PREDICTORS OF NURSE ADOPTION OF A
COMPUTERIZED INFORMATION SYSTEM
AS AN INNOVATION

by

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ABSTRACT

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Carol Ann Romano, Doctor of Philosophy, 1993

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Computerized information systems are viewed as innovations in the health care delivery system and are used by nurses to support the management of clinical and administrative information. The development, implementation and use of computerized information systems are viewed as predictable activities in the future health care environment. Adoption of these innovations is critical to the achievement of improved information management. Nurses are challenged to direct these activities to achieve efficiency, effectiveness and productivity in the delivery of health care services. The adoption of information systems is envisioned as a vehicle to enhance and improve the quality of information and ultimately the quality of nursing practice.

This study explored factors that influence the adoption of a computerized information system as an innovation after it is first introduced to members of a social system. Individual, technological and organizational characteristics were investigated as predictors of adoption using multiple
regression analyses, and the effect of organizational position on adoption was analyzed. Findings evidenced that over one half of the variance in adoption was explained by all three sets of predictors; close to one half of the variance was explained by technological variables alone; and one third of the variance was explained by organizational variables alone. Factors related to an adopter’s personality, socio-economic status and communication behavior were found not to influence nurse adoption. In addition, using analysis of covariance, a significantly lower level of adoption was found for managers compared to non-managers when either need, supervisor values or peer values was controlled.

The results suggest that focus on the perceived advantages of an innovation, the perceived need, values held by peers regarding the innovation and use of communication mechanisms facilitate nurse adoption of a computerized information system as an innovation. A revised theoretical model for the study of innovation adoption was proposed based on the data analysis. The model asserts that a relationship exists among the categories of predictor variables and negates the hypothesized direct influence of adopter characteristics on adoption behavior.

Recommendations for further research, replication and model testing are proposed to expand the body of knowledge in this field. Implications for nursing include the need to focus strategies for planning, development and
implementation of computerized information systems on maximizing the significant predictors. Evaluations of the information management component of current nursing roles is also suggested.
DEDICATION

To
Tony, Maria, and Michael
The Innovations
In My Own Life
ACKNOWLEDGMENTS

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CHAPTER I
INTRODUCTION AND PROBLEM STATEMENT

INTRODUCTION

The importance of recording information related to nursing was emphasized by Nightingale in her Notes on Nursing in 1859. Although various methods for the management and communication of such information have been developed and used over time, these systems to record clinical and management activities have not been used in a systematic way to advance nursing knowledge, develop nursing practice, improve patient care, or effectively manage nursing resources. The Secretary’s Commission on Nursing, a national advisory panel, acknowledged that thirty percent of nurses’ time is spent in information handling; the panel recommended the use of computerized information systems to conserve nursing resources (Barry & Gibbons, 1990).

The computerization of information systems is viewed as an innovation in the health care environment. The use of such systems is continuing to expand within and across health settings because of the increased demand for and volume of information required in health care delivery. Computerized information systems offer the opportunity to identify, manipulate, retrieve, and use data more effectively and efficiently so as to facilitate the achievement of nursing goals (Study Group on Nursing Information Systems, 1983).
Although nursing leaders and health care organizations call for the increased use of computerized information systems in managing clinical care and nursing resources, little is known about the processes or factors that facilitate adoption and use of such technologies by nurses. While it is acknowledged that nurses are the largest users of such systems, and are affected either directly or indirectly by them, it is noted that decisions to incorporate expensive automated information systems into hospitals for the management or delivery of nursing care are not made necessarily by those who are affected by or assigned to use them.

The diffusion of innovations to those who need to adopt them has been studied by several disciplines who have empirically identified a number of factors and influences involved in an individual's decision to adopt and implement an innovation. Few studies have been done in nursing, either in the area of adoption of innovations in general or in the adoption of computerized information systems specifically. There is a lack of knowledge regarding what variables are related to nurse adoption of a computerized information system within an organization, or nurse's willingness to reconceptualize traditional information tasks for integration into automated systems. Despite this, national nursing organizations, government commissions, and agency accreditation bodies have recently encouraged increased use of
such technological innovations to promote nursing care delivery. (Barry & Gibbons, 1990; Patterson, 1990; Peterson & Gerdin-Jelger, 1988)

Despite impressive advances in technology, information system misuse and rejection are more frequent than acceptance. Use and empirical analysis reveal that information systems tend more often to pose problems and be perceived as "troublemakers" (Lyytinen, 1987; Kling, 1980; Lucas, 1975; Turner, 1982). In health care, the resistance by providers to adopt computerized systems has also been documented (Anderson, Jay, Schweer, & Anderson, 1986; Dowling, 1980; Grann, 1982). However, little empirical evidence exists which reveals factors that influence nurse adoption of a computerized information system for nursing as an innovation.

PROBLEM STATEMENT

A dearth of information exists related to identifying factors that influence nurse adoption of computerized information systems as innovations for nursing.

PURPOSES OF THE STUDY

The purpose of this study is to focus on factors that influence the diffusion and adoption of an innovation after it is first introduced to members of a social system. It does not address the introduction of the innovation, nor the processes through which adoption occurs. Derived from this
perspective, 2 specific purposes of the study are:

1) to explore a set of individual, technological and organizational characteristics as predictors of nurse adoption of a computerized information system as an innovation.

2) to investigate the effect of organizational position on adoption of a computerized information system as an innovation.

SIGNIFICANCE OF THE PROBLEM

In a highly competitive, and constantly changing health care environment, agencies are forced to turn to creative and innovative strategies, technologies, and devices to meet the demands for services while staying competitive in the market place. Exploring what factors facilitate the adoption of innovations by health professionals can enhance the integration of new ideas, practices, or objects into the health care environment. Such innovations are needed to enhance quality care and/or services and reduce costs. In constantly changing environments, the implementation of new ideas and practices can be time consuming, expensive, and affect productivity. Identifying factors that facilitate nurse adoption of an organizationally driven innovation can influence strategies that foster organizational as well as individual effectiveness.

Computerized information systems are viewed as
innovations directed toward improving the efficiency and effectiveness of managing health care information needs. They are increasingly being introduced into the health care environment in response to the demand for handling the massive volumes of data produced. Data are transformed to meet the information requirements for delivering patient care services, facilitating organizational communications, and meeting the external demands from accreditation bodies, government agencies, and insurers. In addition, these new automated information systems consume a large percentage of an agency’s budget.

To realize the benefits of such technologies, then, requires the adoption and appropriate use by health care professionals. Inappropriate use or avoidance of use can not only be costly but, more importantly, can jeopardize clinical care by interfering with the timeliness or accuracy of information needed for decision making or service delivery. Exploring factors that facilitate the nurse’s adoption of computerized systems is important because organizations, not nurses, make the decision to implement computerized systems. However, nurses are the largest group of users of such systems, and nursing adoption can conserve organizational resources required to implement change, and avoid drops in productivity or quality which may occur as a result of resistance to the innovation. Knowledge of predictors of nurse adoption can stimulate appropriate strategies for
introducing such innovations to new employees, can influence how systems or new devices are developed, and can effect the strategic planning of future innovations.

This problem also has relevance to professional nursing. New and different ways of handling and managing information have an impact on the traditional information tasks of nurses. An understanding of nurse adoption of technological innovations can facilitate the systematic use of such technologies to advance nursing knowledge, develop practice, improve patient care, and manage resources. The potential to achieve these goals exists when computerized information systems are successfully adopted.

Prior studies of innovation adoption have focused on either the individual (Coleman, 1957; Brett, 1986; Anderson, 1985; Becker, 1970) or individuals acting on behalf of organizations (Bell, 1987; Kimberly, 1978; Kimberly & Evancho, 1981; Hage & Aiken, 1967). Nurses, however, work as individuals within an organization. This study adds to the body of innovation diffusion and adoption literature by exploring whether previously identified variables and relationships hold for nurses as adopters, and for computerized information systems as innovations within an organization. It also extends the study of variables beyond the bivariate level with the individual as the unit of analysis and addresses a set of individual, technological, and social system or organizational characteristics which have been neglected in prior nursing studies.
DEFINITION OF TERMS

Innovation - an innovation is an idea, practice, object, or knowledge perceived as new by an individual or other unit of adoption (Rogers, 1983).

Technology - the practical application of science, whether the results are tools, devices or social instruments exemplified by processes and systems. In health care, technology refers to the drugs, devices and procedures used in the delivery of health care and the organizational or administrative systems that support its use (Office of Technology Assessment, 1982).

Innovation Diffusion - Innovation diffusion is the process by which an innovation is communicated through certain channels over time among members of a social system. It is a special type of communication in that messages are concerned with new ideas. The newness means that some degree of uncertainty is involved (Rogers, 1983).

Innovation Adoption - Innovation adoption is the result of a decision process which an individual uses to accept or reject an innovation. For an individual, it is the decision to accept and commit to use, interact with, or be exposed to the innovation on a continuing basis to accomplish organizational work. Several steps of the decision process are identified (Brett, 1986; Rogers, 1983):

Awareness - The adopter has been exposed to an aspect of the innovation through a variety of means and can recall exposure.
Persuasion - The adopter has formed an opinion about the innovation by seeking information, evaluating advantages and disadvantages and using the innovation on a trial basis.

Adoption - The adopter incorporates the innovation into practice, and expresses satisfaction and a desire or intent to continue the full use, interaction with, or exposure to the innovation.

Computerized Information System (CIS) - This refers to a computer-based or automated information processing system that is designed to support the operations, management, and decision functions of an organization. It has the capability to collect, transmit, process, store, retrieve, and distribute information (Ahituv & Neumann, 1990).

THEORETICAL BASIS FOR THE STUDY

An adaptation of Roger's (1983) model of innovation adoption is used as the framework within which adoption of computerized information systems by nurses could be examined. A basic assumption of Rogers' classical diffusion model is that diffusion patterns and adoption rates of particular innovations are determined primarily by the attributes of the innovation and the unique characteristics of the adopter. Rogers' model was developed to explain the communication of technological innovation. A technology is viewed as a "design
for instrumental action that reduces the uncertainty in the cause-effect relationships involved in achieving a desired outcome" (Roger, 1983, p.12). A technology is noted to have a hardware aspect (the tool) as well as a software or information base for the tool. A technological innovation creates one kind of uncertainty in the minds of adopters about its expected consequences; it also represents opportunity for reduced uncertainty because of the information base of the technology. This latter advantage provides motive that impels individuals to exert effort to learn about innovations and consequences so a decision concerning adoption/rejection can be made.

Two kinds of information are sought by adopters in the decision process. The first kind of information relates to the information part of the technology and asks "what is the innovation, how does it work, and why". The second kind of knowledge is innovation evaluation information and is concerned with what are the consequences, advantages, and disadvantages. Rogers postulates that diffusion is the process of spreading new ideas from source to ultimate adopter or user. It occurs over time and has four major components: the innovation, the potential adopter, a communication channel, and a social system. Each has variable attributes or dimensions that influence the successful diffusion and subsequent adoption of an innovation.
The Innovation

Several variables have been consistently identified as attributes of successful diffusion and adoption efforts (Kolbe & Iverson, 1981) These include the following:

"Compatibility. When innovations are consistent with the economic, sociocultural, and philosophical value system of the adopter, adoption is more likely to take place.

Flexibility. Innovations that can be unbundled and used as separate components will be applicable in a wider variety of user settings.

Reversibility. If for any reason, the adopting individual or organization wants to revert to its previous practices, it is desirable that an innovation be capable of termination. Innovations that are not are less likely to be adopted.

Relative advantage. If an innovation appears to be beneficial when compared to current and previous methods, adoption is more likely.

Complexity. Complex innovations are more difficult to communicate and to understand and are therefore less likely to be adopted." (Orlandi, Landys, Weston, & Haley, 1990, p.290).

All of these features determine how fast innovations diffuse and influence adoption.
Adopters

Innovation adopters have communication, socio-economic, and personality traits that affect their likelihood of using the innovation. Communication behavior refers to the channels used to access information; interpersonal or mass media communication channels provide the means by which an innovation is known to adopters.

Through their communications, adopters' progress through a decision process which includes the stages of awareness, persuasion, and decision to implement, be exposed to, use, or continue interaction with an innovation. These stages usually, but not always, occur in sequence. The steps can be interactive and cyclical. Adoption of an innovation follows these stages and also involves antecedent conditions, such as the existence or perception of a need for the innovation. The decision to adopt an innovation can be optional, collective, or authority based. Computerized information systems in health care are usually adopted by an authority decision of an organization without individual staff nurse influence. Although nurses may be involved, they do not make the final decision to purchase a computer system. They are, however, involved in implementing the organizational decision to adopt an innovation and are required to use or interact with the computerized information system.

Organizational adoption of an innovation, then, does not necessarily mean individual adoption. An innovation must
diffuse through an organization and be adopted by individual members to be successful. This process may be circumvented during implementation or afterward, as noted by Dowling (1979), and result in ineffective use of the innovation because individual adoption had not occurred. The innovation, then, may be inappropriately used or under used.

For this study, adoption of computer information system as an innovation is defined as the intent to continue full use of a computer application which one has become aware of, values, and has tried. This differs from previous definitions used because the decision process for nurses in an organization is controlled to some extent by the organization's policy, expectations and formal sanctions. An individual's decision to adopt an innovation which the parent organization has adopted cannot be inferred from his or her compliance with organizational expectations to use or interact with the innovation.

Compliance with requirements to use, interact with, or be exposed to an organizational innovation is considered separate and different from individual adoption. Compliance without adoption, however, results in inefficiency and insufficiency (Sathe, 1985). Inefficiency relates to the costs of monitoring behavior to secure compliance, as well as the costs of formal sanctions to maintain compliance. Insufficiency refers to the minimal effort and performance levels put forth by organizational members to achieve organizational goals. In
a synthesis of theoretical models of information system implementation and technological innovation and diffusion, Kwon & Zmud (1987) define acceptance, use or performance and satisfaction as factors which indicate the adoption of an innovation. These factors are related to the process of change and precede the incorporation of an innovation into the routine of an organization’s activities. Because it is inappropriate to infer an individual’s adoption from compliance or use of an authority based innovation, an individual’s acceptance, satisfaction, or expressed intent to continue or to maintain the innovation are considered more reflective of one’s adoption of an organizationally initiated innovation.

Organization/Environment

Rogers’ model allows one to study determinants of innovation adoption by focusing on the characteristics of the innovation and the individual adopter. An adaptation to this model incorporates the characteristics of the environment or social system as determinants which interact with the other components to influence adoption. Kjerulff (1988) endorses an interaction framework in which the individual and organization influence each other to create a response to a CIS. While this study focuses on individual adoption and not organizational adoption, it is acknowledged that individuals function as members of a social system; and hence, that
environment needs to be considered in the framework for studying adoption.

Additional support for the three components used as the theoretical framework for this study can be found in Markus’s (1983) discussion of theories of resistance related to implementation of a CIS. Analysis of assumptions and derived predictions from what are referred to as people-determined, system-determined, and interaction theories for resistance suggests that a multivariate approach to studying CIS implementation is needed which addresses characteristics of individual adopters, characteristics of information technologies, and characteristics of the context of use within a socio-political environment.

From a systems theory perspective, Sathe (1985) describes organizations as social systems which contain a formal, psycho-social, and political subsystem. Characteristics of the organization’s environment can be described using these subsystems. Variables within the psychosocial subsystem include the values of the members of the system. Variables for study within the formal subsystem include measures of centralization, formalization, work unit characteristics, resources, and task complexity. One variable from the political subsystem includes formal position status. The model used for this study includes individual adopter, technology innovation, and social system (organizational environment) characteristics. Associated variables of the models which have been studied are shown in Figure One.
INDIVIDUAL ADOPTER CHARACTERISTICS
* Age
* Tenure in organization
  Tenure in nursing
* Attitude toward change (personality trait)
* Education level (socio-economic trait)
* Use of communication mechanism
  (communication behavior)

TECHNOLOGICAL INNOVATION CHARACTERISTICS
* advantage
* complexity
  compatibility
  flexibility
  performance
  reversibility
  *need

ORGANIZATIONAL ENVIRONMENT CHARACTERISTICS
formal systems
* centralization (ability to exert influence)
formalization
work unit characteristics
resources
task complexity
psycho-social system
*member values
political system
*position status

FIGURE 1
Theoretical Model for the Study of Nurse Adoption of Technological Innovations

*Variables studied in this research.
For purpose of this study, 12 variables were investigated and are identified by an asterisk in Figure One. Five adopter characteristics include one communication variable, one personality trait, one socio-economic variable, age and organizational tenure. These are selected because they have been studied in nursing but not specifically with a computerized management information system as the innovation. Three innovation characteristics, advantage, complexity, and need, are included; there is strong evidence for the relationship of these variables with adoption in prior health care studies. Three organizational environment variables, one each from the formal, the psycho-social and the political system are included. While these have been investigated in prior health care studies, all three have not been included in the same study. Satisfaction is selected as the indicator of Innovation Adoption because valid instruments are available for its measurement.

RESEARCH QUESTIONS/HYPOTHESIS

The following research questions were proposed:

1. Is there a relationship between a set of individual nurse characteristics and nurse adoption of an innovation?

2. Is there a relationship between a set of technological characteristics and nurse adoption of an innovation?

3. Is there a relationship between a set of
organizational characteristics and nurse adoption of an innovation?

4. Is there a set of individual, technological, and organizational characteristics that predict adoption of a CIS as an innovation by nurses in a health care setting?

5. What is the effect of organizational position on nurse adoption of a CIS as an innovation?

The following hypotheses will be tested:

1. Age, education level, use of communication mechanisms, attitude toward change, and job tenure are related (as a set) to nurse satisfaction with a CIS as an innovation.

2. Perceived innovation advantage, perceived innovation complexity, and perceived need for the innovation are related (as a set) to nurse satisfaction with a CIS as an innovation.

3. Centralization, role, perceived peer values and perceived supervisor values are related (as a set) to nurse satisfaction with a CIS as an innovation.

4. A set of individual, technological, and organizational characteristics are related (as a set) to nurse satisfaction with a CIS as an innovation.

5. There is a difference in nurse satisfaction with an administrative technological innovation between nurse managers and non-managers in an organization.
ASSUMPTIONS OF THE STUDY

The investigation of the research questions of this study assert the following assumptions:

1. Use of a CIS for nursing resource management is a technological innovation.

2. The adoption of a CIS as an innovation is desirable.

3. Organizations and individuals should seek innovative solutions to problems. The organization, for purposes of this study, is defined as the nursing department within a large teaching hospital.

4. Organizational adoption of a CIS precedes individual member adoption of a CIS.

5. Characteristics of an innovation are not defined in isolation, but rather are defined in terms of one's perception of the innovation in relation to a need or goal. There are as many realities as there are perceptions of the reality.

6. Human information processing is experiential.

7. Data are not an intellectual commodity, but a resource whose distribution through new information systems affect the interests of particular groups.

8. Organizations are complex and change is incremental and evolutionary; large steps are avoided, even resisted.

9. CIS is more than a device. CIS encompasses hardware, software and an organizational process of defining, handling, structuring, and using information in a particular way.
DELIMITATIONS OF THE STUDY

This study is limited to the context of a single large research-teaching hospital, and a single CIS used within that hospital. The population is limited to registered nurses employed by that hospital.
CHAPTER II
REVIEW OF THE LITERATURE

This literature review addresses related research in the field of adoption of innovations. It is organized to address innovations, characteristics that predict adoption, and related information systems implementation research. Characteristics that predict adoption are presented via a review of existing knowledge related to attributes of the innovation, the adopter, and the social system in which adoption occurs.

THE INNOVATION

Rogers (1983) defines an innovation as an idea, practice, or object perceived as new by an individual, a group or an organization. Shortell and Kaluzny (1988) note that the concept of innovation is more restrictive than the generic notion of change; that is, all innovation is considered change, whereas not all change is innovation. An innovation presents an individual or organization with new alternatives or new means for solving problems. The probability of an innovation being superior to previous practice is usually not known. One, thus, is motivated to seek new information about the innovation to cope with the uncertainty it creates (Rogers, 1988).

Several definitions of innovation have been proposed.
These definitions distinguish between the absolute or relative newness of an innovation (Kaluzy and Sprague, 1974); interpret newness in the strict sense as the very first time something has been tried or put into use (Utterback, 1971; Lin and Zaltman, 1973); and define innovation as something new to the potential adopter, regardless of the number of other individuals or organizations that have used it or how long it has been in existence (Brown, 1981). Mohr (1969) defined innovation as change in existing programs rather than substitution or installation of programs in their entirety. Other definitions may refer to innovations as fundamental or significant types of changes. Because "fundamental" and "significant" can only be determined by the adopter, this type of definition is consistent with the view that innovations include relatively new changes which depend on the adopter's perception of newness.

Several researchers have asserted the need to classify innovations and suggest that the major reason for inconsistency in research results is that innovation adoption varies with the type of innovation being considered (Downs and Mohr, 1976; Rogers and Shoemaker, 1971; Kaluzny, Veney, Smith and Elliott, 1976; Gordan and Fisher, 1975).

Nathanson and Morlock (1980) differentiate between innovations that represent new techniques for accomplishing old objectives, and innovations that incorporate new "non-traditional" health care goals. They provide empirical
support for the need to distinguish between technological and social innovations. Two types of technological innovations in health care have been studied and suggest a need to differentiate between technological innovations which support clinical health care programs and those that address administrative health care activities (Becker, 1970; Kaluzny, et. al 1976). Kimberly (1981) found differences in predictors of adoption between technological innovations that focused on core activities in an organization and those that addressed administrative concerns.

A technological innovation is defined as one through which the means, not the ends, of activities are altered (Nathanson & Morlock, 1980). Technological innovations are differentiated from social innovations in that social innovations require changes in goals and values of individuals and organizations. Technology is defined in the broadest sense as an innovation in the practical application of science, whether the results are tools and devices or social instruments exemplified by processes and systems (Office of Technology Assessment, 1982). In health care, technology refers to the drugs, devices, and procedures used in the delivery of health care and the organizational or administrative systems that support their use. Kimberly (1981) defines electronic data processing in health care as an innovation that facilitates the central functions of coordination and control within an organization. It is from
this perspective that this study views automated management information systems with the accompanying methods of information processing and use as a technological innovation.

INNOVATION CHARACTERISTICS

Studies of characteristics which enhance or detract from the adoptability of an innovation have consistently shown that the adopter’s perception of the attribute ultimately affects adoption (Rogers, 1983, Lin and Zaltman, 1973). Downs and Mohr (1976) define primary and secondary attributions of innovations; a primary attribution is one that would be the same for all adopters, whereas a secondary attribute would have to be interpreted in relation to the circumstances and perceptions of the adopter. For example, cost would be a primary attribute if it were so small that all potential adopters could afford it. It would be a secondary attribute if cost were sufficiently high that the wealthy adopter perceives this attribute as negligible and the poor adopter perceives it as prohibitive (Brett, 1986). Secondary attributes of innovation are much more common than primary ones (Downs & Mohr, 1976).

Numerous studies have attempted to determine innovation characteristics which are consistently related to adoption. Brandner and Kearl (1964) found that perceived congruency of hybrid grain sorghum with previously adopted hybrid corn was
found to be associated with early adoption. This characteristic overwhelmed the effect of other factors previously found to be related to adoption such as age, education, mobility of adopter and economic importance of the innovation.

In a meta-analysis of adoption research Rogers (1983) reviewed 11 studies, mainly from the field of education and agriculture. Each study reported 12-50 innovations reviewed and measured 2-15 attributes of the innovations. Those attributes found to be significantly related to the rate of adoption include relative advantage, compatibility, complexity, observability, and trialability. It is noted that relative advantage was found to be significant in all the studies. Relationships were positive for each variable except complexity which had a negative correlation. Correlation with adoption for advantage and complexity (Aydin & Ischar, 1988; Aydin, 1987) and usefulness and ease of use (Davis, Bogozzi & Warshaw, 1989) and advantage, compatibility, and observability (Dlugacz, Siegel & Fischer, 1982) were also reported in studies from the field of management and health care. Other attributes studied in medicine and sociology included cost, regularity of reward, social approval, pervasiveness, (Fliegel & Kevlin, 1966) potential risk (Becker, 1970) and compatibility (Thio, 1971).
While perceived need for the innovation is not studied as a variable in Rogers' (1962) classical diffusion model, it is proposed in his original work to be a precondition for the diffusion-adoption processes to occur. This variable is also echoed by Davis & Salasin (1981) in a decision determinant analysis model for planned change and innovation adoption. Most of the above studies focused on the field of agriculture, management, education or medicine. Only two nursing studies (Adyn, 1987, 1988) were found which specifically focused on characteristics of an innovation as predictors of adoption. A computerized medication system was studied as the innovation in these studies. No study was found that explored the characteristics of advantages, complexity and perceived need in relation to the adoption of a technological innovation for nursing administrative activities within an organization. This study addresses that void.

ADOPTER UNITS

Potential adopters are individuals or other units ranging in size from pairs to small groups and entire organizations (Brett, 1986). The focus for this study is on the individual as a unit of adoption.

Not all individuals in a social system adopt an innovation at the same time, rather they adopt in a time sequence. Rogers (1983) classified adopters on the basis of
their degree of innovativeness, which he defines as the relative length of time before which they first begin using a new idea. He conceptualized five categories of adopters based on observations of reality and designed to make comparisons possible. These categories are labeled as innovators, early adopters, early majority, late majority and laggards. Rogers uses the descriptors of venturesome, respectable, deliberate, skeptical and traditional to describe each of the five categories respectively. Rogers considered early adoption of an innovation and innovativeness to be synonymous. Past research shows that the adoption of an innovation follows a normal, bell-shaped curve when categories of adopters are plotted over time on a frequency basis. However, if the cumulative number of adopters is plotted, over time, the result is an s-shaped curve.

ADOPTER CHARACTERISTICS

Rogers (1983) conducted a content analysis of approximately 900 empirical publications dealing with the diffusion of innovations. Thirty-two individual adopter characteristics related to early adoption of an innovation were identified and grouped according to (1) socioeconomic characteristics, (2) personality variables, and (3) communication behavior. Characteristics identified by Rogers that are pertinent to nursing were summarized by
Brett (1986) and are noted in Appendix B. In addition, job tenure has been identified as one of the most frequently studied individual variables found (Kimberly & Evanisko, 1981) in innovation literature. A review of these variables follows.

**Socioeconomic Characteristics**

Several socioeconomic characteristics were found to be positively associated with the early adoption of innovation. These variables include education, higher social status, unpaid social mobility, work in larger sized units and more specialized operations (Rogers, 1983). Kimberly (1981) confirmed the association between adopters and education in a group of hospital administrators. The nursing literature reports no relationship between level of education or recency of education and the adoption of clinical nursing research results into practice (Brett, 1986; Coyle & Sokop, 1990; Ketefian, 1975; Kirchhoff, 1982). Bell (1987), however, provides some support for the relationship between education level of nurse executives and adoption of technological innovations for administrative activities.

Rogers (1983) reported inconsistent evidence about the relationship between age and early adoption. About half of the 228 studies he reviewed showed no relationship; but, of the studies supporting the existence of a relationship, 19 percent showed that earlier adopters were younger, and 33
percent indicated they were older. The nursing studies also report inconsistent results for age when clinical computer systems were studied as the innovations. No relationship between age and use was evidenced in 2 studies of 60 and 190 nurses respectively (Aydin 1987, 1988); but a negative relationship was documented with a group of 156 nurses (Chang, 1984) when a clinical information system was the innovation investigated.

**Personality Variables**

Personality characteristics found to have a positive relationship to early innovation adoption include empathy, ability to deal with abstractions, rationality, intelligence, favorable attitude to change, ability to cope with uncertainty, favorable attitude toward education, favorable attitude toward science, achievement motivation, and aspirations to advance in one's education and occupation (Rogers, 1983). Fatalism, the degree to which one perceives inability to control one's future, has been found to associate negatively with adoption (Rogers, 1983). The positive relationship between values favorable to change and the adoption of program innovations has also been supported in the organizational and health care literature (Hage & Dewar, 1973; Nathanson & Morlock, 1980).

Milligan and Martin (1980) assert that any process of organizational change evidences promoters of innovation confronting defenders of established practices. Kirton's
(1976) adaption-innovation theory proposes an elaborated personality typology which contrasts adapters and innovators by their preferences for distinct patterns of creativity, decision-making, and problem solving. He argues that this typology reflects a basic fundamental personality trait related to the sponsorship or non-support of institutional change. Adapters seek problem solutions which preserve the framework of the problem, whereas innovators challenge the framework of the problem. Adaption - Innovation theory suggests 3 underlying constructs of individual differences: (1) originality, the preference vs. the ability for generating universal or unique ideas in response to a problem; (2) efficiency, the preference for detailed meticulous behavior; and (3) conformity, the tendency to conform to prevailing rules or group norms. Innovators tend to be more original, less efficient and less conforming than adapters. They are more extraverted, flexible, tolerant of ambiguity, less dogmatic, in need of greater stimulation and more likely to take risks (Goldsmith & Mathers, 1987).

A synthesis of the generalizations of both Rogers' (1983) innovation adoption model and Kirton's (1976) Adaption - Innovation Theory suggests that early adopters of innovations would tend to have the same characteristics of the innovator, rather than the adapter.
Communication Behavior

Communication behavior is viewed by Rogers (1983) as influencing the early adoption of innovations. Communication characteristics of early adopters include: (1) more social participation both within and outside their immediate social system; (2) greater exposure to media, interpersonal, and change agent communication channels; and (3) knowledge of and search for more information about innovations. (Rogers, 1983; Coleman, Katz & Menzel, 1965; Anderson, Jay & Hackman, 1983; Hage & Dewer, 1973; Kimberly, 1978; Becker, 1970; Brett, 1986). The nursing literature suggests that professional activities (Bell, 1987) are related to the adoption of computerized management information systems, and that certain organizational integrative mechanisms, such as reading nursing journals, are related to the awareness and use of nursing practice innovations (Brett, 1985; Coyle & Sokop, 1990; Kirchhoff, 1982).

A communication channel is a network that connects one with knowledge of or experience in using an innovation and another without. It allows sharing and transfer of that knowledge. Various communication channels or networks used by adopters have been investigated and are frequently grouped as either mass-media (radio, television, journals) or interpersonal channels (face-to-face exchange between individuals). Communication channels are also classified as
being either "cosmopolite" or "localite" in nature. Cosmopolite channels originate outside the social system being investigated, such as attending a conference; whereas, localite channels originate within the social system. Rogers (1983) posited that mass-media and cosmopolite channels are knowledge creators, whereas interpersonal networks and localite channels are more important in persuading individuals to adopt or reject an innovation.

There is some evidence of the effectiveness of cosmopolite-interpersonal communication channels such as conferences and presentations on physician and hospital staff adoption of innovation (Kimberly, 1978; Coleman et al, 1965). However, there is no evidence of their effectiveness in nursing. Support does exist for the effectiveness of localite-interpersonal communication channels such as meeting attendance and peer communication (Bell, 1987; Kimberly, 1981; Aydin, 1987) and cosmopolite mass-media channels such as journals (Kimberly, 1981; Brett, 1986; Coyle & Sokop, 1990; Kirchhoff, 1982) in both nursing and non-nursing literature. No evidence to support the effectiveness of localite mass-media channels was found.

Job Tenure

As a variable in the innovative literature, job tenure is generally associated with institutional legitimacy. It has been argued that longevity in a job is a surrogate for
knowledge of how to navigate the political waters to obtain desired outcomes. Alternatively, negative relationships between job tenure and innovative adoption have been asserted from the perspective of a new leader's tendency to advocate and support innovation because of a fresh perspective or absence of allegiances to organizational constituencies. Innovation research supports a positive relationship with this variable (Rogers & Sohemaker, 1971; Kimberly & Evanisko, 1981). Information system implementation research suggests mixed results between job tenure and innovation satisfaction and performance (Lucas, 1975).

Summary of Adopter Characteristics

In summary, while adopter characteristics have been widely studied, validation of these findings is minimal in the nursing literature. Although Rogers' (1983) work is extensive in this area, one is cautioned in using the findings alone to predict adoption for the following reasons. First, the health care or nursing areas are not well represented; second, only bivariate relationships were studied; third, non-linear relationships were ignored; fourth, adopters were not always studied within the context of an organizational environment; and fifth, variance existed in study designs and methods of measurement of independent and dependent variables. Few multivariate
studies were conducted (Bell, 1987; Kimberly, 1981; Aydin, 1987, 1988; Dlugacz et. al, 1982). Variance explained by other variables which contribute to individual adoption, such as characteristics of the innovation and social system, have not been adequately addressed.

SOCIAL SYSTEM CHARACTERISTICS

Brett (1986, p. 31) suggests that the "social system is to the innovation adoption process as the culture medium is to an organism's growth; it can facilitate or hinder it." Social system can be defined as "a set of interrelated units that are engaged in joint problem solving to accomplish a common goal" (Roger, 1983 p. 24). Zey-Ferrell (1979) defines organizations as social systems of goal-oriented collectives that consist of groups of individuals. Organizations have identifiable boundaries, are open to the environment, possess technologies, structures, and processes, and perform activities with varying degrees of effectiveness and efficiencies. As social systems, organizations are constantly changing through conflict and innovation. Sathe (1985) defines a formal, political and psychosocial component of modern organizations. The organization is viewed as the social system in which nurse adoption of technological innovation occurs.
Organizational Theory

Several factors limit the applicability of classical innovation diffusion theory to organizations. It is impossible to assume an organizational identity among all participants in a complex system such as a hospital or health department. Classical innovation-diffusion theory can be applied to organizations only if one assumes that individuals in positions of formal authority act on behalf of organizations, or if one asserts that organizations behave as individuals. However, if one assumes that organizational wholes adopt innovation, then organizational theory must be incorporated into research. Investigators have cited several organizational structure variables as important to the diffusion of innovations.

Studies viewed as consistent with Shortell & Kaluzny's (1988) rational model of organizations are those that focus on structural contingency theory. Hage and Aiken (1967) reported that the organizational properties of complexity, centralization, formalization, and morale were related to the rate of adoption of new programs in 16 social welfare organizations. A high degree of participation in decisions, low job codification, and high job satisfaction were found to be associated with a high rate of program change. Centralization in Hage & Aiken's (1967) study was addressed in terms of distribution of power, that is, participation in decision making, determination of policy and degree of
hierarchy of authority (e.g., were workers allowed to make their own decisions or were decisions referred to supervisors?). In a centralized structure, decisions are made by a few persons high in the hierarchy. In contrast, Zaltman et al (1973) suggested that decentralized decisions and low formalization inhibit the adoption of innovations. Hage and Dewer (1973) noted that structural variables of complexity, centralization, and formalization, as well as the executive director's values, were less effective than the values of the elite inner circle of strategic decision-makers in predicting innovations.

The resource dependency model (Shortell & Kaluzny, 1988) emphasizes the organization's dependency on a larger social system for resources such as information. The process of acquiring the resources from the environment is a critical issue in this model. Information about an innovation must penetrate an organization's boundaries before a decision to adopt can be made. Kimberly (1978) used a resource dependency model to examine the role of integration into external information environments on hospital adoption of innovation. He notes that variability in hospital adoption of an innovation can be partially accounted for by variability in mechanisms that provide access to information about an innovation. The integration of information was found to be a necessary, but not sufficient, condition for adoption. Variability in an
organization's internal structure and decision making accounted for a large measure of variance in this study.

Greer (1985) studied the decisions of 25 hospitals concerning twelve potential adoptions of technology and addressed the issue of power and influence as it related to adoption. Her analysis focused on identification of the decision makers, their values and the purpose guiding them, and the people who adopt the innovation. She identified three "decision systems" for technology adoption. Greer found that the medical individualistic decision system dominated an evaluation of new clinical tools for treating patients and was closely related to prior studies of factors affecting adoption by individuals. Although decisions were made in an organizational context, physician's decisions in this study were rarely challenged. The fiscal management decision system applied to the replacement and accretion of technologies in hospital departments such as radiology. Decision makers here (chief executive officers, chief financial officers, department heads) acted out of concern for the organization and patient aggregates. Important factors included expense, speed, volume, pricing potential, and quality of services.

The third decision system, strategic-institutional dominated, involved innovation proposals that implied major change in the nature or future of the hospital, such as the introduction of coronary artery bypass surgery. These
decisions were made by governing boards; resistance to them was anticipated because they redistribute resources and power of relationships. Greer suggested that failure to differentiate these three decision systems allows the blurring of actors, motivations, and adoption processes. This study clearly asserts that an organization’s perspective on action is triggered by and depends on processes and social constructions.

Kaluzny et al (1976) contrasted two types of program innovations within a hospital: those that improve nonacute services and those that improve organizational efficiency. Researchers studied differences in the process and antecedents of adoption of these programs. The results indicated that when implementation was measured empirically and in judgmental terms, staff training was the most common predictor for both programs. Formalization of positions and organizational size were predictor variables of health services programs but not administrative ones. Although this study contrasted different types of innovations, the researchers used structural contingency theory to assess organizational predictor variables.

In an attempt to study innovation in the context of organizations, Kimberly and Evanisko (1981) examined the combined effect of individual, organizational, and contextual variables on organizational adoption of two types of innovations. One type related to the organization’s core
activity and one related to administrative concerns. The study analyzed a large number of hospitals using an existing data set and sought to examine previously established relationships in a multivariate framework. Three major findings were reported: the individual, organizational, and contextual variables were much better predictors of the adoption of nonadministrative innovation; the educational level of the hospital administrator, the size of the organization, and the presence of competition in the local environment were significant predictors in the administrative innovations; and organizational variables were indisputably better predictors of both types of innovations. Taking an eclectic approach, this study borrowed from both the rational model of organizational theory and the perspective of organizational action as externally constrained.

Social Information Processing

From a sociological perspective and symbolic interactionist point of view, the concept of "social world" defines a society or social system as a "network of interpersonal communications, connecting persons organically" (Stryker, 1981, p.g) which shape the opportunities for interaction and the realities and attitudes formed toward objects such as a new computer system. (Kling, 19870; Aydin & Rice, 1991). Aydin (1987,
1988) used a social information processing model to study acceptance and use of an automated medical information system. She studied this innovation from the perspective of the effect of attitudes of one’s peers and immediate supervisors on nurses adoption. Her results (1987) noted that 71% of the variance in nurse attitudes was explained by friends, co-workers’ and managers’ attitudes. The values of friends and co-workers were both positively related to nurse acceptance of the information systems.

Information System Implementation

Organizational innovation is viewed by Kwon & Zmud (1987) as a three-stage process: initiation, adoption, and implementation. From this perspective, an organizational member’s adoption of an organizationally initiated innovation can be interpreted as the stage of implementation. Kimberly (1981) notes that most innovation studies seek to predict organizational adoption and ignore what happens afterwards with adoption by individual members. In a comparative analysis between innovation and information system (IS) implementation research, Kwon & Zmud (1987) concluded that neither body of literature has adopted a sufficiently broad perspective regarding the manner in which new technologies are introduced and implemented in organizations.
From a synthesis of the literature, five major forces have been identified which influence the IS implementation process. These include individual factors (job tenure, cosmopolitan, education, role involvement); structural organizational factors (specialization, centralization, formalization, informal network); technological factors (compatibility, relative advantage, complexity); task-related factors (task uncertainty, autonomy, responsibility, variety, identity, feedback); and environmental factors (heterogeneity, uncertainty, competition, concentration/dispersion of resources, inter-organizational dependence). While Kwon & Zmud (1987) suggest the need to unify the fragmented models of IS implementation, they recommend that the findings and assertions from the organizational innovation studies should be validated within an IS context.

NURSING RESEARCH

A review of the nursing literature shows a dearth of studies addressing the adoption or diffusion of innovation. Chang’s (1984) study of the willingness of nurses to adopt computer technology after attending a computer workshop applied Hall and Louckes’s (1979) six-stage adoption approach. The researchers noted that those nurses with favorable responses and expectations of computers were more willing to interact with the devices. The study was not
framed in an organizational context, but it is viewed as related to expectancy theory in the rational model of organizational theory, which addresses an individual’s goal directedness and purposefulness in making choices.

Kirchoff (1982) and Brett (1987) used Rogers’ (1983) model of diffusion to study the dissemination and use of research findings. Kirchoff surveyed 600 nurses to assess the impact of published studies on the practice of restricting ice water and measuring rectal temperatures in coronary patients. Although research has cast doubt on these practices, the study showed they were commonly in use. These findings suggest that diffusion of new knowledge and adoption of new practices had not occurred. It was noted, however, that the number of hours spent reading and the number of journals read correlated strongly with greater levels of awareness among nurses that such restrictions were in question.

Building on this work and controlling for organizational size, Brett (1981) surveyed 216 nurses to determine their awareness of, persuasion about, and use of the findings of 14 nursing studies. No relationships were found between the adoption of innovations and the organizational characteristics of size, location, kind of institution, affiliation with a school of nursing, director’s position or tenure, or the percentage of nurses with different educational preparations. The investigator
noted that a nurse’s perceptions about the existence of organizational policy correlated strongly with adoption of the innovations.

Brett (1989) attempted to validate Kimberly’s (1978) findings that organizational integrative mechanisms (activities and structures that potentially increase information flow into an organization) influence the adoption of innovations. Using 14 research findings as innovations, she sampled 216 nurses from a pool of 19 hospitals to assess the existence of five categories of integrative mechanisms and the nurses’ awareness of innovations. The study found that in small hospitals, the amount of publications and research was related to innovation adoption. In larger hospitals, the existence of conferences and presentations, committees responsible for communicating research, and publications were significantly, but negatively, related to adoption. This result is explained because existence does not necessarily infer active participation by members of the organization.

The nursing literature, although limited, exemplifies the classical diffusion approach to the study of innovation with the focus on the individual. Nursing studies in general have not examined innovation diffusion from the organizational perspective. Bell’s (1987) study of nurse executives and organizational adoption of innovation is a rare exception to this. Most studies found in the nursing
literature focus on use of new knowledge. Although the Conduct and Utilization of Research in Nursing Project (1975-1980) conceptualized research integration as a process combining elements of the problem-solving and social-interaction models of knowledge utilization, nursing research has rarely addressed these perspectives.

STATE OF THE ART

In a review of 3,000 studies, Rogers (1983) noted that research in the diffusion of innovation has been conducted by the disciplines of education, communication, marketing, general sociology, public health, medical sociology, and anthropology. Scientists have observed that the fields where research has expanded most since the 1970's are marketing, sociology, public health, and medical sociology. Studies are reported in a variety of journals and books from the sociology, management, and health services literature. Only six studies were found in the nursing literature reported by nurses. The major theoretical perspectives in earlier studies included diffusion theory with a focus on individuals; more recent studies, however, tend to increasingly move from the rational model of organizations to the contingency and resource dependency frame of reference with more of an eclectic approach and multiple variable assessment. This trend did not surface in the nursing literature that focused on the classical diffusion model.
Most of the studies reviewed were case studies that give a detailed analysis of phenomena but offer limited generalization of results. Several studies used comparative cross-sectional analysis that demonstrate association between sets of variables, but are limited in their ability to infer causality. The only longitudinal study found (Hage & Dewer, 1973), reported a relationship between variables after three years of research. This finding suggests that one use caution in the interpretation of cross-sectional studies.

Methodological problems identified in this body of literature include the lack of convincing evidence to validate measurement techniques and the incongruence between a concept and its empirical indicators. At the conceptual level, the difference between innovation as a process of organizational change and innovation as a new idea or technology is not always differentiated. None of the studies focus on the process of innovation per se. As a dependent variable, innovativeness was usually measured by the number of innovations that were adopted. Difficulty existed with the measurement of independent variables as well, particularly when the organization was the unit of analysis. For example, measurement of centralization differs from one study to another (Gordon & Fisher, 1975).

It is also noted that the terms "adoption" and
"diffusion" are frequently confused or used interchangeably, and the boundaries of each are unclear. Rogers (1983) asserts that adoption is the final step of the innovation-decision process, which is one element of the diffusion model. In contrast, Hall and Louckes (1979) assert diffusion is a component of a six-stage adoption process. Clarity is also lacking regarding who adopts an innovation and what constitutes adoption. Moreover, lack of differentiation also exists between interorganizational and intraorganizational diffusion.

Studies have generally identified 3 sets of factors that appear to affect diffusion and adoption: characteristics of organizational members, characteristics of the organization's structure and characteristics of the innovation. The innovating elite are noted to be well-educated and cosmopolitan, to view change with favor, and to prefer the goal of quality health care to that of maximum economic efficiency. There is, however, some evidence of an interactive effect among these characteristics, the nature of the innovation, and other variables (Mohr, 1969). Although research has not produced clear or consistent results, the key organizational variables of complexity, centralization and visibility of consequences have been identified in large scale surveys as powerful predictors of innovation adoption. Some evidence for the influence of social roles and political status has also been established.
Advantages, complexity, compatibility, and trialability of an innovation are noted to influence adoption as well. There is a dearth of literature, however, that addresses the similarities and differences in innovation adoption between leaders of an organization and organizational members. While organizational adoption of innovations has been studied, adoption by individuals within the organization needs further exploration. In addition, confirmation of previous research findings from a multivariate perspective, within the field of nursing, and with information systems, awaits further research.
CHAPTER III

METHODS

RESEARCH DESIGN

A non-experimental, descriptive research design was used for this study. No variables were manipulated and one intact group of subjects was used to investigate relationships. A multiple predictor correlation design supports the intent of the study which was to investigate the ability of a set of variables to predict performance on yet another variable (Shelly, 1984). Because size of a hospital has been identified as influencing adoption of innovations (Brett, 1986; Kimberly & Evanisko, 1981), this variable was controlled by eliminating it from the study. Variability across organizations was also controlled by limiting the scope of the study to one large size hospital. The type of innovation has also been demonstrated to influence adoption; hence, this was controlled by including only one information technology innovation related to the administration of nursing practice.

UNIT OF ANALYSIS

The focus of this study was on adoption of an innovation by individuals within an organization. The unit of analysis was the individual registered nurse.

SETTING
The study was conducted in a large 500-bed, federal teaching-research hospital in Bethesda, Maryland. The hospital introduced the specific innovation under study in May 1991 to inpatient nurses employed in the Department of Nursing.

THE INNOVATION

The innovation selected for study was a new automated method of managing staffing, scheduling, and productivity information for employees of the Nursing Department in the selected hospital. It is referred to, and known as, the Automated Nurse Staffing Office System (ANSOS). The system replaced previous manual methods of planning, communicating, recording, and reporting the staffing patterns, work schedules, and productivity hours of both clinical and management nursing personnel. Although nurse managers and non-managers did not interact directly with computer devices (hardware), they did interact with the new structures and format of information generated by the ANSOS and the new procedures and policies for handling information. The new ANSOS system of processing and managing administrative information was conceptualized as the technological innovation. All staff nurses and managers periodically receive and review computerized documents which contain nurse scheduling information.
SAMPLING

The target population for this study was all registered nurses employed in large hospitals. The study population from which the sample was drawn was all registered nurses in a particular large hospital who work in the Nursing Department in a managerial or staff nurse position. The sample surveyed included all 475 inpatient clinical nurses and all (43) nurse managers. Despite attempts to maximize response rate, a less than 100% response was achieved. Hence, the sample was considered a convenience, nonprobability sample.

A pre-listing of all nurse employees in the Nursing Department who met the criteria of registered nurse, working in an inpatient area, in the position of clinical staff nurse, head nurse, or nurse manager was obtained for the study. Each manager and clinical nurses selected from the pre-list received an invitation to participate and consent form (Appendix C) and a questionnaire (Appendix D).

Stevens (1986) suggests that 15 subjects per predictor variable is needed for a reliable prediction equation. For this study, 12 predictors were tested; hence, a minimum of 180 subjects were needed.

To test the effect of organizational position on adoption (Hypothesis 5) data from all nurse managers who responded was included as well as an equal number of staff nurses selected from among all those who completed and
returned the questionnaire. This resulted in equally-sized
groups for comparison purposes.

**HUMAN SUBJECTS PROTECTION**

Informed consent was implied by completion and return
of the questionnaire. Anonymity was maintained and subject
responses were kept confidential.

This study was reviewed by the Human Volunteer Research
Committee of the University of Maryland at Baltimore
(Institute Review Board). Approval was also obtained from
the Vice President for Nursing in the selected hospital and
from the Hospital’s Research Review Board (Appendix A).

**PILOT STUDY**

A pilot test was conducted to guide the methodological
development of the research plan (Prescott & Soeken, 1989),
to assess clarity of items and directions, to establish an
average questionnaire completion time, and to assess
reliability of questionnaire items. A group of 10 clinical
nurse educators and specialists, as well as a group of 10
staff nurses were included in the pilot study. Subjects
selected for the pilot were not included in the primary
study. Feedback on the questionnaire and methodology was
solicited and revisions made as indicated.
A summary of responses to 4 specific questions included:

1. **Indicate the amount of time you needed to complete the questionnaire.**
   
   Completion time ranged from 6 to 45 minutes. The average completion time was reported to be 17 minutes.

2. **Comment on the clarity of the questions.**
   
   Overall comments indicated that questions were clear, although several respondents noted that questions on the Values Favorable Toward Change Scale were awkwardly worded. Review of this measure indicated that two questions needed to be reworded. Responses also indicated some confusion with the use of the word "system". This word was changed to computerized "method" on the End User Competency Satisfaction Scale and the visual analog scales. The term "support staff" was also clarified to mean non-professional nursing personnel such as nursing assistants and licensed practical nurses. These changes were made prior to the primary study and were reviewed by content experts.

3. **Comment on the clarity of the directions**
   
   Most commented that the directions were clear. Several indicated that key words in the directions should be underlined. One suggested boxing the directions to promote clarity. These alterations were made prior to the primary study.

4. **Note the questions that you found difficult to answer.**
Several respondents commented that the computerized method was not in use for outpatient staff nurses, hence, the End User Computing Satisfaction Scale was difficult to respond to. This resulted in excluding outpatient nurses from the primary study.

Reliability

Measures of 7 predictor variables (values toward change, use of communication mechanisms, advantage, complexity, need, super-visor values, peer values) and the single item criterion variable (innovation adoption) were tested for reliability using the test-retest method. This method addressed the consistency of performance one measure elicits from one group of subjects on two separate measurement occasions. A group of 20 subjects in the pilot study were asked to respond to the questionnaire at two different time periods 10 days apart. Nineteen subjects completed the measure for both time periods. Reliability was assessed using a Pearson correlation coefficient. Table 1 reflects that 7 of the 8 variables correlated greater than 0.80.
Table 1

**Pilot Study Test-Retest Reliability Correlations**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Pearson Correlation Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Values Favorable Toward Change</td>
<td>.368</td>
</tr>
<tr>
<td>Use of Communication Mechanism</td>
<td>.937 *</td>
</tr>
<tr>
<td>Advantage</td>
<td>.878 *</td>
</tr>
<tr>
<td>Complexity</td>
<td>.839 *</td>
</tr>
<tr>
<td>Need</td>
<td>.869 *</td>
</tr>
<tr>
<td>Supervisor Values</td>
<td>.904 *</td>
</tr>
<tr>
<td>Peer Values</td>
<td>.840 *</td>
</tr>
<tr>
<td>Innovation Adoption</td>
<td>.841 *</td>
</tr>
</tbody>
</table>

* p < .01

Table 2 indicates that no significant difference in mean scores for the two times was found for 6 of the 8 variables using a paired t-test with 2-tailed probability.
Table 2

Pilot Study Test-Retest t Values and 2-Tailed Probability

<table>
<thead>
<tr>
<th>Variable</th>
<th>t Value</th>
<th>2-Tailed Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Values Favorable Toward Change</td>
<td>-1.08</td>
<td>.295</td>
</tr>
<tr>
<td>Use of Communication Mechanism</td>
<td>.00</td>
<td>1.000</td>
</tr>
<tr>
<td>Advantage</td>
<td>-3.26</td>
<td>.004 **</td>
</tr>
<tr>
<td>Complexity</td>
<td>-2.25</td>
<td>.037 *</td>
</tr>
<tr>
<td>Need</td>
<td>-1.70</td>
<td>.106</td>
</tr>
<tr>
<td>Supervisor Values</td>
<td>.72</td>
<td>.482</td>
</tr>
<tr>
<td>Peer Values</td>
<td>.00</td>
<td>1.000</td>
</tr>
<tr>
<td>Innovation Adoption</td>
<td>.94</td>
<td>.360</td>
</tr>
</tbody>
</table>

* p < .05
** p < .01

It is noted that the test-retest results for the variable values toward change correlated weakly (r = .368); however, there was no significant change in scores based on the paired t-test. This suggests that although there was no consistent pattern to the scores, the overall differences were not significant. It was noted that subjects recommended rewording of the items to enhance clarity.

Measures of two variables (advantage and complexity) evidenced significant differences between the two time
periods. This can be explained by the possibility that respondents had more time to think about these items and may have paid more attention to them at time two. As noted in Table 3, the means of these variables both increased, and the variance decreased. It is also possible, however, that respondent's interaction with the innovation during the two measurement times resulted in a real change to the perceived advantage and complexity of the innovation.
Table 3

Pilot Study Test-Retest Means and Standard Deviations

<table>
<thead>
<tr>
<th>Variable</th>
<th>Test Mean</th>
<th>Test Standard Deviation</th>
<th>Retest Mean</th>
<th>Retest Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Values Favored</td>
<td>3.80</td>
<td>0.68</td>
<td>3.97</td>
<td>0.51</td>
</tr>
<tr>
<td>Toward Change</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use of Communication Mechanism</td>
<td>3.63</td>
<td>0.90</td>
<td>3.63</td>
<td>0.96</td>
</tr>
<tr>
<td>Advantage</td>
<td>6.53</td>
<td>2.39</td>
<td>7.42</td>
<td>1.74</td>
</tr>
<tr>
<td>Complexity</td>
<td>5.79</td>
<td>1.87</td>
<td>6.32</td>
<td>1.64</td>
</tr>
<tr>
<td>Need</td>
<td>7.53</td>
<td>2.57</td>
<td>8.05</td>
<td>1.78</td>
</tr>
<tr>
<td>Spvsr. Values</td>
<td>5.47</td>
<td>2.22</td>
<td>5.63</td>
<td>1.86</td>
</tr>
<tr>
<td>Peer Values</td>
<td>4.84</td>
<td>2.04</td>
<td>4.84</td>
<td>1.74</td>
</tr>
<tr>
<td>Innovation</td>
<td>5.58</td>
<td>1.81</td>
<td>5.79</td>
<td>1.51</td>
</tr>
<tr>
<td>Adoption</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Internal consistency reliability was also assessed in the pilot study for the Index of Values Favorable Toward Change because this measure had not been previously used with a group of health professionals. A Cronbach’s Alpha of 0.73 was computed for the initial administration, and 0.62 for the follow up administration.
Table 4

Pilot Study Test-Retest Internal Consistency of Index of Values Favorable Toward Change (IVFC)

<table>
<thead>
<tr>
<th>Item</th>
<th>Test Corrected</th>
<th>Test Alpha</th>
<th>Retest Corrected</th>
<th>Retest Alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Item -</td>
<td>if item</td>
<td>Total Correlation</td>
<td>if Item</td>
</tr>
<tr>
<td>Enthusiasm</td>
<td>.53</td>
<td>.6722</td>
<td>.32</td>
<td>.6041</td>
</tr>
<tr>
<td>Time to</td>
<td>.52</td>
<td>.6728</td>
<td>.54</td>
<td>.4907</td>
</tr>
<tr>
<td>Change</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hospital need</td>
<td>.76</td>
<td>.5740</td>
<td>.43</td>
<td>.5525</td>
</tr>
<tr>
<td>Policy need</td>
<td>.25</td>
<td>.7905</td>
<td>.34</td>
<td>.5922</td>
</tr>
<tr>
<td>Structure need</td>
<td>.50</td>
<td>.6770</td>
<td>.36</td>
<td>.6055</td>
</tr>
</tbody>
</table>

For the primary study six additional items were added to the measure and the response scale was increased from 5 to 7 points in an attempt to increase variance and hence reliability.

Validity

Content validity of the Index of Values Favorable Toward Change scale was assessed using a Content Validity Index (CVI). Two content experts, defined as nurse
specialists involved in implementing organizational change for greater than 5 years, were given the objective and the items of this measure. Each expert was asked to independently rate the relevance of each item on the measure to the objective. The objective of the measure was to identify a respondent’s feelings toward change in general. Each item was rated using a 4-point scale: 1 = not relevant, 2 = somewhat relevant, 3 = quite relevant and 4 = very relevant. The Content Validity Index was defined as the proportion of items given a rating of quite or very relevant by both raters. The content validity for the original five items of the measure was 0.80. The content validity was also assessed for the revised 10 item scale and was 0.90.

Criterion validity of the End User Computing Satisfaction Scale was also evaluated using a one item 7 point Likert scale measure of individual adoption. A Pearson correlation coefficient was noted to be .7345 p < .0001.

PROCEDURE

To solicit support and cooperation prior to initiation, information about the study was communicated to the senior nurse managers at a weekly executive staff meeting. In addition, the study was announced at the semi-monthly head nurse management forum.
Measurements of 12 predictor variables and 1 criterion variable were integrated into a self report questionnaire designed for this study (Appendix D). Advantages of a questionnaire are its cost efficiency and convenience for the investigator and respondent who can plan self-administered time and pace. Disadvantages include possible low response rates, missing data, and inability to control conditions of administration. Directions for respondents are important to ensure consistency in completing the measure and were included. The questionnaire was hand delivered to the work areas of a list of predefined subjects during work hours. The researcher, or a designated assistant with research experience, delivered the questionnaires in a sealed envelope to individual mail boxes.

A written letter describing the study, and addressing anonymity, confidentiality, informed consent, risks, benefits and time requirements for participation was included in a cover letter accompanying the questionnaire (Appendix C). Subjects were informed in writing that their participation was voluntary and that the questionnaire should preferably be completed in the work environment at one sitting. While having subjects complete the survey at work provides some consistency in the setting, complete standardization is impossible to achieve in a hospital environment given the variability in work demands and time
constraints of the nurses across clinical areas. All questionnaires were to be returned in a sealed, pre-labeled envelop addressed to the researcher and hand delivered or sent via the intra-organizational mail system.

INSTRUMENTATION

The measurement framework for this study is norm referenced as the purpose of the measurements are to discriminate among subjects with different amounts of a characteristic (Waltz, Strickland, Lenz, 1990).

End-User Computing Satisfaction Scale

Three existing instruments were used in this study for which some evidence of validity and reliability had been established. The first is Doll & Torkzadeh's (1988) measure of end-user computing satisfaction (EUCS). This 12-item, 5-point, Likert-type instrument measures 5 components of end-user satisfaction - content, accuracy, format, ease of use, and timeliness. The instrument focuses on satisfaction with the information product provided by a specific computer application. The reported reliability for internal consistency for this instrument was .92. Factor analysis validated the 5 separate components of the measure. Criterion validity was reported as .76 (p<.000). Two global items measuring perceived overall satisfaction and success were used as the criterion scale. In addition, using the multitrait-multimethod approach, evidence for
convergent and discriminant validity was established by Doll & Torkzadeh (1988). Reliability and validity for this measure were established using a sample of 618 respondents, 16.7% of whom were from health service/hospitals. Respondents by position included professional employees with non-supervisory responsibilities (28.7%) and managers (55.8%).

Of the 25 survey measures and instruments used in management information systems research, Zmud & Boynton (1991) identified the EUCS measure as one of only three which met the criteria of valid, reliable and inclusive of multiple item scales. This researcher found the EUCS more appropriate for a clinical practice setting and more consistent with the intent of this study than the other two measures (Baroudi & Orlikowski, 1988; Chin, Diehl & Norman, 1988).

Distribution of Influence on Practice Scale

The next existing measure used was the Distribution of Influence on Practice Scale (DIPS) developed by Havens (1990). This 21 item, 5-point, Likert-type scale measures the extent and nature of influence exerted by staff nurses and administrators in an organization. A content validity index of 1.0 and an internal consistency reliability of .94 with a sample of 206 nurses was reported by Havens.
Index of Values Favorable Toward Change

The third measure used was the Index of Values Favorable Toward Change (IVFC) which is an adaptation of the measure developed by Neal (1965) and modified and used by Hage & Dewer (1973) and Nathanson & Morlock (1980). The 5-item Likert-type scale was developed to measure a personality orientation toward change. While the researchers do not report psychometric data related to validity and reliability, Hage & Dewer (1973 p. 283) assert that "the battery does have the advantage of being an instrument already developed and tested" and Nathanson and Morlock (1980) report conducting a factor analysis to confirm that the items form a clearly defined cluster.

Internal consistency reliability is an indication of the extent to which all items on an instrument measure the same variable. Because, reliability is sample, not instrument specific, internal consistency of the above instruments was tested for this sample using Cronbach's alpha for each index. A value of .65 is considered acceptable. Results will be reported in chapter 4.

VARIABLES

One dependent variable and 12 predictor (independent) variables were included in this research study.

Criterion
The dependent or criterion variable is innovation adoption. It is operationalized as the score on the EUCS questionnaire and is measured at the metric level. This instrument was described above. For each of the 12 items, a subject reviews a question related to satisfaction with the ANSOS innovation and responds on a Likert-type scale where 1 = almost never, 2 = some of the time, 3 = about half of the time, 4 = most of the time, and 5 = almost always. Scores on each of the 12 items are summed and then averaged to obtain a single total score. A low score indicates low satisfaction and a high score indicates a high satisfaction level. The range of possible scores is 1 to 5. A blank item is to be scored as 3.

To validate this measure, a second measure of innovation adoption was used which was developed for this study. It is a one item Likert scale measure of intent to continue to use or to maintain the innovation in one's environment. The respondent is asked to indicate his/her level of agreement (on a 7-point scale ranging from 1 = very strongly disagree to 7 = very strongly agree) with the following statement: "I believe the organization should continue to use the computerized staffing/scheduling method." Although single item measures have been criticized for possible measurement error and lack of discriminatory power (Zmud & Boynton, 1991), recent work suggests that single-item global measures may be more inclusive and
convenient that the summation of many facet responses (Baroudi & Orlikowski, 1988; Aydin & Rice, 1991). Considering both perspectives, this measure was added as an adjunct to the EUCS measure. The range of possible scores is 1-7 with a low score indicating low adoption and a high score indicating a high level of adoption. A non-response to this item is to be scored as 4 (neutral).

Predictors

A set of 12 independent variables was used to predict innovation adoption; each variable was measured at the metric level.

Values Toward Change - The first predictor variable is values toward change; it is operationalized as the score on the Index of Values Favorable Toward Change. A 7-point Likert scale is used to respond to each of 10 items where a score of 1 = strongly disagree, 2 = disagree, 3 = slightly disagree, 4 = neutral, 5 = slightly agree, 6 = agree, and 7 = strongly agree. Scores on each of the items are summed and averaged to obtain a single total score. A low score indicates values unfavorable to change and a high score indicates values favorable to change. The range of possible scores is 1 - 7. A blank item is to be scored as 3. A positive relationship with the criterion variable was hypothesized.
Use of Communication mechanisms - The second predictor variable is use of integrative communication mechanisms; it is operationalized as the number of communication mechanisms the respondent indicates using. Each of five communication mechanisms are presented to the subject who is asked to respond "no" or "yes" as to whether the communication mechanism is regularly used. Each "no" is scored as 0 and each "yes" is scored as 1. The scores are summed to obtain a single total score. A low score indicates low use of communication mechanisms, a high score indicates high use of communication mechanisms. The range of possible scores is 0 - 5. A blank item is scored as the mean of the group of clinical nurses. A positive relationship with the criterion variable was hypothesized. The use of several integrative communication mechanisms suggests an individual’s active pursuit of opportunities to become aware of new ideas, practices, objects or knowledge and hence, a readiness to adopt innovations.

Age - The third predictor is age, operationalized as the subject’s age in years on his/her last birthday. A blank item is scored as the mean of the group. It was hypothesized that age is not related to innovation adoption.

Education - The next variable is level of education. It is operationalized as the highest level of education completed by the subject. This variable is scored as 1 = Associate Degree, 2 = Diploma, 3 = Baccalaureate, 4 = Master
Degree and 5 = Doctoral Degree. Although categories are used, this level of measurement is considered metric in that each category represents an increasing number of years of education. A positive relationship with innovation adoption was predicted as those who seek higher education seek exposure to new ideas, practices, objects and knowledge.

**Tenure in Organization** - The fifth predictor variable is organizational tenure. It is operationalized as the number of years the subject has worked for the Nursing Department (nursing organization) of the hospital. A blank item is scored as the mean of the group of clinical nurse respondents. A positive relationship with job tenure and the criterion was projected as longevity in a job is a surrogate for knowledge of how to navigate the potential waters to obtain desired outcome in light of any new changes.

**Centralization** - The sixth predictor is centralization, also referred to as the distribution of power in an organization (Hage & Aiken, 1967) or the ability to influence decisions. A high degree of centralization indicates influence is held by a few, high in the hierarchy. This variable is operationalized as the score on the Distribution of Influence on Practice Scale (DIPS). Subjects are asked to respond to 21, 5-point Likert scale items which address areas in which influence can be exerted by different levels of organizational members. The measure is scored to
reflect that influence is distributed to 1 = staff nurses only, 2 = primarily staff nurses - some administrative/management input, 3 = equally shared by administration/management and staff nurses, 4 = primarily administration/management - some staff nurse input, 5 = administration/management only. The scores are summed and averaged to obtain a single total score. A low score indicates a low degree of centralization and high staff nurse influence; a high score indicates a high degree of centralization and low staff nurse influence. The range of possible scores is 1 - 5. A blank item is scored as 3. A bounded perspective and decreased autonomy have been described as negative aspects of centralization, while increased efficiency is given as a positive aspect. Generally negative associations have been found with adoption (Hage & Aiken, 1967; Canary, et al., 1970; and Zaltman et al., 1973) and were hypothesized for this study.

Advantage, Complexity, and Need - The next three predictor variables are measured by visual analog scales. The predictors are perceived advantage of the innovation, perceived complexity of the innovation, and perceived need. Visual analogues have the advantage of being easy to construct, administer and score. A horizontal scale ranging from 0 - 10 with equally spaced numbers is used for each variable, anchored by short phrases which depict extreme states at each end. The subject is instructed to
circle the number on the scale which indicates the amount of the variable that reflects his/her opinion. Anchors include: "The computerized staffing/scheduling method offers no advantages" versus "The computerized staffing/scheduling method offers maximum advantages"; "The computerized staffing/scheduling method is not complex" versus "The computerized staffing/scheduling method is as complex as it can possibly be"; and "there is no need for the computerized staffing/scheduling method in this organization" versus "there is a high need for the computerized staffing/scheduling method in this organization."

Each measure is scored separately. A low score indicates low advantage, complexity or need; a high score indicates high advantage, complexity or need. The range of scores for each scale is 0 - 10. A blank item is scored as 5. A positive relationship with the criterion was predicted for advantage and need; a negative relationship was projected for complexity. Test-retest reliability or consistency of the response that a measure elicits from one group on two separate occasions was tested during the pilot using a Pearson correlation coefficient and was found to be greater than 0.80. A value of .8 is considered acceptable. A paired T-test was also be done. Each of the three scales were tested.

Member Values related to the innovation - The tenth and
eleventh predictors are perceived supervisor and peer values toward the innovation. Each variable is operationalized using a one-item 7-point Likert scale measure which asks the subject to rate his/her agreement with the following statements: "I believe my immediate supervisor thinks the organization should continue should use the computerized staffing/scheduling system"; and "I believe my peers/co-workers think the organization should continue to use the computerized staffing/scheduling system." The measures are scored with 1 = strongly disagree, 2 = disagree, 3 = slightly disagree, 4 = neutral, 5 = slightly agree, 6 = agree, 7 = strongly agree. A 7-point scale is used to increase the variance in the measure and hence the potential for reliability. A low score indicates the subject perceives his/her supervisor/peers to minimally value the innovation. A high score reflects the perception of another's value of the innovation as highly favorable. The possible range of scores is 1 - 7. A blank item is scored as 4. Positive correlations for each variable were hypothesized as it is suggested that the social environment of an individual influences his/her opinions, as does the formal authority structure and expectations of an organization.

Role - The final predictor is organizational role. This additional independent variable was used also to test the differences in innovation adoption between nurse managers and clinical nurses. It is operationalized as the
self-reported current role of the subject in the organization where 0 = non-manager (Clinical Staff Nurse) and 1 = manager (Head Nurse, Service Chief, Associate, Deputy or Division Director). This dichotomous variable is considered metric level data. A positive relationship was hypothesized because it was assumed that the organizational decision to adopt the innovation was made by nurse managers.

DATA ANALYSIS

Descriptive statistics were used to assess measures of central tendency and variability for each variable. Bivariate correlations between the predictor variables using Pearson correlation coefficients were assessed to determine if multicollinearity exists. A correlation of greater than .80 between any two predictors assumes the presence of multicollinearity. If this occurs, the bivariable relationships of each of the involved variables with the dependent variable are assessed and the variable that correlates higher with the dependent variable is maintained in the regression analysis, the other variable is deleted.

Multiple regression was used as the statistical procedure to test the relationships asserted by the first 4 hypotheses of this study. All variables are metric level, one dependent and multiple independent variables (predictors) exist.
Because the intent was to test a set of predictors to determine if variance in the criterion is explained by the set, direct entry method multiple regression was used; all the predictor variables were included. For Hypothesis 4, the variables of each cluster were entered using regular regression. Nonsignificant predictors were deleted. Alpha was set at .05 for determining significance.

Multiple R was used as the measure of strength of the relationship between the criterion and the combined predictors. Multiple R squared indicates the amount of variance explained by the predictors. The adjusted R' is an indicator of the validity of the prediction equation. Beta weights are compared to assess the relative explanatory power of different predictors.

One way ANOVA was used to test for differences in means on innovation adoption between a group of nurse managers and a random sample of non-managers (Hypothesis 5). The means and standard deviations for each group were computed. Alpha was set at .05 level to test for significance.

Homogeneity of variance was tested using Cochran's C. The probability of incorrectly failing to reject the null hypothesis (Type II error) was calculated for non-significant results.
Chapter IV

RESULTS

INTRODUCTION

This study tested five hypotheses related to the prediction of nurse adoption of innovation. It also explored the effect of organizational position on innovation adoption. Findings are presented via a description of the sample, a discussion of each variable, an analysis of instrumentation and an evaluation of the results of the testing of each hypothesis.

RESPONSE RATE

A total of 518 subjects were invited to participate in this research study. This sample included the total population of nurse managers (43) and inpatient clinical nurses (475) in one hospital. Table 5 depicts the response rate of the sample and the subgroups. Because the number of subjects needed for the planned regression analysis was achieved and because time constraints existed, there was no follow up to nonrespondents.
Table 5

Subject Response Rate

<table>
<thead>
<tr>
<th></th>
<th>Managers</th>
<th>Non-Managers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Invited Subjects</td>
<td>43</td>
<td>475</td>
</tr>
<tr>
<td>Participating Subjects</td>
<td>34</td>
<td>193</td>
</tr>
<tr>
<td>Response rate</td>
<td>79%</td>
<td>41%</td>
</tr>
</tbody>
</table>

*Total number includes 2 subjects who did not identify their role.

Of the 475 questionnaires mailed to non-managers, 20 were returned incomplete and had to be discarded and excluded from data analysis.

DESCRIPTION OF SAMPLE

A review of selected demographics of the sample of 229 nurses focused on age, tenure in nursing, job tenure, education, gender and employment status. The majority of subjects were female (92%) and were employed full time (86%). Table 6 depicts age of subjects ranged from 22 to 69 years old. Fifty-two (52) subjects were in their twenties, 70 subjects were in their thirties, 6 subjects were in their forties, and 46 subjects were fifty or above. Managers were
significantly older than non-managers (t-value = 2.45, p < .05).

Table 6
Description Statistics for Age in Years

<table>
<thead>
<tr>
<th></th>
<th>Manager</th>
<th>Non-Manager</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>34</td>
<td>193</td>
</tr>
<tr>
<td>mean</td>
<td>43</td>
<td>38</td>
</tr>
<tr>
<td>median</td>
<td>42</td>
<td>39</td>
</tr>
<tr>
<td>mode</td>
<td>41</td>
<td>39</td>
</tr>
<tr>
<td>st. deviation</td>
<td>8.15</td>
<td>10.60</td>
</tr>
<tr>
<td>range</td>
<td>27-57</td>
<td>22-69</td>
</tr>
</tbody>
</table>
A description of tenure in nursing is shown in Table 7. It is noted that managers tended to have significantly more years of experience practicing nursing (t-value = 4.23, p < .0001), with 5 years being the minimum for this group. Of the total sample, 7 subjects worked for 1 year or less in nursing, 86 subjects reported 2-10 years experience, 69 had 10-19 years, 42 had 20-29 years, and 25 subjects reported over 30 years tenure in nursing.

Table 7

Descriptive Statistics for Tenure in Nursing

<table>
<thead>
<tr>
<th></th>
<th>Manager</th>
<th>Non-Manager</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>34</td>
<td>193</td>
<td>229</td>
</tr>
<tr>
<td>mean</td>
<td>20</td>
<td>13</td>
<td>14</td>
</tr>
<tr>
<td>median</td>
<td>20</td>
<td>10</td>
<td>13</td>
</tr>
<tr>
<td>mode</td>
<td>20</td>
<td>2</td>
<td>15</td>
</tr>
<tr>
<td>st. deviation</td>
<td>7.70</td>
<td>9.69</td>
<td>9.81</td>
</tr>
<tr>
<td>range</td>
<td>5-35</td>
<td>0-44</td>
<td>0-44</td>
</tr>
</tbody>
</table>
Table 8 depicts the job tenure of the sample. It is noted that managers worked for the organization significantly longer than those in non-management positions (t-value = 3.58, p < .01). Thirty-five (35) of the subjects worked one year or less, 136 reported a 2-9 year tenure, 46 reported 10-19 years, and 12 reported working for the organization over 20 years.

Table 8
Descriptive Statistics for Job Tenure in Years

<table>
<thead>
<tr>
<th></th>
<th>Manager</th>
<th>Non-Manager</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>34</td>
<td>193</td>
<td>229</td>
</tr>
<tr>
<td>mean</td>
<td>10.5</td>
<td>5.8</td>
<td>6</td>
</tr>
<tr>
<td>median</td>
<td>10</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>mode</td>
<td>5</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>st. deviation</td>
<td>7.37</td>
<td>5.51</td>
<td>6.05</td>
</tr>
<tr>
<td>range</td>
<td>1-28</td>
<td>0-26</td>
<td>0-28</td>
</tr>
</tbody>
</table>

Five levels of education were reported by subjects. Missing data was noted for one subject. Five subjects reported an Associate Degree as the highest level of education achieved. Twenty-five (11%) reported a diploma nursing education, 145 (63%) reported having completed a baccalaureate degree, 50 (22%) completed a masters degree, and 3 reported doctoral level education. Table 9 notes the
number and percent of nurses in each education level for the manager and non-manager subgroups. The majority of managers reported a masters level education while the majority of non-managers reported a baccalaureate level. The difference in distribution was tested and found significant (Chi square = 73.64, p = .0001).

Table 9
Descriptive Statistics for Education Level

<table>
<thead>
<tr>
<th></th>
<th>Managers</th>
<th></th>
<th>Non-Managers</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>%</td>
<td>N</td>
<td>%</td>
</tr>
<tr>
<td>Associate Degree</td>
<td>-</td>
<td>-</td>
<td>5</td>
<td>2.5</td>
</tr>
<tr>
<td>Diploma</td>
<td>2</td>
<td>6</td>
<td>23</td>
<td>12</td>
</tr>
<tr>
<td>Baccalaureate</td>
<td>5</td>
<td>15</td>
<td>139</td>
<td>72</td>
</tr>
<tr>
<td>Masters</td>
<td>26</td>
<td>76</td>
<td>23</td>
<td>12</td>
</tr>
<tr>
<td>Doctoral</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>
DESCRIPTION OF VARIABLES

A review of the means, standard deviations and ranges for the predictor and criterion variables is presented in Table 10.

Table 10

Descriptive Statistics for Study Variables

(N = 229)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Values Toward Change</td>
<td>5.55</td>
<td>.81</td>
<td>1-7</td>
</tr>
<tr>
<td>Use of Communication Mech.</td>
<td>3.08</td>
<td>.99</td>
<td>0-5</td>
</tr>
<tr>
<td>Centralization</td>
<td>3.86</td>
<td>.43</td>
<td>2-4*</td>
</tr>
<tr>
<td>Advantage</td>
<td>4.97</td>
<td>2.73</td>
<td>0-10</td>
</tr>
<tr>
<td>Complexity</td>
<td>6.03</td>
<td>2.36</td>
<td>0-10</td>
</tr>
<tr>
<td>Need</td>
<td>5.74</td>
<td>3.13</td>
<td>0-10</td>
</tr>
<tr>
<td>Supervisor Values</td>
<td>5.04</td>
<td>1.72</td>
<td>1-7</td>
</tr>
<tr>
<td>Peer Values</td>
<td>3.90</td>
<td>1.90</td>
<td>1-7</td>
</tr>
<tr>
<td>Individual Adoption</td>
<td>4.37</td>
<td>2.01</td>
<td>1-7</td>
</tr>
<tr>
<td>End User Computing Satisfaction</td>
<td>2.88</td>
<td>1.07</td>
<td>1-5</td>
</tr>
</tbody>
</table>

*For all variables, actual and possible ranges were the same with the exception of centralization, which had a possible range of 1-5.
A comparison of the means of managers and non-managers is presented in Table 11.

Table 11
Means for Scale Scores and t-Values for Managers and Non-Managers

<table>
<thead>
<tr>
<th>Variable</th>
<th>Manager (N = 34)</th>
<th>Non-Manager (N = 193)</th>
<th>t-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Values Toward Change</td>
<td>5.86</td>
<td>5.49</td>
<td>-2.44*</td>
</tr>
<tr>
<td>Use of Communication</td>
<td>3.79</td>
<td>2.97</td>
<td>-4.71***</td>
</tr>
<tr>
<td>Mechanisms</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Centralization</td>
<td>3.74</td>
<td>3.88</td>
<td>1.70</td>
</tr>
<tr>
<td>Advantage</td>
<td>5.03</td>
<td>4.93</td>
<td>-0.19</td>
</tr>
<tr>
<td>Complexity</td>
<td>5.62</td>
<td>6.10</td>
<td>1.11</td>
</tr>
<tr>
<td>Need</td>
<td>6.82</td>
<td>5.53</td>
<td>-2.24*</td>
</tr>
<tr>
<td>Supervisor Value</td>
<td>6.09</td>
<td>4.83</td>
<td>-5.41***</td>
</tr>
<tr>
<td>Peer Values</td>
<td>4.38</td>
<td>3.81</td>
<td>-1.61</td>
</tr>
<tr>
<td>Individual Adoption</td>
<td>5.18</td>
<td>4.21</td>
<td>-2.62***</td>
</tr>
<tr>
<td>End User Computing</td>
<td>2.68</td>
<td>2.91</td>
<td>1.15</td>
</tr>
</tbody>
</table>

| Satisfaction              |                  |                        |         |

* p < .05       ** p < .01       *** p < .000
Managers reported significantly higher values for values toward change, use of communication mechanisms, need, supervisor values and individual adoption than non-managers. The managers also reported that their supervisors valued the innovation more than they themselves did, while their peers valued the innovation less. Non-managers reported this same pattern. The results of 2 tailed paired t-test analyses are shown in Table 12.

Table 12
Paired t-test Analysis of Individual Adoption, Peer and Supervisor Values

<table>
<thead>
<tr>
<th>Pair</th>
<th>Manager t-Value (N = 34)</th>
<th>Non-Manager t-Value (N = 193)</th>
<th>Total t-Value (N = 229)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individual adoption/</td>
<td>-3.40**</td>
<td>-4.82**</td>
<td>-5.74***</td>
</tr>
<tr>
<td>supervisor values</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Individual adoption/</td>
<td>2.67*</td>
<td>5.00***</td>
<td>5.67***</td>
</tr>
<tr>
<td>peer values</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supervisor/peer values</td>
<td>5.42***</td>
<td>8.88***</td>
<td>10.35***</td>
</tr>
</tbody>
</table>

*p < .05                      **p < .01                    ***p < .000

An analysis of the use of communication mechanisms reveals that certain types of communication mechanisms were used more frequently by managers. Table 13 depicts the
percentage of subjects who reported use of each of 5
different communication mechanisms. Managers reported a
higher use of all mechanisms, with use of both types of
organizational communication methods (mass media and
interpersonal) reported by all members of this subgroup.
Table 13

**Percentage of Respondents Using Specific Communication Mechanisms**

<table>
<thead>
<tr>
<th>Communication Mechanism</th>
<th>% Managers (N = 34)</th>
<th>% Non-Managers (N = 193)</th>
<th>% Total (N = 229)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outside professional meetings/initiatives</td>
<td>65</td>
<td>39</td>
<td>43</td>
</tr>
<tr>
<td>(EXTERNAL INTERPERSONAL)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Professional journals</td>
<td>91</td>
<td>76</td>
<td>77</td>
</tr>
<tr>
<td>(EXTERNAL MASS MEDIA)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enrolled in Degree Program</td>
<td>24</td>
<td>14</td>
<td>15</td>
</tr>
<tr>
<td>(INTERNAL INTERPERSONAL &amp; MASS MEDIA)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Organization meetings/committees</td>
<td>100</td>
<td>69</td>
<td>74</td>
</tr>
<tr>
<td>(INTERNAL INTERPERSONAL)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Organization memos, newsletters</td>
<td>100</td>
<td>98</td>
<td>99</td>
</tr>
<tr>
<td>(INTERNAL MASS MEDIA)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
One item on the Distribution of Influence on Practice Scale, which was used to operationalize the centralization variable, specifically addressed nurse schedules. Because the innovation was focused on the information handling of staffing schedules, a review of manager and non-manager responses to this item was made. The data revealed that 4% or 7 non-managers reported "staff only" involvement with this activity and 42% or 80 reported "mostly staff/some management" involvement. In contrast, no manager reported that scheduling was a "staff only" activity, and 35% reported "mostly staff/some management" involvement. Three percent (3%) of both groups reported this activity as being influenced by "management only". Fifty percent (50%) of managers and 28% of non-managers said nurse scheduling was equally influenced by staff and management.

Measurement Scales

Internal consistency reliability of three scales were assessed during the primary study: the End User Computing Satisfaction Scale (EUCS), the Distribution of Influence on Practice Scale (DIPS), and the Index of Values Favorable Toward Change (IVFC). The coefficient alpha for the EUCS was 0.968; the correlation for each of the 12 scale items with the total score ranged from .73 to .89. Reliability of the DIPS was also assessed using a coefficient alpha. This 21 item scale evidenced an alpha of 0.859. Each item
correlated with the total score with the range of .28 to .57. The IVFC was re-evaluated for internal consistency after 5 items were added to the scale, and the response options were increased from 5 to 7 points following the pilot study. A 0.868 alpha was achieved with a range of item-to-total correlations from .35 to .68.

The EUCS scale was also evaluated for criterion validity against a single item 7-point Likert scale measure of individual adoption. While the pilot study (N=19) evidenced a Pearson correlation of .7345 (p < .001), the primary study (N=229) resulted in a correlation of .5625 (p < .001). The significant, but weaker correlation in the primary study could be explained by the differences in the pilot and primary study samples. The former included 50% staff nurses and 50% clinical/management specialists but no managers. The less than strong correlation in the primary study can also be explained by the limitations of using a single item criterion, which despite the advantages of inclusiveness and convenience (Baroudi and Orlikowski, 1988; Aydin and Rice, 1991), still may have exhibited possible measurement error or lack of discriminatory power (Zmud and Boynton, 1991). It is also possible that subjects may have misinterpreted the single item criterion variable to mean adoption of a computerized information system rather than the computerized system used by the hospital. It was noted that two respondents made a written comment to this effect.
on the survey instrument. While the EUCS focused subjects on the characteristics of the specific innovation, the 1 item criterion did not. Because reliability was established and is a precondition for validity, and because of prior evidence for validity of this measure, the measure was assumed to be valid.

Correlation Among Variables

An analysis of the correlation of each of the 12 predictor variables with the dependent variable yielded only 4 significant, moderate, correlations as shown in Table 14. It is noted that 2 of those variables (advantage and need) are categorized as technology predictors and 2 are organizational predictors (supervisor and peer values). All 4 of these variables correlated positively and in the direction hypothesized. Conversely, none of the variables categorized as individual predictors (values toward change, use of communication mechanisms, age, education, job tenure) correlated significantly. Correlations for the adopter related predictors were less than 0.1, and with the exception of education, were in the opposite direction to what was hypothesized. In addition, one organizational variable (role) correlated in the opposite direction to what was hypothesized ($r = -0.1$). These correlations, however, were so low that the direction of correlation was viewed as not pragmatically significant.
Table 14

Correlations Between Predictor Variables and Dependent Variable

<table>
<thead>
<tr>
<th>Variable</th>
<th>Innovation</th>
<th>Adoption (EUCS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Values Toward Change</td>
<td></td>
<td>-.02</td>
</tr>
<tr>
<td>Use of Communication Mechanisms</td>
<td></td>
<td>-.01</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td>-.10</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td>.10</td>
</tr>
<tr>
<td>Job Tenure</td>
<td></td>
<td>-.09</td>
</tr>
<tr>
<td>Advantage</td>
<td></td>
<td>.66*</td>
</tr>
<tr>
<td>Complexity</td>
<td></td>
<td>-.11</td>
</tr>
<tr>
<td>Need</td>
<td></td>
<td>.43*</td>
</tr>
<tr>
<td>Centralization</td>
<td></td>
<td>-.00</td>
</tr>
<tr>
<td>Supervisor Values</td>
<td></td>
<td>.32*</td>
</tr>
<tr>
<td>Peer Values</td>
<td></td>
<td>.58*</td>
</tr>
<tr>
<td>Role</td>
<td></td>
<td>-.10</td>
</tr>
</tbody>
</table>

*p < .001

The correlations among all predictor variables was evaluated to assess for multicollinearity. As shown in Tables 15 and 16, no variables correlated higher than 0.73, and hence, all 12 predictors were included in the regression analysis. Most correlations were less than \( r = .15 \) and...
most were significant. The strongest relationship was
between need and advantage \((r = .73)\), the weakest
significant correlations were between advantage and values
toward change \((r = .11)\) and between centralization and
values toward change \((r = .11)\). A review of the
correlations among the variables in the individual set
revealed that use of communication mechanisms correlated
significantly \((p < .05)\) with education \((r = .14)\) and with
job tenure \((r = .11)\).

As shown in Table 15, all three technology variables
significantly correlated with each other as well as with
education and supervisor values. Advantage correlated with
3 individual variables and 2 organizational variables.
Complexity correlated negatively with 1 individual and 1
organization variable. Need correlated with 4 of the 5
individual variables and 3 of the 4 organizational
variables. Ten of the twelve variables correlated with at
least 1 of the 3 technology variables; centralization and
job tenure which did not correlate with any of the three
variables.
Table 15

Correlations Between Technology Variables and Other Predictor Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Advantage</th>
<th>Complexity</th>
<th>Need</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Individual</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Values Toward Change</td>
<td>.11*</td>
<td>.03</td>
<td>.15*</td>
</tr>
<tr>
<td>Use of Communication</td>
<td>.10</td>
<td>-.09</td>
<td>.13*</td>
</tr>
<tr>
<td>Mechanisms</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>-.14*</td>
<td>.09</td>
<td>-.15*</td>
</tr>
<tr>
<td>Education</td>
<td>.19**</td>
<td>-.12*</td>
<td>.22*</td>
</tr>
<tr>
<td>Job Tenure</td>
<td>-.04</td>
<td>.02</td>
<td>-.10</td>
</tr>
<tr>
<td><strong>Organization</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Role</td>
<td>.04</td>
<td>-.08</td>
<td>.16**</td>
</tr>
<tr>
<td>Centralization</td>
<td>-.06</td>
<td>-.08</td>
<td>-.04</td>
</tr>
<tr>
<td>Supervisor Values</td>
<td>.43***</td>
<td>-.13*</td>
<td>.51***</td>
</tr>
<tr>
<td>Peer Values</td>
<td>.62***</td>
<td>-.11</td>
<td>.60***</td>
</tr>
<tr>
<td><strong>Technology</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Advantage</td>
<td>-</td>
<td>-.12*</td>
<td>.73***</td>
</tr>
<tr>
<td>Complexity</td>
<td>-.12*</td>
<td>-</td>
<td>-.15*</td>
</tr>
<tr>
<td>Need</td>
<td>.73***</td>
<td>-.15*</td>
<td>-</td>
</tr>
</tbody>
</table>

* p<.05       ** p<.01       *** p<.001
Table 16

Correlation Between Organizational Variables and Other Predictor Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Supervisor Values</th>
<th>Peer Values</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Role</td>
<td>Centralization</td>
</tr>
<tr>
<td><strong>Individual</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Values Toward</td>
<td>.15*</td>
<td>.11*</td>
</tr>
<tr>
<td>Change</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use of Communication</td>
<td>.22***</td>
<td>-.17**</td>
</tr>
<tr>
<td>Mechanism</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>.13*</td>
<td>.01</td>
</tr>
<tr>
<td>Education</td>
<td>.40***</td>
<td>.05</td>
</tr>
<tr>
<td>Tenure</td>
<td>.25***</td>
<td>-.08</td>
</tr>
<tr>
<td><strong>Organization</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Role</td>
<td></td>
<td>-.10</td>
</tr>
<tr>
<td>Centralization</td>
<td>-.10</td>
<td>-</td>
</tr>
<tr>
<td>Supervisor Values</td>
<td>.27***</td>
<td>-.12*</td>
</tr>
<tr>
<td>Peer Values</td>
<td>.12</td>
<td>-.09</td>
</tr>
</tbody>
</table>

* p<.05  ** p<.01  *** p<.000

Table 16 shows that all 4 organizational variables correlated significantly with use of communication mechanisms (individual category). It is noted that supervisor values was the only organizational variable that
correlated with all the other organizational variables. Role correlated with all 5 individual variables; supervisor values correlated with 4, peer values with 3, and centralization with 2. It was also noted that the individual variables correlated positively and weakly with each other ($r = < .22$). Significant positive relationships were noted with communication behavior and values toward change ($r = .22, p < .001$), education ($r = .14, p < .01$), and job tenure ($r = 11, p < .05$). An analysis of all variables was conducted to test for skewness. Results were negative and confirmed that a normal distribution of error existed. Hence, this assumption for the statistical analysis was not violated.

A review of Tables 15 and 16 indicates that variables within sets correlate across sets; for example, most of the individual variables correlate with most of the organizational variables. To assess how the sets of variables correlate with each other, a canonical correlation analysis was used. Using the Wilks test, the relationship between the individual variable set (age, education, job tenure, use of communication mechanisms and values toward change) and the technology variable set (advantage, complexity and need) was found to be significant (canonical value = .869, $F = 2.13, p = .008$). The correlation of the first pair of canonical variables was .34. This represented 11% of the variance in the two sets of variables. The
second canonical correlation was .13, explaining 2% of the variance; the third correlation was .08, explaining .6% of the variance.

The relationship between the set of individual variables and the set of organizational variables (role, peer values, supervisor values, centralization) was also found to be significant using the Wilks test (canonical value = .609, F = 5.86, p = .000). The four canonical correlations were .53, .30, .23 and .11 which explained 29%, 9%, 5% and 1% of the variance in these two sets of variables respectively. The relationship between the set of organizational variables and the set of technology variables was also found to be significant (canonical value = .514, F = 14.00, p < .001). The three resulting canonical correlations were .68, .23, and .07. This represents 46%, 5% and 0.4% of the variance in these two sets of variables.

HYPOTHESIS TESTING

Five hypotheses were tested. The results for each are discussed below. For each regression analysis, examination of the normal probability plot suggested that the distribution of residuals was normal.
Hypothesis 1

Age, education level, use of communication mechanisms, attitude toward change, and job tenure are related (as a set) to nurse satisfaction with a CIS as an innovation.

Hypothesis 1 was not supported. Table 17 depicts the results of the regular regression analysis. All variables were entered into the analysis together.

Table 17
Regression of Innovation Adoption (EUCS) on Individual Variables
(N = 229)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Beta</th>
<th>T Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Education</td>
<td>.111</td>
<td>1.64</td>
</tr>
<tr>
<td>Age</td>
<td>.094</td>
<td>-1.14</td>
</tr>
<tr>
<td>Values Toward Change</td>
<td>.033</td>
<td>-.30</td>
</tr>
<tr>
<td>Job Tenure</td>
<td>.025</td>
<td>-.48</td>
</tr>
<tr>
<td>Use of Communication Mechanisms</td>
<td>.018</td>
<td>-.26</td>
</tr>
</tbody>
</table>

R² = .024 (Adjust R² = .002), F = 1.15, p = .36

Of the 5 individual variables, education had the highest Beta weight and use of communication mechanisms the lowest. However, no predictors were found to be significant and only 2.4% of the variance in innovation adoption was
explained by these individual predictors. The research hypothesis was not supported.

Hypothesis 2

Perceived innovation advantage, perceived innovation complexity, and perceived need for the innovation are related (as a set) to nurse satisfaction with a CIS as an innovation.

Hypothesis 2 was supported. Table 18 depicts the results of the regression analysis. Advantage had a higher Beta weight than the other two predictors and was the only significant predictor in the set. Forty-three percent (43.6%) of the variance in innovation adoption was explained by this set of technology variables. The results support the research hypothesis. One can conclude that this set of technology variables predicts nurse adoption of an innovation.
Table 18

Regression of Innovation Adoption (EUCS) on Technology Variables
(N = 229)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Beta</th>
<th>T Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advantage</td>
<td>.724</td>
<td>9.96*</td>
</tr>
<tr>
<td>Need</td>
<td>.099</td>
<td>-1.36</td>
</tr>
<tr>
<td>Complexity</td>
<td>.033</td>
<td>-.66</td>
</tr>
</tbody>
</table>

R² = .436 (Adjust R² = .428), F = 57.95*, p < .0001

Hypothesis 3

Centralization, role, perceived peer values and perceived supervisor values are related (as a set) to nurse satisfaction with a CIS as an innovation.

Hypothesis 3 was supported. Table 19 shows the regression analysis of the four organizational variables. It is noted that peer values had the highest beta weight, and supervisor values, the lowest. Approximately thirty-five percent of the variance in innovation adoption was explained with two of the four variables noted to be significant: peer values and role. The data supported the research hypothesis.
Table 19

Regression of Innovation Adopted (EUIC) on Organizational Variables
(N = 229)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Beta</th>
<th>T Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peer values</td>
<td>-.585</td>
<td>8.743**</td>
</tr>
<tr>
<td>Role</td>
<td>.111</td>
<td>-1.975*</td>
</tr>
<tr>
<td>Centralization</td>
<td>.042</td>
<td>.769</td>
</tr>
<tr>
<td>Supervisor Value</td>
<td>.011</td>
<td>.163</td>
</tr>
</tbody>
</table>

R² = .346 (Adjust R² = .334), F = 29.597**
* p < .05       ** p < .0001

Hypothesis 4

A set of individual (age, education level, use of communication mechanisms, attitude toward change, job tenure), technological (perceived advantage, complexity and need), and organizational characteristics (centralization, role, perceived peer value and perceived supervisor values) are related (as a set) to nurse satisfaction with a CIS as an innovation.

Hypothesis 4 was supported. Table 20 depicts the regression analysis using all 12 predictor variables. Four individual variables, 3 technology variables and 4
organizational variables were included simultaneously in the analysis.

Table 20

**Regression of Innovation Adoption (EUCS) on All Predictors**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Beta</th>
<th>T Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Technology</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Advantage</td>
<td>.599</td>
<td>8.019**</td>
</tr>
<tr>
<td>Complexity</td>
<td>-.035</td>
<td>-.722</td>
</tr>
<tr>
<td>Need</td>
<td>-.180</td>
<td>-2.393*</td>
</tr>
<tr>
<td><strong>Individual</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Communication Mechanisms</td>
<td>-.073</td>
<td>-1.412</td>
</tr>
<tr>
<td>Values Toward Change</td>
<td>-.062</td>
<td>-1.237</td>
</tr>
<tr>
<td>Age</td>
<td>.058</td>
<td>.950</td>
</tr>
<tr>
<td>Job Tenure</td>
<td>-.057</td>
<td>-.922</td>
</tr>
<tr>
<td>Education</td>
<td>-.020</td>
<td>-.361</td>
</tr>
<tr>
<td><strong>Organization</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Centralization</td>
<td>.047</td>
<td>.937</td>
</tr>
<tr>
<td>Role</td>
<td>-.043</td>
<td>-.749</td>
</tr>
<tr>
<td>Peer</td>
<td>.341</td>
<td>4.093**</td>
</tr>
<tr>
<td>Supervisor Values</td>
<td>.002</td>
<td>.029</td>
</tr>
</tbody>
</table>

\[ R^2 = .517 \text{ (Adjust } R^2 = .490), \ F = 19.163** \]

* p < .05 \hspace{1cm} ** p < .0001
The highest Beta weight is held by a technology predictor (advantage). The three significant predictors include one technology predictor (advantage) and two organizational variables (peer values and need). Peer values and advantage were significant predictors when tested separately with their respective sets of organizational and technological predictors. However, role which had been significant in the organizational set failed to be significant here. Approximately 52% of the variance in innovation adoption is explained (F = 19.163, df = 12.215, p < .0001). The data support the research hypothesis.

To further analyze the contribution of the individual category predictors to adoption, a stepwise regression was done. Four variables entered into the regression equation: advantage, peer values, need, and use of communication mechanisms. Fifty percent of the variance ($R^2 = .50$) was explained by these four variables (Adjust $R^2 = .495$, F = 56.7, p < .0001) with at least 1 variable from each of the predictor sets entering into the equation. Table 21 depicts the Beta Weights and t-values of the four variables.
Table 21

**Stepwise Regression of EUCS on all Predictors**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Beta</th>
<th>t-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advantage</td>
<td>.596</td>
<td>8.17***</td>
</tr>
<tr>
<td>Peer values</td>
<td>.337</td>
<td>5.36***</td>
</tr>
<tr>
<td>Need</td>
<td>-.190</td>
<td>-2.65**</td>
</tr>
<tr>
<td>Use of Communication</td>
<td>-.105</td>
<td>-2.20*</td>
</tr>
</tbody>
</table>

\[ R^2 = .50, \ F = 56.7, \ p < .001 \]

* p = <.05  ** p = < .01  *** p = <.0001

Hierarchical regression analysis was used to explore the 3 sets of variables. The technology set of variables, as noted previously, explained 43.6% of the variance in innovation adoption. When this set was controlled and the organizational set of variables was added, an additional 6.8% of variance was explained. The change in R square was significant (F change = 7.60, p < .0001), and 50.4% of the variance in adoption was explained. When the individual variable set was subsequently added, the R square change (0.13) was found to be nonsignificant (F change = 1.13, p = .35).

A second hierarchical regression was done to further explore the data. As before, the technology set was entered first. When the individual set was added, the variance
explained increased from 43.6% to 45.1%; however, the R
squared change of .015 was found to be nonsignificant (F
change = 1.26, p = .28).

Table 22 depicts the variance explained by the
different combinations of variable sets and the resulting R
square change. Technology and organization variables as
sets together explain a significant proportion of the
variance in adoption with each set contributing
significantly. The set of individual variables does not
contribute significantly either alone or in combination with
the other two sets.

Table 22

<table>
<thead>
<tr>
<th>Variable Set</th>
<th>Variance Explained</th>
<th>R Square</th>
</tr>
</thead>
<tbody>
<tr>
<td>Change</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technology/Individual</td>
<td>.451</td>
<td></td>
</tr>
<tr>
<td>Technology</td>
<td>.436</td>
<td>.015</td>
</tr>
<tr>
<td>Technology/Organization</td>
<td>.504</td>
<td>.068*</td>
</tr>
<tr>
<td>Technology/Organization/Individual</td>
<td>.517</td>
<td>.013</td>
</tr>
</tbody>
</table>

* p = .0000
Hypothesis 5

There is a difference in nurse satisfaction with an administrative technological innovation between nurse managers and non-managers in an organization.

This hypothesis was supported only when error variance was controlled statistically. A random sample of 34 non-managers was selected to create equal size groups for an analysis of variance to test for differences in mean EUCS (adoption) scores. Table 23 depicts that the mean innovation adoption score was higher for non-managers than for managers. The difference, however, was not significant (Table 24).

Table 23

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-Manager</td>
<td>34</td>
<td>3.025</td>
<td>1.11</td>
</tr>
<tr>
<td>Manager</td>
<td>34</td>
<td>2.681</td>
<td>1.01</td>
</tr>
</tbody>
</table>

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Table 24

Analysis of Variance for Innovation Adoption (EUCS) by Role

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Sum of Squares</th>
<th>Mean Squares</th>
<th>F</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Probability</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between Groups</td>
<td>1</td>
<td>2.00</td>
<td>2.00</td>
<td>1.77</td>
<td>.19</td>
</tr>
<tr>
<td>Within Groups</td>
<td>66</td>
<td>76.61</td>
<td>1.13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>67</td>
<td>76.61</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Cochrans C = .5450, p = .61

Power analysis indicated power = .26 with the probability of Type II error (Beta) = .74 and a small effect size (.32). Only 2% of the variance in innovation adoption could be explained (eta squared = .02). In order to increase power, decrease systematic bias, and reduce within group or error variance, several ANCOVA analyses were conducted using as covariates the variables that correlated significantly with the dependent variable (EUCS).

As shown in Table 25, three of the four covariates produced significant F values. The three covariates were tested and met the assumption for homogeneity of regression: need (F = .51, p = .48), peer values (F = 2.14, p = .15), supervisor values (F = .23, p = .63). Controlling for peer values, need, or supervisor values, there is a significant
difference in innovation adoption between managers and non-managers with managers having lower scores on the EUCS
(Table 26). The covariate that allowed for explanation of the most variance in adoption by role was supervisor values
(eta squared = .12).

Table 25

Analysis of Covariance for EUCS by Role

<table>
<thead>
<tr>
<th>Covariate</th>
<th>Mean Square Between</th>
<th>Mean Square Error</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Need</td>
<td>4.24</td>
<td>.93</td>
<td>4.56*</td>
</tr>
<tr>
<td>Peer Values</td>
<td>3.57</td>
<td>.76</td>
<td>4.68*</td>
</tr>
<tr>
<td>Supervisor Values</td>
<td>8.79</td>
<td>.93</td>
<td>9.42**</td>
</tr>
<tr>
<td>Advantage</td>
<td>1.14</td>
<td>.48</td>
<td>2.35</td>
</tr>
</tbody>
</table>

df = 1.65

* p < .05
** p < .01
Table 26 depicts the adjusted means for the significant covariates.

Table 26

Adjusted Means for Analysis of Covariance of EUCS by Role with Need, Peer Values and Supervisor Values

(N = 68)

<table>
<thead>
<tr>
<th>Covariate</th>
<th>Adjusted Mean Manager</th>
<th>Adjusted Mean Non-Manager</th>
</tr>
</thead>
<tbody>
<tr>
<td>Need</td>
<td>2.60</td>
<td>3.10</td>
</tr>
<tr>
<td>Peer Values</td>
<td>2.62</td>
<td>3.08</td>
</tr>
<tr>
<td>Supervisor Values</td>
<td>2.45</td>
<td>3.25</td>
</tr>
</tbody>
</table>
Summary

Five hypotheses were tested regarding nurse adoption of innovation. Data analysis yielded support for 4 of the 5 research hypothesis. The data evidenced that:

a) A set of technological characteristics predicts nurse adoption of an innovation.

b) A set of organizational characteristics predicts nurse adoption of innovation.

c) A set of individual, technological and organizational characteristics predicts nurse adoption of an innovation.

d) Organizational position affects nurse adoption of an innovation when need, supervisor values or peer values are controlled with managers reporting lower adoption scores.

The hypothesis that a set of individual adopter characteristics predicts nurse adoption was not supported.
CHAPTER V
DISCUSSION AND SUMMARY

This study explored the relationship between individual adopter, technological, and organizational variables and nurse adoption of a computerized information system as an innovation. The study also examined the effect of organizational position on nurse adoption behavior. Study findings and conclusion in relation to the five research hypotheses are discussed. Limitations of the study are identified, implications for practice are defined and areas for future research are recommended.

This study attempted to add to the body of innovation diffusion and adoption literature by exploring whether the relationship between previously identified variables and innovation adoption holds for nurses as adopters and for computerized information systems as innovations.

PREDICTORS

Predictors of nurse adoption of innovation were studied from the perspectives of sets of individual adopter, technological and organizational variables respectively, as well as from the perspective of a set of variables that included all three of these clusters.
Individual Variables

The five variables in the set of individual variables reflected socio-economic (education), personality (values toward change), and communication behavior variables identified by Rogers (1983) to be positively associated with adoption. In addition, age and tenure were also included in this set. The nonsignificant relationship of this set of variables with innovation adoption suggests that a focus only on a set of adopter characteristics is inappropriate to the study adoption of a CIS in an organizational setting.

From a univariate perspective, each of the individual variables correlated non significantly and very weakly with adoption ($r = .01$ to $.10$). The data suggest that a univariate perspective may not be appropriate to the study of adoption behavior in organizations. While these variables in isolation have been found to contribute to organizational adoption and to individual adoption in prior studies, the results suggest that adoption by individuals in an organization is not related to individual adopter characteristics when nurses are the adopters and a computerized information system is the innovation.

Technological Variables

In contrast, the results support the relationship between a set of technological characteristics and nurse adoption of a CIS. It was noted that the three predictors
in this set of variables all correlated with adoption in the
direction hypothesized. While advantage and need were found
to be significantly related to adoption (p < .001) in the
univariate analysis, only advantage was a significant
predictor in the multivariate analysis. A large percentage
of the variance in adoption was explained by all three
variables in the set. This result supports prior research
findings (Rogers, 1983; Aydin, 1987).

It is noted, however, that the $R^2$ change between
advantage alone and all three predictors was only .04% and
not significant
($F = .053$). While Rogers (1983) and Davis and Salasin
(1981) all identify need as a precondition for the
diffusion-adopton processes to occur, in this study
advantage was stronger than need as a predictor of adoption.
This was evidenced in the univariate analysis, as well as in
the multivariate analysis. This finding suggests that the
advantages of an innovation are more important to the
adopter than need; a strong need for the innovation may or
may not be perceived. The findings also suggest that
adopters may be willing to tolerate complexity in an
innovation if it offers high enough advantage.
Organizational Variables

From the perspective of organizational variables, the study findings support the relationship between a set of these variables to nurse adoption of a CIS as an innovation. The set of organizational variables, however, did not explain as much variance as the technology set. Only peer values was found to be a significant predictor in both the univariate and multivariate analysis of these predictors. This finding supports Aydin's (1987, 1988) work and reinforces the value of social information processing. It also suggests that centralization, or the level of decision making in an organization, may not be a critical factor in the individual adoption of an innovation as it has been found to be in organizational adoption studies. One may need to use caution, then, in translating the results of prior studies of organizational adoption to situations of individual adoption within an organization.

While supervisor values was a significant univariate predictor, multivariate analysis evidenced nonsignificance of this variable. It also produced the lowest beta weight in the multiple regression analysis. This finding suggests that the organizational hierarchy of formal position power is less important than the influence of one's peers and coworkers in dealing with the uncertainty and decision making related to the adoption of a CIS as an innovation in an organization. This finding is consistent with Aydin's (1987, 1991) work on social information processing.
An analysis of the relationship between one's intent to have the organization continue to use the innovation and one's perception of peer and supervisor values toward the innovation evidenced significant differences. For both managers and non-managers, subjects perceived their supervisor to have a higher value and their peers to have a lower value of the innovation than they themselves possessed. This finding suggests that significant differences of opinion regarding an innovation in an organization are perceived among different groups in terms of the extent to which an innovation is valued. From the perspective of the formal system of an organization which defines expectations via supervisor roles, it is suggested that if subjects believe their supervisors place high value on the innovation, then they may also believe that they are expected to value the innovation as well.

Individual/Technological/Organizational Variables

The set of all three categories of predictors was found to be significantly related to nurse adoption and suggests that a multivariate perspective is appropriate to the study of adoption. While a total of three significant predictors (advantage, need, peer values) from two of the clusters (technological and organizational) were identified, and explained a little over half of the variance in adoption, a stepwise regression analysis evidenced at least 1 significant predictor from each cluster.
This suggests that when predictors of adoption are studied, variables from each predictor category contribute significantly to explaining the variance in adoption. This has been demonstrated in prior studies and was reviewed in Chapter 2. However, the conceptualization of the three sets of variables (individual, technological, organizational) as predictors of adoption has not been previously tested. The results of this study indicate that the only way an individual category variable was significant was in the stepwise regression. Perhaps previous researchers have found selected individual variables to be significant because the separate variables were not conceptualized as coming from a set or because either organizational or technological variables that correlate with individual variables were not included in the studies.

When the technological and organizational sets of variables were controlled to account for intercorrelations among the sets, then the individual set did not contribute as a set. It is concluded that all three sets as one mega-set explain adoption, but that one set (individual) is not contributing directly. Organizational and/or technological variables may mediate the effect of individual adopter characteristics on the adoption. The individual variable set, then, has no direct path to adoption, but rather exerts influence indirectly through its relationship with the other 2 sets.
Use of communication mechanisms, an individual category variable, was noted to be significant in the stepwise regression. This predictor correlated significantly with all four organizational variables and with one of the three technology variables. Of these five variables that correlated with use of communication mechanisms, only peer values and need were significant in the regular regression. When these five variables were controlled in the stepwise analysis, use of communication mechanisms was identified as an additional significant predictor. This suggests that use of communication mechanisms may be necessary in the adoption process but not a sufficient condition for adoption to occur. This finding is congruent with Roger’s (1983) stages of adoption in which awareness is viewed as a precondition for one to be persuaded to try and ultimately to adopt an innovation. Use of communication mechanisms is viewed as a vehicle for increasing this awareness of new ideas, objects, devices or systems.

EFFECT OF ORGANIZATIONAL POSITION

The innovation selected for this study was already adopted by the organization, and is considered an authority based innovation from the perspective of required usage. This study focused on individual adoption of an authority based innovation. A significantly lower level of nurse adoption of an innovation was found in nurse managers.
compared with non-managers. It is interesting to note that organizational adoption was not synonymous with manager adoption. Prior studies have reviewed organizational adoption from the perspective of the Chief Executive Officer (CEO) or Medical or Nursing Officer (Bell, 1987; Kimberly, 1981); the results of this study suggest that adoption by a group of managers in an organization cannot be inferred from an organization’s adoption decision. It is noted that mid-level as well as senior level nurse managers were included in this study. The findings suggest that organizational adoption and actual member adoption are different concepts. It is unclear whether these two concepts are influenced by different processes.

In this study, an administrative authority based innovation was used which focused on a new method of handling staffing and scheduling information that is used by all employees. Responsibility for managing and making decisions related to this type of information, however, traditionally rests within the role of the nurse manager. While most subjects reported that involvement with nurse schedules included "mostly staff with some management" input, the ultimate organizational accountability and responsibility are assigned to the nurse manager.

The introduction of computer-based systems and applications requires a change in how information is acquired, processed and managed. Boddy and Buchanan (1982)
have demonstrated empirically that technology has the potential to either replace or complement roles depending on its capability and on how work is organized. Certain roles in an organization may be made redundant and obsolete, while other roles are facilitated by the accessibility of information via an automated system. Traditionally, organizational roles that focus on moving and processing information may need to be redirected as technology better accomplishes these types of activities (Ahituv, 1990, Gorry and Morton, 1989).

It can be concluded that the difference in adoption may be related to the differences in role impact experienced by members in different organizational positions. Thus, the lower level of adoption may be reflective of the higher sociotechnical impact of the innovation on the role of nurse managers (Markus, 1983). The results also suggest that nurse managers who may be responsible for implementing technological innovations may not have individually adopted the innovation themselves.

REVISED THEORETICAL FRAMEWORK

While this study proposed to test whether previously held research findings would hold for nurse adoption and CIS innovations, a review of the results suggests that the conceptual model for the study of innovation adoption be modified. The theoretical framework for the study of
adoption (p.15) reflects a modification of Rogers' (1983) theory and an integration of organizational theory. It includes individual adopter, technological and organizational sets of variables as predictors that directly relate to adoption. The results of this study suggest, however, that the individual, technological and organizational sets of predictors are interrelated as sets of variables. The canonical correlations evidenced significant relationships among all three sets of predictors. In addition, the hypothesized direct relationship between the set of individual characteristics and innovation adoption was found to be an indirect relationship. That is, individual characteristics, as a set, influence adoption indirectly via relationships with the technological and organizational sets of variables. A revised theoretical model for the study of nurse adoption of technological innovations, thus, is presented in Figure 2. It indicates that a multivariate perspective should be used for the study of adoption of innovations and that three categories of variables be included in future research studies.
INDIVIDUAL ADOPTER CHARACTERISTICS
Age
Tenure in organization
Tenure in nursing
Attitude toward change (personality trait)
Education level (socio-economic trait)
Use of communication mechanism
(comunication behavior)

TECHNOLOGY INNOVATION CHARACTERISTICS
advantage
complexity
compatibility
flexibility
need

ORGANIZATIONAL ENVIRONMENT CHARACTERISTICS
formal systems
centralization (ability to exert influence)
formalization
work unit characteristics
resources
task complexity
psycho-social system
member values
political system
position status

INNOVATION ADOPTION
acceptance
satisfaction
use
performance

Figure 2
Revised Theoretical Model for the Study of Nurse Adoption of Technological Innovations
STUDY LIMITATIONS

Several limitations of this study of nurse adoption of a CIS as an innovation are acknowledged. Because the study focused on factors that explain innovation adoption, several variables were controlled by eliminating them from the study. While this reduced error, it also limited the generalizability of the study findings to large size hospitals, to inpatient settings and to administrative technological innovations in a clinical environment. In addition, while the response rate was acceptable, the result was a non probability convenience sample from which generalizations to the population are restricted. The study also was limited by the disadvantages of a self report survey methodology which one must assume was reflective of subjects’ true responses.

Because of time constraints in conducting the study, a two week time period was allowed for subject responses. This may have excluded individuals who received their questionnaires late or who chose to respond past the deadlines. The innovation selected for study was also introduced into the nursing organization by the nursing organization’s free choice. It is not clear whether the study findings would hold for an innovation that was imposed on an organization. In this latter situation the organization may be reluctant to diffuse the innovation that was to members and facilitate its adoption. The study was
further limited to previously studied variables and to innovation adoption by individuals within an organizational context. Finally the study was limited to a quantitative analysis.

IMPLICATIONS FOR NURSING

The results of this study herald several implications for nursing and for the planning, development and implementation of computerized information systems as innovations in the health care delivery system. It is asserted that computerized information systems are increasing and will continue to increase in the health care environment to facilitate management of the clinical and administrative information that represents nursing practice. Not only is nursing challenged to represent its practice in new and appropriate information forms, but nursing is also responsible for the introduction of these new innovative methods to members of a social system. Successful adoption of computerized information systems has the potential to improve the efficiency, effectiveness and quality of information management.

The findings of this study suggest that a focus on individual adopter characteristics may be ineffective in facilitating adoption. Individual personality traits or one's disposition to accepting change, in general, is not predictive of adoption behavior. Nursing strategies, then,
need to be directed toward enhancing characteristics of the innovations and marketing its advantages. A synthesis of adopter need and perceived advantage must direct the nursing planning and development of CISs for nursing. An ongoing assessment and evaluation of the perceived need and advantage of an innovation are viewed as requiring an interactive process of participation in, articulation of and reclarification of the expectations of the technological innovation so that advantage can be maximized (Keen, 1986). The use of respected peers as change agents is also suggested as contributory to adoption. This implies that not only does nursing need to develop a cadre of nurses with knowledge and expertise in information systems, but that these nurses need to possess the ability to influence peer providers.

Because the use of communication mechanisms significantly influences innovation adoption, nursing is also challenged to seek information through mass media and interpersonal educational forums so that knowledge and understanding of an innovation are enhanced. Administratively, this activity needs to be planned and financially supported with resources. This finding also implies that nursing has a responsibility to communicate to the professional community positive and negative experiences with CISs so that innovation adoption decisions can be informed.
The effects of organizational position on nurse adoption of a CIS as an innovation implies that nurse managers and non-managers need to be involved in the development and implementation of innovations that affect them. More importantly, an evaluation of the information management component of current nursing roles is needed so that the need for a redesign of work and roles can be anticipated and addressed.

Finally, the most critical nursing implication is the need to pursue scientific investigation into the innovation adoption process and resulting adoption behavior. Continued research will develop the body of knowledge in this field and confirm the basis for strategic planning and administrative interventions.

RECOMMENDATIONS

As expected with any scientific inquiry, more questions are raised than answered by a particular study and its findings. Additional study of nurse adoption of a CIS as an innovation is warranted, not only to validate the findings of this study but also to explore other perspectives and dimensions of the proposed theoretical framework. A need exists to empirically test the proposed model for the study of innovation adoption and to explore additional variables not investigated in this study.

Future research is needed in the area of concept development and measurement of innovation adoption as a
phenomena so that measurement across studies and across innovations can be compared and contrasted more easily and validly. Innovation adoption was conceptualized as an outcome in this study, but future study of the innovation adoption process over time is also needed so that interventions to facilitate adoption can be strategically planned. Longitudinal study would also allow for an investigation of the reinvention phenomena in which adopters adapt to the innovation (Rogers, 1983). While this study focused on adoption, legitimate decisions to discontinue the use of an innovation after one becomes aware of and uses it should be pursued by future researchers who should attempt to measure the extent of innovation rejection.

Because the scope of this study was limited, future research is needed to investigate the similarities and differences between adoption of clinical and administrative innovations for managers and non-managers within an organization. In addition, adoption within an organizational context verses adoption of a CIS in independent practice settings as well as inpatient verses ambulatory care settings is needed so a comprehensive understanding can be achieved.

The use and effectiveness of different communication mechanisms to facilitate innovation adoption is also recommended. Investigation beyond usage is also needed to explore the media selections appropriate to organizational
communications and to managerial characteristics (Russ, Daft and Lengel, 1990; Trevino, Lengel, Bodensteiner, Gerloff and Muir, 1990). The interpersonal communication methods of nurses could be explored from the perspective of social networking (Anderson, Jay and Hackman, 1983) and its effect on adoption. The interactionist perspective of shared meaning also needs to be investigated from the social analysis view of computing as suggested by Kling (1930). These and other types of qualitative research evaluations are needed to explore the meaning that a CIS imparts to nurses and the qualitative experiences of adoption. Focused studies also need to be conducted on the consequent role changes experienced by different organizational members through use of a CIS as an innovation.

SUMMARY

Computerized information systems are viewed as innovations in the health care delivery system and are used by nurses to support the management of clinical and administrative information. This study explored factors that influence the adoption of a CIS as an innovation after it is first introduced to members of a social system. Individual, technological and organizational characteristics were investigated as predictors of adoption using multiple regression analysis, and the effect of organizational position on adoption was analyzed. Findings evidenced that
over one half of the variance in adoption was explained by all three sets of predictors; close to one half of the variance was explained by technological variables alone; and one third of the variance was explained by organizational variables alone. Factors related to an adopter's personality, socio-economic status and communication behavior were found not to influence nurse adoption. In addition, using analysis of covariance, a significantly lower level of adoption was found for managers compared to non-managers when either need, supervisor values or peer values was controlled.

The results suggest that focus on the perceived advantages of an innovation, the perceived need, values held by peers regarding the innovation and use of communication mechanisms facilitate nurse adoption of a CIS as an innovation. A revised theoretical model for the study of innovation adoption was proposed based on the data analysis. The model asserts that a relationship exists among the categories of predictor variables and negates the hypothesized direct influence of adopter characteristics on adoption behavior.

While this study is limited in its generalizability, recommendations for further research, replication and model testing are proposed to expand the body of knowledge in this field. Implications for nursing include the need to focus strategies for planning, development and implementation of
computerized information systems on maximizing the significant predictors. Evaluations of the information management component of current nursing roles is also suggested.

In summary, the development, implementation and use of computerized information systems as innovations are viewed as predictable activities in the current and future health care environment. Nurse adoption of these innovations is critical to the achievement of promised improvement in clinical and administrative information management. Nurses are challenged to direct the development and use of computerized information systems to achieve efficiency, effectiveness and productivity in the delivery of health care services. The adoption of effective computerized information systems is envisioned as a vehicle to enhance and improve the quality of information and ultimately the quality of nursing practice.
MEMORANDUM

TO: Carol Ann Romano, Principal Investigator

FROM: UMB Institutional Review Board (IRB)
Assurance Number M1174-01NR

RE: "Predictors of Nurse Adoption of an Information System as an Innovation"

DATE: February 10, 1993

The above-referenced project has been reviewed and determined to be exempt from the IRB approval process according to the Department of Health and Human Services Office for Protection from Research Risks Code of Federal Regulations 45 CFR 46.101.b(2).

If the protocol is altered in any way, it must be reviewed by the IRB.

Please keep a copy of this letter for future reference. If you have any questions, please do not hesitate to contact Joe Gifftes, IRB Coordinator, at [Redacted].

David Van Echo, MD, Chairman
Institutional Review Board

CC: IRB Exemption File
OHSR RESPONSE TO REQUEST FOR REVIEW OF RESEARCH ACTIVITY INVOLVING HUMAN SUBJECTS

To: Carol Romano, Division of NIS/QA

From: Office of Human Subjects Research (OHSR)

Nature of Research Activity: Predictors of Nurse Adoption of a Computerized Information System as an Innovation

Original Request Received in OHSR on: 2/12/93

OHSR review of your request dated 2/10/93 has determined that:

[  ] Federal regulations for the protection of human subjects do not apply to the above-named activity. No further action necessary.

[ X ] The activity is designated EXEMPT, and has been entered in the OHSR database. PLEASE NOTIFY OHSR OF ANY SIGNIFICANT CHANGES THAT MAY ALTER THE EXEMPT STATUS OF THIS RESEARCH ACTIVITY.

[  ] OHSR recommends IRB Review. Your request has been forwarded for action to the Chair of your IRB, who may ask you to provide additional information in order to determine whether expedited or full review is appropriate.

[  ] Other

Director, OHSR
Title

2/16/93
Date
APPENDIX B  
SUMMARY OF RESEARCH SUPPORTING GENERALIZATIONS

<table>
<thead>
<tr>
<th>Independent Variable &amp; Direction of Relation -ship to Innovativeness</th>
<th>Number of Studies</th>
<th>% of Studies Supporting Relationship</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Support Non-support</td>
<td></td>
</tr>
<tr>
<td><strong>Socioeconomic Characteristics</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>+Education</td>
<td>203</td>
<td>72</td>
</tr>
<tr>
<td>+High Social Status</td>
<td>275</td>
<td>127</td>
</tr>
<tr>
<td>+Upward social mobility</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>+Larger-sized units</td>
<td>152</td>
<td>75</td>
</tr>
<tr>
<td>+More Specialized operations</td>
<td>9</td>
<td>6</td>
</tr>
<tr>
<td><strong>Personality Variables</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>+Empathy</td>
<td>9</td>
<td>5</td>
</tr>
<tr>
<td>+Able to deal with abstractions</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>+Rationality</td>
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<tr>
<td>+Intelligence</td>
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<td>+More favorable attitude to change</td>
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<td>+Ability to cope with uncertainty</td>
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<td>+More favorable attitude to education</td>
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<td>+More favorable attitude to science</td>
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<td>7</td>
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<tr>
<td>-Fatalism</td>
<td>14</td>
<td>3</td>
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<td>+Achievement motivation</td>
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<td>+Cosmopolitaness</td>
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<tr>
<td>+Knowledge of innovations</td>
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Key: + • Positive relationship
- • Negative relationship

APPENDIX C
CONSENT FORM

Dear Registered Nurse:

In light of the current trends to use clinical and management information systems in nursing and health care, it is important to obtain information about the implementation, use, and reactions to computerized information technology. I am conducting a research study which explores how an automated information system, specifically the Automated Nurse Staffing System (ANSOS), is perceived by nurses.

I am a doctoral candidate at the University of Maryland School of Nursing and this research is being conducted under the direction of Dr. Mary Etta Mills. Your name was selected from a list of registered nurses employed at the Clinical Center in the Nursing Department.

Your participation in the research is entirely voluntary. All responses will be kept confidential and anonymous. No individual person will be identified in the final results. Participants in this study are not exposed to any risk and are asked simply to complete a questionnaire. While you will receive no direct benefit, your participation will help to advance the nursing knowledge in this area. A summary of the results will also be made available to you.

In order for the results to be valid, it is extremely important that all participants complete and return the questionnaire. I would appreciate your taking some time today, or at your earliest convenience, to complete the enclosed form and return it to me. It should take no more than 20 to 30 minutes of your time. Instructions for completing the questionnaire are included on the form and I have enclosed a self-addressed envelope for your convenience.

Return of the completed questionnaire will indicate your informed consent to participate in the study. Please do not hesitate to contact me or my Dissertation Chair, Dr. Mills, if you have any questions regarding this research. I can be reached at [phone number] or Voice Beeper [phone number]. Dr. Mills can be reached at [phone number]. Thank you in advance for your anticipated response.

Sincerely,

Carol A. Romano, RN, MS, FAAN
PhD. Candidate

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APPENDIX D
QUESTIONNAIRE

Directions:

This questionnaire asks for your feelings, attitudes and perceptions about yourself, the health care environment and the Computerized Staffing and Scheduling System (ANSOS). It is divided into 3 parts.

There are no right or wrong answers or responses. Please read each statement or question carefully and respond with your honest feelings, attitudes or perceptions. Do not spend too much time on any one statement. Record your initial response. It is suggested that you complete the questions at work and in one uninterrupted setting if possible. It should take approximately 20-30 minutes to complete.

Please return the completed questionnaire by March 18, 1993 in the enclosed envelope and mail to:

Carol A. Romano, RN, MS

Thank you.
PART ONE

The first part of this questionnaire focuses on the nurse and the health care environment.

Consider the following statements in relation to how you feel toward change in general. Use the following scale to respond to the statements. Circle the number which best represents the extent to which you agree or disagree with each statement.

1 = strongly disagree  
2 = disagree  
3 = slightly disagree  
4 = neutral  
5 = slightly agree  
6 = agree  
7 = strongly agree

1. There is something refreshing about enthusiasm for change . . . . . . . . 1 2 3 4 5 6 7

2. If I followed my feelings, I would devote much time to change efforts . . . 1 2 3 4 5 6 7

3. The current situation in the hospital calls for change . . . . . . . . . 1 2 3 4 5 6 7

4. In order for change to occur in an organization, it's the policy of the organization as a whole that needs to be changed . . . . . 1 2 3 4 5 6 7

5. Over time, any organizational structure needs to be revitalized . . . . . 1 2 3 4 5 6 7

6. I get excited about change efforts 1 2 3 4 5 6 7

7. I like being involved in change activities . . . . . . . . . . . . . . . . 1 2 3 4 5 6 7

8. Change is needed in my present working environment . . . . . . . . . . . . 1 2 3 4 5 6 7

9. To implement any change, the environment/organization, not just people, has to change . . . . . . . . . . . . . . 1 2 3 4 5 6 7

10. Most things, over time, need to be changed and revitalized . . . . . . . . . . . . . . . . . . . . . . . . . . . 1 2 3 4 5 6 7
Consider the following behaviors. Circle the number which best represents your typical, routine behavior.

11. I regularly interact with, and/or attend professional meetings with nurses who do not work at this hospital
   0 no
   1 yes

12. I regularly read professional journals
   0 no
   1 yes

13. I am currently enrolled in a degree granting program
   0 no
   1 yes

14. I regularly attend Nursing Department/Nursing Service/ Hospital committees, meetings or task forces
   0 no
   1 yes

15. I routinely read Nursing Department memos, communications, newsletters
   0 no
   1 yes
Consider your nursing unit or area when answering the following questions. Circle the number which best describes the group of individuals who influence each of the activities or decisions listed. Use the following scale to respond to the statements:

1 = staff nurses only
2 = primarily staff nurses - some administration/management input
3 = equally shared by administration/management and staff nurses
4 = primarily administration/management - some staff nurse input
5 = administration/management only

16. Scheduling ........................................ 1 2 3 4 5
17. Unit coverage ........................................ 1 2 3 4 5
18. Development of practice standards ............. 1 2 3 4 5
19. Definition of scope of practice ................... 1 2 3 4 5
20. Monitoring of RN practice standards ............ 1 2 3 4 5
21. Evaluation of staff nurse practice .............. 1 2 3 4 5
22. Recruitment of RNs to practice on the unit .... 1 2 3 4 5
23. Interview of RNs for hire on the unit .......... 1 2 3 4 5
24. Selection of RNs for hire on the unit .......... 1 2 3 4 5
25. Recommendation of disciplinary action for RNs 1 2 3 4 5
26. Selection of unit leader (e.g., head nurse) .... 1 2 3 4 5
27. Review of unit leader’s performance .......... 1 2 3 4 5
28. Recommendation for promotion of staff RNs 1 2 3 4 5
29. Determination of unit budgetary needs .......... 1 2 3 4 5
30. Determination of equipment/supply needs ..... 1 2 3 4 5
31. Development of standards for support staff (LPN, NA, PCT) 1 2 3 4 5
32. Specification of number/type of support staff (LPN, NA, PCT) 1 2 3 4 5
33. Monitoring of standards for support staff (LPN, NA, PCT) 1 2 3 4 5

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34. Liaison with other departments re: patient care
1 2 3 4 5
35. Relations with physicians re: patient care
1 2 3 4 5
36. Conflict resolution among RN staff on unit
1 2 3 4 5
PART TWO

The second part of this questionnaire focuses on the **computerized method** we currently use to manage nurse’s staffing and scheduling information (**ANSOS**). The statements below refer to the automated format, processing and procedures for handling your staffing and scheduling data including the printed forms and reports. It does **NOT** refer to your interaction at a computer terminal.

Consider the following statements about your satisfaction with ANSOS. Circle the number which **best** represents your response to the following statements. Use the following scale:

1 = almost never  
2 = some of the time  
3 = about half of the time  
4 = most of the time  
5 = almost always

37. The computerized method provides the precise information I need .......................... 1 2 3 4 5

38. The information content meets my needs .......................... 1 2 3 4 5

39. This method provides printouts that seem to be just what I need .......................... 1 2 3 4 5

40. The computerized method provides sufficient information .......................... 1 2 3 4 5

41. The method promotes accuracy .......................... 1 2 3 4 5

42. I am satisfied with the accuracy of the method .......................... 1 2 3 4 5

43. I think the output is presented in a useful format .......................... 1 2 3 4 5

44. The information is clear .......................... 1 2 3 4 5

45. The computerized information is user friendly .......................... 1 2 3 4 5

46. The computerized information is easy to use .......................... 1 2 3 4 5

47. I get the information I need in time .......................... 1 2 3 4 5

48. The method provides up-to-date information .......................... 1 2 3 4 5
Consider the following pair of descriptions of the computerized staffing and scheduling system (ANSCS) and circle the number which best indicates your perception of this system. Note the following example which describes a pillow. The circle indicates I consider the pillow soft, but not as soft as it could be.

**EXAMPLE:** This pillow is not soft at all 1 2 3 4 5 6 7 8 9 10 This pillow is as soft as it can possibly be

49. The computerized staffing and scheduling method offers no advantages 0 1 2 3 4 5 6 7 8 9 10

50. The computerized staffing and scheduling method is not at all complex 0 1 2 3 4 5 6 7 8 9 10

51. There is no need for the computerized staffing and scheduling method in this organization 0 1 2 3 4 5 6 7 8 9 10

52. There is a high need for the computerized staffing and scheduling method in this organization 0 1 2 3 4 5 6 7 8 9 10

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Please rate how strongly you agree or disagree with the following statements by circling the number which best reflects your response. Use the following scale to respond to each statement:

1 = strongly disagree
2 = disagree
3 = slightly disagree
4 = neutral
5 = slightly agree
6 = agree
7 = strongly agree

52. I believe the organization should continue to use the computerized staffing/scheduling method . . . . . . . . . . . . . 1 2 3 4 5 6 7

53. I believe my immediate supervisor thinks the organization should continue to use the computerized staffing/scheduling method . . . . . . . . . . . . . 1 2 3 4 5 6 7

54. I believe my peers/co-workers think the organization should continue to use the computerized staffing/scheduling method . . . . . . . . . . . . . 1 2 3 4 5 6 7
PART THREE

This part of the questionnaire will be used to describe the study participants. Please answer the following questions and circle the appropriate response.

55. How old were you on your last birthday?

____________________ years.

56. What is your gender?

0 Male

1 Female

57. What is the highest level of education you have completed?

1 Associate Degree

2 Diploma

3 Baccalaureate (BS, BSN, BA)

4 Master Degree (MS, MSN, MA)

5 Doctoral Degree (PhD., DSN Ed)

58. What is your Current Employment Status in this Nursing Department?

0 Part time

1 Full time

59. How long have you worked for this Nursing Department?

____________________ year(s)

60. How long have you worked as a registered nurse anywhere?

____________________ year(s)
61. What is your current role in the Nursing Department?

0 Clinical Nurse
1 Head Nurse, Acting Head Nurse
   Service Chief
   Associate/Deputy or Division Director
2 Other

62. What Nursing area do you work in?

0 Inpatient
1 Outpatient/Day Hospital
2 Both inpatient and outpatient
   Not applicable

Thank You for Your Participation
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Degree and date to be conferred: Doctor of Philosophy, 1993

Date of birth: August 18, 1950

Place of birth: Hazleton, Pennsylvania

Secondary education: Hazleton High School
Hazleton, Pennsylvania
1968

Collegiate institutions attended:

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Professional publications:

**JOURNALS:**


**CHAPTERS IN BOOKS:**


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**PROCEEDINGS:**


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<td>Warren Grant Magnuson Clinical Center, National Institutes of Health (NIH) Bethesda, MD</td>
<td>1987 - present</td>
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<tr>
<td>Interim Quality Assurance Specialist</td>
<td>Warren Grant Magnuson Clinical Center, NIH Bethesda, MD</td>
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