and Creech, James C. "Ordinal Measures in Multiple Indicator Models: A Simulation of Categorization Errors", American Sociological Review, Vol. 48, 1983, pp. 398-407.

Joreskog, Karl G. "A General Method for Estimating a Linear Structural Equation System", in A.S. Goldberger and O.D. Duncan, eds., Structural Equation Models in the Social Sciences, Seminar Press, New York, 1973, pp. 85-112.

Joreskog, Karl G., and Sorbom, Dag. LISREL VI: Analysis of Structural Relationships by Maximum Likelihood, Instrumental Variables, and Least Squares Methods, Scientific Software Inc, Mooresville, IN, 1984.

Kahn, Beverly R., and Garceau, Linda R. "Controlling the Microcomputer Environment", Journal of Systems Management, May 1984, pp.14-20.

Kahneman, Daniel, and Tversky, Amos. "Choices, Values and Frames", American Psychologist, Vol. 39, No. 4, April 1984, pp. 341-350.

Kanter, Rosabeth M. "Power Failure in Management Circles", Harvard Business Review, July-August 1979, pp. 65-75.

Keen, Peter G.W. "MIS Research: Reference Disciplines and a Cumulative Tradition", in Ephraim R. McLean, Ed., Proceedings of the First International Conference on Information Systems, Philadelphia, Pa., Dec. 8-10, 1980, pp. 9-18.

Keen, Peter G.W. "Information Systems and Organizational Change", Communications of the ACM, Vol. 24, No. 1, January 1981, pp. 24-33.

Keen, Peter G.W., and Woodman, Lynda A. "What To Do With All Those Micros", Harvard Business Review, Vol. 62, No. 5, September-October 1985, pp. 142-150.

Kerlinger, Fred N. Foundations of Behavioral Research, Third Edition, Holt, Rinehart and Winston, New York, 1978.

Kimberly, John R., and Evanisko, Michael J. "Organizational Innovation: The Influence of Individual, Organizational, and Contextual Factors on Hospital Adoption of Technological and Administrative Innovations", Academy of Management Journal, Vol. 24, No. 4, pp.689-713.

Kimberly, John R. "Managerial Innovation", in Nystrom, Paul C., and Starbuck, William H., eds., Handbook of Organizational Design, Oxford University Press, New York, 1981, pp.84-104.

Kirkpatrick, David. "How Safe are Video Terminals?", Fortune, August 29 1988, pp. 66-69.

Klein, Donald. "Some Notes on the Dynamics of Resistance to Change: The Defender Role", in Warren G Bennis, Kenneth D. Benne, Robert Chin, and Kenneth E Corey, eds., The Planning of Change. Holt, Rinehart, and Winston, New York, 1976, pp. 117-124.

Klonglan, Gerald, and Coward, Walter Jr. "The Concept of Symbolic Adoption: A Suggested Interpretation", Rural Sociology, Vol. 35, March 1970, pp.77-83.

Knight, K. "A Descriptive Model of the Intra-Firm Innovation Process", Journal of Business, Vol. 40, October 1967, pp.478-496.

Kraemer, Kenneth. Personal Communication, 1986.

Laberis, Bill. "Managers Grappling With Power Base Erosion", Computerworld, November 7, 1983, p. 18.

Larker, D.F. and Lessig, V.P. "Perceived Usefulness of Information: A Psychometric Examination", Decision Sciences, Vol. 11, No. 1, 1980, pp. 121-134.

Lee, Denis M. "Usage Patterns and Sources of Assistance for Personal Computer Users", MIS Quarterly, December 1986, pp. 313-325.

Lee, R. "Social Attitudes and the Computer Revolution", Public Opinion Quarterly, Vol. 34, 1970, pp. 53-59.

Leonard-Barton, Dorothy. "Experts as Negative Opinion Leaders in the Diffusion of a Technological Innovation", Journal of Consumer Research, Vol. 11, March 1985, pp. 914-926.

Lewin, Kurt. Field Theory in Social Science, Harper & Row, New York, 1951.

Licker, Paul S., Newsted, Peter R., and Sheehan, Bernard S. "A Value-Added Model of Electronic Mail Utilization", Working Paper #07-86, Faculty of Management, University of Calgary, September 1986.

Lieberman et al. Office Automation, Wiley, NY, 1982.

Lucas, Henry C. "Empirical Evidence for a Descriptive Model of Implementation", MIS Quarterly, Vol. 2, No. 2, June 1978, pp. 27-42.

Lutz, Richard J. "Changing Brand Attitudes Through Modification of Cognitive Structure", Journal of Consumer Research, Vol. 1, March 1975, pp. 49-59.

Mack, Robert L., Lewis, Clayton H., and Carroll, John. M. Learning to Use Word Processors: Problems and Prospects", ACM Transactions on Office Information Systems, Vol. 1, No. 3, July 1983, pp. 254-271.

Maish, Alexander M. "A User's Behavior Towards His MIS", MIS Quarterly, Vol. 3, No. 1, March 1979, pp. 39-52.

March, James G., and Simon, Herbert A. Organizations, Wiley, 1958.

Matherly, Timothy A., and Matherly, Donna M. "Employee Participation Eases the Transition to Office Automation", Journal of Systems Management, February 1985, pp.17-23.

McCartney, Laton. "The New Info Centers", Datamation, July 1983, pp. 30-46.

McClelland, David C. Power: The Inner Experience, Irvington Publishers, New York, 1975.

McFarlan, F. Warren, McKenney, James L., and Pyburn, Philip. "The Information Archipelago - Plotting a Course", Harvard Business Review, January/February 1983, pp. 145-156.

McKenney, James L., and McFarlan, F. Warren. "The Information Archipelago-Maps and Bridges", Harvard Business Review, September-October, 1982, pp.109-119.

Mechanic, D. "Sources of Power of Lower Participants in Complex Organisations", Administrative Science Quarterly, Vol. 7, pp. 349-364.

Meyer, N. Dean. "The Office Automation Cookbook: Management Strategies for Getting Office Automation Moving", Sloan Management Review, Vol. 24, No. 2, Winter 1983, pp. 51-60.

Midgley, David F. "A Simple Mathematical Theory of Innovative Behaviour", Journal of Consumer Research, Vol. 3, June 1976, pp.31-41.

Midgley, David F., and Dowling, Grahame R. "Innovativeness: The Concept and Its Measurement", Journal of Consumer Research, Vol. 4, March 1978, pp.229-242.

Mintzberg, Henry. "The Manager's Job: Folklore and Fact", Harvard Business Review, Vol. 53, No. 4, July-August 1975, pp. 49-61.

Moore, Gary C. "Reconciling the Differences in Users' Acceptance of Personal Work Stations through a Diffusion of Innovations Framework", presented at the Seventh Annual International Conference on Information Systems Doctoral Consortium, San Diego, Ca., Dec 14-16 1986.

Moore, Gary C. "End User Computing and Office Automation: A Diffusion of Innovations Perspective", Infor, Vol. 25, No.3, 1987, pp. 214-235.

Morrison, Perry R. "A Survey of Attitudes toward Computers", Communications of the ACM, Vol. 26, No. 12, December 1983, pp. 1051-1057.

Munro, Malcolm C., Huff, Sid L., and Moore Gary C. "Expansion and Control of End User Computing", Journal of Management Information Systems, December 1987, (forthcoming).

Nunnally, Jum C. Psychometric Theory, McGraw Hill, New York, 1967.

--------------- Psychometric Theory, McGraw Hill, New York, 1978.

Nutt, P.C. "Tactics of Implementation", Academy of Management Journal, Vol. 29, No. 2, 1986, pp. 230-261.

Ostlund, Lyman E. "Product Perceptions and Predispositional Factors as Determinants of Innovative Behavior", Unpublished Doctoral Dissertation, Harvard University, 1969.

Ostlund, Lyman E. "Perceived Innovation Attributes as Predictors of Innovativeness", Journal of Consumer Research, Vol. 1, September 1974, pp. 23-29.

"Overcoming Resistance", Infosystems, February 1984, p. 82.

Pavri, Francis. "An Empirical Study of the Factors Contributing to Micrcomputer Usage", unpublished Doctoral Dissertation, University of Western Ontario, 1987.

Perry, James L., and Kraemer, Kenneth L. Technological Innovation in American Local Governments/ The Case of Computing, Pergamon Press Inc., New York, 1979.

Perry, William. "Getting Micros On Track", Computerworld, June 24,

Pettigrew, Andrew M. The Politics of Organizational Decision Making, Willmer Brothers Ltd, Birkenhead, England, 1973.

Petty, Richard E., Cacioppo, John T., and Schumann, David. "Central and Peripheral Routes to Advertising Effectiveness: The Moderating Role of Involvement", Journal of Consumer Research, Vol. 10, September 1983, pp. 135-146.

Petty, Richard E., and Cacioppo, John T. Attitudes and Persuasion: Classic and Contemporary Approaches. Wm. C. Brown Company Publishers, Dubuque, Iowa, 1981.

Pfeffer, Jeffrey. Organizational Design, Arlington Heights, IL, AHM Publishing, 1978.

Pindyck, Robert S., and Rubinfeld, Daniel L. Econometric Models and Economic Forecasts, McGraw Hill, New York, 1981.

Prouty, Jack. "Take Charge of Micros With A Pro-active Approach", Data Management, August 1984, pp. 24-31.

Pyburn, Philip J. "Managing Personal Computer Use: The Role of Corporate Management Information Systems", Journal of Management Information Systems, Vol. 3, No.3, Winter 1986-87, pp.49-70.

Quible, Zane, and Hammer, Jane N. "Office Automation's Impact on Personnel", Personnel Administrator, September 1984, pp. 25-32.

Raho, Louis E., and Belohlav, James A. "Integrating Personal Computers into Organizations: Problems, Benefits, and Training Issues", Journal of Systems Management, March 1985, pp. 16-19.

Rubenstein, A.H., Radnor, M., Baker, N.R., Heiman, D.R., and McColly, J.B. "Some Organizational Factors Relating to the Effectiveness of Management Science Groups in Industry", Management Science, Vol. 13, No. 8, April 1967, pp. B508-B518.

Rice, Ron. Personal Communication, 1987.

Robertson, Thomas. Innovative Behavior and Communication, Holt, Rinehart, and Winston, New York, 1971.

Robertson, Thomas S., and Wind, Yoram. "Organizational Psychographics and Innovativeness", Journal of Consumer Research, Vol. 7, June 1980, pp.24-31.

Robey, Daniel. "User Attitudes and Management Information Systems Use", Academy of Management Journal, Vol. 22, No. 3, 1979, pp. 527-538.

Rockart, John F., and Flannery, Lauren S. "The Management of End User Computing", Communications of the ACM, Vol. 26, No. 10, October 1983, pp. 776-784.

Rogers, Everett M. Diffusion of Innovations, First Edition, Free Press of Glencoe, New York, 1962.

Rogers, Everett M. Diffusion of Innovations, Third Edition, The Free Press, New York, 1983.

Rogers, Everett M. "Interdependencies Among Users of a New Communication Technology", presented at the Association for Consumer Research Conference, Las Vegas, October 18-20, 1985.

Rogers, Everret M, and Kincaid, D. Lawrence. Communication Networks: Towards a New Paradigm for Research, The Free Press, New York, 1981.

Rogers, Everett M., and Shoemaker, Floyd F. Communication of Innovations, The Free Press, New York, 1971.

Ryan, Michael J. "Behavioural Intention Formation: The Interdependency of Attitudinal and Social Influence Variables", Journal of Consumer Research, Vol. 9, December 1982, pp. 268-277.

Salerno, Lynn M. "What Happened to the Computer Revolution", Harvard Business Review, November-December 1985, pp. 129-138.

Schewe, C.D. "The MIS User: An exploratory Behavioral Analysis", Academy of Management Journal, Vol. 19, No. 4, 1976, pp. 577-590.

Schultz, Randall L., and Slevin, Dennis P. "Implementation and Management Innovation", in Schultz, Randall L., and Slevin, Dennis P., Eds., Implementing Operations Research/ Management Science, American Elsevier Publishing Co. Inc., New York, 1975, pp. 3-20.

Siegel, Sidney. Nonparametric Statisitics for the Behavioral Sciences, McGraw-Hill Book Company, New York, N.Y., 1956.

Simon, Herbert A. The New Science of Management Decision, Prentice-Hall Inc., Englewood Cliffs, NJ, 1977.

Simon, Herbert A. The Sciences of the Artificial, Second Edition, The MIT Press, Cambridge, Mass., 1981.

Spector, Aron N., Brown, Lawrence A., and Malecki, Edward J. "Acquaintance Circles and Communication: An Exploration of Hypotheses Relating to Innovation Diffusion", The Professional Geographer, Vol. 28, No. 3, August 1976, pp.267-276.

Spinrad, R.J. "Office Automation", Science, Vol. 215, No. 12, February, 1982, pp. 808-813.

Sprague, Ralph H., and McNurlin, Barbara C. Information Systems Management In Practice, Prentice-Hall Inc., Englewood Cliffs, NJ, 1986.

Srinivasan, Anath. "Alternative Measures of System Effectiveness: Associations and Implications", MIS Quarterly, Vol. 9, No 3, September 1985, pp. 243-253.

Staples, E.R. "Who's Responsible for Office Automation", Infosystems, February, 1985, pp. 56-57.

Strassman, Peter A. Information Payoff: The Transformation of Work in the Electronic Age, The Free Press, New York, N.Y., 1985.

Susser, Peter A. "Modern Office technology and Employer Relations", Employee Relations Today, Winter 1987, pp. 363-371.

Swanson, E.B. "Management Information Systems: Appreciation and Involvement", Management Science, Vol. 21, October 1974, pp. 178-188.

Swanson, E.B. "Information Channel Disposition and Use", Decision Sciences, Vol. 18, 1987, pp. 131-145.

Tabachnik, Barbara G., and Fidell, Linda S. Using Multivariate Statistics, Harper & Row, Publishers, New York, N.Y., 1983

Thiel, Carol Tomme. "Office Automation - Training Starts with Top-Down Acceptance", Infosystems, May 1984, pp. 60-64.

Tornatzky, Louis G., and Klein, Katherine J. "Innovation Characteristics and Innovation Adoption Implementation: A Meta-Analysis of Findings", IEEE Transactions on Engineering Management, EM-29, No. 1, February 1982, pp. 28-45.

Turoff, Murray, and Hiltz, Starr R. "Management Issues in Human Communication via Computer", in Robert Landau, ed., Emerging Office Systems, Ablex Publishing Corp., Norwood, NJ, 1982.

Uttal, Bro. "What's Detaining the Office of the Future", Fortune, May 3, 1982, pp. 176-196.

Verity, John W. "In Focus", Datamation, Vol. 31, No. 21, November 1, 1985, pp. 20-32.

Vogel, Douglas R., and Wetherbe, James C. "Office Automation: End User Impact", in James C Wetherbe, ed., ACM Proceedings of the Twenty-First Annual Computer Personnel Research Conference, May 2-3, 1985, pp. 165-171.

Watson, Goodwin. "Resistance to Change", in Zaltman, Gerald, Kotler, Philip, and Kaufman, Ira, eds., Creating Social Change. New York: Holt, Rinehart, and Winston, 1972, pp. 610-618.

Weber, Ron. "Toward a Theory of Artifacts: A Paradigmatic Base for Information Systems Research", Unpublished Paper, University of Queensland, April 1985.

Wheaton, Blair, Muthen, Bengt, Alwin, Duane, and Summers, Gene. "Assessing Reliability and Stability in Panel Models", in D. Heise (ed.), Sociological Methodology, Jossey-Bass, San Francisco, 1977, pp. 84-136.

Wilson, Debbie. "Workplace Wakes Up to Stress", in Vancouver Sun, March 26, 1985.

Withington, Frederic G. "Coping With Computer Proliferation", Harvard Business Review, May-June 1980, pp. 152-164.

Wright, Peter. "The Harassed Decision Maker: Time Pressures, Distractions and the Use of Evidence", Journal of Applied Psychology, Vol. 59, October 1974, pp. 555-561.

Wynne, Brian, and Otway, Harry J. "Information Technology, Power, and Managers", Office: Technology and People, Vol. 2, 1983, pp. 43-56.

Zajonc, Robert B., and Markus, Hazel. "Affective and Cognitive Factors in Preferences", Journal of Consumer Research, Vol.9, September 1982, pp.123-131.

Zaltman, Gerald, Duncan, Robert, and Holbek, Jonny. Innovations and Organizations, Wiley and Sons, New York, 1973.

Zink, Ronald A. "The Tilt to End-User Programming", Computerworld, 23 July, 1984, Vol. 18, No. 7A, pp. 5-14.

Zmud, Robert W. "Diffusion of Modern Software Practices: Influence of Centralization and Formalization", Management Science, Vol. 28, No. 12, December 1982, pp. 1421-1431.

Zmud, Robert W. "The Effectiveness of External Information Channels in Facilitating Innovation Within Software Groups", MIS Quarterly, June 1983, pp. 43-58.

Zmud, Robert W. "An Examination of 'Push-Pull' Theory Applied to Process Innovation in Knowledge Work", Management Science, Vol. 30, No. 6, June 1984, pp. 727-738.

Zuboff, Shosanna. "New Worlds of Computer Mediated Work", Harvard Business Review, September-October 1982, pp. 142-152.

**APPENDIX ONE**

# INITIAL ITEM POOL

Attached is the initial item pool generated for the construction of scales to measure the **Perceived Characteristics** of using the PWS. The sources of items are indicated by letters in brackets following the items. The letters follow the code below:

| | |
|---|---|
| B | Bolton (1981) |
| D | Davis (1985) |
| Ho | Holloway (1977) |
| H | Hurt & Hubbard (1987) |
| L | Licker, Newsted & Sheehan (1986) |
| N | New items |
| O | Ostlund (1969) |

**PERCEIVED VOLUNTARINESS OF PWS USAGE**

1. My use of a PWS is voluntary (as opposed to required by my superiors or job description) (L).

2. My superiors expect me to use a PWS (N).

3. I must use a PWS in order to get my required work done (N).

4. Whether or not I use a PWS is entirely up to me (N).

5. Although it might be helpful, using a PWS is certainly not compulsory in my job (N).

7. My boss does not require me to use a PWS (N).

**PERCEIVED IMAGE**

1. Because of my use of a PWS, I see myself as a more valuable employee (L).

2. Because of my use of the PWS, others in my organisation see me as a more valuable employee (L).

3. People in my organisation who use a PWS have more prestige than those who do not (N).

4. Having a PWS is a status symbol in my organisation (N).

5. People in my organisation who use PWS are more modern in their approaches than those who do not (N).

6. People in my organisation who won't use a PWS are behind the times (N).

7. Using a PWS improves my image within my organisation (Ho).

8. People in my organisation who use a PWS have a high degree of visibility (N).

**PERCEIVED RELATIVE ADVANTAGE**

1. Overall, I find using the PWS to be advantageous in my job (D).
2. Using the PWS enhances my effectiveness on the job (D).
3. Using the PWS improves my job performance (D).
4. Using the PWS improves the quality of work I do (D).
5. Using the PWS increases my productivity (D).
6. The PWS supports critical aspects of my job (D).
7. Using the PWS allows me to accomplish more work than would otherwise be possible (D).
8. The PWS enables me to accomplish tasks more quickly (D).
9. Using the PWS makes it easier to do my job (D).
10. Using the PWS gives me greater control over my work (D).
11. Using the PWS reduces the time I spend on unproductive activities (D).
12. Using the PWS saves me time (D).
13. Using the PWS addresses my job-related needs (D).
14. My job would be difficult to perform without using the PWS (D).
15. Using the PWS offers me real advantages over the way I used to do things (O).
16. I'd rather work by hand than use a PWS (H).
17. Using a PWS may be fast, but it has a lot of other disadvantages (H).
18. Using a PWS is beneficial because it cuts down on the amount of work you have to do (H).
19. I don't think there is any useful advantage to be gained by using a PWS (H).
20. The disadvantages of my using a PWS far outweigh the advantages (H40).
21. I like the idea of using the PWS because it would provide me with a lot of advantages at school, at work, or in my personal life (H).
22. Personally I would benefit from using the PWS (L).

23. Using the PWS has made me more effective in my job (L).

24. As a result of using the PWS I am more timely in completing my work (L).

25. All in all, I do a better job because of my use of the PWS (L).

26. I have come to rely on the PWS in performing my job (L).

**PERCEIVED COMPATIBILITY**

1. I think that using the PWS fits right in with the way I choose to work (B).

2. The PWS is not a product intended for a person like me (O).

3. Using the PWS would probably cut down on the amount that we talk to one another in my work group (B).

4. My work group might object if I used a PWS (O).

5. I would have to change some of the ways that I do things if I used a PWS (O).

6. To me using a PWS seems to be a luxury (B).

7. I really need a tool like the PWS (B).

8. I expect that using the PWS will become a real necessity in the work place (B).

9. Using a PWS would be [is] completely compatible with my current situation (H).

10. I've no need to use the PWS (H).

11. I cannot imagine that using the PWS would fit into my work style (H).

12. Given my current situation, I could really use a PWS (H).

13. I do not need one right now, but I imagine that in the future I'll need a PWS (H).

14. Using a PWS would help me a lot with my work (H).

15. I could really use a PWS at my job (H).

16. A PWS would really fit in and help me manage my work (H).

17. I cannot imagine where using a PWS would be [in]compatible with any part of my work (H).

18. Using a PWS would require [requires] a large change in the way that I do my work (N).

19. Many of my colleagues/acquaintances use the PWS (N).

20. Using computers is an accepted part of my work environment (N).

21. Computers are necessary in the work place (N).

22. I believe that computers play valuable roles in our work life (N).

23. I generally like high technology (L).

24. I am experienced in using high technology products (N).

25. My work group would be better off without the PWS (N).

26. In general, I am used to having work done for me by computers (N).

27. Using a PWS is a new experience for me (N).

28. Using a PWS would radically change my work habits (N).

29. Using a PWS is not similar to anything that I've done before (N).

**PERCEIVED COMPLEXITY**

1. I believe that the PWS is cumbersome to use (D).

2. Learning to operate the PWS is easy for me (D).

3. Interacting with the PWS is often frustrating (D).

4. I believe that it is easy to get the PWS to do what I want it to do (D).

5. I believe that the PWS is rigid and inflexible to interact with (D).

6. It is easy for me to remember how to perform tasks using the PWS (D).

7. Interacting with the PWS requires a lot of mental effort (D).

8. My interaction with the PWS is clear and understandable (D).

9. I believe that it takes a lot of effort to become skillful at using the PWS (D).

10. Overall, I believe that the PWS is easy to use (D).

11. I have no difficulty understanding how the PWS technically works (O).

12. Using a PWS requires a lot of technical know-how (O).

13. I understand how to use the PWS (O).

14. The PWS is hard to learn how to use (H).

15. PWS are so complex that I could never learn how to use one (H).

16. Using a PWS is not nearly as complex as many people think (H).

17. The PWS will have to become a lot easier to use before I'll use it (H).

18. PWS are very simple to learn how to use (H).

19. PWS are so complex that I'd have to have a lot of training before I could use one correctly (H).

20. The technology has become so advanced that anyone could learn to use a PWS with very little trouble (H).

21. I don't think that it will ever be easy for me to use a PWS (H).

22. Although they're complex now, I think that the PWS will be easier for me to use in the future (H).

23. The ways to use a PWS seem complex to me (H).

24. I feel confident using the PWS (L).

**PERCEIVED OBSERVABILITY**

1. Using the PWS would probably give my work group something to talk about (B).

2. I have heard about or seen devices like the PWS before (B).

3. The results of using the PWS are not the sort of thing that I am able to tell my friends and colleagues about (O).

4. I think that I would have no difficulty in telling my friends what using the PWS is like (O).

5. I've never had a chance to see what the PWS could do for me (H).

6. I've seen people become efficient as a result of their use of the PWS (H).

7. I've seen the positive changes that using the PWS can make in work efficiency (H).

8. I've seen people use PWS and I don't think that they have become more efficient by doing so (H).

9. I've heard about all the various things that a PWS can do (H).

10. I've never seen anyone working with a PWS (H).

11. I'd like to have more opportunity to see what a PWS could do for me before I use one (H).

**APPENDIX ONE**

12. I've had plenty of opportunity to observe what a PWS could do for me (H).

13. I wish there were a greater opportunity to see exactly what I could do with the PWS (H).

14. I think I could very easily demonstrate the results of using the PWS (Ho).

15. I think that the benefits of using the PWS are mostly "soft", intangible, or not very visible (N).

16. I believe that if a person knew how to do it, he or she could actually measure the benefits of using the PWS (N).

17. Even if I thought using the PWS were beneficial, I would have difficulty in explaining the benefits to others (N).

18. It is easy for me to perceive the results of using a PWS (Ho).

19. It is difficult to observe the advantages of using a PWS (Ho).

20. The real advantages of using the PWS are hard to prove (Ho).

21. The results of using a PWS are apparent to me (N).

**PERCEIVED TRIALABILITY**

1. I really wouldn't lose much if I tried the PWS and it didn't work out as I thought (O).

2. I wouldn't have to expend very much effort to try out the PWS (O).

3. I would probably be permitted to use the PWS on a trial basis for a month or two (B).

4. I've had a great deal of opportunity to try and work with the PWS (H).

5. I've never been around a PWS (H).

6. I've a great deal of experience using computers (H).

7. I've never tried a PWS and I don't want to (H).

8. I'd use a PWS if I could try it for awhile first (H).

9. My organisation won't let me try a PWS long enough before I have to decide whether to use one (H).

10. I have very little useful information about using the PWS (H).

11. I like to try something on a limited basis before I commit to using it (H).

**APPENDIX ONE**

12. I think that I've had enough experience with the PWS to commit to using one on a regular basis (H).

13. I don't really have opportunities to try out different things on the PWS (H).

14. I am able to experiment with the PWS (N).

15. Before deciding whether to use any PWS applications, I am able to try them out (N).

16. I know where I can go to try out various uses of the PWS (N).

17. I've never had a chance to try out a PWS (N).

18. I've had no access to a PWS on a trial basis (N).

19. I could try out a PWS if I wanted to (N).

20. I can have access to a PWS to investigate it (N).

21. I am not able to try to see if a PWS would help me (N).

22. A PWS is available for me to test run various applications (N).

23. I can have a PWS for a test period (N).

24. An on-the-job tryout of the various uses of the PWS isn't possible (N).
25. I can have a PWS just to check it out (N).

26. There is no opportunity to just try out a PWS for awhile (N).

27. I can get a PWS for a short term trial (N).

28. I could try out a co-worker's PWS if I wanted to (N).

29. There is no risk to me if I start using a PWS and later decide against it (N).

30. In order for me to acquire a PWS in my organisation, there is no minimum amount that I must use it (N).

31. There are people in my organisation who will help me try the various uses of the PWS (N).

**APPENDIX TWO**

# ITEM POOL FOR SORTING ROUNDS

**PERCEIVED VOLUNTARINESS**

1. My use of a PWS is voluntary (as opposed to required by my superiors or job description).

2. My superiors expect me to use a PWS.

3. I must use a PWS in order to get my required work done.

4. Whether or not I use a PWS is entirely up to me.

5. Although it might be helpful, using a PWS is certainly not compulsory in my job.

6. My boss does not require me to use a PWS.

**PERCEIVED IMAGE**

7. Because of my use of a PWS, I see myself as a more valuable employee.

8. Because of my use of the PWS, others in my organisation see me as a more valuable employee.

9. People in my organisation who use a PWS have more prestige than those who do not.

10. Having a PWS is a status symbol in my organisation.

11. People in my organisation who use PWS are more modern in their approaches than those who do not.

12. People in my organisation who won't use a PWS are behind the times.

13. Using a PWS improves my image within my organisation.

14. People in my organisation who use a PWS have a high degree of visibility.

**PERCEIVED RELATIVE ADVANTAGE**

15. Overall, I find using the PWS to be advantageous in my job.

16. Using the PWS enhances my effectiveness on the job.

17. Using the PWS improves my job performance.

18. Using the PWS improves the quality of work I do.

19. Using the PWS increases my productivity.

20. The PWS supports critical aspects of my job.

21. Using the PWS allows me to accomplish more work than would otherwise be possible.

22. The PWS enables me to accomplish tasks more quickly.

23. Using the PWS makes it easier to do my job.

24. Using the PWS gives me greater control over my work.

25. Using the PWS offers me real advantages over the way I used to do things.

26. Using a PWS is beneficial because it cuts down on the amount of work you have to do.

27. I don't think there is any useful advantage to be gained by using a PWS.

28. The disadvantages of my using a PWS far outweigh the advantages.

29. Personally I would benefit from using the PWS.

30. Using the PWS has made me more effective in my job.

31. As a result of using the PWS I am more timely in completing my work .

32. All in all, I do a better job because of my use of the PWS.

**PERCEIVED COMPATIBILITY**

33. I think that using the PWS fits right in with the way I choose to work.

34. The PWS is not a product intended for a person like me.

35. My work group might object if I used a PWS.

36. I would have to change some of the ways that I do things if I used a PWS.

37. I expect that using the PWS will become a real necessity in the work place.

38. Using a PWS would be completely compatible with my current situation.

39. I cannot imagine that using the PWS would fit into my work style.

40. I cannot imagine where using a PWS would be compatible with any part of my work.

41. Using a PWS would require a large change in the way that I do my work.

42. Using computers is an accepted part of my work environment.

**APPENDIX TWO**

43. I generally like high technology.

44. I am experienced in using high technology products.

45. In general, I am used to having work done for me by computers.

46. Using a PWS is a new experience for me.

47. Using a PWS would radically change my work habits.

48. Using a PWS is not similar to anything that I've done before.

**PERCEIVED COMPLEXITY**

49. I believe that the PWS is cumbersome to use.

50. Learning to operate the PWS is easy for me.

51. Interacting with the PWS is often frustrating.

52. I believe that it is easy to get the PWS to do what I want it to do.

53. I believe that the PWS is rigid and inflexible to interact with.

54. It is easy for me to remember how to perform tasks using the PWS.

55. Interacting with the PWS requires a lot of mental effort.

56. My interaction with the PWS is clear and understandable.

57. I believe that it takes a lot of effort to become skillful at using the PWS.

58. Overall, I believe that the PWS is easy to use.

59. I have no difficulty understanding how the PWS technically works.

60. Using a PWS requires a lot of technical know-how.

61. I understand how to use the PWS.

62. The PWS is hard to learn how to use.

63. Using a PWS is not nearly as complex as many people think.

64. PWS are very simple to learn how to use.

65. The technology has become so advanced that anyone could learn to use a computer with very little trouble.

66. The ways to use a PWS seem complex to me.

# APPENDIX TWO

## PERCEIVED OBSERVABILITY

67. The results of using the PWS are not the sort of thing that I am able to tell my friends and colleagues about.

68. I think that I would have no difficulty in telling my friends what using the PWS is like.

69. I've seen people become efficient as a result of their use of the PWS.

70. I've seen the positive changes that using the PWS can make in work efficiency.

71. I've heard about all the various things that a PWS can do.

72. I've had plenty of opportunity to observe what a PWS could do for me.

73. I think I could very easily demonstrate the results of using the PWS.

74. I think that the benefits of using the PWS are mostly "soft", intangible, or not very visible.

75. I believe that if a person knew how to do it, he or she could actually measure the benefits of using the PWS.

76. Even if I thought using the PWS were beneficial, I would have difficulty in explaining the benefits to others.

77. It is easy for me to perceive the results of using a PWS.

78. It is difficult to observe the advantages of using a PWS.

79. The real advantages of using the PWS are hard to prove.

80. The results of using a PWS are apparent to me.

80-2 I believe I could communicate to others the consequences of using the PWS.

80-3 I have yet to hear a good explanation of what computers can and cannot do for me.

## PERCEIVED TRIALABILITY

81. I really wouldn't lose much if I tried the PWS and it didn't work out as I thought.

82. I wouldn't have to expend very much effort to try out the PWS.

83. I would probably be permitted to use the PWS on a trial basis for a month or two.

84. I've had a great deal of opportunity to try and work with the PWS.

85. I don't really have opportunities to try out different things on the PWS.

86. I've am able to experiment with the PWS.

87. Before deciding whether to use any PWS applications, I am able to try them out.

88. I know where I can go to try out various uses of the PWS.

89. A PWS is available for me to test run various applications.

90. I can have a PWS for a test period.

91. An on-the-job tryout of the various uses of the PWS isn't possible.

92. There is no risk to me if I start using a PWS and later decide against it.

93. In order for me to acquire a PWS in my organisation, there is no minimum amount that I must use it.

94. There are people in my organisation who will help me try the various uses of the PWS.

**VISIBILITY**

95. I have seen what others do using their PWS.

96. It is easy for me to observe PWS usage in my firm.

97. I have had plenty of opportunity to observe PWS usage.

98. I have not seen many colleagues use a PWS in my department.

99. PWS are not visible in my organisation.

100. In my organisation, one sees PWS on many desks.

101. I have seen advertisements for the PWS on TV and/or in magazines.

102. I have seen the PWS in use outside my firm.

103. I have seen the PWS in the homes of many of my friends.

**COMPUTER AVOIDANCE**

104. My using a PWS gives my superiors more power to control my work.

105. My using a PWS enables my superiors to more closely monitor my job performance.

106. PWS usage results in many aspects of my job becoming more reptitive and boring.

## APPENDIX TWO

107. Introduction of the PWS in my organisation may eventually result in the elimination of my job.

108. My using a PWS unrealistically raises my superiors' expectations about the amount of work that I can accomplish.

109. Using a PWS may adversely affect my health.

**APPENDIX THREE**

## CARD SORTING INSTRUCTIONS FOR INITIAL SORT

You will be given a set of cards, each of which contains one statement about the **Personal Work Station**, or PWS as it is labelled here. Each statement is intended to reflect a particular belief or attitude about the PWS. You are requested to sort the various statements into as many categories (piles) as you think necessary (approximately 5-10 should be adequate) so that the statements in each category relate more to one another than they do to statements in a separate category. You will note that many statements will appear very similar to one another, but you are asked to try to determine the primary underlying idea that each statement reflects. Then, establish your categories based on the various common, underlying ideas or concepts. Groupings should **not** be established based on different dimensions of the same concept. For example, the words "hot" and "cold" could very well be grouped together if the underlying concept were "degree of heat", as might "wet" and "dry" if the concept were "moisture".

The number of statements in each category is not necessarily uniform and could vary significantly depending on the categories you establish. As you go through the cards try to identify what you think the underlying concept is for each category. You may find that you change your mind and resort cards as you read more of them. This is very normal and acceptable. Finally, once you have established your final categories, please review each pile one more time to ensure that all cards are in the "right" category, and that none might have a better fit in a different category.

Finally, this is not a test, nor any attempt to identify what or how **YOU** think about the PWS. It is simply intended to see if certain statements group together as was originally intended when they were written for the purposes of constructing a questionnaire.

Your assistance is greatly appreciated.

APPENDIX FOUR

## ITEM DEVELOPMENT HISTORY

In the table below, the development history for each item listed in Appendix 2 is shown. Each column represents a different stage of the development process. Comments are made in the appropriate column to show whether the items were deleted, reworded, or added for that development stage. Comments for the first round of Step 3 are not included as the items were exactly as listed in Appendix 2. In the Pre-Pilot and Pilot stages the numbers in the column indicate the number of the item in the appropriate sections (B and C) of the questionnaire.

| Construct | Item # | Step 4-1 | Step 3-2 | Step 4-2 | Pre-Pilot Question # | Pilot Question # |
|---|---|---|---|---|---|---|
| **Voluntariness** | | | | | | |
| | 1 | | | | 23 | 14 |
| | 2 | | | | 5 | 4 |
| | 3 | | | deleted | | |
| | 4 | | | | 14 | deleted |
| | 5 | | | | 38 | 22 |
| | 6 | | | | 31 | 18 |
| **Image** | | | | | | |
| | 7 | | | deleted | | |
| | 8 | | | | 11 | 9 |
| | 9 | | | | 34 | 21 |
| | 10 | | | | 80 | 49 |
| | 11 | | | | 49 | deleted |
| | 12 | | | | 36 | deleted |
| | 13 | | | | 7 | 6 |
| | 14 | | | | 43 | 25 |
| **Relative Advantage** | 15 | | | | 61 | 37 |
| | 16 | | | | 68 | 42 |
| | 17 | | | | 57 | 34 |
| | 18 | | | | 9 | 7 |
| | 19 | | | | 79 | 48 |
| | 20 | | | | 37 | deleted |
| | 21 | | | | 72 | deleted |
| | 22 | | | | 2 | 1 |
| | 23 | | | | 10 | 8 |
| | 24 | | | | 78 | 47 |
| | 25 | | | | 16 | deleted |
| | 26 | | | | 25 | deleted |
| | 27 | | | | 81 | deleted |
| | 28 | | | | 44 | 26 |
| | 29 | | | | deleted | |
| | 30 | | | | deleted | |
| | 31 | | | | deleted | |
| | 32 | | | | deleted | |

# APPENDIX FOUR

| Construct | Item # | Step 4-1 | Step 3-2 | Step 4-2 | Pre-Pilot Question # | Pilot Question # |
|---|---|---|---|---|---|---|
| **Compatibility** | | | | | | |
| | 33 | reworded | | | 13 | 11 |
| | 34 | deleted | | | | |
| | 35 | deleted | | | | |
| | 36 | | | | 54 | deleted |
| | 37 | deleted | | | | |
| | 38 | | | | 03 | 2 |
| | 39 | | reworded | | 74 | 44 |
| | 40 | | reworded | | 4 | 3 |
| | 41 | | | | 69 | deleted |
| | 42 | | reworded | | 28 | deleted |
| | 43 | deleted | | | | |
| | 44 | deleted | | | | |
| | 45 | | | | 20 | deleted |
| | 46 | | reworded | | 71 | deleted |
| | 46 | | | | 52 | deleted |
| | 48 | | | | 1 | deleted |
| **Ease of Use** | | | | | | |
| | 49 | | | | 6 | 5 |
| | 50 | | | | 65 | 40 |
| | 51 | | | | 42 | 24 |
| | 52 | | | | 50 | 31 |
| | 53 | | | | 59 | deleted |
| | 54 | | | | 22 | 13 |
| | 55 | | | | 41 | 23 |
| | 56 | | | | 47 | 29 |
| | 57 | | | | 19 | deleted |
| | 58 | | | | 53 | 32 |
| | 59 | | | | deleted | |
| | 60 | deleted | | | | |
| | 61 | | | | deleted | |
| | 62 | | | | deleted | |
| | 63 | | | | deleted | |
| | 64 | | | | deleted | |
| | 65 | | | | deleted | |
| | 66 | | | | deleted | |

## APPENDIX FOUR

| Construct | Item # | Step 4-1 | Step 3-2 | Step 4-2 | Pre-Pilot Question # | Pilot Question # |
|---|---|---|---|---|---|---|
| **Result Demonstrability** | | | | | | |
| | 67 | deleted | | | | |
| | 68 | deleted | reworded | | 32 | 19 |
| | 69 | | deleted | | | |
| | 70 | | deleted | | | |
| | 71 | | deleted | | | |
| | 72 | deleted | | | | |
| | 73 | | reworded | | 24 | deleted |
| | 74 | | deleted | | | |
| | 75 | | reworded | | 40 | deleted |
| | 76 | | reworded | | 75 | 45 |
| | 77 | | | | 39 | deleted |
| | 78 | | reworded | | 35 | deleted |
| | 79 | | deleted | | | |
| | 80 | | | | 70 | 43 |
| | 80-2 | | added | | 46 | 28 |
| | 80-3 | | added | deleted | | |
| **Trialablity** | 81 | | | deleted | | |
| | 82 | | | | 17 | deleted |
| | 83 | | | | 77 | 46 |
| | 84 | | | | 27 | 16 |
| | 85 | | | | 21 | deleted |
| | 86 | | | | 8 | deleted |
| | 87 | | | | 62 | 38 |
| | 88 | | | | 33 | 20 |
| | 89 | | | | 45 | 27 |
| | 90 | | | | 15 | deleted |
| | 91 | | | | 51 | deleted |
| | 92 | | | deleted | | |
| | 93 | deleted | | | | |
| | 94 | | | | 73 | deleted |
| **Visibility** | 95 | | added | | 26 | 15 |
| | 96 | | added | | 55 | deleted |
| | 97 | | added | | 63 | deleted |
| | 98 | | added | | 30 | 17 |
| | 99 | | added | | 60 | 36 |
| | 100 | | added | | 76 | deleted |
| | 101 | | added | | 29 | deleted |
| | 102 | | added | | 56 | 33 |
| | 103 | | added | | 66 | deleted |
| **Extras Added For Pre-Pilot** | | | | | | |
| | 104 | | | | 12 | 10 |
| | 105 | | | | 58 | 35 |
| | 106 | | | | 18 | 12 |
| | 107 | | | | 64 | 39 |
| | 108 | | | | 67 | 41 |
| | 109 | | | | 48 | 30 |

APPENDIX FIVE

# RESULTS OF ITEM SORTING

This Appendix shows the results of the sorting of items as carried out by the judges in the various rounds. Each round is reported separately. Each letter in a category column indicates how the judge represented by that letter placed the particular item corresponding to that row. Although the same letter may appear in two separate sorting rounds, they represent different judges. The presentation format is that of a matrix, with the theoretical constructs plotted against actual categories. For example, items 1-6 in Step 3-Round One were intended to measure the perceived voluntariness of PWS usage. These are arranged as a group together on the Y-axis and labelled as such. One can then see into which groups judges actually placed items by going across the X-axis opposite the items and checking the column, or actual category, they are in. Then by going down the Y-axis one can determine which other items were grouped with that item. The actual category heading under which the items are placed for each judge was determined by the largest sub-grouping of items for that judge which corresponded to the target constructs. For example, in Step 3 - Round One, Judge F had all **Relative Advantage** items grouped together, along with Item 3. In that Relative Advantage roughly corresponds to Category C, Item 3 was placed in that category along with the rest of the items in that judge's grouping.

In Step 3-Round One the asterisk (*) beside a particular letter indicates that the judge moved the item to the main grouping after discussion, as described in the chapter.

# APPENDIX FIVE

## STEP 3 - ROUND ONE

### ACTUAL CATEGORIES

| | Item No. | A | B | C | D | E | F | G | N/A |
|---|---|---|---|---|---|---|---|---|---|
| | 1 | FBPS | | | | | | | |
| | 2 | FBP | | | S* | | | | |
| VOL | 3 | BP | | F* | S* | | | | |
| | 4 | FBPS | | | | | | | |
| | 5 | FBPS | | | | | | | |
| | 6 | FBP | | | S* | | | | |
| | 7 | | FB S | P | | | | | |
| | 8 | | FB S | P | | | | | |
| | 9 | | FBPS | | | | | | |
| IMAGE | 10 | | FBPS | | | | | | |
| | 11 | | FBPS | | | | | | |
| | 12 | | FBPS | | | | | | |
| | 13 | | FB S | P* | | | | | |
| | 14 | | FBPS | | | | | | |
| | 15 | | | FBPS | | | | | |
| | 16 | | | FBPS | | | | | |
| | 17 | | B* | F PS | | | | | |
| | 18 | | | FBPS | | | | | |
| | 19 | | | FBPS | | | | | |
| | 20 | | | FBPS | | | | | |
| | 21 | | | FBPS | | | | | |
| | 22 | | | FBPS | | | | | |
| REL | 23 | | | FBPS | | | | | |
| ADV | 24 | | | FBPS | | | | | |
| | 25 | | | FBPS | | | | | |
| | 26 | | | FBPS | | | | | |
| | 27 | | | FBPS | | | | | |
| | 28 | | | FBPS | | | | | |
| | 29 | | | FBPS | | | | | |
| | 30 | | | FBPS | | | | | |
| | 31 | | | FBPS | | | | | |
| | 32 | | | FBPS | | | | | |
| | 33 | | | | FBPS | | | | |
| | 34 | S | | | FB | | | | P |
| | 35 | | F | | B S | | | | P |
| | 36 | | | | FBPS | | | | |
| | 37 | | | PB | S | | F | | |
| | 38 | | | P* | FB S | | | | |
| | 39 | | | | FBPS | | | | |
| COMPAT | 40 | | | | FBPS | | | | |
| | 41 | | | | FBPS | | | | |
| | 42 | P* | | | FB S | | | | |
| | 43 | | | | | FB | | | PS |
| | 44 | | | | | FB | | | PS |
| | 45 | | | | FB S | | | | PS |
| | 46 | S | | | FB | | | | P* |
| | 47 | S* | | | FBP | | | | |
| | 48 | S* | | | FBP | | | | |

**APPENDIX FIVE**

**STEP 3 - ROUND ONE**

ACTUAL CATEGORIES

| | Item No. | A | B | C | D | E | F | G | N/A |
|---|---|---|---|---|---|---|---|---|---|
| | 49 | | | S* | | FBP | | | |
| | 50 | | | | | FBPS | | | |
| | 51 | | | | | FBPS | | | |
| | 52 | | | | | FBPS | | | |
| | 53 | | | S* | | FBP | | | |
| | 54 | | | | | FBPS | | | |
| | 55 | | | | | FBPS | | | |
| COMPLX | 56 | | | | | FBPS | | | |
| | 57 | | | | | FBPS | | | |
| | 58 | | | | | FBPS | | | |
| | 59 | | | | | FBPS | | | |
| | 60 | | | | | FBP | | | S |
| | 61 | | | | | FBPS | | | |
| | 62 | | | | | FBPS | | | |
| | 63 | | | | | FBPS | | | |
| | 64 | | | | | FBPS | | | |
| | 65 | | | | | FBPS | | | |
| | 66 | | | | | FBPS | | | |
| | 67 | | | P | | S | FB | | |
| | 68 | | | P | | S | FB | | |
| | 69 | | | BPS | | | F | | |
| | 70 | | B | PS | | | F | | |
| | 71 | | | | | B | F | | PS |
| | 72 | B | | | | | F | PS | |
| | 73 | | | P | | | FB S | | |
| OBSERV | 74 | | | BP | | | F S | | |
| | 76 | | | BP | | | F S | | |
| | 77 | | | BP | | | F S | | |
| | 78 | | | BP | | | F S | | |
| | 79 | | | FBP | | | S | | |
| | 80 | | | BP | | | F S | | |
| | 81 | F | | | B | | | PS | |
| | 82 | B* | | | | | | F PS | |
| | 83 | B* | | | | | | F PS | |
| | 84 | B* | | | | | | F PS | |
| | 85 | B* | | | | | | F PS | |
| TRIAL | 86 | B* | | | | | | F PS | |
| | 87 | B* | | | | | | F PS | |
| | 88 | B* | | | | | | F PS | |
| | 89 | B* | | | | | | F PS | |
| | 90 | B* | | | | | | F PS | |
| | 91 | B* | | | | | | F PS | |
| | 92 | FB* | | | | | | PS | |
| | 93 | FB*S | | | | | | P | |
| | 94 | B* | | | | | | F PS | |

# APPENDIX FIVE

## STEP 4 - ROUND ONE

### ACTUAL CATEGORIES

| | Item No. | A | B | C | D | E | F | G | N/A |
|---|---|---|---|---|---|---|---|---|---|
| | 1 | MRGB | | | | | | | |
| | 2 | MRGB | | | | | | | |
| VOL | 3 | RGB | | M* | | | | | |
| | 4 | MRGB | | | | | | | |
| | 5 | MRGB | | | | | | | |
| | 6 | MRGB | | | | | | | |
| | 7 | | MRGB | | | | | | |
| | 8 | | MRGB | | | | | | |
| | 9 | | MRGB | | | | | | |
| IMAGE | 10 | | MRGB | | | | | | |
| | 11 | | MRGB | | | | | | |
| | 12 | | MRGB | | | | | | |
| | 13 | | MRGB | | | | | | |
| | 14 | | MRGB | | | | | | |
| | 15 | | | MRGB | | | | | |
| | 16 | | B | MRG | | | | | |
| | 17 | | | MRGB | | | | | |
| | 18 | | | MRGB | | | | | |
| | 19 | | | MRGB | | | | | |
| | 20 | | | MRGB | | | | | |
| | 21 | | | MRGB | | | | | |
| REL | 22 | | | MRGB | | | | | |
| ADV | 23 | | | MRGB | | | | | |
| | 24 | | | MRGB | | | | | |
| | 25 | | | MRGB | | | | | |
| | 26 | | | MRGB | | | | | |
| | 27 | | | MRGB | | | | | |
| | 28 | | | MRGB | | | | | |
| | 29 | | R | G | B | | | | M |
| | 30 | | B | MRG | | | | | |
| | 31 | | | MRGB | | | | | |
| | 32 | | MR | B | | | | G | |
| | 33 | | | R | M GB | | | | |
| | 36 | | | | MRGB | | | | |
| | 38 | | | | MRGB | | | | |
| | 39 | | | | MRGB | | | | |
| COMPAT | 40 | | | | MRGB | | | | |
| | 41 | | | | MRGB | | | | |
| | 42 | B | | | RG | | | | M |
| | 45 | | | | MRGB | | | | |
| | 46 | | | | MR B | | | | G |
| | 47 | | | | MRGB | | | | |
| | 48 | | | | MRGB | | | | |

# APPENDIX FIVE

## STEP 4 - ROUND ONE

### ACTUAL CATEGORIES

| | Item No. | A | B | C | D | E | F | G | N/A |
|---|---|---|---|---|---|---|---|---|---|
| | 49 | | | | | MRGB | | | |
| | 50 | | | | | MRGB | | | |
| | 51 | | | | | MRGB | | | |
| | 52 | | | | | MRG | B | | |
| | 53 | | | | | MRGB | | | |
| | 54 | | | | | MRGB | | | |
| | 55 | | | | | MRGB | | | |
| COMPLX | 56 | | | | | MRGB | | | |
| | 57 | | | | | MRGB | | | |
| | 58 | | | | B | MRG | | | |
| | 59 | | | | | MRGB | | | |
| | 61 | | | | | MRGB | | | |
| | 62 | | | | | MRGB | | | |
| | 63 | | | | | MRGB | | | |
| | 64 | | | | | MRGB | | | |
| | 65 | | | | | MRGB | | | |
| | 66 | | | | | MRGB | | | |
| | 69 | | R | B | | | M G | | |
| | 70 | | | R | | | M GB | | |
| | 71 | | | | B | | MR | | G |
| | 73 | | | | | | MRGB | | |
| OBSERV | 74 | | | R B | | | M G | | |
| | 75 | | | M | | | RGB | | |
| | 76 | | | | | | MRGB | | |
| | 77 | | | | | | MRGB | | |
| | 78 | | | G | | | R B | | M |
| | 79 | | | M B | | | RG | | |
| | 80 | | | | | | MRGB | | |
| | 81 | | | | | | | MRGB | |
| | 82 | | | | | G | | MR B | |
| | 82 | | | | | | | MRGB | |
| | 83 | | | | | | | MRGB | |
| | 84 | | | | | | | MRGB | |
| | 85 | | | | | | | MRGB | |
| TRIAL | 86 | | | | | | | MRGB | |
| | 87 | | | | | | | MRGB | |
| | 88 | | | | | | | MRGB | |
| | 89 | | | | | | | MRGB | |
| | 90 | | | | | | | MRGB | |
| | 91 | | | | | | | MRGB | |
| | 92 | | | | | | | MR B | G |
| | 94 | | | | | | | MRGB | |

# APPENDIX FIVE

## STEP 3 - ROUND TWO

### ACTUAL CATEGORIES

| | Item No. | A | B | C | D | E | F | G | H | N/A |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | MSNDJ | | | | | | | | |
| | 2 | MSNDJ | | | | | | | | |
| VOL | 3 | SN J | | M D | | | | | | |
| | 4 | MSNDJ | | | | | | | | |
| | 5 | MSNDJ | | | | | | | | |
| | 6 | MSNDJ | | | | | | | | |
| | 7 | | MS J | ND | | | | | | |
| | 8 | D | MS J | N | | | | | | |
| | 9 | D | MSN J | | | | | | | |
| IMAGE | 10 | D | MSN J | | | | | | | |
| | 11 | D | MSN J | | | | | | | |
| | 12 | D | MSN J | | | | | | | |
| | 13 | D | MS J | N | | | | | | |
| | 14 | D | MSN J | | | | | | | |
| | 15 | | | MSNDJ | | | | | | |
| | 16 | | | MSNDJ | | | | | | |
| | 17 | | | MSNDJ | | | | | | |
| | 18 | | | MSNDJ | | | | | | |
| | 19 | | | MSNDJ | | | | | | |
| | 20 | | | MSNDJ | | | | | | |
| | 21 | | | MSNDJ | | | | | | |
| | 22 | | | MSNDJ | | | | | | |
| REL | 23 | | | MSNDJ | | | | | | |
| ADV | 24 | | | MSNDJ | | | | | | |
| | 25 | | | MSNDJ | | | | | | |
| | 26 | | | MSNDJ | | | | | | |
| | 27 | | | MS DJ | | N | | | | |
| | 28 | | | MS DJ | | N | | | | |
| | 30 | | | MSNDJ | | | | | | |
| | 31 | | | MSNDJ | | | | | | |
| | 32 | | | MSNDJ | | | | | | |
| | 33 | | | ND | MSJ | | | | | |
| | 36 | | | | MSJ | ND | | | | |
| | 38 | | | N | MSJ | D | | | | |
| | 39 | | | D | MSJ | N | | | | |
| COMPAT | 40 | | | D | MSJ | N | | | | |
| | 41 | | | | MSJ | N | | D | | |
| | 42 | N | | | SJ | | | M | D | |
| | 45 | | | | SJ | N | | | D | M |
| | 46 | | | | SJ | ND | | M | | |
| | 47 | | | | MSJ | ND | | | | |
| | 48 | | | | SJ | M N | | | D | |

## APPENDIX FIVE

## STEP 3 - ROUND TWO

### ACTUAL CATEGORIES

| | Item No. | A | B | C | D | E | F | G | H | N/A |
|---|---|---|---|---|---|---|---|---|---|---|
| | 49 | | | | | MSNDJ | | | | |
| | 50 | | | | | MSNDJ | | | | |
| | 51 | | | | | MSNDJ | | | | |
| | 52 | | | | | MSNDJ | | | | |
| | 53 | | | | | MSNDJ | | | | |
| | 54 | | | | | MSNDJ | | | | |
| | 55 | | | | | MSNDJ | | | | |
| COMPLX | 56 | | | | | MSNDJ | | | | |
| | 57 | | | | | MSNDJ | | | | |
| | 58 | | | | | MSNDJ | | | | |
| | 59 | | | | | MSNDJ | | | | |
| | 61 | | | | | MSNDJ | | | | |
| | 62 | | | | | MSNDJ | | | | |
| | 63 | | | | | MSNDJ | | | | |
| | 64 | | | | | MSNDJ | | | | |
| | 65 | | | | | MSNDJ | | | | |
| | 66 | | | | | MSNDJ | | | | |
| | 68 | | | | | | MSNDJ | | | |
| | 73 | | | | | | MSNDJ | | | |
| | 75 | | | | | | MSNDJ | | | |
| RESULT | 76 | | | | | | MSNDJ | | | |
| DEMO | 77 | | | | | | MSNDJ | | | |
| | 78 | | | | | | MSNDJ | | | |
| | 80-1 | | | | | | MSNDJ | | | |
| | 80-2 | | | | | | MSNDJ | | | |
| | 80-3 | | | | | | S DJ | N | | M |
| | 81 | S | | | | | | NDJ | | M |
| | 82 | | | | | N | | MS DJ | | |
| | 82 | | | | | | | MSNDJ | | |
| | 83 | | | | | | | MSNDJ | | |
| | 84 | | | | | | | MSN J | D | |
| TRIAL | 85 | | | | | N | | MS DJ | | |
| | 86 | | | | | | | SNDJ | | M |
| | 87 | | | | | | | SNDJ | | M |
| | 88 | | | | | | | MSN J | D | |
| | 89 | | | | | | | MSNDJ | | |
| | 90 | | | | | | | MSNDJ | | |
| | 91 | | | | | | | MSNDJ | | |
| | 92 | SN | | | | | | DJ | | M |
| | 94 | | | | | | | MSNDJ | | |

# APPENDIX FIVE

## STEP 3 - ROUND TWO

### ACTUAL CATEGORIES

| | Item No. | A | B | C | D | E | F | G | H | N/A |
|---|---|---|---|---|---|---|---|---|---|---|
| | 95 | | | | | | | M | SNDJ | |
| | 96 | | | | | | | MS | NDJ | |
| | 97 | | | | | | | MS | NDJ | |
| VIS | 98 | | | | | | | MS | NDJ | |
| | 99 | | | | | | | M | SNDJ | |
| | 100 | | | | | | | M | SNDJ | |
| | 101 | | | | | | | M | SNDJ | |
| | 102 | | | | | | | M | SNDJ | |
| | 103 | | | | | | | M | SNDJ | |

## APPENDIX FIVE

### STEP 4 - ROUND TWO

ACTUAL CATEGORIES

| | Item No. | A | B | C | D | E | F | G | H | N/A |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | JCWP | | | | | | | | |
| VOL | 2 | JCWP | | | | | | | | |
| | 4 | JCWP | | | | | | | | |
| | 5 | JCWP | | | | | | | | |
| | 6 | JCWP | | | | | | | | |
| | 8 | | JCWP | | | | | | | |
| | 9 | | JCWP | | | | | | | |
| | 10 | | JCWP | | | | | | | |
| VOL | 11 | | J P | W | | | | | | C |
| | 12 | | JCWP | | | | | | | |
| | 13 | | JCWP | | | | | | | |
| | 14 | | JCWP | | | | | | | |
| | 15 | | | JCWP | | | | | | |
| | 16 | | | JCWP | | | | | | |
| | 17 | | | JCWP | | | | | | |
| | 18 | | | JCWP | | | | | | |
| | 19 | | | CWP | J | | | | | |
| | 20 | | | W | C P | | | J | | |
| REL | 21 | | | JCWP | | | | | | |
| ADV | 22 | | | JCWP | | | | | | |
| | 23 | | | JCWP | | | | | | |
| | 24 | | | JCWP | | | | | | |
| | 25 | | | JCWP | | | | | | |
| | 26 | | | JCWP | | | | | | |
| | 27 | | | CWP | | | | J | | |
| | 28 | | | WP | | | J | | | C |
| | 30 | | | JC P | | | W | | | |
| | 31 | | | JCWP | | | | | | |
| | 32 | | | JC P | | | W | | | |
| | 33 | | | | JCWP | | | | | |
| | 36 | | | | JCWP | | | | | |
| | 38 | | | | JCWP | | | | | |
| | 39 | | | | JCWP | | | | | |
| COMPAT | 40 | | | | JCWP | | | | | |
| | 41 | | | | JCWP | | | | | |
| | 42 | | | | JCWP | | | | | |
| | 45 | | | | CWP | | | J | | |
| | 46 | | | | JCWP | | | | | |
| | 47 | | | | JCWP | | | | | |
| | 48 | | | | JCWP | | | | | |

# APPENDIX FIVE

## STEP 4 - ROUND TWO

### ACTUAL CATEGORIES

| | Item No. | A | B | C | D | E | F | G | H | N/A |
|---|---|---|---|---|---|---|---|---|---|---|
| | 49 | | | | | JCWP | | | | |
| | 50 | | | | | JCWP | | | | |
| | 51 | | | | | JCWP | | | | |
| | 52 | | | | | JCWP | | | | |
| | 53 | | | | | CWP | | J | | |
| | 54 | | | | | JCWP | | | | |
| | 55 | | | | | JCWP | | | | |
| COMPLX | 56 | | | | | JCWP | | | | |
| | 57 | | | | | CWP | | J | | |
| | 58 | | | | | JCWP | | | | |
| | 59 | | | | J | CWP | | | | |
| | 61 | | | | | CWP | | J | | |
| | 62 | | | | | JCWP | | | | |
| | 63 | | | | | JCWP | | | | |
| | 64 | | | | | JCWP | | | | |
| | 65 | | | | | CWP | | J | | |
| | 66 | | | | | JCWP | | | | |
| | 68 | | | | | | JCWP | | | |
| | 73 | | | | | | JCWP | | | |
| RESULT | 75 | | | | | | JCWP | | | |
| DEMON | 76 | | | | | W | JC P | | | |
| | 77 | | | | | | JCWP | | | |
| | 78 | | | | | | J WP | | | C |
| | 80-1 | | | | | | JCWP | | | |
| | 80-2 | | | J | | | CWP | | | |
| | 82 | | | | | | | JCWP | | |
| | 83 | J | | | | | | CWP | | |
| | 84 | J | | | | | | CWP | | |
| | 85 | J | | | | | | CWP | | |
| TRIAL | 86 | | | | | | | JCWP | | |
| | 87 | J | | | | | | CWP | | |
| | 88 | | | | | | | JCWP | | |
| | 89 | J | | | | | | CWP | | |
| | 90 | J | | | | | | CWP | | |
| | 91 | J | | | | | | CWP | | |
| | 94 | | | | | | | JCWP | | |

## APPENDIX FIVE

## STEP 4 - ROUND TWO

### ACTUAL CATEGORIES

| | Item No. | A | B | C | D | E | F | G | H | N/A |
|---|---|---|---|---|---|---|---|---|---|---|
| | 95 | | | | | | | JW | C P | |
| | 96 | | | | | | | | JCWP | |
| | 97 | | | | | | | | JCWP | |
| | 98 | | | | | | | | JCWP | |
| VIS | 99 | | | | | | | | JCWP | |
| | 100 | | | | | | | | JCWP | |
| | 101 | | | | | | | | JCWP | |
| | 102 | | | | | | | | JCWP | |
| | 103 | | | | | | | | JCWP | |

APPENDIX SIX

## JUDGES' LABELS FOR CATEGORIES

**STEP 3 - ROUND ONE**

JUDGES

| CATEGORIES | | B | F | S | P |
|---|---|---|---|---|---|
| | A | Access/ Barriers | Voluntariness | Personal Fit | Voluntariness |
| | B | Image/ Visibility | Image | Image | Status |
| | C | Advanatages/ Disadvantages | Benefits | General Usefulness | Value |
| | D | Fit with Personal Style | Experience | Fit with job | Change in Work Patterns |
| | E | Required Skills | Understanding | Ease of use | Ease |
| | F | Explaining Results | Perception of Results | Measureability | |
| | G | | Trialability | Trialability | Availability |

**STEP THREE - ROUND ONE: PANEL'S LABELS AND DEFINITIONS**

A VOLUNTARINESS: the degree to which the use of the PWS is perceived as being voluntary.

B IMAGE: the degree to which the use of the PWS enhances one's image or status within the organisation.

C BENEFIT: the degree to which the use of the PWS is a benefit in one's job.

D COMPATIBILITY: the degree to which use of the PWS is compatible with (or requires change) in one's job.

E EASE OF USE: the degree to which the PWS is easy to learn and use.

F MEASUREABILITY: the degree to which the benefits of using the PWS are measureable.

G TRIALABILITY: the degree to which it is possible to try using the PWS.

APPENDIX SIX

# JUDGES' LABELS FOR CATEGORIES

## STEP THREE - ROUND TWO

JUDGES

<table>
<tr><th></th><th>M</th><th>S</th><th>N</th><th>D</th><th>J</th></tr>
<tr><td>A</td><td>Voluntary Usage</td><td>Voluntariness & Risk of Failure</td><td>PWS Required For Job?</td><td rowspan="2">External Pressure to Use PWS</td><td>Degree of Org/ Management Pressure to Use PWS</td></tr>
<tr><td>B</td><td>Status</td><td>Status</td><td>Visibility/ Status of PWS</td><td>Effect on Personal Image</td></tr>
<tr><td>C</td><td>Efficiency</td><td>Advantages of PWS</td><td>Job Enhancement</td><td>Perceived Costs & Benefits of Using PWS</td><td>Effects of PWS on job performance</td></tr>
<tr><td>D</td><td>Compatib- ility</td><td>Effect on Work habits/ Environment</td><td rowspan="2">Initial Perceptions of Using PWS</td><td></td><td>Amount of Change Required in Work Habits to Adopt PWS</td></tr>
<tr><td>E</td><td>Ease of Use</td><td>User Friendliness</td><td>Ease of Use</td><td>User Friendliness</td></tr>
<tr><td>F</td><td>Tangibil- ity</td><td>Measureability</td><td>Ability to Communicate Knowledge</td><td>Understand- ing conseq- uences of using PWS</td><td>Communicating pros & cons of PWS usage</td></tr>
<tr><td>G</td><td rowspan="2">Exposure</td><td>Accessibility</td><td>Testing the PWS</td><td>Ease of Experiment- ation</td><td>Climate for risk taking, experi- mentation</td></tr>
<tr><td>H</td><td>Familiarity with PWS</td><td>Awareness of PWS</td><td>Exposure to PWS</td><td>Exposure to PWS appearance and usage by o hers</td></tr>
</table>

APPENDIX SEVEN

# INTER-JUDGE AGREEMENTS

| | STEP 3-1 | STEP 4-1 | STEP 3-2 | STEP 4-2 |
|---|---|---|---|---|
| Raw Agreement | .86 | .88 | .64 | .74 |
| | .74 | .87 | .60 | .75 |
| | .83 | .85 | .82 | .78 |
| | .80 | .87 | .79 | .91 |
| | .85 | .86 | .74 | .96 |
| | .90 | .82 | .69 | .93 |
| | | | .94 | |
| | | | .76 | |
| | | | .78 | |
| | | | .76 | |
| Average | .83 | .86 | .75 | .85 |
| Cohen's Kappa | | | | |
| | .84 | .86 | .58 | .70 |
| | .70 | .85 | .53 | .72 |
| | .80 | .82 | .79 | .74 |
| | .76 | .84 | .76 | .89 |
| | .82 | .83 | .70 | .96 |
| | .89 | .79 | .64 | .92 |
| | | | .94 | |
| | | | .70 | |
| | | | .74 | |
| | | | .71 | |
| Average | .80 | .83 | .71 | .82 |
| Placement Ratios Summary (See Appendix 8) | | | | |
| Voluntariness | 1.00 | .96 | .93 | 1.00 |
| Image | .94 | 1.00 | .72 | .93 |
| Relative Adv | 1.00 | .90 | .98 | .87 |
| Compatibility | .73 | .91 | .53 | .98 |
| Ease of Use | .99 | .96 | 1.00 | .93 |
| Observability | .43 | .73 | | |
| Result Demon | | | .94 | .91 |
| Trialability | .91 | .96 | .83 | .84 |
| Visibility | | | .73 | .94 |
| Average | .85 | .92 | .86 | .92 |

APPENDIX EIGHT

# ITEM PLACEMENT RATIOS

## TABLE 1 : STEP 3-1

ACTUAL CATEGORIES
(Before Discussion)

| TARGET CAT | VOL | IMAGE | RELADV | CMPAT | EOU | OBSERV | TRIAL | N/A | TOTAL | TGT % |
|---|---|---|---|---|---|---|---|---|---|---|
| VOL | 20 | | 1 | 3 | | | | | 24 | 83 |
| IMAGE | | 29 | 3 | | | | | | 32 | 91 |
| RELADV | | 1 | 71 | | | | | | 72 | 99 |
| CMPAT | 5 | 1 | 3 | 42 | 4 | 1 | | 8 | 64 | 66 |
| EOU | | | 2 | | 69 | | | 1 | 72 | 96 |
| OBSERV | 1 | 1 | 23 | | 3 | 24 | 2 | 2 | 56 | 43 |
| TRIAL | 17 | | | 1 | | | 38 | | 56 | 68 |

Hits: 293 Overall ratio: 78%

## TABLE 2: STEP 3-1

ACTUAL CATEGORIES
(After Discussion)

| TARGET CAT | VOL | IMAGE | RELADV | CMPAT | EOU | OBSERV | TRIAL | N/A | TOTAL | TGT % |
|---|---|---|---|---|---|---|---|---|---|---|
| VOL | 24 | | | | | | | | 24 | 100 |
| IMAGE | | 30 | 2 | | | | | | 32 | 94 |
| RELADV | | | 72 | | | | | | 72 | 100 |
| CMPAT | 2 | 1 | 2 | 47 | 4 | 1 | | 7 | 64 | 73 |
| EOU | | | | | 71 | | | 1 | 72 | 99 |
| OBSERV | 1 | 1 | 23 | | 3 | 24 | 2 | 2 | 56 | 43 |
| TRIAL | 4 | | | 1 | | | 51 | | 56 | 91 |

Hits: 376 Overall Ratio: 85%

## APPENDIX EIGHT

### TABLE 3: STEP 4-1

ACTUAL CATEGORIES

| TARGET CAT | VOL | IMAGE | RELADV | CMPAT | EOU | OBSERV | TRIAL | N/A | TOTAL | TGT % |
|---|---|---|---|---|---|---|---|---|---|---|
| VOL | 23 | | 1 | | | | | | 24 | 96 |
| IMAGE | | 32 | | | | | | | 32 | 100 |
| RELADV | | 3 | 65 | 2 | | | | 2 | 72 | 90 |
| CMPAT | 1 | | 1 | 40 | | | | 2 | 44 | 91 |
| EOU | | | | 1 | 66 | 1 | | | 68 | 96 |
| OBSERV | | 1 | 8 | 1 | | 32 | | 2 | 44 | 73 |
| TRIAL | | | | | 1 | | 50 | 1 | 52 | 96 |

Hits: 376 Overall Ratio: 85%

### TABLE 4: STEP 3-2

ACTUAL CATEGORIES

| TARGET CAT | VOL | IMAG | RADV | CMPT | EOU | DEMO | TRIAL | VIS | N/A | TOTAL | TGT % |
|---|---|---|---|---|---|---|---|---|---|---|---|
| VOL | 28 | | 2 | | | | | | | 30 | 93 |
| IMAGE | 7 | 29 | 4 | | | | | | | 40 | 72 |
| REL ADV | | | 83 | | 2 | | | | | 85 | 98 |
| COMPAT | 1 | | 5 | 29 | 13 | | 3 | 3 | 1 | 55 | 53 |
| EOU | | | | | 85 | | | | | 85 | 100 |
| DEMON | | | 1 | | | 47 | 1 | | 1 | 50 | 94 |
| TRIAL | 3 | | 1 | | 2 | | 54 | 2 | 4 | 65 | 83 |
| VIS | | | | | | | | 12 | 33 | 45 | 73 |

Hits: 388 Overall Ratio: 86%

## APPENDIX EIGHT

### TABLE 5: STEP 4-2

ACTUAL CATEGORIES

| TARGET CAT | VOL | IMAG | RADV | CMPT | EOU | DEMO | TRIAL | VIS | N/A | TOTAL | TGT % |
|---|---|---|---|---|---|---|---|---|---|---|---|
| VOL | 20 | | | | | | | | | 20 | 100 |
| IMAGE | | 26 | 1 | | | | | | 1 | 28 | 93 |
| REL ADV | | | 59 | 3 | | 3 | 2 | | 1 | 68 | 87 |
| COMPAT | | | | 43 | | | 1 | | | 44 | 98 |
| EOU | | | | 1 | 63 | | 4 | | | 68 | 93 |
| DEMON | | | 1 | | 1 | 29 | | | 1 | 32 | 91 |
| TRIAL | 7 | | | | | | 37 | | | 44 | 84 |
| VIS | | | | | | 2 | | 34 | | 36 | 94 |

Hits: 311 Overall Ratio: 92%

**APPENDIX TEN**

# FINAL QUESTIONNAIRE FORMAT

This appendix contains those sections in the questionnaire with items relevant to this dissertation. Section A of the questionnaire is not included in that its contents were not relevant. Similarly, the instructions for completion of the questionnaire have also been deleted.

The various PCI and the **Voluntariness** items were placed in a common section in random order. Therefore, for ease of reference, each of these constructs are listed below with an indication of the items used to measure them. Item numbers prefixed by "U" (for Users in Section B), and "N" (for Non-Users in Section C), parallel one another and hence, unless indicated otherwise, only the listing for users will be provided below. All respondents were directed to respond to **Section D** which includes the **Subjective Norm** items.

| | |
|---|---|
| **Attitude**: | B-1, Section B (Users); or C-1, Section C (Non-Users) |
| **Avoidance**: | U-10, U-12, U-30, U-35, U-39, U-41 |
| **Compatibility**: | U-2 (N-7), U-3, U-11, U-44 |
| **Ease of Use**: | U-5, U-13, U-23, U-24, U-29, U-31, U-32, U-40 |
| **Image**: | U-6, U-9, U-21, U-25, U-49 |
| **Relative Advantage**: | U-1, U-7 (N-2), U-8, U-26, U-34, U-37, U-42, U-47, U-48 |
| **Result Demonstrability**: | U-19, U-28, U-43, U-45 |
| **Trialability**: | U-16, U-20, U-27, U-38, U-46 |
| **Visibility**: | U-15, U-17, U-33, U-36, U-50 |
| **Voluntariness**: | U-4, U-14, U-18, U-22 |

# APPENDIX TEN

## WELCOME!

You are about to participate in a study of opinions about the usage of computers. In some sections, you will be asked questions about, and see reference to the **PWS**, which stands for **PERSONAL WORK STATION**. A **PWS** is defined as a set of computerized tools for an **individual**, and usually consists of a personal or **microcomputer** with one or more software packages, such as a spreadsheet or a word processing program. A PWS could also be a **computer terminal** that is hooked up to a central mainframe computer, again with the appropriate software. The key aspect of a PWS is that it is computer technology that you would use directly, as opposed to having someone else use for you.

In completing the questionnaire, please remember:

1. All the information you give is kept confidential.

2. We need answers to all questions. Please don't skip any.

3. Be honest - tell it like it is.

4. Please don't talk to others about how to respond to the questions. We would like your opinion, not the opinion of the group.

5. Even if you have never used a PWS, please answer all the questions as best as you can.

6. Move rapidly through the questionnaire. We are interested in your first impressions, so please don't spend an excessive amount of time on each question.

## APPENDIX TEN

### INSTRUCTIONS

In the attached questionnaire, we ask questions which make use of rating scales with seven places; you are asked to place an 'X' in the place that best describes your opinion. For example, if you were asked to rate "Driving a car in winter is easy" on such a scale, it would appear as follows:

Driving a car in winter is easy.

| likely | | | | | | | | unlikely |
|---|---|---|---|---|---|---|---|---|
| | extremely | quite | slightly | neither | slightly | quite | extremely | |

If you think that it is **extremely likely** that driving a car in winter is easy, you would make your mark as follows:

Driving a car in winter is easy.

| likely | X | | | | | | | unlikely |
|---|---|---|---|---|---|---|---|---|
| | extremely | quite | slightly | neither | slightly | quite | extremely | |

If you think that it is **neither likely nor unlikely** that driving a car in winter is easy, you would make your mark as follows:

Driving a car in winter is easy.

| likely | | | | X | | | | unlikely |
|---|---|---|---|---|---|---|---|---|
| | extremely | quite | slightly | neither | slightly | quite | extremely | |

In addition to the "likely-unlikely" pairs, other pairs such as "disagree-agree" will also be used. They should be answered in the same fashion. In making your ratings, please remember the following points:

1. Place your marks in the **middle** of spaces, **NOT ON THE BOUNDARIES.**

| likely | | X | | | | | x | unlikely |
|---|---|---|---|---|---|---|---|---|
| | extremely | quite | slightly | neither | slightly | quite | extremely | |
| | | **THIS** | | | | **NOT THIS** | | |

2. Never put more than one 'X' on a single answer line.

One other question format will also be used. In this case you will be asked to circle a number or letter corresponding to a particular answer for a question. Please be careful to see that your circle goes around only the letter or number which corresponds to your desired response.

## APPENDIX TEN

### SECTION B

Please answer questions in this section only if you currently use the PWS.

FIRST, WE WOULD LIKE TO GET YOUR IMPRESSIONS OF THE PWS.
IN THE FOLLOWING, WE WILL PRESENT YOU WITH A NUMBER OF STATEMENTS EXPRESSING PARTICULAR VIEWPOINTS ABOUT THE PWS. WE WOULD LIKE YOU TO INDICATE HOW MUCH EACH STATEMENT REFLECTS YOUR PERSONAL VIEWPOINT BY PLACING AN "X" IN THE APPROPRIATE PLACE ON THE DISAGREE-AGREE SCALES PROVIDED. ALTHOUGH THERE MAY APPEAR TO BE A NUMBER OF SIMILAR STATEMENTS, PLEASE PROVIDE A RESPONSE TO EACH ONE.

U-1 Using a PWS enables me to accomplish tasks more quickly.

disagree ¦____¦____¦____¦____¦____¦____¦____¦ agree
strongly quite slightly neither slightly quite strongly

U-2 Using a PWS improves the quality of work I do.

disagree ¦____¦____¦____¦____¦____¦____¦____¦ agree
strongly quite slightly neither slightly quite strongly

U-3 Using a PWS is compatible with all aspects of my work.

disagree ¦____¦____¦____¦____¦____¦____¦____¦ agree
strongly quite slightly neither slightly quite strongly

U-4 My superiors expect me to use a PWS.

disagree ¦____¦____¦____¦____¦____¦____¦____¦ agree
strongly quite slightly neither slightly quite strongly

U-5 I believe that a PWS is cumbersome to use.

disagree ¦____¦____¦____¦____¦____¦____¦____¦ agree
strongly quite slightly neither slightly quite strongly

U-6 Using a PWS improves my image within the organization.

disagree ¦____¦____¦____¦____¦____¦____¦____¦ agree
strongly quite slightly neither slightly quite strongly

U-7 Using a PWS is completely compatible with my current situation.

disagree ¦____¦____¦____¦____¦____¦____¦____¦ agree
strongly quite slightly neither slightly quite strongly

## APPENDIX TEN

U-8 Using a PWS makes it easier to do my job.

disagree ¦ ______ ¦ ______ ¦ ______ ¦ ______ ¦ ______ ¦ ______ ¦ ______ ¦ agree
strongly quite slightly neither slightly quite strongly

U-9 Because of my use of a PWS, others in my organization see me as a more valuable employee.

disagree ¦ ______ ¦ ______ ¦ ______ ¦ ______ ¦ ______ ¦ ______ ¦ ______ ¦ agree
strongly quite slightly neither slightly quite strongly

U-10 My using a PWS enables my work to be more controlled by others.

disagree ¦ ______ ¦ ______ ¦ ______ ¦ ______ ¦ ______ ¦ ______ ¦ ______ ¦ agree
strongly quite slightly neither slightly quite strongly

U-11 I think that using a PWS fits well with the way I like to work.

disagree ¦ ______ ¦ ______ ¦ ______ ¦ ______ ¦ ______ ¦ ______ ¦ ______ ¦ agree
strongly quite slightly neither slightly quite strongly

U-12 PWS usage results in many aspects of my job becoming more repetitive and boring.

disagree ¦ ______ ¦ ______ ¦ ______ ¦ ______ ¦ ______ ¦ ______ ¦ ______ ¦ agree
strongly quite slightly neither slightly quite strongly

U-13 It is easy for me to remember how to perform tasks using a PWS.

disagree ¦ ______ ¦ ______ ¦ ______ ¦ ______ ¦ ______ ¦ ______ ¦ ______ ¦ agree
strongly quite slightly neither slightly quite strongly

U-14 My use of a PWS is voluntary (as opposed to required by my superiors or job description).

disagree ¦ ______ ¦ ______ ¦ ______ ¦ ______ ¦ ______ ¦ ______ ¦ ______ ¦ agree
strongly quite slightly neither slightly quite strongly

U-15 I have seen what others do using their PWS.

disagree ¦ ______ ¦ ______ ¦ ______ ¦ ______ ¦ ______ ¦ ______ ¦ ______ ¦ agree
strongly quite slightly neither slightly quite strongly

U-16 I've had a great deal of opportunity to try various PWS applications.

disagree ¦ ______ ¦ ______ ¦ ______ ¦ ______ ¦ ______ ¦ ______ ¦ ______ ¦ agree
strongly quite slightly neither slightly quite strongly

## APPENDIX TEN

U-17 In my organization, one sees PWS on many desks.

disagree ¦____¦____¦____¦____¦____¦____¦____¦ agree
strongly quite slightly neither slightly quite strongly

U-18 My boss does not require me to use a PWS.

disagree ¦____¦____¦____¦____¦____¦____¦____¦ agree
strongly quite slightly neither slightly quite strongly

U-19 I would have no difficulty telling others about the results of using a PWS.

disagree ¦____¦____¦____¦____¦____¦____¦____¦ agree
strongly quite slightly neither slightly quite strongly

U-20 I know where I can go to satisfactorily try out various uses of a PWS.

disagree ¦____¦____¦____¦____¦____¦____¦____¦ agree
strongly quite slightly neither slightly quite strongly

U-21 People in my organization who use a PWS have more prestige than those who do not.

disagree ¦____¦____¦____¦____¦____¦____¦____¦ agree
strongly quite slightly neither slightly quite strongly

U-22 Although it might be helpful, using a PWS is certainly not compulsory in my job.

disagree ¦____¦____¦____¦____¦____¦____¦____¦ agree
strongly quite slightly neither slightly quite strongly

U-23 My using a PWS requires a lot of mental effort.

disagree ¦____¦____¦____¦____¦____¦____¦____¦ agree
strongly quite slightly neither slightly quite strongly

U-24 Using a PWS is often frustrating.

disagree ¦____¦____¦____¦____¦____¦____¦____¦ agree
strongly quite slightly neither slightly quite strongly

U-25 People in my organization who use a PWS have a high profile.

disagree ¦____¦____¦____¦____¦____¦____¦____¦ agree
strongly quite slightly neither slightly quite strongly

## APPENDIX TEN

U-26 The <u>disadvantages</u> of my using a PWS far outweigh the advantages.

disagree ¦____¦____¦____¦____¦____¦____¦____¦ agree
strongly quite slightly neither slightly quite strongly

U-27 A PWS was available to me to adequately test run various applications.

disagree ¦____¦____¦____¦____¦____¦____¦____¦ agree
strongly quite slightly neither slightly quite strongly

U-28 I believe I could communicate to others the consequences of using a PWS.

disagree ¦____¦____¦____¦____¦____¦____¦____¦ agree
strongly quite slightly neither slightly quite strongly

U-29 My interaction with a PWS is clear and understandable.

disagree ¦____¦____¦____¦____¦____¦____¦____¦ agree
strongly quite slightly neither slightly quite strongly

U-30 Using a PWS may adversely affect my health.

disagree ¦____¦____¦____¦____¦____¦____¦____¦ agree
strongly quite slightly neither slightly quite strongly

U-31 I believe that it is easy to get a PWS to do what I want it to do.

disagree ¦____¦____¦____¦____¦____¦____¦____¦ agree
strongly quite slightly neither slightly quite strongly

U-32 Overall, I believe that a PWS is easy to use.

disagree ¦____¦____¦____¦____¦____¦____¦____¦ agree
strongly quite slightly neither slightly quite strongly

U-33 I have seen a PWS in use outside my firm.

disagree ¦____¦____¦____¦____¦____¦____¦____¦ agree
strongly quite slightly neither slightly quite strongly

U-34 Using a PWS improves my job performance.

disagree ¦____¦____¦____¦____¦____¦____¦____¦ agree
strongly quite slightly neither slightly quite strongly

U-35 My using a PWS enables my job performance to be more closely monitored by others.

disagree ¦____¦____¦____¦____¦____¦____¦____¦ agree
strongly quite slightly neither slightly quite strongly

## APPENDIX TEN

U-36 PWS are not very visible in my organization.

disagree : strongly : quite : slightly : neither : slightly : quite : strongly : agree

U-37 Overall, I find using a PWS to be advantageous in my job.

disagree : strongly : quite : slightly : neither : slightly : quite : strongly : agree

U-38 Before deciding whether to use any PWS applications, I was able to properly try them out.

disagree : strongly : quite : slightly : neither : slightly : quite : strongly : agree

U-39 Introduction of a PWS in my organization may eventually result in the elimination of my job.

disagree : strongly : quite : slightly : neither : slightly : quite : strongly : agree

U-40 Learning to operate a PWS is easy for me.

disagree : strongly : quite : slightly : neither : slightly : quite : strongly : agree

U-41 My using a PWS unrealistically raises others' expectations about the amount of work that I can accomplish.

disagree : strongly : quite : slightly : neither : slightly : quite : strongly : agree

U-42 Using a PWS enhances my effectiveness on the job.

disagree : strongly : quite : slightly : neither : slightly : quite : strongly : agree

U-43 The results of using a PWS are apparent to me.

disagree : strongly : quite : slightly : neither : slightly : quite : strongly : agree

U-44 Using a PWS fits into my work style.

disagree : strongly : quite : slightly : neither : slightly : quite : strongly : agree

## APPENDIX TEN

U-45 I would have difficulty explaining why using a PWS may or may not be beneficial.

| disagree | strongly | quite | slightly | neither | slightly | quite | strongly | agree |
|---|---|---|---|---|---|---|---|---|

U-46 I was permitted to use a PWS on a trial basis long enough to see what it could do.

| disagree | strongly | quite | slightly | neither | slightly | quite | strongly | agree |
|---|---|---|---|---|---|---|---|---|

U-47 Using a PWS gives me greater control over my work.

| disagree | strongly | quite | slightly | neither | slightly | quite | strongly | agree |
|---|---|---|---|---|---|---|---|---|

U-48 Using a PWS increases my productivity.

| disagree | strongly | quite | slightly | neither | slightly | quite | strongly | agree |
|---|---|---|---|---|---|---|---|---|

U-49 Having a PWS is a status symbol in my organization.

| disagree | strongly | quite | slightly | neither | slightly | quite | strongly | agree |
|---|---|---|---|---|---|---|---|---|

U-50 It is easy for me to observe others using PWS in my firm.

| disagree | strongly | quite | slightly | neither | slightly | quite | strongly | agree |
|---|---|---|---|---|---|---|---|---|

**FINALLY, IN THIS SECTION WE WOULD LIKE TO ASK YOU A FEW QUESTIONS ABOUT YOUR USE OF THE PWS.**

B-1 Overall, my using a PWS in my job is: (place an X on all four scales)

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| good | extremely | quite | slightly | neither | slightly | quite | extremely | bad |
| harmful | extremely | quite | slightly | neither | slightly | quite | extremely | beneficial |
| wise | extremely | quite | slightly | neither | slightly | quite | extremely | foolish |
| negative | extremely | quite | slightly | neither | slightly | quite | extremely | positive |

## APPENDIX TEN

B-3 Approximately when (month and year) did you first start using a PWS beyond any trial of it you may have carried out?

______ MONTH
______ YEAR

B-4 Overall, how many hours per week do you use a PWS?

______ HOURS

B-5 How regularly do you now use a PWS?

1 NOT AT ALL
2 LESS THAN ONCE PER MONTH
3 ABOUT 1-3 TIMES PER MONTH
4 ABOUT ONCE PER WEEK
5 ABOUT 2 TO 4 TIMES PER WEEK
6 ABOUT ONCE PER DAY
7 MORE THAN ONCE PER DAY

B-6 For each computer function listed below, please indicate whether you use it on a mainframe computer, on a microcomputer, on both, or on neither. (Circle one number in each row)

| | Mainframe | Micro | Both | Neither |
|---|---|---|---|---|
| a. Database Management System | 1 | 2 | 3 | 4 |
| b. Modelling System (planning, budgeting) | 1 | 2 | 3 | 4 |
| c. Spreadsheet | 1 | 2 | 3 | 4 |
| d. Text/word processing | 1 | 2 | 3 | 4 |
| e. Statistical analysis | 1 | 2 | 3 | 4 |
| f. Graphics generation | 1 | 2 | 3 | 4 |
| g. Electronic mail | 1 | 2 | 3 | 4 |
| h. Calendaring | 1 | 2 | 3 | 4 |
| i. Information retrieval | 1 | 2 | 3 | 4 |
| j. Report generation | 1 | 2 | 3 | 4 |
| k. Interactive structured programming language | 1 | 2 | 3 | 4 |
| l. Other (please specify) | 1 | 2 | 3 | 4 |

________________________________________

## APPENDIX TEN

B-7 On average, how <u>frequently</u> do you <u>currently</u> use the following functions (Circle one number in each row):

| | not at all | less than once per month | about 1-3 times per month | about once per week | 2-4 times per week | about once per day | more than once per day |
|---|---|---|---|---|---|---|---|
| a. Database Management System | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| b. Modelling System (planning, budgeting) | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| c. Spreadsheet | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| d. Text/word processing | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| e. Statistical analysis | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| f. Graphics generation | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| g. Electronic mail | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| h. Calendaring | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| i. Information retrieval | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| j. Report generation | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| k. Interactive structured programming language | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| l. Other (please specify) | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

_______________________________________________

B-8 On average how many <u>hours per week</u> do you spend using the PWS on the following functions?

Hours

_____ Database Management System

_____ Modelling System (planning, budgeting)

_____ Spreadsheet

_____ Text/word processing

_____ Statistical analysis

_____ Graphics generation

_____ Electronic mail

_____ Calendaring

_____ Information retrieval

_____ Report generation

_____ Interactive structured programming language

_____ Other (please specify) ______________________________

_______________________________________________

## APPENDIX TEN

B-9 Please indicate approximately how long (in months) you have been regularly using any of the following functions.

Months

_____ Database Management System
_____ Modelling System (planning, budgeting)
_____ Spreadsheet
_____ Text/word processing
_____ Statistical analysis
_____ Graphics generation
_____ Electronic mail
_____ Calendaring
_____ Information retrieval
_____ Report generation
_____ Interactive structured programming language
_____ Other (please specify) ____________________
__________________________________________

B-10 Overall, how has your usage of the PWS changed in the last six months?

1 INCREASED SIGNIFICANTLY
2 INCREASED SOMEWHAT
3 INCREASED MARGINALLY
4 STAYED ABOUT THE SAME
5 DECREASED MARGINALLY
6 DECREASED SOMEWHAT
7 DECREASED SIGNIFICANTLY

B-11 I have been using a PWS for (pick most accurate number):

1 LESS THAN 1 MONTH
2 BETWEEN 1 AND 3 MONTHS
3 BETWEEN 3 AND 6 MONTHS
4 BETWEEN 6 AND 12 MONTHS
5 BETWEEN 12 AND 18 MONTHS
6 BETWEEN 18 AND 24 MONTHS
7 MORE THAN 24 MONTHS

## APPENDIX TEN

## SECTION C

Please answer questions in this section only if you do NOT currently use a PWS

IN THE FOLLOWING WE WILL PRESENT YOU WITH A NUMBER OF STATEMENTS EXPRESSING PARTICULAR VIEWPOINTS ABOUT THE PWS. WE WOULD LIKE YOU TO INDICATE HOW MUCH EACH STATEMENT REFLECTS YOUR PERSONAL VIEWPOINT BY PLACING AN "X" IN THE APPROPRIATE PLACE ON THE DISAGREE-AGREE SCALE. ALTHOUGH THERE MAY APPEAR TO BE A NUMBER OF SIMILAR STATEMENTS, PLEASE PROVIDE A RESPONSE TO EACH ONE.

N-1 Using a PWS would enable me to accomplish tasks more quickly.

disagree :______:______:______:______:______:______:______: agree
strongly quite slightly neither slightly quite strongly

N-2 Using a PWS would improve the quality of work I do.

disagree :______:______:______:______:______:______:______: agree
strongly quite slightly neither slightly quite strongly

N-3 Using a PWS would be compatible with all aspects of my work.

disagree :______:______:______:______:______:______:______: agree
strongly quite slightly neither slightly quite strongly

N-4 My superiors expect me to use a PWS.

disagree :______:______:______:______:______:______:______: agree
strongly quite slightly neither slightly quite strongly

N-5 I believe that a PWS would be cumbersome to use.

disagree :______:______:______:______:______:______:______: agree
strongly quite slightly neither slightly quite strongly

N-6 Using a PWS would improve my image within the organization.

disagree :______:______:______:______:______:______:______: agree
strongly quite slightly neither slightly quite strongly

N-7 Using a PWS would be completely compatible with my current situation.

disagree :______:______:______:______:______:______:______: agree
strongly quite slightly neither slightly quite strongly

## APPENDIX TEN

N-8 Using a PWS would make it easier to do my job.

disagree ¦ strongly ¦ quite ¦ slightly ¦ neither ¦ slightly ¦ quite ¦ strongly ¦ agree

N-9 If I were to use a PWS, others in my organization would see me as a more valuable employee.

disagree ¦ strongly ¦ quite ¦ slightly ¦ neither ¦ slightly ¦ quite ¦ strongly ¦ agree

N-10 My using a PWS would enable my work to be more controlled by others.

disagree ¦ strongly ¦ quite ¦ slightly ¦ neither ¦ slightly ¦ quite ¦ strongly ¦ agree

N-11 I think that using a PWS would fit well with the way I like to work.

disagree ¦ strongly ¦ quite ¦ slightly ¦ neither ¦ slightly ¦ quite ¦ strongly ¦ agree

N-12 PWS usage would result in many aspects of my job becoming more repetitive and boring.

disagree ¦ strongly ¦ quite ¦ slightly ¦ neither ¦ slightly ¦ quite ¦ strongly ¦ agree

N-13 It would be easy for me to remember how to perform tasks using a PWS.

disagree ¦ strongly ¦ quite ¦ slightly ¦ neither ¦ slightly ¦ quite ¦ strongly ¦ agree

N-14 My use of a PWS is voluntary (as opposed to required by my superiors or job description).

disagree ¦ strongly ¦ quite ¦ slightly ¦ neither ¦ slightly ¦ quite ¦ strongly ¦ agree

N-15 I have seen what others do using their PWS.

disagree ¦ strongly ¦ quite ¦ slightly ¦ neither ¦ slightly ¦ quite ¦ strongly ¦ agree

N-16 I've had a great deal of opportunity to try various PWS applications.

disagree ¦ strongly ¦ quite ¦ slightly ¦ neither ¦ slightly ¦ quite ¦ strongly ¦ agree

## APPENDIX TEN

N-17 In my organization, one sees PWS on many desks.

disagree : _____ : _____ : _____ : _____ : _____ : _____ : _____ : agree
strongly quite slightly neither slightly quite strongly

N-18 My boss does not require me to use a PWS.

disagree : _____ : _____ : _____ : _____ : _____ : _____ : _____ : agree
strongly quite slightly neither slightly quite strongly

N-19 I would have no difficulty telling others about the results of using a PWS.

disagree : _____ : _____ : _____ : _____ : _____ : _____ : _____ : agree
strongly quite slightly neither slightly quite strongly

N-20 I know where I can go to satisfactorily try out various uses of a PWS.

disagree : _____ : _____ : _____ : _____ : _____ : _____ : _____ : agree
strongly quite slightly neither slightly quite strongly

N-21 People in my organization who use a PWS have more prestige than those who do not.

disagree : _____ : _____ : _____ : _____ : _____ : _____ : _____ : agree
strongly quite slightly neither slightly quite strongly

N-22 Although it might be helpful, using a PWS is certainly not compulsory in my job.

disagree : _____ : _____ : _____ : _____ : _____ : _____ : _____ : agree
strongly quite slightly neither slightly quite strongly

N-23 My using a PWS would require a lot of mental effort.

disagree : _____ : _____ : _____ : _____ : _____ : _____ : _____ : agree
strongly quite slightly neither slightly quite strongly

N-24 Using a PWS would often be frustrating.

disagree : _____ : _____ : _____ : _____ : _____ : _____ : _____ : agree
strongly quite slightly neither slightly quite strongly

N-25 People in my organization who use a PWS have a high profile.

disagree : _____ : _____ : _____ : _____ : _____ : _____ : _____ : agree
strongly quite slightly neither slightly quite strongly

## APPENDIX TEN

N-26 The disadvantages of my using a PWS far outweigh the advantages.

disagree ¦ strongly ¦ quite ¦ slightly ¦ neither ¦ slightly ¦ quite ¦ strongly ¦ agree

N-27 A PWS is available to me to adequately test run various applications.

disagree ¦ strongly ¦ quite ¦ slightly ¦ neither ¦ slightly ¦ quite ¦ strongly ¦ agree

N-28 I believe I could communicate to others the consequences of using a PWS.

disagree ¦ strongly ¦ quite ¦ slightly ¦ neither ¦ slightly ¦ quite ¦ strongly ¦ agree

N-29 My interaction with a PWS would be clear and understandable.

disagree ¦ strongly ¦ quite ¦ slightly ¦ neither ¦ slightly ¦ quite ¦ strongly ¦ agree

N-30 Using a PWS may adversely affect my health.

disagree ¦ strongly ¦ quite ¦ slightly ¦ neither ¦ slightly ¦ quite ¦ strongly ¦ agree

N-31 I believe that it would be easy to get a PWS to do what I want it to do.

disagree ¦ strongly ¦ quite ¦ slightly ¦ neither ¦ slightly ¦ quite ¦ strongly ¦ agree

N-32 Overall, I believe that a PWS would be easy to use.

disagree ¦ strongly ¦ quite ¦ slightly ¦ neither ¦ slightly ¦ quite ¦ strongly ¦ agree

N-33 I have seen a PWS in use outside my firm.

disagree ¦ strongly ¦ quite ¦ slightly ¦ neither ¦ slightly ¦ quite ¦ strongly ¦ agree

N-34 Using a PWS would improve my job performance.

disagree ¦ strongly ¦ quite ¦ slightly ¦ neither ¦ slightly ¦ quite ¦ strongly ¦ agree

## APPENDIX TEN

N-35 My using a PWS would enable my job performance to be more closely monitored by others.

disagree :_____:_____:_____:_____:_____:_____:_____: agree
strongly quite slightly neither slightly quite strongly

N-36 PWS are <u>not</u> very visible in my organization.

disagree :_____:_____:_____:_____:_____:_____:_____: agree
strongly quite slightly neither slightly quite strongly

N-37 Overall, I would find using a PWS to be advantageous in my job.

disagree :_____:_____:_____:_____:_____:_____:_____: agree
strongly quite slightly neither slightly quite strongly

N-38 Before deciding whether to use any PWS applications, I would be able to properly try them out.

disagree :_____:_____:_____:_____:_____:_____:_____: agree
strongly quite slightly neither slightly quite strongly

N-39 Introduction of the PWS in my organization may eventually result in the elimination of my job.

disagree :_____:_____:_____:_____:_____:_____:_____: agree
strongly quite slightly neither slightly quite strongly

N-40 Learning to operate a PWS would be easy for me.

disagree :_____:_____:_____:_____:_____:_____:_____: agree
strongly quite slightly neither slightly quite strongly

N-41 My using a PWS would unrealistically raise others' expectations about the amount of work that I can accomplish.

disagree :_____:_____:_____:_____:_____:_____:_____: agree
strongly quite slightly neither slightly quite strongly

N-42 Using a PWS would enhance my effectiveness on the job.

disagree :_____:_____:_____:_____:_____:_____:_____: agree
strongly quite slightly neither slightly quite strongly

N-43 The results of using a PWS are apparent to me.

disagree :_____:_____:_____:_____:_____:_____:_____: agree
strongly quite slightly neither slightly quite strongly

## APPENDIX TEN

N-44 Using a PWS would fit into my work style.

disagree ¦____¦____¦____¦____¦____¦____¦____¦ agree
strongly quite slightly neither slightly quite strongly

N-45 If I were to use a PWS, I would have difficulty explaining why using a PWS may or may not be beneficial.

disagree ¦____¦____¦____¦____¦____¦____¦____¦ agree
strongly quite slightly neither slightly quite strongly

N-46 I would be permitted to use a PWS on a trial basis long enough to see what it could do.

disagree ¦____¦____¦____¦____¦____¦____¦____¦ agree
strongly quite slightly neither slightly quite strongly

N-47 Using a PWS would give me greater control over my work.

disagree ¦____¦____¦____¦____¦____¦____¦____¦ agree
strongly quite slightly neither slightly quite strongly

N-48 Using a PWS would increase my productivity.

disagree ¦____¦____¦____¦____¦____¦____¦____¦ agree
strongly quite slightly neither slightly quite strongly

N-49 Having a PWS is a status symbol in my organization.

disagree ¦____¦____¦____¦____¦____¦____¦____¦ agree
strongly quite slightly neither slightly quite strongly

N-50 It is easy for me to observe others using a PWS in my firm.

disagree ¦____¦____¦____¦____¦____¦____¦____¦ agree
strongly quite slightly neither slightly quite strongly

**FINALLY, IN THIS SECTION WE WOULD LIKE TO ASK A GENERAL QUESTION**

C-1 Overall, my using a PWS in my job would be: (place an X on all four scales)

good ¦____¦____¦____¦____¦____¦____¦____¦ bad
extremely quite slightly neither slightly quite extremely

harmful ¦____¦____¦____¦____¦____¦____¦____¦ beneficial
extremely quite slightly neither slightly quite extremely

wise ¦____¦____¦____¦____¦____¦____¦____¦ foolish
extremely quite slightly neither slightly quite extremely

negative ¦____¦____¦____¦____¦____¦____¦____¦ positive
extremely quite slightly neither slightly quite extremely

## APPENDIX TEN

## SECTION D

In this last section, we would like to ask you some questions about yourself. Remember, all answers are confidential, and no respondent can be identified, so please give as honest a response as possible.

**FIRST, WE WOULD LIKE YOU TO ONCE AGAIN INDICATE AGREEMENT OR DISAGREEMENT WITH A NUMBER OF STATEMENTS; THIS TIME ABOUT YOURSELF. PLEASE PLACE AN "X" IN THE APPROPRIATE SPACE.**

I-1 I am generally cautious about accepting new ideas.

disagree ¦________¦________¦________¦________¦________¦________¦________¦ agree
strongly quite slightly neither slightly quite strongly

I-2 I rarely trust new ideas until I can see whether the vast majority of people around me accept them.

disagree ¦________¦________¦________¦________¦________¦________¦________¦ agree
strongly quite slightly neither slightly quite strongly

I-3 I am aware that I am usually one of the last people in my group to accept something new.

disagree ¦________¦________¦________¦________¦________¦________¦________¦ agree
strongly quite slightly neither slightly quite strongly

I-4 I am reluctant about adopting new ways of doing things until I see them working for people around me.

disagree ¦________¦________¦________¦________¦________¦________¦________¦ agree
strongly quite slightly neither slightly quite strongly

I-5 I find it stimulating to be original in my thinking and behaviour.

disagree ¦________¦________¦________¦________¦________¦________¦________¦ agree
strongly quite slightly neither slightly quite strongly

I-6 I tend to feel that the old way of living and doing things is the best way.

disagree ¦________¦________¦________¦________¦________¦________¦________¦ agree
strongly quite slightly neither slightly quite strongly

I-7 I am challenged by ambiguities and unsolved problems.

disagree ¦________¦________¦________¦________¦________¦________¦________¦ agree
strongly quite slightly neither slightly quite strongly

## APPENDIX TEN

I-8 I must see other people using new innovations before I will consider them.

disagree :______:______:______:______:______:______:______: agree
strongly quite slightly neither slightly quite strongly

I-9 I am challenged by unanswered questions.

disagree :______:______:______:______:______:______:______: agree
strongly quite slightly neither slightly quite strongly

I-10 I often find myself skeptical of new ideas.

disagree :______:______:______:______:______:______:______: agree
strongly quite slightly neither slightly quite strongly

**NEXT, WOULD YOU PLEASE INDICATE HOW LIKELY OR UNLIKELY EACH OF THE FOLLOWING STATEMENTS ARE BY ONCE AGAIN PLACING AN "X" IN THE APPROPRIATE SPACE.**

S-1 Most people who are important to me think I should use the PWS in my job.

likely :______:______:______:______:______:______:______: unlikely
extremely quite slightly neither slightly quite extremely

S-2 My close friends think that I should use the PWS in my job.

likely :______:______:______:______:______:______:______: unlikely
extremely quite slightly neither slightly quite extremely

S-3 My co-workers (peers) think that I should use the PWS in my job.

likely :______:______:______:______:______:______:______: unlikely
extremely quite slightly neither slightly quite extremely

S-4 My immediate superiors think that I should use the PWS in my job.

likely :______:______:______:______:______:______:______: unlikely
extremely quite slightly neither slightly quite extremely

S-5 Senior management thinks that I should use the PWS in my job.

likely :______:______:______:______:______:______:______: unlikely
extremely quite slightly neither slightly quite extremely

## APPENDIX TEN

S-6 My subordinates think I should use the PWS in my job.

likely :____:____:____:____:____:____:____: unlikely
extremely quite slightly neither slightly quite extremely

S-7 Generally speaking, I want to do what most people who are important to me think I should do.

likely :____:____:____:____:____:____:____: unlikely
extremely quite slightly neither slightly quite extremely

S-8 Generally speaking, I want to do what my close friends think I should do.

likely :____:____:____:____:____:____:____: unlikely
extremely quite slightly neither slightly quite extremely

S-9 Generally speaking, I want to do what my co-workers think I should do.

likely :____:____:____:____:____:____:____: unlikely
extremely quite slightly neither slightly quite extremely

S-10 Generally speaking, I want to do what my immediate superiors think I should do.

likely :____:____:____:____:____:____:____: unlikely
extremely quite slightly neither slightly quite extremely

S-11 Generally speaking, I want to do what senior management thinks I should do.

likely :____:____:____:____:____:____:____: unlikely
extremely quite slightly neither slightly quite extremely

S-12 Generally speaking, I want to do what my subordinates think I should do.

likely :____:____:____:____:____:____:____: unlikely
extremely quite slightly neither slightly quite extremely

## APPENDIX TEN

**FINALLY, WE WOULD LIKE TO ASK A FEW QUESTIONS ABOUT YOURSELF FOR STATISTICAL PURPOSES. COULD YOU PLEASE INDICATE:**

P-1 Your sex (circle number of your answer)

1 MALE
2 FEMALE

P-2 Your present age: ______ years

P-3 Your department: ______________________________

P-4 Your job title: ______________________________

P-5 Years you have worked in your current department. _______ years

P-6 Years you have worked in this company. _______ years

P-7 What is the highest level of education that you completed? (circle number)

1 GRADE SCHOOL
2 SOME HIGH SCHOOL
3 HIGH SCHOOL GRADUATE
4 SOME TECHNICAL COLLEGE
5 TECHNICAL COLLEGE GRADUATE
6 SOME COMMUNITY COLLEGE
7 COMMUNITY COLLEGE GRADUATE
8 SOME UNIVERSITY
9 UNIVERSITY GRADUATE
10 POSTGRADUATE

P-8 Circle which <u>best</u> describes your job with respect to organizational level.

1 EXECUTIVE/TOP MANAGEMENT
2 MIDDLE MANAGEMENT
3 SUPERVISORY
4 PROFESSIONAL/EXEMPT
5 TECHNICAL/NON-EXEMPT
6 CLERICAL
7 OTHER (please specify)______________________________

## APPENDIX TEN

P-15 **THANK YOU VERY MUCH FOR YOUR PARTICIPATION!**

If you wish to add any comments or further observations, please use the space below or simply attach them to this page.

APPENDIX ELEVEN

# INVENTORY OF HYPOTHESES

**H1**: One's attitude towards using PWS will influence one's innovativeness with respect to PWS usage.

**H2**: Relative Advantage will have a contribution greater than any other PCI in the formation of one's attitude towards adopting a PWS.

**H3**: Computer Avoidance will have a contribution less than any other PCI on one's attitude towards adopting PWS.

**H4**: The Subjective Norm will influence one's innovativeness with respect to PWS usage.

**H5**: The Subjective Norm will influence one's attitude towards adopting the PWS.

**H6**: Voluntariness is negatively related to one's innovativeness with respect to PWS usage.

**H7**: Voluntariness will be negatively related to one's attitude towards using PWS.

**APPENDIX TWELVE**

## GLOSSARY OF ABBREVIATIONS

| | |
|---|---|
| AGFI | Adjusted Goodness of Fit Index |
| $A_B$ | Attitude towards performing a behaviour |
| $A_m$ | Attitude as directly measured by questionnaire items |
| $A_o$ | Attitude towards an object |
| B | Behaviour |
| BI | Behavioural Intention |
| DOI | Diffusion of Innovations |
| DSS | Decision Support System |
| EUC | End User Computing |
| GFI | Goodness of Fit Index |
| GLB | Guttman's Lower Bound for Scale Reliability |
| ID Model | Innovation Diffusion Model |
| IFPS | Interactive Financial Planning System |
| IS | Information Systems |
| ISD | Information Systems Department |
| IT | Information Technology |
| MC | Motivation to Comply |
| MIS | Management Information Systems |
| MS/OR | Management Science/ Operations Research |
| MTMM | Multi-Trait Multi-Method |
| NB | Normative Belief |
| OA | Office Automation |
| PCI | Perceived Characteristics of Innovating |
| PWS | Personal Work Station |
| RA | Reasoned Action |
| RMR | Root Mean-Square Residual |
| SMC | Squared Multiple Correlation |
| SN | Subjective Norm |
| TAM | Technology Acceptance Model |
| TE | Total Effects |