A FRAMEWORK FOR TECHNOLOGICAL DECISION MAKING: AN INVESTIGATION INTO THE ADOPTION SHELVING AND REJECTION OF NEW TECHNOLOGIES IN INDUSTRIAL ORGANIZATIONS

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PREFACE

The focus of this study was to identify and evaluate the decision-process factors which predominantly impact the organizational decision response to proposed new technologies. To accomplish this, a survey was conducted to the top management of 215 medium-to large industrial organizations across the United States who were directly involved in technological decision making processes. Information obtained from the literature search was used to develop a theoretical framework for this empirical research. This framework then became the basis for the development of the study's stated hypotheses. Data collected showed a total of 104 proposed new technologies which had been adopted, shelved or rejected in the sample organizations across the United States. This wide range of new technologies was identified into six general categories: manufacturing technologies, information technologies, product technologies, process technologies, operations technologies, and energy cost reduction technologies, respectively. Data was evaluated, and statistical analysis was conducted to provide the descriptive results as well as to test the stated hypotheses for this study.

Survey and statistical results are presented in table forms, as well as statistical results, for the testing of the individual hypotheses. A summary of all the hypotheses tested, along with results, are presented in the body of this document.

I wish to express my sincere gratitude to the individuals who assisted me in this research effort and during my graduate studies at Oklahoma State University. My special appreciation goes to my dissertation advisor, Dr. David E. Mandeville, whose advice, perseverance, guidance, and insightful comments were indispensable to me throughout my doctoral program. His constructive critique of several aspects of this study helped me understand the depth of the problems addressed in the research.

I am also most appreciative of the knowledgeable assistance and support I received from the other members of the committee: Dr. Wayne C. Turner, Dr. M. Palmer Terrell, Dr. Carl B. Estes, and Dr. Margaret A. White. I would like to especially thank Dr. Wayne C. Turner, whose dedication to excellence and professionalism has been an inspiration to me for as long as I have been associated with him. My due respect is extended to Dr. M. Palmer Terrell whose experience, wisdom and teachings have helped me to understand the intricacies of decision processes in practical life. I also gratefully acknowledge the help of Dr. Carl B. Estes, who initially served on my committee as chairman before leaving Oklahoma State University. I am deeply indebted to Dr. Margaret A. White for her guidance, generous consultation, and encouragement throughout my doctoral program.

My sincere appreciation goes to Mrs. Janice Walter for her tremendous assistance during the mailing of the survey instrument. My special thanks go to Ms. Zenaida Sarabia who helped improve the readability of this document.

Throughout the years, my family and dear friends have been a virtual treasure of support, love, and inspiration and, for this, I am eternally grateful. Most of all, I would like to thank my wife, Ye-Qiong Zhu, for her intelligent suggestions, for her strength when I wavered, for her humor when I needed it, for her pride in my accomplishments, and for her love. Above all, I am thankful to God, whose grace and guidance have maintained me in all my life.

Finally, I wish to dedicate this dissertation to the loving memory of my father who did not live to see the accomplishment of my doctoral program.

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CHAPTER I

INTRODUCTION

Technology has been portrayed as an important driving force that improves quality, engenders productivity, reduces operating costs, and thus maximizes the profit potential of an organization. Managers in organizations today are faced with the task of making important technological decisions in an increasingly complex and turbulent environment. However, over the last two decades, the concept of technology has changed dramatically. The notion of 'new technologies' includes a wide variety of advanced technologies generally based on the application of computers and microelectronics.

A decision to incorporate a proposed new technology into an organization's operating environment is an important managerial activity. New technologies are generally considered to be a crucial resource of an organization which may improve the productivity and quality of its operations. In the current debate on management of technology, several scholars have identified the role of new technologies as being a competitive edge for industrial organizations. For example, Burgleman and Maidique (1988) have emphasized that the effective management of technology is an important determinant for the competitive success of an organization.

A wide range of new technologies is proposed to an organization's management by in-house technical experts, technology producers, and consultants hired by the organization. These proposed opportunities for introducing a new technology trigger a set of technological decision processes within the organization. These decision processes culminate in the final adoption or non-adoption of the proposal. The adoption decision is itself comprised of two decisions: first, the decision to approve the proposal, and second, the decision to implement the proposed new technology. Non-adoption of a new technology proposal may further be described as a decision outcome comprising of shelving, or rejection of the proposal. Shelving is an outcome of the decision process whereby the decision-makers have neither fully accepted nor outright rejected the proposal. Rejection, on the other hand, is considered to be an outcome where the decision-makers clearly disapprove the new technology proposal.

Presently, the most intriguing questions facing researchers as well as decision-makers in organizations include: How and why certain proposed new technologies are adopted and others are either shelved or rejected? Why one organization adopts a particular proposed new technology while another organization shelves or rejects the same new technology? While there has been widespread research in the area of organizational decision making, literature on the implementation of new technologies is only presently emerging. The available research and pertinent literature have not adequately addressed the issues in this important area.

The study of organizational decision making faces a perennial problem in that every decision is unique. Decision-making theory has remained highly fragmented, with some writers focusing on the decision-making process itself, while others examining actual decisions and the outcome of such processes. According to Rowe (1989), "even those who concentrated on processes could be further subdivided between those who adopted a psychological approach - viewed the organizations as information processing system; stressed the constraints of 'bounded rationality'; and argued that individuals 'muddle through' to 'satisfactory' decisions - and those who saw decision-making more as a political process involving conflict, and power relationships".

That organizations assimilate new technologies through complex decision processes at varying rates has been demonstrated by various researchers (e.g., Collins et al., 1988; Daft & Becker, 1978; Mintzberg et al., 1976). There are two dominant perspectives on how characteristics of an organization affect the process of its technology assimilation: (1) structural, and (2) technoeconomic.

Researchers who take the structural perspective have focused on how organizational characteristics, such as size, inventory of technical skills, organizational policies, rewards, training, structural complexity, and patterns of social relations among decision-making units affect the amount, rate, and permanence of technological innovations in an organization (Baldridge & Burnham, 1975; Beyer & Trice, 1978;

Burns & Stalker, 1961; Daft & Becker 1978; Ettlie, 1986; Hage, 1980, 1986; Hull & Hage, 1982; Kimberly & Evanisco, 1981; Landau, 1982; Solberg et al., 1985). A recent review of the literature on technological innovation conducted by the National Science Foundation (Tornatzky et al., 1983) concluded that much of the technological change malaise in organizations is mainly due to managerial and organizational characteristics.

Researchers taking the technoeconomic perspective, on the other hand, have primarily been concerned with how the juncture of internal manufacturing processes and external market factors affect the type and rate of technological innovations within firms (Abernathy & Townsend, 1974; Abernathy & Wayne, 1974; Gerwin, 1988; Pavitt & Rothwell, 1976; Utterback, 1971; Utterback & Abernathy, 1975). The technoeconomic perspective has further examined how characteristics of existing production technologies in a firm themselves affect organizational capacity for subsequent adoption of new technologies (Skinner, 1985).

Most investigators adopting the technoeconomic perspective have assumed that opportunities in an organization's operating environment primarily determine the organization's desire to adopt new technologies. These opportunities, arising due to environmental issues, may include: changes in a product's life cycle, external competitive pressures, required changes in production processes to reduce costs, improvement in quality and productivity, etc. However, extant technological attributes affect the manner and degree to which managers can respond to market pulls and technological push because of such factors as fixed costs, technical feasibility and economic justification of new technologies (Collins et al., 1988).

Theories of decision making in organizations generally recognize that the consequences of organizational processes are often highly uncertain. Much of the modern development of theories of choice can be described as the elaboration of ways to deal with incomplete information concerning the consequences of organizational actions. The present literature does not discriminate much between organizational decision making and technological decision making.

Rational theories of organizational decision making presume that voluntary choices are made intentionally in the name of individual or collective purposes (Harrison, 1981; Newell & Simon, 1972; Simon, 1965). These theories assume that the alternative with the highest expected value is chosen (Schlaifer, 1959). However, empirical studies of actual decision-making processes in organizations seem to show that these processes are not so logical and deliberate (Isenberg, 1984). Indeed, such decision processes are immensely complex, dynamic and surrounded by ambiguities and disorder (Cohen, March & Olsen 1972). Mintzberg et al. (1976) have indicated that although organizational decision processes are highly complex, dynamic, and unstructured, they are amenable to conceptual structuring. A major gap in the existing literature is in the lack of understanding of the relationship between technological decision processes and their structure in the context of organizational decision making.

The issue of which critical factors impact an organizational decision to adopt or 'not adopt' a proposed new technology has not been adequately addressed in the literature of organizational studies. However, an emerging body of literature on adoption and successful implementation of new technologies has identified through case studies certain critical factors that may facilitate or hinder the successful adoption of proposed new technologies. But these studies were limited in their setting; either they addressed a particular set of new technologies, or their focus was on the adoption process of a new technology in a particular organization. This literature provided the basis for developing a theoretical and practical framework to accomplish the objectives and goals set for this study.

A review of literature pertinent to technological decision making identified the critical factors that were predominantly mentioned as impacting the successful or unsuccessful implementation of new technologies in organizations. A few empirical studies concerning the adoption of innovations in organizations were also reviewed. These studies indicated that a myriad of factors facilitate the successful adoption of new innovations. To guide the empirical research effort of this study, a framework was developed based on the theoretical support of the current literature and the findings of related studies on innovation. Building both on the structural, as well as technoeconomic perspectives of an organization, this framework provides an integrated view of technological decision processes which culminate in the adoption, shelving, and rejection of proposed new technologies in organizations. The framework is shown in figure 1.

This framework has two main aspects. First, based on the emerging literature on the adoption and successful implementation of new technologies, it includes thirteen critical factors that may impact the choice outcome of the technological decision process in an organization. Second, by drawing on the support from the pertinent literature, it predicts how these decision-process predictors differentially impact the decision outcome of adoption, shelving, and rejection of a proposed new technology in an organization. A further discussion on the theoretical framework used in this study is presented in a later section of this chapter. The literature review to support this model is presented in Chapter II.

The main purpose of this study is to identify and to evaluate the critical factors which predominantly impact the technological decision processes culminating in the adoption, shelving, or rejection of proposed new technologies in an organization. From the review of pertinent literature, factors common across a variety of technological decisions, were identified and formed the basis for the constructs of the framework used in this study. Based also on the relevant information from literature, a survey instrument was developed

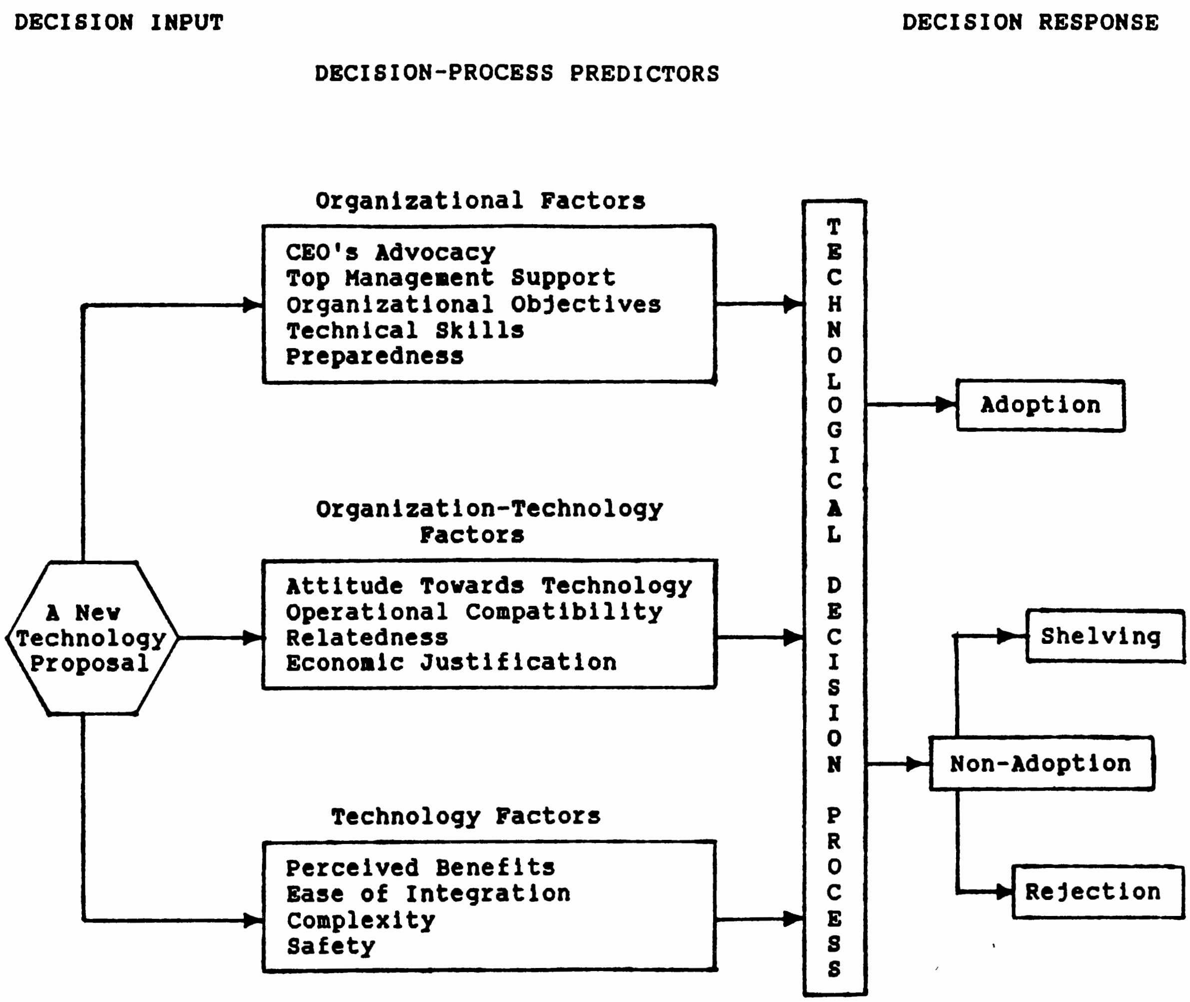

Figure 1. A Framework for Technological Decision Making

to collect data. The survey was conducted in a selected sample of industrial organizations across the United States. Results of this study indicate that there is a commonality of factors accountable for impacting an organizational decision to adopt, shelve, or reject a proposed new technology. This study is expected to provide some direction and guidelines for decision-makers in organizations who face the choice of a new technology.

Succeeding sections will discuss the need for this study; statement of the problem; purpose and objectives of the study; scope and limitation; assumptions; theoretical and practical framework, and a summary list of the stated hypotheses for this study.

Need for the Study

Why and how do organizations adopt, shelve and reject proposed new technologies? The assimilation of innovative new technologies into an organization is a process unfolding in a series of decision processes to evaluate, approve, adopt, and implement these technologies (Meyer & Goes, 1988). Perhaps owing to disciplinary boundaries, contributors to organizational literature have inadvertently treated the organizational characteristics and technology determinants of decision-making processes separately. In spite of the fact that there is a prevailing technology school in organizational sociology (Perrow, 1967; Woodward, 1965), there has been little research concerning how organizational characteristics, technology attributes, and the interaction of organizational contextual variables with technological attributes influence the outcome of decision processes (Meyer & Goes, 1988). Since technology and an organization's structural characteristics are to some extent interdependent, in effect, if not by design (Scott, 1987), it is imperative that researchers understand how the set of these two factors impact an organization's decision response to proposed new technologies.

A review of the pertinent literature indicates that researchers have developed a variety of decision making models examining, in general, organizational decision processes, but none directly offers an integrated framework of the technological decision making process. The literature on decision processes relating to new technologies has been described as "fragmentary" (Kelly & Kranzberg, 1978), "contradictory" (Kimberley & Evanisco, 1981), and "beyond interpretation" (Downs & Mohr, 1976). Mohr (1982) has pointed out that no real theory has emerged that will permit the prediction of the extent to which a given organization will employ a given new technology. Meyer and Goes (1988) contend that from both theoretical and practical perspectives, our cumulative knowledge of why and how organizations adopt and implement innovative new technologies is considerably less than the sum of its parts.

After investigating a number of potential antecedents, a few researchers have found fragmentary evidence linking the adoption of new technologies to the attributes of environments, organizations, leaders, key decision makers, and the technologies themselves. But most of the links are tenuous. Some investigators have retrospectively inferred antecedents from correlation analysis (e.g. Aiken & Hage, 1971; Moch & Morse, 1977; Daft and Becker, 1978), but such analyses mask the underlying causal processes. Most comparative studies with large samples have examined short lists of predictor variables. Consequently, little is known about the relative influence of the predictors (Baldridge & Burnham 1975; Kimberley & Evanisco, 1981), and virtually nothing is known about how the predictors interact (Downs & Mohr, 1976 ; Meyer & Goes, 1988).

In view of the above indications by various researchers, an integrated framework is needed to understand the technological decision processes, that are triggered when new technology proposals are put forward for organizational decision making. Further, a comprehension of the underlying factors which impact the organizational decision response to new technology proposals will help managers, as well as proposers of new technologies, assess the decision outcome in the contexts of both organizational characteristics and the proposed new technology per se.

Statement of the Problem

This study was designed to fill the void in literature relating to the technological decision making processes in organizations. The information addressing the adoption and non-adoption of new technologies available in the current literature is predominantly based on case studies and reports relating to the implementation of singular new technology projects in individual organizations. This body of knowledge in the current literature does not provide a generalizable pattern of factors that impact the outcome of technological decisions concerning proposed new technologies across organizations. Empirical studies indicating the commonality of any set of factors impacting an organizational decision regarding adoption, shelving or rejection of a proposed new technology is currently lacking. Such information is required to provide decision-makers in organizations direction in their technological decision making processes concerning the proposed new technologies. This study synthesized the critical factors commonly cited in literature as being decision-process factors impacting an organizational decision response to proposed new technologies. A theoretical and practical framework was developed based on pertinent literature support and the hypotheses were formulated in the view of this framework. Subsequently, empirical research was conducted in industrial organizations across the United States. The aim of this investigation was to determine if there were any generalizable patterns in the factors that accounted for the adoption, shelving, and rejection of proposed new technologies across organizations.

Purpose and Objectives of the Study

The purpose of this study was to identify and evaluate the critical factors which predominantly impact the technological decision processes in organizations culminating in the adoption, shelving, and rejection of proposed new technologies. The present study has two main objectives:

1. To investigate if the set of decision-process factors indicated in the literature as impacting an organization's technological decisions are seen as important factors by decision-makers across organizations.

2. To determine if there are any generalizable patterns of factors that impact the technological decisions concerning the adoption, shelving, or rejection of proposed new technologies across organizations.

Scope and Limitations

This study was limited to a selected sample of 215 industrial organizations across the United States. The decisions relating to the adoption or non-adoption of proposed new technologies were presumed to be carried out at the higher levels of such organizations: the survey instrument was addressed to the top management of the sample industrial organizations.

Assumptions

This research made the following assumptions:

1. All the industrial organizations included in the sample for this study had adopted or not adopted some proposed new technology in their operations within the last two years.

2. All participants had been personally involved in the decision making processes concerning the choice of the adoption or non-adoption of proposed new technologies in their respective organizations.

3. All participants understood the intent and purpose of each of the survey questions.

Theoretical and Practical Framework for the Study

To guide the empirical research effort, a framework for technological decision making was developed. The framework is shown in figure 1, page 8. This framework depicts three major elements involved in a decision-making model: decision input, decision response, and decision-process predictors.

The construct of decision input assumes that new technologies adopted or `not adopted' in an organization are presented to the decision-makers in the form of a new technology proposal. The construct of the decision response involves two major dimensions of the decision outcomes namely: adoption, and non-adoption. The non-adoption decision outcome is further discerned into shelving and rejection.

The construct of decision-process predictors identifies a set of thirteen critical factors that may impact the technological decision processes concerning the choice of a proposed new technology in an organization. The selection of these thirteen factors was based on the support of the emerging literature on the adoption and successful implementation of new technologies in organizations. These factors are grouped into three broad categories: organizational factors, organization-technology factors, and technology factors. The constituent factors in the category of organizational factors reflect only those characteristics of an organization that, in general, are considered to play an important role in determining the decision outcome in the context of a proposed new technology. The group of organization-technology factors reflects the predictors which address the interrelationship of organizational characteristics and the attributes of the proposed new technology per se. Similarly, the technology construct is comprised of individual factors which reflect the attributes of a proposed new technology.

The existing literature on the adoption and implementation of new technologies implies a link between these critical factors and successful technology implementation. This implied link has not been directly tested. In this study, these factors are treated as independent predictors of technological decision making processes. The existing literature does not indicate that there is much emphasis on an interactive explanation of these critical factors. Moreover, in the scope of this study, a more inclusive and simpler additive model is conceived. The detailed discussion and the literature support in developing this framework is presented in Chapter II.

In the following section, using this framework as a basis of empirical research, a set of hypotheses are summarized which were developed based on existing theory and literature.

Hypotheses

Thirty four hypotheses were derived to test the relationship suggested by the theoretical framework for this study. In the literature review (Chapter II), the argument and related discussion for the development of each individual hypothesis will be presented. The research hypotheses are summarized in two sets: (1) the hypotheses which address the impact of decision-process factors on the adoption and non-adoption of a proposed new technology in an organization, (2) the hypotheses that address the differentiating role of decision-process predictors relating to the adoption, shelving, and rejection of a new technology proposal in an organization.

Hypotheses relating to Adoption and Non-adoption:

1. The degree of a CEO's advocacy will be significantly higher for a proposed new technology that is adopted than for one which is not adopted.

2. The degree of top management support and commitment will be significantly higher for a proposed new technology that is adopted than for one which is not adopted.

3. A proposed new technology that is adopted will have a significantly higher degree of fit with organizational objectives than one which is not adopted.

4. The degree of technical skills will be significantly higher where a proposed new technology is adopted than where one is not adopted.

5. The degree of organizational preparedness will be significantly higher for a proposed new technology that is adopted than for one which is not adopted.

6. The degree of management's positive attitude towards a proposed new technology will be significantly higher for a technology that is adopted than for one which is not adopted.

7. The degree of operational compatibility will be significantly higher for a proposed new technology that is adopted than for one which is not adopted.

8. A proposed new technology that is adopted will have a significantly higher degree of relatedness to the existing technological and business operations of the firm, than the one which is not adopted.

9. A proposed new technology that is adopted will likely have more economic justification than the one which is not adopted.

10. A proposed new technology that is adopted will have a significantly higher degree of perceived benefits to the firm than the one which is not adopted.

11. A proposed new technology that is adopted will have a significantly higher degree of ease of integration than the one which is not adopted.

12. A proposed new technology that is adopted will be less complex than one which is not adopted.

13. The degree of safety will be significantly higher for a proposed new technology that is adopted than the one which is not adopted.

14. Organizational factors will be a significant differentiating predictor to the adoption or non-adoption of a proposed new technology.

15. Organization-technology factors will be a significant differentiating predictor to the adoption or non-adoption of a proposed new technology.

16. Technology factors will be a significant differentiating predictor to the adoption or non-adoption of a proposed new technology in an organization.

17. The aggregate of the decision-process factors will be a significant differentiating predictor to the adoption or non-adoption of a proposed new technology.

Hypotheses relating to adoption, shelving, and rejection:

1a. The degree of a CEO's advocacy will be a significant differentiating factor for a new technology proposal to be adopted, shelved or rejected.

2a. The degree of top management support and commitment will be a significant differentiating factor for a new technology proposal to be adopted, shelved or rejected.

3a. The degree of fit between a proposed new technology and organizational objectives will be a significant differentiating factor for this new technology to be adopted, shelved or rejected.

4a. The degree of technical skills will be a significant differentiating factor for a new technology proposal to be adopted, shelved or rejected.

5a. The degree of organizational preparedness will be a significant differentiating factor for a new technology proposal to be adopted, shelved or rejected.

6a. The degree of management's positive attitude towards a proposed new technology will be a significant differentiating factor for this technology to be adopted, shelved or rejected.

7a. The degree of operational compatibility of a proposed new technology will be a significant differentiating factor for this technology to be adopted, shelved or rejected.

8a. The degree of relatedness of a proposed new technology to the existing technological and business operations of a firm will be a significant differentiating factor for this technology to be adopted, shelved or rejected.

9a. The degree of economic justification will be a significant differentiating factor for a proposed new technology to be adopted, shelved or rejected.

10a. The degree of perceived benefits will be a significant differentiating factor for a proposed new technology to be adopted, shelved or rejected.

11a. The degree of the ease of integration will be a significant differentiating factor for a proposed new technology to be adopted, shelved or rejected.

12a. The degree of complexity will be a significant differentiating factor for a proposed new technology to be adopted, shelved or rejected.

13a. The degree of safety will be a significant differentiating factor for a proposed new technology to be adopted, shelved or rejected.

14a. Organizational factors will be a significant differentiating predictor to the adoption, shelving or rejection of a proposed new technology.

15a. Organization-technology factors will be a significant differentiating predictor to the adoption, shelving or rejection of a proposed new technology.

16a. Technology factors will be a significant differentiating predictor to the adoption, shelving, or rejection of a proposed new technology.

17a. The aggregate of the decision-process factors will be a significant differentiating predictor to the adoption, shelving, or rejection of a proposed new technology.

Definitions of Terms

Most of the terms used in this study may be classified as common knowledge in the literature of organizational decision making. However, the following definitions are provided to avoid misinterpretation of their use within this study:

Adoption: The adoption of a proposed new technology is comprised of two sets of decisions. First, the decision to approve the new technology proposal. Second, the set of decisions to implement the proposed new technology.

Non-adoption: The non-adoption of a new technology proposal is an organizational decision response indicating that the proposal is not approved for adoption.

<u>Shelving:</u> An outcome of an organizational decision processes whereby the new technology proposal is neither accepted nor rejected by decision-makers in an organization.

<u>Rejection:</u> An outcome of the organizational decision process where the new technology proposal is clearly disapproved by the decision makers in an organization.

<u>Technological Decision Process:</u> An organization's decision process involving the choice of a proposed technology.

<u>Decision-process predictors:</u> A set of factors or variables that indicate (predict) the outcome of the decision-making process.

<u>New Technologies:</u> Advanced technologies based on computers and microelectronics. Examples of such technologies are: new manufacturing technologies, new information technologies, new product/process technologies, and new production technologies.

Organization of the Study

This chapter provided an overview of the topic under study, as well as the rationale for the preparation of this study. Chapter II presents a review of the pertinent literature and the development of a theoretical framework to guide the empirical research efforts for the study. The methodology and procedures to conduct this study will be described in Chapter III. Chapter IV provides the analyses and findings of the survey pertaining to the first objective of the study. The test statistics and results of individual hypotheses, as well as implications, will be presented in Chapter V. The summary, conclusions, and recommendations for future research constitute the contents of Chapter VI.

CHAPTER II

REVIEW OF LITERATURE

The literature review in this chapter is presented to develop an integrated perspective of the technological decision making processes within organizations. First, an overview of the organizational decision making literature is provided. The overview focuses on the current issues in the areas of organizational decision processes, organizational decision-making units, and a typology of organizational decisions. Second, in the light of related literature, the concepts of technological decision processes, in conjunction with new technology proposals in organizations, are discussed. Third, from the review of the pertinent literature and case studies, various factors that influence the technological decision processes in organizations are identified. Fourth, the need for an integrated view of the technological decision making process in an organization is explored. The concepts derived from the existing literature are further elaborated to develop a framework for technological decision making in organizations. Finally, a detailed discussion of the framework is presented in view of the pertinent literature support and relevant research. This framework provides a basis for developing hypotheses to be tested for this study.

The Organizational Decision Making Literature

The literature focusing on organizational decision making has not yet fully arrived at any definitive theory agreeable to the majority of researchers and theorists in the area of organizational studies. Some researchers have emphasized that organizational decisions are based on the notions of rationality and optimality, while others argue that decision making processes in organizations are haphazard, uncertain, and full of ambiguity (e.g., Cohen et al., 1972; Harrison, 1981; Isenberg, 1984; Mintzberg et al., 1976; Schlaifer, 1959; Simon, 1955). The extensive stream of research on organizational decision making indicates a diversity of research disciplines used in the study of decision making. It is commonly acknowledged that scholars and practitioners involved in decision making differ significantly in their concepts, approaches, methods, and applications.

Ungson and Braunstein (1982) argue that research in organizational decision making focuses on contextual relationships underlying decision making in groups and organizations, but lacks the experimental controls necessary to rigorously examine these relationships. There is little cross-referencing in the research literature among researchers of behavioral decision making, human problem solving, and organizational decision making. This lack of integration is not surprising, as the research fields are differentiated in methodology, levels of analysis, and epistemology. The proliferation of labels in the field of decision making (e.g., behavioral decision making, decision theory, human information processing, judgement theory), is testimony of the growing divergence and complexity of decision-making research (Abelson, 1976; Dawes, 1979; Gerwin & Tuggle, 1978; Hammond et al., 1980; MacCrimmon & Taylor, 1976; March & Olsen 1976; Mintzberg et al., 1976; Mitroff & Emshoff, 1979; Newell & Simon, 1972; Simon & Hayes, 1976; Tversky & Kahneman, 1974).

The literature on theories of decision making can be basically divided into two distinct fields: (1) Behavioral decision theory, and (2) Organizational decision theory. According to March and Sharpia (1982), these two fields of decision making are different, but they have a history of conspicuous cross-pollination. Some of the early work in organizational decision theory was, in a very general way, an effort to represent decision making in organizations as intendedly rational, but subject to rather severe cognitive constraints (Simon, 1955; Tversky & Kahneman, 1974).

Some of the early work in behavioral decision theory was affected by speculations about organizations. In fact, researchers and observers of decision making move rather easily back and forth from discussions of individual decision making to discussion of organizational decision making, using many of the same concepts for both. Rational models see decisions as being made by the evaluation of alternatives in terms of their future consequences for prior preferences. A large portion of the literature discussing the theoretical developments in the analysis of decision response - both at the individual and the organizational level - is some form of elaboration of that underlying vision of willful human action. Both in studies of individuals and organizations, there is a persistent fascination with the extent to which decision making reflects processes and produces outcomes familiar to the modern decision scientists.

Organizational decision theory is primarily theoretical rather than empirical. For the most part, the organizational decision making theory is a collection of simple ideas and metaphors intended to help make some sense of the naturally occurring events of organizational life. Most recent work in behavioral decision theory adopts the perspective of anticipatory action (Brehmer, 1978; Einhorn & Hogarth, 1978; Hammond et al., 1980; Schaeffer, 1976; Staddon & Motheral, 1978). The studies of decision making in this area basically are examinations of the extent to which individuals treat preferences, expectations, probabilities, and information in the ways one would expect from a proper decision theorist.

Recent work on organizational decision making is less focused on the view of decision response as some variation of willful problem solving. Although ideas about bounded rationality and problematic search are standard, recent work emphasizes the ubiquity and significance of unresolved conflict in organizations, a picture of organizations as reacting to experience rather than anticipating the future, and the ambiguities underlying organizational actions. Notions of loose coupling, disorderliness, non-decision, problematic attention, learning, and "garbage can" decision processes are frequent themes (e.g., Cohen et al., 1972; March & Olsen, 1976; Mintzberg et al., 1976; Olsen, 1976; O'Reilly et al., 1987; Tversky & Kahneman, 1974).

In aggregate, organizational decision theory is a cognitive interpretation of organizations, how they make decisions and deal, more or less deliberately, with questions of information, control, choice, and management.

Organizational Decision Processes

The most important aspect of the descriptive analysis of an organizational decisions is understanding the decision processes in which various organizational members participate. The basis of an action is decision. Kunreuther and Schoemaker (1982) define organizational decision processes as the collection, processing, and dissemination of specific types of information in determining a specific course of action. Others (e.g., Mintzberg et al., 1976; Pinfield, 1986), have defined a decision as a specific commitment to action, and a decision process as a set of actions and dynamic factors, that begins with the identification of a stimulus for action, and ends with the specific commitment to action.

To help managers meet the challenges of their work, researchers have developed information processing and decision-making models for organizations. O'Reilly, Chatman, and

Anderson (1987) indicate that empirical research, underlying the organizational decision models, appears to reflect two distinct perspectives: (1) communication, or the acquisition and flow of information in the organization, and (2) decision making, or information use in the organization. They argue that communication researchers have failed to consider the manner in which decision makers use the acquired information. On the other hand, O'Reilly et al. (1987) have pointed out that decision-making investigators have limited their studies to the use of cues in choice and judgement without an understanding of the organizational information acquisition processes. Various researchers (e.g., Connolly, 1977; O'Reilly et al., 1987) have urged an integration of these two complementary perspectives.

Rational theories of organizational decision making presume that voluntary choices in organizations are made intentionally in the name of individual or collective purpose. Researchers in this area argue that the basis of an organizational choice is rationality, and optimality (Harrison, 1981; Newell & Simon, 1972; Simon, 1965). Schlaifer (1959) has pointed out that the basic assumption in all theories of rational and optimal decision making in organizations is hinged on the notion that the alternative with the highest expected value is chosen. However, empirical studies of actual decision-making processes seem to show that these processes are not so logical and deliberate (Isenberg, 1984). The actual decision-making processes in organizations do not reflect that decision making is a sequential, predetermined, and orderly phenomenon. Cohen, March, and Olsen (1972) have indicated that, in fact, organizational decision processes are immensely complex and dynamic, and surrounded by ambiguities and disorder.

The difference in perspectives concerning how organizational decision processes may take place, is vividly illustrated in two central streams of the decision making literature: the process model, and the "garbage can" model. Simon (1965) first advanced a process model of decision making, consisting of an intelligence phase (initiating activity), a design phase (alternative course of action), and a choice phase (among the alternative courses of action). Mintzberg et al. (1976) built upon Simon's model, a more complex general model of interrelated decision processes comprised of: (1) an identification phase, consisting of recognition and diagnostic routines, (2) an alternatives development phase, consisting of search and design routines, and (3) a selection phase, comprised of screen, evaluation-choice, and authorization routines. This model recognized a number of factors that prevent a steady, undisturbed progression from one routine to another. These factors, involving limited rationality, conflict, complexity, and preference ambiguity, limit the orderliness of decision-making processes. Instead, these factors create a dynamic, open system process subjected to interferences, feedback loops, and dead ends.

Cohen, March, and Olsen (1972) first presented the idea of the "garbage can" model of organizational decision making. They contend that the decision making processes in organizations are neither rational nor orderly but they are ambiguous as well as of random nature. The "garbage can" model is an alternative way for discovering order in decision making that complements the process approach (Pinfield, 1986).

The central idea of the "garbage can" model is the substitution of a temporal order for a consequential order. According to Cohen et al. (1972), to understand the decision processes within organizations, "one can view a choice opportunity as a garbage can into which various kinds of problems and solutions are dumped by participants as they are generated. The mix of garbage in a single can depends on the mix of cans available, on the labels attached to the alternative cans, on what garbage is currently being produced, and on the speed with which garbage is collected and removed from the scene. Organizations can be viewed for some purposes as collections of choices looking for problems, issues and feelings looking for decision situations in which they might be aired, solutions looking for issues to which they might be an answer, and decision makers looking for work."

Mintzberg et al. (1976) contend that the literature of organizational decision making still lacks a single acceptable theory to describe how decision processes flow through organizational structures. They have indicated that the literature on organizational studies does not even provide a helpful typology of the kinds of decisions made in organizations, especially of those decisions that are found between the operating decisions of the bottom of the hierarchy and the strategic decisions of the top.

Organizational Decision-Making Units

In many situations, organizational subunits are responsible for making decisions. Such decisions may range from those pertaining to strategic issues to those pertaining to operational matters of the organization. Aside from the many individuals who might participate in the process of decision making, there is usually one individual or one group of individuals that is formally accountable for a particular decision or subset of decisions. Such an individual or group is referred to as a decision unit (Duncan, 1974). Organizational members and groups of members make decisions on behalf of their organizations.

Lee, McCosh, and Migliarese (1988) have indicated that even though organizational members of a decision unit tend to choose decision aids and organizational decision procedures that facilitate the making of timely and technically satisfactory decisions, they also consider other criteria when making their choices. These "other criteria" may be specific to the operating environment of an organization. According to Huber (1990), most decision making criteria in an organization are a function of the organization's business activity and are imposed by organizational resource constraints, strategy and functional policies, and structure.

Typology of Organizational Decisions

Decisions may be categorized by the stimuli that evoked them. These stimuli may be described as a continuum. At one extreme are opportunity decisions. Opportunity decisions are those initiated on a purely voluntary basis to improve an already secure situation. An example of such a decision is the introduction of a new product to enlarge an existing market share. Another example is the decision to incorporate new manufacturing technologies to improve an organization's production operations, or a decision to install a new process technology in order to reduce operating costs.

At the other extreme are crisis decisions, where organizations respond to intense internal or external pressures. In these severe situations an immediate organizational action is required. For example, an organization seeking a merger to stave off bankruptcy, or to fix malfunctioning equipment crucial to the production activity of the firm. Thus, opportunity and crisis decisions may be considered to form the two ends of a continuum of decision making.

Problem decisions may be defined as those that fall in between, evoked by milder pressures than crises. Problem decisions typically require multiple stimuli. Decision-makers in this case, presumably, wish to read the situation before taking action. A decision-maker may be reluctant to act on a problem for which he/she sees no apparent solution. Similarly, he/she may hesitate to use an opportunity that does not deal with a difficulty. The interesting phenomenon in the recognition of opportunity, problem, and crisis is that of matching. Mintzberg et al. (1976) found that when an opportunity is matched with a problem situation, a decision-maker is more likely to initiate a decision-making process. According to Huber (1990), to some degree, all organizations scan their external and internal environments for information about problems or opportunities. Yet, sometimes the managers do not learn about problems or opportunities in time to act with maximum effectiveness. In many cases, the alerting message is delayed as it moves through the sequential nodes in an organization's communication network (Huber, 1990).

Mintzberg et al. (1976) have categorized the decision processes on the opportunity-problem-crisis continuum based on the stimuli that evoked these decision processes. They contend that during the development of a solution, a given decision process can shift along the decision continuum because of a delay in decision making or due to a specific managerial action that may block a timely decision. For example, an ignored opportunity can later emerge as a problem or even a crisis. The managers may convert a crisis to a problem by seeking a temporary solution, or the same managers may use a crisis or problem situation as an opportunity to innovate.

Mintzberg et al. (1976) have analyzed 25 strategic decision processes in various organizations including: government institutions, service organizations, and manufacturing firms. These strategic decision processes varied from the acquisition of new manufacturing equipment, to the development of new markets and programs, to the production of new products and the construction of new facilities. These 25 decisions when categorized on an opportunity-problem-crisis continuum were found to contain: one crisis decision, five opportunity decisions, nine problem decision, four problem-crisis decisions, and six as opportunity-problem decisions. The authors have concluded that although organizational decision processes are immensely complex, dynamic, and unstructured, yet such decision processes are amenable to conceptual structuring. They have further indicated that the major gap in the literature is the relationship between decision processes and their structure.

Technological Decision Processes and New Technologies

Technological decision processes are assumed to be invoked when new technology proposals are put forward for the choice of decision makers in organizations. In today's competitive environment, technology is considered to be a strategic resource of an organization. A wide range of technologies are proposed by in-house technical experts or the consultants hired by an industrial organization to improve organizational performance.

Definitions of technology abound, but most are either broad or narrow. The broad meaning of technology refers to the knowledge, and strategies involved in transforming organizational inputs into outputs. In its stricter or narrower meaning, technology refers to the equipment, devices, systems, and techniques or methodologies required by an organization's workflow activities to transform raw materials into products.

Various scholars have subsequently operationalized the narrow concept of technology and have developed typologies of production technologies for industrial organizations. For example, Woodward (1958) proposed an 11-category classification of manufacturing technology based on the level of its increasing complexity. In her view, the technical complexity mean, "the extent to which the production process is controllable and its results predictable" in an organization. In the area of production technology (e.g., product/process technologies) Woodward's 11-categories classification has generally been collapsed into a threefold categorization by other researchers: unit and small batch, large batch and mass, and continuous process.

Thompson (1967) categorized technology into three types: (1) assembly-line technology, (2) mediation technology, and (3) intensive technology. Harvey (1968) defines technology as, "the mechanism or processes by which an organization turns out its product or services." In his view, industrial organizations are distinguishable on the basis of technology they use. He grouped organizations along the continuum from technical diffuseness to technical specificity.

However, over the last two decades the concept of technology has changed dramatically. According to Rhodes and Wield (1985), discussion of the incorporation of new technologies in organizations within the focus of current debate is likely to be perceived in terms of the application of technologies based on microelectronics. In this context, manufacturing technologies based on microelectronics and computers have often been portrayed as new manufacturing technologies or advanced manufacturing technologies in the current literature. Similarly, advanced technologies in the realm of production and information areas have been referred to as new process technologies, new product technologies, and new information technologies, and so forth. The term 'new' technology is thus used not only for the establishment of complete new production or information systems but also as it relates to large-and small-scale technological changes within the established production or operating systems of an organization.

A few researchers have emphasized the role of new technologies in an industrial organization as a competitive advantage for the firm. For example, Burgleman and Maidique (1988), in their discussion of management of technology in an organization, argue that technology issues should be given more strategic consideration when formulating or executing corporate strategies. In this sense, the organizational decisions processes concerning the incorporation of new technologies should involve many critical factors that may impact the organizational choice about these technologies.

In the context of this discussion, an organization's decision process involving the choice of a proposed technology may categorically be defined as technological decision process.

New Technology Proposals

New technologies present to organizations an opportunity to improve productivity, reduce operating costs, or maintain competitiveness in their operating environments. Managers are driven by these motivations to incorporate proposed new technologies in their organizations as a means of exploiting these opportunities.

There are two major ways that new technologies are proposed in organizations (Collins, Hage & Hull, 1988 ; Armenakis & Burdg, 1988). One method is that the technology proposals may be pushed by the technical staff. This is commonly referred to as the "bottom-up" approach. In this case, the in-house technical staff hopes for substantial improvement in organizational operations through the use of the latest technologies. The second method is the solicitation of technology proposals by top management of an organization. Such solicitation may be to the organization's technical experts, outside consultants, or vendors. Under this method, top management hopes to exploit perceived opportunity through the use of new technologies.

Ansoff (1987) contend that when organizations are considering the incorporation of new technologies, major influences can be in the form of demand-pull or technology-push factors. Munro and Noori (1988) present a conceptual framework which deals with the factors influencing the managers' decision to incorporate new technologies. According to these authors, there are three sources of motivation which affect the levels of managerial commitment to incorporate new technologies. These are: (1) technological-push forces, (2) market-pull forces, and (3) technological-push/market-pull forces.

Technological-push forces stem from a recognition of a new technological means for enhancing a firm's performance. There is sufficient evidence available to suggest that the properties of the new manufacturing technologies could potentially improve, in a significant way, the competitiveness of many industrial organizations (e.g., Skinner, 1983). However, there is potential for managers to become somewhat influenced by the perceived benefits of a particular technology at the expense of adequately addressing how these benefits can assist in meeting the particular needs of a firm. At a minimum, therefore, technological-push requires an appreciation for what the technology can potentially deliver. Munro and Noori (1988) contend that push forces, because they deal with potential benefits, tend to be more opportunistic than defensive in nature.

Market-pull forces, in the context of manufacturing new technologies can be conceptualized as occurring along two fronts: (1) marketing performance deficiencies that stem from manufacturing and/or, (2) perceived marketing opportunities that could be exploited because of enhancements to manufacturing processes. The former tends to put management in a defensive or reactive mode while the latter is more opportunistic or proactive in a sense that by improving manufacturing the organization would reduce its operating costs as well as open up new product-market plans.

Technological-Push/Market-Pull forces or an integration of push-pull considerations occur when management engages in more of a matching process between the means provided by the new technology and the need to address particular performance deficiencies, or to capitalize on identified opportunities. Munro and Noori (1988) found that both the technology-push and the integrative perspective of push-pull forces deal with opportunities and yield more organizational commitment to the adoption of new technologies than did the market-pull forces.

Factors Influencing Technological Decision Processes

The decision to adopt or 'not adopt' a proposed new technology is not made instantaneously by individual decision makers in organizations. The decision to incorporate a proposed new technology initiates a series of processes within an organization. The adoption process of a proposed new technology infiltrates within an organization, moving between social units and passing through such phases as awareness, evaluation, adoption, utilization and institutionalization (Beyer and Trice, 1978; Ettlie and Vallenga, 1979).

Some researchers have indicated that the assimilation of innovative new technologies into organizations is a process unfolding in a series of decisions to evaluate, adopt, and implement these technologies. For example, Meyer and Goes (1988) define assimilation of an innovation or new technology as an organizational process that: (1) is set in motion when individual organizational members first hear of an innovation or development of new technology, (2) can lead to the acquisition of the innovation and, (3) sometimes cause to result in the innovation's full acceptance, utilization and institutionalization.

A series of factors may influence the organizational processes involving the choice to adopt or 'not adopt' a proposed new technology. Various researchers have identified, through case studies, a myriad of factors influencing the technological decision processes when proposed new technologies are implemented successfully in organizations. Ettlie (1986) proposed that the factors which influence these processes can be divided into three categories. First, the attributes of a proposed new technology itself influence the decision processes. Examples of factors in this category involve; perceived benefits, safety, technological sophistication, and implementation cost. The second broad category of factors consists of the characteristics of organization attempting to incorporate the proposed new technology. Examples of factors in this category are; organizational strategy, policy, degree of fit, availability of resources, skills, and reward systems. The third category of factors comprise the context of the organization. He indicated that for manufacturing firms this category of factors may involve; suppliers, customers, and economic resources of the firm.

Synder and Elliot (1988) have identified a list of factors affecting the technological decision process, such as: top management support, firm's priorities, cost, quality, training programs, positive work environment, employee involvement, and organizational communication. Bergstrom (1987) has emphasized that organizational needs and goals influence the decision processes involving new technologies. Tichy (1983) has indicated that factors of organizational culture, and organizational political systems are important in the decision process. Gerwin (1982) has pointed out the compatibility of technology with existing operations as an influencing factor. Quantz (1984) has proposed that the availability of a new technology "champion" is an important factor for the successful adoption of a proposed new technology.

Beck (1986) has identified the following factors as influencing the decisions pertaining to the successful adoption of a new technology: education and training programs, teamwork, interdepartmental cooperation, and technical skills. Pearson (1986) has emphasized that employee training programs and rewards for technical accomplishments are important factors. Putnam (1987) points out that the success of a modernization project in organizations where new technologies are involved may be impacted by the following crucial factors: need for quality and productivity improvement, capital funds, implementation costs, real needs of the firm, and appropriate integration of new technology with existing systems.

Brauninger (1986) has pointed out that customer demands, and competitive advantage were the crucial factors for the adoption of a new manufacturing technology in a particular firm. White (1986) has identified that design complexity, and problems of integration of a new technology with exiting operations were important factors impacting the decision to adopt a new technology in a firm.

Similarly, a number of other case studies have identified that the perceived benefits of new technologies are an important factor in their adoption. The benefits of new technologies in manufacturing, frequently mentioned in concurrent literature, comprise a long list (e.g., Craig & Noori, 1985; Dutton, 1986; Gerwin, 1982; Gunn, 1982; Kinnucan, 1982; Merchant, 1984; Meridith & Hill, 1987; Noori & Templer, 1983; Seifert, 1986; Voss, 1987). Such benefits are accrued over a period of time through the successful implementation and use of a new technology. The perceived benefits in manufacturing firms, that have been indicated in various case studies are; reduction in manufacturing costs, flexible response, reduced processing time, reduced floor space requirement, product quality, better machine utilization, competitive advantage, serviceability, maintainability, long term profitability, reduced inventories, etc.

A recent empirical study focused on determining the impact of organizational factors and technology factors in the context of hospital organizations (Meyer and Goes, 1988). To validate their conceptual model of innovation assimilation, the authors had suggested that three factors determine the assimilation of proposed technological innovations into organizations: (1) attributes of the innovations, (2) attributes of the organizational contexts, and (3) attributes arising from the interaction of innovations and organizational contexts termed as "innovation-decision attributes". The study examined about 300 processes of organizational decision making in 25 hospitals by investigating the adoption of 12 new medical technologies over a period of five years. Meyer and Goes (1988) identified that the factors which play significant role in the adoption of new technologies involve: organization's size, CEO's advocacy, complexity of organization structure, technical skills, and compatibility of technology.

Collins et al. (1988) in a study of 54 manufacturing firms pointed out that the choice of new production technologies in manufacturing organizations was impacted by factors, such as: existing production system, decentralization of line-operating decisions, formalization, and complexity of technological system.

Towards an Integrated View of Technological Decision Making

The literature review suggests that there is a major gap in the research relating to organizational decision processes focusing on adoption or non-adoption of proposed new technologies in organizations. Many researchers have pointed out the need of an integrated framework of technological decision making processes in organizations relating to the choice of new technologies (e.g., Collins et al., 1988; Downs & Mohar, 1976; Kelly & Kranzberg, 1978; Kimberley & Evanisco, 1981; Meyer & Goes, 1988).

Comparative studies to date have arrived at contradictory conclusions. These studies have examined various categories of predictor variables in the context of specific new technologies as well as companies relating to specific industries. The factors identified in the reports and case studies mentioned in the previous section were regarded as crucial for the successful implementation of new technologies. These individual case studies and reports do not empirically provide a generalizeable pattern of the factors that impact the technological decision outcome. As a consequence there exists a theoretical vacuum, and a need for a framework to draw existing knowledge together in such a way as to promote research and guide practice.

A few case studies do partially address this research issue. However, the focus of these studies has been on a particular new technology within the context of an organization which had successfully adopted this technology (e.g., Beyer & Trice, 1978; Craig & Noori, 1985; Collins et al., 1988; Daft & Becker, 1978; Meyer & Goes, 1988; Noori & Templer, 1983). The focus of these studies had been the observation and analysis of decision processes over a period of time and evaluation of the predictor variables retrospectively. Unfortunately, there is no unifying perspective across these studies. Each study defines the problem concerning adoption of a new technology in an organization differently, focuses on a different aspect of it, and employ different approaches to studying it. The result is a scattering of isolated insights and observations, with no basis for an integrated, generalizeable understanding of the overall issue. What would be useful for research at this stage is a theoretical and analytical framework to pull together these various strands of literature. This framework would then be used to guide the study of the factors that impact the decision response of organizations with respect to proposed new technologies.

Furthermore, the available information in the current literature about the successful implementation of new technologies provides some insight to assimilate a set of critical factors that are anticipated to impact the decision processes in organizations culminating in the adoption or non-adoption of a proposed new technology. In the light of the support provided by available literature, a theoretical framework is developed to aid in understanding the contextual factors affecting technological decisions in organizations as relating to the decision outcomes of adoption, shelving, and rejection of proposed new technologies. The development and theoretical support for this framework is discussed in the next section.

A Framework for Technological Decision Making

To understand and evaluate the factors impacting technological decision processes in organizations relating to adoption, and non-adoption of proposed new technologies a framework is proposed as shown in figure 1, page 8. The framework depicts three major elements that are involved in a general model of decision making, namely: (1) decision input, (2) decision response, (3) decision-process predictors.

The element of decision input assumes that new technologies adopted or 'not adopted' are put forward for the decision makers in an organization in the form of new technology proposals. The element of decision response indicates two major dimensions of decision outcome depicted as adoption, and non-adoption. The decision to adopt a new technology proposal comprises two sets of decisions: first, the decision to approve the proposal, and second, the series of decisions to implement the approved proposal. However, a non-adoption outcome may further be distinguished on two dimensions - shelving, or rejection. These dimensions of decision outcome have been ascertained in the observation of practical decisions as reported by various researchers (e.g., Bayer & Melone, 1988; Beatty & Gordon, 1988; Farley et al., 1987; Timothy & Hlavacek, 1984).

The element of decision-process predictors depicts the set of critical factors that are anticipated to impact the decision outcome relating to a proposed new technology in an organization. The set involving thirteen critical factors assimilated through the review of pertinent literature and case studies has been grouped into three broad categories: (1) organizational factors, (2) organization-technology factors, (3) technology factors. Every critical factor depicted in the framework is assumed to impact the technological decision process independently. The construct of the decision-process predictors also assumes the additivity of individual factors. This framework provides a basis for developing hypotheses to be tested for this study.

Discussion of the Framework and Hypotheses

The views presented in this discussion of the framework provide an integrating perspective for increasing our understanding of some of the factors that may affect an organizational decision response to a proposed new technology. Drawing from existing literature and further development of the relevant concepts, a series of hypotheses are formulated. The hypotheses will provide theoretical and analytical insight for the framework.

A detailed discussion concerning the three constituent elements of this framework is provided in the following sections. A comprehensive review of the pertinent research and literature has also been interspersed into this discussion.

Decision Input

Decision input is depicted in the form of a new technology proposal. The proposal is formulated either by the internal agents of an organization or has been submitted by an external agent such as, an hired consultant, vendor, etc. Additionally, technologies may be proposed through the collaborative efforts of both the firm's internal staff and outside consultants or vendors. It is assumed that there is a performance gap in the internal operations of the firm. A performance gap is the positive difference between aspiration and existing performance on some dimensions relevant to the organization (Gerwin, 1988). This performance gap can be construed as either an organizational need or an identified opportunity that may be materialized by the incorporation of a proposed new technology. A number of researchers have ascribed the rationale for the choice of a new technology to areas of cost reduction, productivity improvement, quality enhancement, or increasing the production flexibility of the firm (e.g., Craig & Noori, 1985; Gerwin, 1982; Gunn, 1982; Meridith & Hill, 1987).

Decision Response

A decision response is an outcome of the decision processes in conjunction with the decision input. In the context of the framework, an organizational decision response to a proposed new technology is primarily classified as adoption or non-adoption. The adoption response consists of the decision to accept the proposed technology and a set of further decisions on how to implement the approved technology. The non-adoption of a proposed new technology is discerned as a decision to 'not adopt' the technology. The non-adoption outcome is further distinguished on two dimensions: (1) shelving, and (2) rejection. The shelving response is described as neither acceptance nor rejection of the proposed technology. The rejection response is identified as the outcome when the organizational decision makers have decided not to accept the proposed technology. A further discussion of adoption, shelving and rejection responses is provided in light of the existing literature.

Adoption

Adoption of a technology at its most basic level refers to the acceptance and then appropriate and repeated use of the technology by the decision makers and the organization as a whole. The excessive amount of time between the acceptance of new technologies and their subsequent successful implementation in industrial organizations is a well established fact (Riddle, 1984).

This lag time is of a serious concern to both the proposers or promoters of new technologies and the managers in organizations which are responsible for facilitating the use of these new technologies. Both groups perceive a critical need to understand the adoption process so that strategies can be designed to yield optimal rates and levels of new technology adoption. Without an understanding of the adoption process, practitioners in organizations are unable to make informed decisions concerning successful adoption of new technologies. The diffusion of a new technology or innovation is conceptualized as the process by which knowledge of an innovation spreads throughout a population, eventually to be adopted or not adopted by an individual or other decision making units in the population. Roger (1983) has defined the innovation decision process as "the process by which an individual or other decision-making unit passes from first knowledge of an innovation, to forming an attitude towards the innovation, to a decision to adopt or reject, to implementation of the new idea, and to the confirmation of this decision."

Diffusion theory asserts that characteristics of innovation or new technology either facilitate or inhibit its adoption. Tornatzky and Klein (1982) have provided some empirical support concerning the characteristics of innovations or new technologies that have been emphasized in the literature of diffusion theory. These characteristics include:

* The relative advantage of the new technology over adoption of alternative technologies or non-adoption. For example, the advantages derived from economic, social-prestige, convenience, or satisfaction aspect of the new technology.
* The compatibility of the innovation with existing values, past experiences, or needs of individuals or organizations.

* The complexity of the innovation: new technologies which are easier to understand are adopted more rapidly.
* The trialability of the innovation; the ability to use a new technology on a trial or partial basis lowers the risk of adoption, and thus tends to encourage adoption.
* The observability of the innovation or its outcomes; intangible innovations, such as, new software development philosophies are difficult to observe and measure, and therefore tend to be adopted more slowly than more visible innovations, such as hardware innovations.

The diffusion theory has been broadly applied to the diffusion of technologies in organizations ranging from new ideas to new equipment (e.g., Teece, 1980; Zmud, 1982; Zmud and Apple, 1986; Rogers, 1983 ; Tornatzky et al., 1983). Diffusion theory provides a framework for predicting the length of time it will take for a new technology to be adopted. This prediction is based on: the characteristics of technology, networks used to communicate information about the technology, characteristics of the organization that adopts technology, and the degree of similarity between the change agents and potential adopters.

Bayer and Melone (1988) have identified limitations in applying the existing conceptualizations of diffusion theory to the acquisition and adoption of new technologies, such as computer software. In the classical diffusion literature, adoption is both conceptualized and measured as a binary occurrence - adopt or not adopt. A consumer is depicted as "adopting" a home computer; a farmer "adopts" a new type of agricultural technique; an organization "adopts" a new process technology. In reality, however, it is an oversimplification to portray adoption as binary. For example, an organization may acquire an intelligent telephone system, but individuals within the organization may adopt only the basic telephone capabilities (Manross and Rice, 1986). Characterizing adoption as binary does not capture the instances of partial adoption or cases where the new technology is adopted in some form other than the one intended by the developers or the proposers of the technology.

In view of the above discussion, understanding the forms of adoption will help in comprehending the process of adoption of new technologies in organizations.

Forms of Adoption

Industrial organizations are heterogeneous in their receptivity to new technologies. They have varying requirements for new technologies, and different sources and criteria for acquiring and adopting them. Acquisition of new technology consists of purchasing, developing, or otherwise providing access to technology for use by individuals or groups within the organization. Acquisition does not imply the repeated use of a technology. That an organization's management has accepted or authorized the use of an innovation or new technology does not necessarily mean that the technology has been adopted by the organization. For this reason, the application of diffusion theory in understanding the adoption by the organization of a technology requires a formal extension to more precisely map the "degree" of adoption.

Bayer and Melone (1988) have emphasized the need to modify diffusion theory to capture non-binary adoption. Such a modification should not only delineate the degree of adoption, but also the specific "form" of adoption. These authors have suggested that the adoption of new technologies be viewed as a multilevel organizational process in which: (1) the organization accepts the new technology by deciding to acquire it, and (2) the organization adopts the technology by electing to use it in solving its problems through an implementation plan.

The relative speed with which an innovation or new technology is adopted, has been shown to follow an S-shape curve. The explanation as to why the curve is S-shaped varies by research paradigm (Rogers, 1983). Communication researchers have focused on information transfer. Economists focus on technological substitutability, uncertainty reduction, and economic advantage. Social psychologists have focused on learning models of innovation diffusion (Mahajan & Peterson, 1985). According to Rogers (1983), variations in the S-shaped curve can be categorized by differences in potential adopter attributes. Adopters are categorized in terms of their innovativeness based on their relative time of adoption.

Adopters are assumed to be normally distributed with respect to time until adoption. The adopter categories identified in theory are: (1) Innovators, (2) Early adopters, (3) Early majority, (4) Late majority, and (5) Laggards. Associated with each adopter category are specific personality variables, socioeconomic levels, and communication behavior. For example, "innovators" can be categorized as possessing higher tolerance for uncertainty about the innovation, being of higher socioeconomic status, belonging to interpersonal networks that go beyond the local social system, and partaking of mass media communications to a higher degree.

The concept of adopter categories is purported to have several benefits in understanding the adoption process of new technologies in organizations. One such benefit is that change agents (internal/external), by understanding the adoption behavior of an organization as a social group, can predict the form of adoption an organization will have in perusing a new technology.

Adoption and Implementation

Given the distinction between adoption and acceptance of new technologies in organizations, adoption may be treated as a multi-step decision process in which :

(1) an organization or the decision-making unit in the organization accepts the proposed new technology and makes a decision to acquire it.

(2) the decision making unit in the organization decides

to implement the use of this technology across the organization.

The form of adoption of technologies may be better understood in the following expression:

Adoption = Acceptance + Mode of implementation

This expression implies that the form of adoption can vary in conjunction with further decisions about the mode of implementation that an organization will follow after the decision to accept a proposed technology. In general, the term implementation has usually been used in literature to relate to the process of putting policy intentions - 'decisions' - into action (Rhodes & Wield, 1985).

Implementation has not received the same attention from organizational theorists as has decision making (Sproull, 1986). Decision making is often assumed to be relatively well-bound in time and space. It may have an observable end, a tangible outcome, often ratified by a vote, hand shake, or organizational announcement. Implementation, by contrast, has no clear boundaries. Apart from difficulties in knowing when or whether an initiating decision occurred, getting things done requires a cascade of decisions made by organizational players over time.

Sproull and Hofmeister (1973) have indicated that one implementation study identified 70 decisions necessary to implement just one provision of a proposed economic development program. Few studies, however, have examined the choice processes that precede adoption or assessed the utilization of technologies after their adoption (Tornatzky et al., 1983; Kimberley, 1981). Tornatzky and Klein (1982) have found only five studies that measured both adoption and implementation in their meta-analysis of 75 studies relating to innovation characteristics. Although there are some notable exceptions (Beyer & Trice, 1978; Nutt, 1986; Pelz and Munson, 1982), much of the implementation literature is impressionistic.

The mode of implementation of a new technology will basically be determined by the pace and scope of sociotechnical change that an organization can assimilate in order to successfully utilize a new technology. The mode of implementation may further be impacted by the requirement and assimilation of contingent resources that the organization will need to allocate for the installation of new technological systems. These organizational resources will in turn be controlled by the players who may be different from the one who made the decision to accept the new technology. Some technologies that require fewer organizational resources may be implemented early based on the "one-shot" decision to release the necessary resources. Those technologies which require substantial resources as well as require additional organizational skills and contingent changes in existing operations may be incrementally implemented.

In cases where the organization needs to make drastic changes in its sociotechnical system to accommodate new technology, the process of implementation may be delayed until the organization is well enough prepared to operationalize the new technology. Thus, there may be varying rates of implementation depending on the inherent characteristics of the technology, the organization as well as the resources required by the implementation. Three forms of adoption as related to the mode of implementation can be shown in the following expressions:

Early Adoption = *Acceptance + Early Implementation*

Incremental Adoption = *Acceptance + Incremental Implementation*

Late Adoption = *Acceptance + Late Implementation*

Non-Adoption

If the decision outcomes relating to a proposed new technology in organizations are considered only as binary, then a proposed new technology that is 'not adopted' can be considered as the one which is not approved to be adopted. However, evidence in the literature indicates that most organizational decisions are not inherently binary. The decision outcome may vary on a continuum between acceptance and rejection.

In the context of the organizational decision response depicted in the framework developed herein, the decision outcome of non-adoption of a proposed new technology can be further distinguished on two dimensions: (1) shelving, and (2) rejection. Further discussion on the concept of non-adoption of a proposed new technology in terms of shelving and rejection is presented in the light of pertinent literature.

Shelving

Technology proposals which are not adopted are either shelved or rejected. Shelving is an outcome of the decision processes whereby decision-makers have neither accepted the proposal nor outright rejected the proposal. Shelving is representative of a deferred decision. The other nomenclature used in organizations to represent this dimension of the decision outcome may vary in vocabulary as well as interpretations. However, the concept of shelving as a decision outcome is well understood in almost all organizations.

Timothy and Hlavacek (1984), in their study of 46 of the largest firms in the Cleveland metropolitan area, have analyzed the shelving and unshelving of Research and Development (R&D) project proposals. These authors have identified four stages of R&D projects where the shelving and unshelving of projects has occurred: (1) technical development, (2) engineering testing, (3) manufacturing, and (4) marketing. One-half of the projects studied were shelved early in the development (technical development and engineering testing) and the other half were shelved later in the development process.

In twenty case studies of the shelving and successful unshelving of R&D projects, Timothy and Hlavacek (1984) have identified the reasons for the shelving of the proposed projects. The reasons include:

* Management had other priorities which were more

demanding of organizational resources.

* Economically impractical state-of-the-art technology.
* Difficulty in production/operations.
* The project did not get accepted in field trials.
* Alternative process technology became economically superior.
* Capital limitation of the company.
* Availability of a low-priced substitute.
* Project champion "died" or left the organization.
* Management reorganization/lacked top management's commitment.
* Funding difficulty in justifying the project.
* Trend, at the time, towards alternative technologies.
* Required a major modification of existing system.
* Could not achieve technical objectives of the firm.
* Development of the new system offered no significant benefits over the present system.
* Did not meet the management's expectations at time.
* Too big a change.
* Outside of strategic interest of the division in the firm.
* Project implementation cost was high.
* Too advanced for the operational environment of the company.

In their assessment, the authors concluded that product or technology-driven laboratories, divisions, or companies probably have more shelved projects than the market-driven or customer-driven companies. The authors have further contented that the top management of technology-based companies should not see all shelved proposals as being permanently dead and buried, but rather as part of a working inventory of projects. Some of the shelved projects and technology proposals are only waiting for approval and further implementation at an appropriate time.

Rejection

Why is it that some industrial organizations adopt a particular new technology while the other organizations in the same industry reject the same technology outright? Researchers have not reached any generalizeable theory that can predict the rejection of new technologies in organizations. Various case studies have depicted the underlying reasons of why an organization may reject a particular technology even where the proposed technology was deemed to be economically and technically feasible.

Much of the research on the impediments to the introduction of new technologies focuses on the changes in organizational behavior that will be required in order to successfully adopt these technologies. Such behavioral changes include: (1) reorganization of operations to make the new technologies compatible with the operating environment, and (2) adapting to the complexity of the new technology by enhancing the organizational inventory of skills.

Some researchers have attributed the rejection of new technologies to various types of barriers that exist in the operating environment of an organization. For example, Beatty and Gordon (1988) have identified three categories of barriers that hinder the adoption of new technologies. These are: (1) structural barriers, (2) human barriers, and (3) technical barriers.

In many industrial organizations the structural barriers are the built-in mechanisms that deter the acceptance and successful use of new manufacturing technologies. In most cases these structural barriers are those factors inherent in the organization's structure or systems that are not compatible with the actual use of the new technology. These factors can include: reporting relationships; organizational functional subdivisions; and planning, measurement, and reward systems.

Human barriers include psychological factors that arise in those periods of change that are impacted by the introduction of a new technology. Some of the factors identified by various researchers include: uncertainty, risk avoidance, resistance to change, skill gap, and workforce dislocations.

Technical barriers are factors inherent in the technology itself. Beatty and Gordon (1988) contend that if a proposed new technology is not compatible with existing technologies or there are severe problems integrating the new technology with the operating core technologies of a firm, then such technical barriers may cause decision makers to reject the new technology.

Farley et al. (1987), in their exploratory study of 29 large U.S. companies, have modeled the variables that shape the organizational decision in the choice of new manufacturing technologies. The authors have identified two set of variables impacting the decision to automate or not automate, which are: (1) endogenous variables, and (2) exogenous variables. The endogenous variables are: current automation level, intention to increase the level of automation, attitude towards automation, and indices of perceived benefits and perceived problems. The exogenous variables include specific organizational characteristics, such as; existing sales, nature of current manufacturing operations, relative competitive standing of the company, organizational climate, performance responsibility, and top management's willingness to invest.

Decision-Process Predictors

The framework depicts a set of thirteen decision-process predictors that are anticipated to impact an organization's technological decision process. The relevant literature and various case studies reviewed have identified the crucial role of these factors. These studies have either treated them independently or addressed a particular organizational issue attributed to these factors. While each factor has been assumed to impact the outcome of a technological decision process independently, the framework categorizes these factors into three constructs, namely: (1) organizational factors,

(2) organization-technology factors, and (3) technology factors.

The factors in the organizational construct reflect only those characteristics of an organization that, in general, are considered to play an important role in determining the decision outcome in the context of a proposed new technology. The organizational factors i.e., CEO's advocacy, top management support and commitment, organizational objectives, technical skills, and organizational preparedness, are anticipated to have independent impact on the decision outcome pertaining to a proposed new technology. In view of the construct of the framework these factors will also be anticipated to have an aggregate impact as organizational factors due to the assumed notion of additivity. This aspect of the framework has been reflected in the formulation of subsequent hypotheses to be tested for this study.

Similarly, the factors in the organization-technology construct address the interrelationship of organizational characteristics and the attributes of the proposed new technology per se. This category is comprised of four factors: management's attitude towards technology, operational compatibility of new technology, relatedness, and economic justification.

The factors in the technology construct reflect the attributes of a proposed new technology in context of the organization. The factors included in this category are: perceived benefits of technology, ease of integration, complexity, and safety.

A further discussion of these factors is presented in conjunction with the current research and pertinent literature. The hypotheses formulated for this study have also been introduced in the discussion of these thirteen critical factors.

Organizational Factors

The characteristics of organizations vary in terms of their size, structure, strategy, technology policies, type and scale of business activity, organization culture, and numerous other attributes. However, in case of technology related decisions there are certain characteristics which may play a more dominant role than other characteristics.

Based on the support of relevant literature and case studies the following have been assimilated as a set of critical organizational factors which may impact the decision processes culminating in the adoption, shelving, or rejection of a proposed new technology in an organization: (1) CEO's advocacy, (2) top management support and commitment, (3) organizational objectives, (4) technical skills, and (5) organizational preparedness.

CEO's Advocacy

Some researchers and observers in the area of organizational decision making have recognized the critical impact that the Chief Executive Officer (CEO) of an organization can have on the decision processes of its organization. Bergstrom (1987) in a case study concerning the implementation of new manufacturing technologies points out that the obligation for the successful utilization of a proposed new technology begins at the top of an organization. He, however, indicates that it is also the seat of many hurdles and bottlenecks.

Beyer and Trice (1978) have identified that one of the potentially important technology-decision element is the extent to which an organization's CEO champions or opposes the adoption. Meyer and Goes (1988), in their empirical study, have found that a CEO's demographic characteristics such as, education, tenure, and recency of technical skills may not determine aggregate rates of adoption of innovations or new technologies by their organizations. Nonetheless, CEO's advocacy can have substantial impact on the assimilation of specific innovations or new technologies in their organizations .

Ettlie (1984) has indicated that the most important predictor of the successful utilization of a proposed new technology is likely to be affected by the strategy formulation and implementation process of an organization. He points out that the CEO's advocacy to incorporate a new manufacturing technology subsequently influences all other decision processes down the line which facilitate the successful utilization of a costly system like CIM.

This suggests the following hypotheses:

Hypothesis #1: The degree of a CEO's advocacy will be significantly higher for a proposed new technology that is adopted than for one which is not adopted.

Hypothesis #1a: The degree of a CEO's advocacy will be a significant differentiating factor for a new technology proposal to be adopted, shelved or rejected.

Top Management Support and Commitment

Top management's support and commitment for the incorporation of a proposed new technology can be described as the extent to which the higher management in an organization can exert its influence during the decision making processes leading to adoption or non-adoption of a proposed new technology. Whether these leaders' impact on their organizations are primarily instrumental or symbolic is an unresolved issue (Pfeffer & Davis-Blake, 1986). However, both logic and some evidence suggest that those who allocate resources can influence the adoption or non-adoption of innovative new technologies in the organizations (Hage & Dewar, 1973; Kimberley & Evanisko, 1981).

In many organizations, decisions about the introduction of new technologies may involve the participation of both top managers and functional experts. Greer (1984) has found that in hospital organizations, both administrators and physicians share power, and both are potential sponsors of new medical technologies in hospitals. Among administrators, those with long tenures and graduate professional degrees are most likely to posses the budgetary acumen and legitimacy needed to facilitate or block the adoption of new medical equipment. Among physicians, those who have recently been exposed to state-of-the-art technologies through professional training, tend to seek the adoption of new technologies in their organizations.

Daft and Becker (1978) have found that top management's support and influence was a predictor of the adoption of costly new equipment in an organization. Snyder and Elliot (1988) have pointed out that among various factors that facilitate the successful implementation of a new technology, top management's commitment and support to provide necessary organizational resources plays a key role. Kelly (1976) has emphasized top management support and commitment as requisite for the success of technological innovations in an organization.

This suggests the following hypotheses:

Hypothesis #2: The degree of top management support and commitment will be significantly higher for a proposed new technology that is adopted than for one which is not adopted.

Hypothesis #2a: The degree of top management support and commitment will be a significant differentiating factor for a new technology proposal to be adopted, shelved or rejected.

Organizational Objectives

An organization's policies and corporate objectives act as a lever for introducing and institutionalizing technology-supportive practices in that organization. Technology-related objectives of a firm place limits on independent actions of the decision-makers and set boundaries on the kinds and direction of actions that can be taken. Organizational objectives also help to shape the character of the internal work climate and to translate corporate philosophy into how things are done, how people are treated, and what the corporate beliefs and attitudes mean in terms of everyday activities.

An organization's policies relating to its technological operations potentially play a key role in establishing a fit between its operating technologies and its business goals. Burgleman and Maidique (1988) contend that the decision to incorporate a new technology in an organization is a strategic decision. They suggest a close relationship between an organization's strategic objectives and its technological policy. Mintzberg et al. (1976) pointed out that the choice of a proposed technology in an organization involves strategic decision processes and a firm's technological policy is basically driven by its corporate strategic objectives. In the current literature on management of technology, several scholars have emphasized the importance of a close fit between an organization's strategic objectives and its technological operations. For example, Brown and Karagozoglu (1989), in their organization system model of technological innovation, have identified three major decision inputs that contribute to the technological "innovativeness" of an organization. These decision inputs are: (1) overall company strategy, (2) technology policy, and (3) the beliefs and values of top management.

Overall company strategy refers to the large-scale plans dealing with the opportunities and threats faced by an organization. Technology-based organizations confront special kinds of opportunities and threats. For example, technological advances may occur abruptly, creating rapid changes in the opportunities and threats facing a firm's existing products and manufacturing process technologies. Maidique and Patch (1982) argue that a technology policy suitable for a particular organization depends on the overall company strategy being pursued. For example, those companies emphasizing a first-to-market strategy must consider the early adoption of state-of-the-art production technologies.

The impact of the beliefs and values of top managers on an organization's strategy and objectives has been frequently emphasized in the strategic management literature. For example, Hage and Dewar (1973) find that the values of top management are better predictors of an organization's innovative performance than any other single structural dimension. Ettlie and Bridges (1982) see a specific relationship between organizational objectives and managerial beliefs in that the choice of a technology closely embodies the innovative attitudes and values of top management.
This leads then to the following hypotheses:

Hypothesis #3: A proposed new technology that is adopted will have a significantly higher degree of fit with organizational objectives than one which is not adopted.

Hypothesis #3a: The degree of fit between a proposed new technology and organizational objectives will be a significant differentiating factor for this new technology to be adopted, shelved or rejected.

Technical Skills

The inventory of technical skills and the quality of human resources of a firm play an important part in determining what level of technology will be suitable for that organization. New technologies demand a higher level of worker skills and thus organizational arrangements to adapt workers to the skill requirements of the technologies. For example, computer technologies and new information technologies require new skills, and subsequent training of the workforce is needed to operationalize these technologies.

Meyer and Goes (1988) have identified that the specialized expertise of an organization's professional members may exert no uniform effect on the adoption of new technologies. However, they contend that in conjunction with the potential benefits and skills required to use a particular new technology, such specialized expertise can become an important determinant of adoption and utilization. In case studies relating to the successful implementation of proposed new technologies in a variety of organizations various researchers have indicated the presence of technical skills in a firm as a key facilitating factor (Ettlie, 1986; Hayes and Wheelright, 1984; Quantz, 1984; Rummel and Holland, 1988; Sepehri, 1987; Voss, 1987).

Quantz (1984) has pointed out the importance of critical skills relating to the successful adoption of new manufacturing technologies in a variety of organizations. He has indicated that many manufacturing organizations are poorly equipped to deal with the operationalization of new technologies because of the dearth of the requisite skills. The inventory of available skills within an organization can play an important role in impacting the decision processes culminating in the adoption, or non-adoption of a proposed new technology.

This suggests the following hypotheses:

Hypothesis #4: The degree of technical skills will be significantly higher where a proposed new technology is adopted than where one is not adopted.

Hypothesis #4a: The degree of technical skills will be a significant differentiating factor for a new technology proposal to be adopted, shelved or rejected.

Organizational Preparedness

An organization's preparedness to incorporate a proposed new technology indicates the readiness of organizational systems to successfully utilize the technology. The major organizational issues involved in its readiness to adopt a proposed new technology may vary from the availability of training programs to the systems of rewards, from communication of organizational needs to dealing with employees resistance to change.

Keen (1985) has indicated that the complexity of organizational systems, and "social inertia" can be a hindrance to the adoption of new technologies. The concept of social inertia is the indicator of an organization's resistance to change. The author argues that an organization's preparedness to adopt new technologies will be proportionately increased by enhancement of its skill level. Furthermore, the author contends that an organization will be less prepared to adopt a new technology if the organization has a high level of social inertia.

The rewards systems and salary structure of an organization are a key determinant of attracting and keeping on competent people within the organization. The availability of technical competence and related organizational systems enhance the preparedness level of a firm which further facilitate the smooth running as well as successful implementation of contingent changes in its technological systems. In fact, an organization's preparedness level to successfully adopt a proposed new technology is reflected in its management processes.

Stonich (1982) has indicated that the management process of an organization is the set of tools that management has available to successfully attain its strategic objectives. Organizational preparedness toward adopting a proposed new technology demands a strong fit among its organizational systems and technological systems. An effective management process that facilitates employee participation, teamwork, and technical expertise may also be helpful in overcoming employee resistance to the imposition of new technological systems.

Snyder and Elliot (1988) have pointed out that an organization's contingent reward systems, employee participation, work environment, and communication channels may facilitate or hinder the adoption process of a new technology. The level of employees' resistance to technological changes can also be an indicator to the successful or unsuccessful adoption of a proposed new technology in an organization.

Hence, the following hypotheses are suggested:

Hypothesis #5: The degree of organizational preparedness will be significantly higher for a proposed new technology that is adopted than for one which is not adopted.

Hypothesis #5a: The degree of organizational preparedness will be a significant differentiating factor for a new technology proposal to be adopted, shelved or rejected.

Organization-Technology Factors

The organization-technology construct of decision-process predictors takes into consideration those factors which have a critical impact on the organizational decision processes that are invoked due to the interplay of the organizational characteristics as well as the attributes of the proposed new technology per se. The selected set of these critical factors involves; management's attitude towards proposed technology, operational compatibility of technology, relatedness of the new technology to organizational operations, and economic justification of the proposed new technology.

In the further discussion, each of these factors is described in the light of this research and pertinent literature.

Attitude Towards Technology

Attitudes towards technologies are formed based on the perceptions of the attributes relevant to a specific use of a technology. Once attitudes are established, they are relatively stable because existing beliefs serve to mediate and filter new information (Young, 1972). Some attributes, such as, workforce reduction may make a negative contribution to the attitudes of an opponent of a specific technology, but make a positive contribution to the attitudes of its supporters. For example, debate on the social acceptability of technologies based on computer systems or communication technologies tend to focus on aspects such as privacy, social change, working conditions and loss of jobs.

Perceptions related to the attributes of a technology can either enhance or diminish the acceptability of the technology, depending on the values of those doing the perceiving. The attributes of a technology will generally be influenced by the perceptions of its benefits, risks, and the social, technical, and the political outcomes associated with the use of this technology. People can characterize a technology by any set of attributes that they have come to associate with the technology. Therefore, managerial attitudes towards each technology are quite likely to be determined by a different set of attributes.

Otway and Haastrup (1989) contend that technologies in organizations are judged and accepted or rejected on the basis of a complete package of beliefs about them. Research on the "perception" of technological attributes has taken two main approaches. One approach was to have respondents rate a large number of different technologies on the same set of attributes to see how perceptions differed in the resulting factor space (e.g., Fischhoff et al., 1978). The other approach (e.g., Otway et al., 1978) was to study attitudes towards specific technologies in depth (or of alternate technologies intended to provide the same benefits) as a function of the underlying beliefs and values of the respondents. Otway and Haastrup (1989) have indicated that the results of the two methods are in broad general agreement.

Thomas et al. (1980) have indicated that technical people, consistent with their training, tend to define a technology-based system in technical terms, and also define its risk in terms of those losses that are measurable. Management may be inclined to define risk as insurable losses, consistent with the widespread use of risk as an expected value of loss. The employees in organizations, in contrast, seem to define a technology-based system "globally", including its interaction with social and cultural systems, and thus define risk in terms of how they expect the technology to affect their work lives.

Otway and Haastrup (1989) have indicated that the general attitude towards a new technology in an organization depends upon the level of effective communication between technical people and the user groups. As an example, smaller or more decentralized organizations can be more responsive in different ways to users' concerns about increasing centralization and depersonalization caused by new information technologies. These authors contend that an organization's overall attitude toward the incorporation of a new technology will depend upon it's employees' awareness level concerning the new technology. In this sense, the perceptions of the attributes of a specific technology and the attitude of both technical and user groups in an organization may become a legitimate part of the decision making process. This will in turn impact the decision response of the decision making group concerning the adoption or non-adoption of a proposed new technology.

Moreover, attitudes towards a technology can also be influenced by events external to the technology in question. For example, the oil crisis of 1979 has influenced corporate managements in their decisions concerning the adoption of energy conservation technologies. Similarly, the incidents of oil spills have impacted corporate decisions to use safer technologies for the transportation of oil. A few technologies, such as nuclear technology, have encountered public opposition even in the face of their demonstrated economic benefits.

Hence, this leads to the following hypotheses:

Hypothesis #6: The degree of management's positive attitude towards a proposed new technology will be significantly higher for a technology that is adopted than for one which is not adopted.

Hypothesis #6a: The degree of management's positive attitude towards a proposed new technology will be a significant differentiating factor for this technology to be adopted, shelved or rejected.

Operational Compatibility

The compatibility of a proposed new technology with the existing technological base of the organization is an important determinant for its successful adoption. Beatty and Gordon (1988) have indicated that most manufacturing companies in the United States generally organize their production by tool rather than by part produced. In this situation,the adoption of even the most elementary Flexible Manufacturing System (FMS) requires a reorganization of the manufacturing operations. A more complex system of FMS may have far reaching consequences on the entire organization adopting such a technology.

An organization while considering the adoption of a new technology may react to two aspects of the compatibility issue: (1) external compatibility, (2) internal compatibility. External compatibility issues arise because new technologies, such as information technologies or manufacturing process technologies, may drastically change the relationships with its customers as well as competitors. Internal compatibility issues may arise because of workforce related problems as well as an organization's structure related problems. Most new manufacturing technologies require the replacement of hourly workers or upgrading the skill levels of the existing workforce to match the requirements of new technologies.

Blumberg and Gerwin (1985) have identified the compatibility issue of Computer Integrated Manufacturing (CIM) with the existing mode of manufacturing operations. According to these authors, too much attention is paid to technical sophistication and not enough to the adjustments needed in organizations to accommodate the new technology. This produces a lack of fit between the demands made by the technology and the skills, attitudes, needs, and values embodied in the social and technical structure of the organization. The result is that the new technology raises both cognitive and motivational problems with which managers, staff specialists and workers have great difficulty in coping.

Savage (1988) indicates that it makes little sense to install third, fourth, and fifth generation computer-based technologies in second generation organizations. Yet, some manufacturing companies have opted to incorporate advanced manufacturing technologies such as, FMS and CIM, without contemplating the issue of the operational compatibility of these technologies. Many new manufacturing technologies are perceived to be beneficial in improving manufacturing processes, but at the same time the implementation of these new technologies raises tough management issues in an organization. This usually occurs when the decision makers decide to adopt a proposed new technology in an organization while ignoring the operational compatibility of this technology with the apparatus operandi of its management systems.

Various case studies, in the area of successful implementation of new technology projects have identified operational compatibility as an important factor influencing the organizational choice (e.g., Blumberg & Gerwin, 1985; White, 1986; Meyer & Goes, 1988).

This leads then to the following hypotheses:

Hypothesis #7: The degree of operational compatibility will be significantly higher for a proposed new technology that is adopted than for one which is not adopted.

Hypothesis #7a: The degree of operational compatibility of a proposed new technology will be a significant differentiating factor for this technology to be adopted, shelved or rejected.

Relatedness

The relatedness of a proposed new technology with the core technologies and strategic business objectives of an organization has been much emphasized in the recent literature focusing on the management of technology. Burgelman's (1984) conceptual framework for assessing an organization's internal entrepreneurial proposals focuses on two key dimensions of organizational strategic decision-making. One dimension is the strategic importance for corporate development. The second dimension is the degree to which proposals are related to the core capabilities of the corporation, i.e., their operational relatedness. Maidique and Frevola (1988), in their technological policy framework, contend that the technological strategy of a firm cuts across such functional policies as manufacturing, finance, R&D, as well as corporate-wide policies regarding product-market focus, financial and personnel resource allocation, and control. In that context, industrial firms need to make decisions about the selection and embodiment of technologies which have strong relatedness with the firm's corporate strategy.

When technology proposals await the assessment of a decision making unit within an organization, in many cases, the strategic assessment will result in the classification of a proposal as "very" or "not at all" important. In other cases, the situation will be more ambiguous and lead to assessments such as "important for time being" or "may be important in the future". Similarly, the decision makers may assess these technology proposals on the operational relatedness dimension in terms of a firm's existing technological capabilities, skills, growth opportunities, quality and productivity improvement efforts, and/or cost reduction measures. In light of this, the new technology proposals will sometimes be classified as "very" or "not at all" related. In other cases, the situation may again be somewhat unclear and lead to a "partly related" assessment. Thus, the following hypotheses are suggested:

Hypothesis #8: A proposed new technology that is adopted will have a significantly higher degree of relatedness to the existing technological and business operations of the firm, than the one which is not adopted.

Hypothesis #8a: The degree of relatedness of a proposed new technology to the existing technological and business operations of a firm will be a significant differentiating factor for this technology to be adopted, shelved or rejected.

Economic Justification

Organizations use varied methods for the economic justification of new technologies. Some firms use payback period, present value, or internal rate of return while others have incorporated more sophisticated Decision Support Models for the economic justification of new technologies.

Industrial organizations may use one or more criteria for the economic justification of a proposed new technology. A few researchers have indicated that some organizations may use very sophisticated techniques like Multi-Attribute Utility Theorem (MAUT) in the economic justification of a new technology (e.g., Zeleny, 1982; Gerwin, 1982). Meredith and Hill (1987) have described the difficulties in organizations of economically justifying new manufacturing technologies. They contend that the most important benefits of new manufacturing technologies are often strategic and difficult to quantify. In such cases the decision makers face a near-impossible task when they must justify a new technology on the basis of direct return on investment.

Since organizational rationale for adopting new technologies varies, it is expected that the justification process would also vary across different organizations. Evidence is beginning to appear which indicates that companies have difficulty in rationally deciding whether or not to purchase new technologies such as advanced manufacturing systems. Blumberg and Gerwin (1985) in their research on manufacturing enterprises in the United states, Great Britain and Germany have concluded that most companies do not have the required human skills and/or financial tools to perform meaningful analyses of benefits that may accrue due to the adoption of new technologies.

Various researchers have indicated that economic justification techniques appropriate for low-level technological systems are simply inadequate for higher-level technological systems. For example, Gold (1982) argues that industrial organizations need to consider new accounting techniques to capture the economic benefits that new technologies present such as; reduction in cost of indirect labor, intangible benefits, and economies of scope. In his view, the existing economic justification techniques only take into consideration the direct labor cost, tangible benefits, and economies of scales which are the measurable attributes of low-level technological systems.

Nabseth and Ray (1974) found that both United States and European companies had difficulties in assessing the anticipated profitability of Numerically Controlled (NC) machine tools and therefore decisions tended to be subjective. A study of small and medium-sized firms conducted by the Illinois Institute of Technology has concluded that the majority of non users rejected NC equipment because they were unable to properly evaluate and hence justify the investment (Gerwin, 1982).

The implementation cost of a new technology may generally impact the outcome of decision processes but not in the same way in all organizations. For large companies the implementation cost of a new technology may have a small impact in terms of percentage of their annual operating budgets. Meanwhile, the same implementation cost may have a larger impact on the financial resources of a small company.

Ginsberg (1978) indicates that it is the acquisition purpose that determines the economic justification process, not the type and cost of equipment. However, both the implementation cost of a new technology and the economic justification criteria of a firm may impact the organizational decision response to a proposed new technology.

This discussion suggests the following hypotheses:

Hypothesis #9: A proposed new technology that is adopted will likely have more economic justification than the one which is not adopted.

Hypothesis #9a: The degree of economic justification will be a significant differentiating factor for a proposed new technology to be adopted, shelved or rejected.

Technology Factors

The attributes as well as characteristics of a technology vary in terms of its use in the context of an organization. However, in the case of a technology related decision the organizational context determines the dominance of certain characteristics. Based on the support provided by relevant literature and case studies the following characteristics have been assimilated as a set of critical technology factors which may impact the technological decision processes in an organization. These involve: (1) perceived benefits of a technology, (2) ease of integration, (3) complexity of technology, and (4) safety.

Perceived Benefits of Technology

Perceived benefits of a proposed new technology are usually contingent upon the core operations of an organization. In general, the decision makers in an industrial organization take due consideration of the perceived benefits that a proposed new technology might deliver to improve the operations of the organization. In fact the perceived benefits of a new technology may encompass a bundle of improvements in various operational areas of an organization. Most of the organizations while making decisions about a proposed new technology may consider its perceived benefits in more than one area. In industrial organizations the various perceived benefits which may impact the decision process involve: productivity improvement, manufacturing cost reduction, profitability, quality improvement, and other advantages depending upon the nature of business operations.

New technologies in manufacturing, in general, are perceived as promising lower operating costs, increasing productivity and flexibility. While there have been some failures, significant benefits have been realized by many companies even from individual elements of new technologies, such as Computer Numerical Control (CNC), Flexible Manufacturing System (FMS), Computer Integrated Manufacturing (CIM), Group Technology (GT), and cellular manufacturing. Robots have replaced workers in hazardous, unpleasant, and monotonous jobs, in some cases providing two to three years of investment payback (Farley et al., 1987).

Kinnucan (1982) has tracked in his case study of firms using Computer Aided Design (CAD), the increased drafting productivity and considerable enhancement of creativity of their designing function. Gunn (1982) has described how General Motors has been able to cut automobile redesign time from twenty-four months to twelve months because of a CAD system. Gerwin (1982) has described how the use of stand-alone Numerical Control tools has resulted in greater repeatability for complex parts, less scrap, and the ability of the companies to make design changes more quickly.

A number of case studies have indicated that the perceived benefits of a new technology is a crucial factor for its adoption in an organization. Product quality, manufacturing cost reduction, productivity improvement, long-term profitability, and flexibility of operations are the major benefits that various researchers have identified as the motivation of many companies which have adopted new manufacturing and information technologies (e.g., Dutton, 1986; Jaikumar, 1986; Merchant, 1984; Voss, 1987)

The technical justification criteria of a firm may reflect how the decision makers of the firm perceive benefits of the proposed new technology. In addition to perceptions of measurable costs and economic benefits, a number of qualitative benefits/costs can be attributed to specific technologies. Some technologies have been perceived to be more beneficial or risky than might be indicated by engineering benefit/cost estimates. Even where the intangible benefits of a new technology cannot be fully quantifiable, the level of perceived benefits of a proposed new technology by decision makers may influence the decision response of an organization. Thus, the following hypotheses are suggested:

Hypothesis #10: A proposed new technology that is adopted will have a significantly higher degree of perceived benefits to the firm than the one which is not adopted.

Hypothesis #10a: The degree of perceived benefits will be a significant differentiating factor for a proposed new technology to be adopted, shelved or rejected.

Ease of Integration

The issue of integration of a proposed new technology with the existing core technologies of a firm can play a determining role in its adoption or non-adoption. Webster's New Collegiate Dictionary defines the verb "integrate" as follows: to form or blend into a whole, to unite with something else, to incorporate into a larger unit.

New technologies are not simply stand alone devices. They may involve sophisticated technological systems which need to be incorporated in the existing technology base of an organization. Advanced manufacturing technology such as, FMS and CIM can affect drastically the existing mode of technological operation of a firm which decides to adopt it. How easy or difficult a proposed new technology is to integrate with the existing set of a firm's technologies demands detailed technical considerations by the decision makers in an organization.

A firm's overall technology encompasses the set of technologies that are used in different aspects of its activities. Thus, a company's technology can often be decomposed into its constituting technologies. Porter (1985) has suggested a framework to decompose the overall technology into the representative technologies of a firm's value chain i.e., the level of technology used in its inbound logistics, operations, outbound logistics, marketing/sales, service, and management information and control systems.

Devaney (1984) has indicated that the decision makers in a manufacturing organization have to consider at least three aspects of integration while deciding to incorporate advanced manufacturing technologies: (1) organizational or functional integration (where responsibilities or duties change or combine due to new technological operations), (2) process or methods integration (where machine or tool sequences change or combine), (3) data or information integration (where data elements or representations change or combine).

Meridith and Hill (1987) have identified that manufacturing firms choose a new manufacturing technology based on the level of integration that the new technology will demand. They argue that the technical justification process in a manufacturing organization becomes far more difficult if the level of integration required by the new technology affects the overall operations of a firm.

Organizations are hetrogeneous in their needs for new technologies and respectively they may have their own criteria for the technical justification of proposed new technologies. It should be noted that two organizations may decide to adopt an identical new technology but have quite different purposes in mind, at least in terms of level of integration. Various researchers, while analyzing the implementation processes of new technologies, have indicated that decision makers in organizations consider very carefully the issue of integration when choosing a new technology (e.g., Rummel and Holland, 1988; Synder and Elliot, 1988; Voss, 1987; White, 1986). It is anticipated that the ease of integration of a proposed new technology with the core technologies of a firm may impact the organizational decision processes culminating in the adoption or non-adoption of this technology.

This leads then to the following hypotheses:

Hypothesis #11: A proposed new technology that is adopted will have a significantly higher degree of ease of integration than the one which is not adopted.

Hypothesis #11a: The degree of the ease of integration will be a significant differentiating factor for a proposed new technology to be adopted, shelved or rejected.

<u>Complexity</u>

The general perception of a technology as being either "high" or "low" technology depends upon the complexity of its use in the existing environment of an organization. At any given time, a company has a stock of technologies which are to a greater or lesser extent embodied in its product/services and production/delivery systems. There is also a rate of change in the stock of technologies which is driven by internal and external technological development efforts.

Harvey (1968) proposed that industrial organizations are distinguishable on the basis of the specificity of technology they use. Covin et al. (1990) argue that the individual business practices and decisions of an industrial organization are influenced by the level of technological sophistication it has incorporated in its operations. While the actual number of industries categorized as "high-tech" by government sources is quite limited (Mar et al., 1985), a large number of industries would meet the criteria suggested by academic scholars. Shanklin and Ryans (1987), for example, suggest that an organization needs to meet the following three criteria in order to be categorized as high-tech: (1) the organization requires a strong scientific-technical basis; (2) new technology can quickly make existing technology obsolete; and (3) as new technologies come on stream, their applications create or revolutionalize markets and demands.

Meredith and Hill (1987) have categorized the complexity of new manufacturing and process technologies at four levels. Each level of manufacturing technologies has different characteristics in terms of their purpose of acquisition, organizational objectives, benefits, scope of effects, organizational impact, and risk of capital investment in the technology. The level-1 manufacturing technologies are referred to as stand alone equipment. Examples of stand alone equipment are NC machine tools, and robots. Level-2 consists of cellular groupings of equipment, material, and workforce for the production of families of parts. Cellular grouping may or may not be computerized. Various versions of cellular groupings such as GT, FMS and Computer-Aided Engineering (CAE) may belong to level-2 of manufacturing technologies.

Level-3 represents the integration of manufacturing technologies with related functions through "linked islands". Technologies such as Computer Aided Design/Computer Aided Manufacturing (CAD/CAM), Manufacturing Resource Planning (MRP II), and Computer Aided Process Planning (CAPP) when linked together often comprise level-3 of technology. At this level, the multiple departments and functions of an organization are affected by the extensive change required: the change may even affect the organizational structure. This level of technology may provide an organization competitive advantages such as: production flexibility, the ability to more easily and quickly generate new products and enter new markets, and the opportunity to bring synergy to production operations. However, at the same time the extensive integration and complexity of level-3 systems add more risk. The failure of any one element, or the lack of full coordination can cause the entire network to fail, or at least compromise its effectiveness.

With the increasing level of a technology, subsequently the complexity of an organization's operations is also affected. Level-4 technologies provide an organization the opportunity to fully integrate its manufacturing function with all other functional departments and top management, as well as firm's major suppliers and customers. This level of technology typically demands a major change in the way an organization is run including purchasing, finance, marketing, and even top management functions. To utilize the benefits of this level of technology, major organizational changes are required in the firm. Of course, this involves major risk as well. This magnitude of technological change will demand the use of newly trained workers doing new jobs with new equipment to perform new operations.

An organization's technology level can be impacted by the acquisition and adoption of more complex technologies. For example, a manufacturing organization with NC machines which adopts direct computer controls with FMS. The technology level as well as the complexity of operations of such a firm is considered to be enhanced. Similarly, the same firm's technology is further enhanced when it upgrades its manufacturing as well as functional operations with integrated computer controls using CIM. The magnitude of such technological changes in turn impacts the complexity of overall operational environment of an organization.
Hence, the following hypotheses are suggested:

Hypothesis #12: A proposed new technology that is adopted will be less complex than one which is not adopted.

Hypothesis #12a: The degree of complexity will be a significant differentiating factor for a proposed new technology to be adopted, shelved or rejected.

Safety

The terms safe and safety are part of our everyday vocabulary, but an exact and complete definition of them regarding a technology is difficult to set. One may say that a technology is safe if it is free of hazards or free of recognized hazards. Such a definition may suffice for casual conversation, but technically it is not adequate in the operating environment of an organization. No technology is really free of hazards, and a hazard may be present without being recognized. According to Lowrance (1976) safety is defined as a judgement of the acceptability of risk, and risk, in turn, as a measure of the probability and severity of harm to human health.

The issue of safety of a technology in organizations is considered on two parallel tracks: (1) operational safety, and (2) environmental safety. Organizations are legally obliged to meet the standards set forth by the statutes of the Occupational Safety and Health Administration (OSHA) which deal with the occupational safety and health of employees in the working environment of an organization. The working environment of an organization involves basically techno-social systems which ensue from the incorporation of a technology. Additionaly, an organization is bound by the statutes of the Environmental Protection Agency (EPA) which deals with the impact of an organization's technological operations on the general environment. Various process and product technologies may be considered to drastically impact the general environment due to their use of hazardous materials or production of toxic by-products.

In view of the public sensitivity to general environmental issues and the current debate on organizational responsibility toward the environment, the environmental safety of a proposed new technology is considered to be an important factor for its adoption or non-adoption. Even where an inherently safe technology can undeniably improve an organization's operations, negative perceptions about a particular technology can delay its acceptance, or even block its adoption completely. Otway and Haastrup (1989) argue that negative public perception of certain hazardous technologies, such as nuclear technology, is also a common reason for non-adoption of these technologies in many organizations.

This suggests the following hypotheses:

Hypothesis #13: The degree of safety will be significantly higher for a proposed new technology that is adopted than the one which is not adopted.

Hypothesis #13a: The degree of safety will be a significant differentiating factor for a proposed new technology to be adopted, shelved or rejected.

Aggregate Impact of Decision-Process Predictors

It is anticipated that the organizational factors when aggregated will have an additive impact on the decision response of an organization to a proposed new technology. It is further expected that the aggregation of organizational factors will also be a significant differentiating predictor to the adoption, shelving, or rejection of a proposed new technology. The same argument can be advanced for the organization-technology factors, as well as the technology factors.

When all decision-process factors are considered, it is also expected that the aggregate of organizational factors, organization-technology factors, and technology factors will have an additive impact on an organization's decision response concerning the adoption or non adoption of a proposed new technology. It is further anticipated that the framework will provide a discriminatory power in differentiating the decision responses of an organization in terms of the adoption, shelving, and rejection of a proposed new technology. Hence, to validate the above premise the following set of hypotheses are suggested:

Hypotheses relating to organizational factors:

Hypothesis #14: Organizational factors will be a significant differentiating predictor to the adoption or non-adoption of a proposed new technology.

Hypothesis #14a: Organizational factors will be a significant differentiating predictor to the adoption, shelving or rejection of a proposed new technology.

Hypothesis relating to organization-technology factors:

Hypothesis #15: Organization-technology factors will be a significant differentiating predictor to the adoption or non-adoption of a proposed new technology.

Hypothesis #15a: Organization-technology factors will be a significant differentiating predictor to the adoption, shelving or rejection of a proposed new technology.

Hypotheses relating to technology factors:

Hypothesis #16: Technology factors will be a significant differentiating predictor to the adoption or non-adoption of a proposed new technology.

Hypothesis #16a: Technology factors will be a significant differentiating predictor to the adoption, shelving, or rejection of a proposed new technology.

Hypotheses relating to aggregate of Decision-process factors:

Hypothesis #17: The aggregate of the decision-process factors will be a significant differentiating predictor to the adoption or non-adoption of a proposed new technology.

Hypothesis #17a: The aggregate of decision-process factors will be a significant differentiating predictor to the adoption, shelving, or rejection of a proposed new technology.

CHAPTER III

METHODS AND PROCEDURES

Introduction

The purpose of this study is to assess and generalize on the critical factors that impact the technological decision process culminating in the adoption, shelving, or rejection of proposed new technologies in an organization. From the review of literature presented in Chapter II, those predictors which were common across a variety of technological decisions were identified. These predictors form a basis for the constructs of the decision framework presented and discussed in the literature review. This chapter describes the methods and procedures used to conduct the study including; the research design, selection of the survey sample, development of the survey instrument, pretesting of the questionnaire, pilot study, data collection process, and the procedures for analyzing the data.

Research Design

The most appropriate research design for any empirical study depends on a combination of the following factors: sampling technique, population characteristics, survey cost, allowable time, survey instrument, and complexity. The population from which the sample for this study was drawn represented industrial organizations across the United States. These organizations were known to have in-house manufacturing operations. Given the available time to complete the study, limited funds, and geographical distribution of the respondents, a survey research design in the form of a mail questionnaire was considered the most feasible method.

The goal of the questionnaire was to collect data on the decision-process factors included in the framework. This data resided with the higher management of these industrial organizations where most of the decisions concerning the adoption or non-adoption of proposed new technologies are usually made. Therefore, the questionnaire was targeted to the vice-presidents of technology, manufacturing managers, production and operation managers, vice-presidents of research and development, and plant managers. This targeting was possible due to the fact that the top management structure of the selected companies is a matter of public information. Identification of the respondents by name and their management positions was construed by the analysis of the management structure of the individual organizations.

Survey participants were asked to complete a questionnaire with three major sections designed for obtaining quantifiable data for subsequent analyses. Detailed discussion of the questionnaire developed and used in this study is presented in a separate section later in this chapter.

A number of researchers have discussed some major weaknesses and advantages of the mail questionnaire. For example, Wallace (1954) presents the following notable weaknesses: the problems of non-returns leading to a biased sample; validity of data depends on the willingness of the respondent to provide accurate information; questions may be misinterpreted by respondents without the opportunity for the researcher to offer clarification. Despite those drawbacks, the mail survey has a number of advantages as pointed out by many researchers (e.g., Dillman, 1978; Francel, 1966; Hayman, 1955; Sudman, 1967; Warwick & Osherson, 1973; Warwick & Lininger, 1975).

Some key advantages mentioned in the literature, include: it provides the ability to obtain a large sample with minimal expense; there is opportunity for wider contact in dispersed geographical locations; it offers the ability to reach people who are difficult to locate and interview; more consideration by respondents is permitted in answering the questions; there is greater uniformity in the manner in which questions are posed; respondents are given a sense of privacy; and absence of an interviewer may promote honesty and frankness.

Some researchers have indicated that the most effective technique for gathering data is through interpersonal contact of interviewer and respondent (e.g., Gorden, 1969; Kahn, 1967; Warwick & Osherson, 1973). On the other hand, Dillman (1972) has pointed out that due to the problems of locating prospective respondents for face-to-face interviews this mode of conducting research is becoming prohibitively expensive.

However, due to the recent proliferation of direct marketing and public availability of target mail listings, the response rate of a mail survey is also problematic. Suggestions abound in the research literature on how to improve response rate in mail questionnaire design and administration (e.g., Bunning, 1973; Dillman, 1978; Francel, 1966; Gullahorn, 1963; Wallace, 1954). Some of the key suggestions are: an attractive questionnaire design, keeping the questionnaire brief, using colored stationary, official sponsorship of research, personalization of cover letter and other correspondence, anonymity and confidentiality, rewards and incentives to respondents including return postage and other token gifts, and follow-up reminders.

In designing and administering the survey instrument for this study, the various suggestions for improving response rate were incorporated where possible. Efforts were made to minimize the length of the questionnaire, the questionnaire was pretested for clarity, and a pilot study was conducted to further test comprehension of the questions as well as development of the scoring methodology. A complete discussion of the pilot study is presented later in this chapter. A cordial cover letter that accompanied the questionnaire, explained the importance of this study as well as indicated sponsorship, in this case affiliation with the School of Industrial Engineering and Management at Oklahoma State University (see Appendix C). The departmental letterhead was used for the cover letter accompanying the questionnaire. Return postage was provided for convenience along with a pre-addressed return envelope. In view of these steps, an effort was made to avoid many problems usually associated with a mailed survey questionnaire.

Selecting the Survey Sample

The survey sample for this study was selected to be representative of the industrial organizations within the United States that are known to have incorporated new technologies. A purposive sample of 215 companies was selected from the Standard and Poor's Register of Corporations; Directors and Executives 1991.

The criteria for selecting the sample companies were as follows:

1. The company should be an industrial organization with the indication of internal manufacturing operations.
2. The company should be medium size with at least 200 employees and annual sales of at least $50 million.
3. The sample companies should encompass a variety of industries.

The researcher believes that a purposive sample meeting these criteria represented a more knowledgeable sample for the scope of this study than a randomized approach would. The individuals selected as respondents were expected to have at some time been actually involved in their company's technological decision making processes concerning the adoption or non-adoption of proposed new technologies. Individual respondents in the selected sample companies were to be in higher management positions. This consideration was based on the understanding that individuals in higher management positions are usually involved in the decision making activities being studied in this research. The participants selected were individually identified by their name. Their exact designation and areas of responsibilities were determined from the respective management structure of the companies available in the latest edition of Standard and Poor's Register 1991. The intent was to address the survey questionnaire to selected participants that were publicly known to be most likely involved in the technological decision making processes in their respective organizations.

Development of the Survey Instrument

This section covers the procedures carried out to develop the questionnaire used to conduct the survey for this study. This study involved two objectives. First, to conduct an investigation to empirically determine the title role that certain factors play in the outcome of technological decisions culminating in the adoption or non-adoption of proposed new technologies in organizations. Second, to collect the necessary data from the participants of the sample industrial organizations to test the stated hypotheses for this study.

In designing the questionnaire, information was obtained from the review of relevant literature to support the different factors addressed in the hypotheses. The issues delineated from the literature concerning each hypothesis composed a general list of questions that became the master list for planning the instrument. Items from the general list were grouped into major sections addressing each of the hypothesis stated for this study. After the questions were written in the desired format, it was necessary to cross-check with the general list, and select the appropriate number of questions that would make up the set addressing each hypothesis. Each set of statements would solicit quantifiable information for testing the specific hypothesis that the set addressed. Comparing the draft copy of the questionnaire with the general list of issues helped to identify and eliminate gaps and overlaps in the initial questionnaire.

This initial questionnaire was pretested and a pilot study was undertaken prior to finalizing the survey instrument. The methods used in the pretest and the pilot study are discussed later in this chapter. The final survey instrument is presented in Appendix A. The following is a brief description of the survey instrument:

* The opening section defined certain key concepts (words) used in the rest of the questionnaire. It also presented an overview of what exactly is desired of the respondent. The whole instrument was divided into four sections. Every section was preceded by an instruction for the completion of that particular section.
* A basic assumption was that the companies would have adopted, shelved and rejected a variety of technologies

depending on differences in their business operations. For example, manufacturing companies would have adopted new manufacturing technologies specific to the type of products or the nature of their business operations. Some companies would have incorporated proprietary new technologies that do not fall in the broad set of standard new technologies. Moreover, due to the concerns of confidentiality of a new technology to a company, the respondent might not be in a position to exactly describe this technology. For this reason, the indication of a specific new technology that a respondent company would have adopted, shelved or rejected was left to the discretion of the respondent.

* Section A of the questionnaire was basically designed to solicit information identifying the title importance of underlying factors that impact technological decision making processes in an organization. The importance of these factors were determined in terms of the responses. This section was not directly related to the testing of the hypotheses in the other two parts of the questionnaire. At the outset of the survey, it was presumed that decision-makers may perceive the importance of a particular factor differently in the context of their own organization. For example, the perceived benefits of a technology may have different dimensions in the process of technological decision making depending upon the organization. Some

organizations may emphasize improving productivity, while others may consider manufacturing cost reduction or quality improvement as important factors impacting their technological decision making process. The response in section A were measured using a five-point Likert scale. The scale ranged from "Not at All Important" to "Very Important". The respondents were asked to rate their perception of the importance of a particular factor.

* Section B of the instrument was designed to test the hypotheses concerned with the adoption of a new technology in an industrial organization. This part consisted of 30 statements. Each response in this section was gathered on a seven-point Likert scale, with the low end being "Disagree Strongly" and the high end being "Agree Strongly".
* Section C of the instrument was composed of 27 statements and solicited information on shelving or rejection of the technology. The response in this section were gathered using a seven-point Likert scale.
* Statements in Section B and Section C were the same but their sequence was changed in Section C to avoid confusion and tedium of the respondents. However, three additional statements in Section B solicited information concerned with the incremental aspect of implementation of the accepted new technology.
* Section D consisted of demographic-related questions.

Responses in this part were meant to aid in the evaluation of the credibility of a respondent. This section specifically sought on the respondent's qualifications to be the participant in the technological decision making processes of his/her respective organization. Data obtained was considered valid when the respondent's qualifications were established.

* Questions were of the open and closed-ended types. This combination was designed to permit the respondent to answer with some feelings of confidentiality.

Pretesting of the Questionnaire

The questionnaire was pretested twice. Participants of the pretest/review group included four professors, nine graduate students and two practicing engineers from industry. All participants had some experience with organizational decision making processes used in industry. Two other individuals currently working in higher management positions in industry served as outside consultants. They provided input regarding the general structure of the instrument. Each question was criticized using a standardized critiquing questionnaire (see Appendix B) adapted from Van Dalen (1973) and Leedy (1974). The critique of the questionnaire was done to check and refine the general structure of the instrument as well as improve clarity of questions and statements.

As mentioned previously, each hypothesis was represented by a set of statements. These sets were not explicitly shown on the questionnaire. Rather all the questions in a section were grouped together maintaining flow and consistency to some extent. The relationship of the questions in the survey instrument to a particular hypothesis was identified for only critiquing purposes. This documentation was attached along with the survey instrument for the group of people involved in the pretest and critiquing process of the survey document. The participants were asked to provide ideas or suggestions for improving the questionnaire. Based on the input from the pretest/review group, necessary adjustments were incorporated in the questionnaire. The same process was repeated for the second critique and revision. After the second revision, the questionnaire was finalized. Some of the revisions prompted by the pretest/review process included: rewriting some questions for clarity, rewriting some instruction sections, and in some areas combining or completely eliminating some questions.

Pilot Study

The pilot study was designed to sample a small group similar to the population to be surveyed. The pilot study group consisted of 40 participants who have previously worked in industrial organizations and have experience with the technological decision making process.

The participants belonged to the Energy Analysis and Diagnostic Center at Oklahoma State University (OSU), the Computer Integrated Manufacturing Center at OSU, the MBA program and School of Journalism at OSU, as well as some currently employed in various industrial organizations in the state of Oklahoma. The responses to the pilot study were analyzed using methodology described in the data analysis section. Based on the responses and comments from the pilot study, final revisions were made on the survey instrument.

Data Collection Process

Data collection was accomplished through the use of the questionnaire. The questionnaire was mailed to the executives of 215 selected companies in the United States. A personalized cover letter (see Appendix C) to the respondents identifying the purpose of the study as well as its sponsor accompanied the survey instrument. This letter assured the respondents of confidentiality. Return postage on a pre-addressed envelope was provided to eliminate one common detriment to respond. The respondents were given the option to receive a summary report of the study in appreciation of their participation.

After selecting the 215 companies comprising the sample, a plan was established for mailing the questionnaire. Three dispatches with an interval of one week was decided on. The first batch of survey instrument was mailed on April 9, 1991, to an initial group of 115 respondents. At the time of initial mailing of the questionnaires, three dates were designated as accounting and closing dates of the questionnaire returned. The closing date of returned questionnaire for the first batch was set on May 15, 1991. The second batch was mailed on April 15, 1991, to a group of 50 respondents with a closing date of returned questionnaires as May 23, 1991. The third batch was mailed on April 23, 1991, to the last group of 50 respondents with a closing date of returned questionnaire as May 31, 1991.

As pointed out earlier, the survey instrument was addressed to individuals by their name as well as their exact designated position in the organization. For example, it was addressed to "Thomas Irving", The Vice-president Technology, rather than addressing it simply to "The Vice-president Technology". The directory for executives of the selected companies was helpful in pinpointing the respondents for the study. This personalized approach was done to encourage respondents to participate, thereby stimulating higher response rates.

At the start of the study, it was planned that no follow-up would be done if the response rate exceeded twenty-five percent. When the response from the first dispatch exceeded more than 27 percent, the 'no follow-up strategy' was maintained. This strategy was implemented on the assumption that those individuals who may not want to participate in the study would also ignore a follow-up request. A response of approximately 50 organizations was considered appropriate to conduct necessary statistics for this study. Contingent upon cost constraints as well as time, the follow-up seemed unnecessary after a satisfactory response was achieved.

Procedures Used to Analyze the Data

Data collected were tabulated and analyzed statistically. Section A of the questionnaire concerned the "Evaluation of Technological Decision-Process Factors". The data collected from this section were analyzed using descriptive statistics. These statistics indicate the title importance of the specified factors which impact the technological decision making process. These data are summarized in various tables in Chapter IV.

The data from Sections B and C of the questionnaire were used to test the different hypotheses for this study. The statements in Section B were used to test the level of importance of a factor and the impact it had on the adoption of a specific new technology in an industrial organization. Each statement was evaluated in terms of the response on the seven-point Likert scale. Some of the statements were evaluated by using reversed scoring i.e., subtract the position entered by the respondent from 8. The statements posed for reversed scoring were intended to ascertain that the respondents do clearly understand different issues as constituent elements of a factor to which these statements were addressed. For example, in Section B, statements #16, #17, #18, and #19 addressed the factor of operational compatibility of a proposed new technology that was adopted. Statements #17, and #19 were evaluated by using reversed scoring. The scores of all statements addressing a particular hypothesis were normalized and the degree of importance of each factor in the adoption of a new technology was determined in terms of scores ranging from 1 to 7. A "1" indicated a low degree of impact for a particular factor while a "7" indicated a high degree of impact for that factor in the technological decision process.

The 27 statements in Section C were similarly evaluated to determine the average score of each factor that had impacted the technological decision outcome of non-adoption of a proposed new technology. This new technology was further distinguished as either being shelved or rejected in the respondent's organization. Each of the stated hypotheses were then tested using the information obtained from the evaluation of statements in Section B and Section C of the questionnaire.

A t-test was used to test for significant differences in responses to the set of statements addressing each hypothesis. This type of test was adequate because only independent groups (adoption vs non-adoption), (adoption vs shelving), (adoption vs rejection), and (shelving vs rejection) were dealt with in testing each of the hypothesis.

Salsow (1982) provided a decision tree for selecting suggested statistical tests to meet the requirements of the data to be analyzed. The tree indicated that a t-test for independent groups would be appropriate for testing the hypotheses stated for the study, given the fact that the scales used for the questions were specified by the author as interval scales, and testing involved two samples at a time. Bodwitch and Buono (1982) indicate that a t-test is appropriate for situations where there are only two samples to be compared at a time. They pointed out that this test is one of the most common techniques used for comparisons of two samples, by using sample means as a basis for comparison. The t-test would indicate whether or not the difference between two groups is statistically significant. According to Wilkinson (1987), when a sample is small enough (less than 30), a t-test is preferred to a z-test.

A computer program in BASICA was developed to run t-tests for this study. This program was based on the test procedure as shown in Chapter V. A statistical significance level for the t-test was set at $p < .005$, $p < .01$, and $p < .05$. These significance levels were pivoted in the code of the program so that the results were tested from higher to lower levels of significance before the program indicated a final level of test significance for each stated hypothesis. A test significance level of $p < .05$ was chosen for the rejection of a stated hypothesis. The results of individual testing of the hypotheses are presented in Chapter V.

To facilitate the complete data analysis, information from the questionnaire was extracted and entered on a tally sheet (using LOTUS 1-2-3). Analyses to determine the descriptive statistics were performed using MICROSTAT statistical software. Summary tables of the statistical results were then developed showing the relevant descriptive statistics for each factor as well as the results of the t-test and the significance level for the testing of each hypothesis.

CHAPTER IV

PRESENTATION AND ANALYSIS OF DATA

Introduction

The first objective of this study was to investigate and analyze the factors which predominantly impact the organizational decision response to proposed new technologies. This objective was achieved by determining the importance of the specified factors which impact the technological decision making process in organizations. This chapter analyzes the collected data pertaining to the first objective of this study. Prior to the analysis a description of the questionnaire return rates; categories of new technologies, adopted, shelved, and rejected; and demographic data is included. The summary results are presented in table forms.

Questionnaire Return Rates

The survey instrument for this study was mailed to a total of 215 industrial organizations across the United States. A total of 67 (31.2%) questionnaires were returned. Seven questionnaires (3.25%) returned were not completed. The reason provided was that the addressed respondent had either left the organization or had been transferred to some other part of the organization. Five additional incomplete questionnaires (2.32%) were returned with the explanation that the companies do not intend to participate in this study due to the confidentiality of the technologies in their organizations. The total number of responses finally used (usable return rate) was 55 out of 215 (25.6%). The size of the selected sample may indicate the probable rate of return to a mail survey. One of the major causes of low return rate to a mailed survey questionnaire is that the participants are essentially volunteers. However, the response rate to the survey designed for this empirical research was sufficient to conduct exigent statistical analysis of the respondents' data.

The 55 respondent industrial organizations in this study represent the general industrial classification, the numbers indicating respondents in respective industry: computers (7), electrical & electronics (8), telecommunication (2), industrial and farm equipment (5), food products (2), rubber and plastics products (1), scientific and medical equipment (4), automotive parts (3), apparel and textiles (2), food processing (2), transportation equipment (4), building materials (3), chemical products and petroleum (3), pharmaceuticals (1), and metal products (8).

A summary of the geographical distribution of the respondent industrial organizations represented in the study, by states, is presented in Table I.

TABLE I

GEOGRAPHICAL DISTRIBUTION OF RESPONDENT INDUSTRIAL ORGANIZATIONS: BY STATES

State	# of Respondent Companies	State	# of Respondent Companies
Arizona	1	Nebraska	1
California	6	New Jersey	2
Colorado	2	New York	3
Connecticut	1	Ohio	4
Florida	2	Oklahoma	6
Georgia	2	Oregon	2
Illinois	3	Pennsylvania	3
Indiana	3	South Carolina	1
Kansas	1	Tennessee	1
Kentucky	2	Texas	3
Louisiana	1	Utah	1
Massachusetts	4	Virginia	1
Michigan	3	Washington	1
Minnesota	4	Wisconsin	2
Missouri	1		

Categories of New Technologies Adopted Shelved and Rejected

A total of 104 different new technologies adopted or not-adopted were represented in the sample. These technologies were classified into six major areas of new technologies, namely: manufacturing technology, information and computer technology, product technology, process technology, operations technology, and energy cost reduction technology. A seventh category of miscellaneous technology represents those new technologies which are specific to a respondent's particular organization.

The individual new technologies classified into the manufacturing category include: flexible manufacturing system (FMS), cellular manufacturing, group technology, robotics, vision systems, automated assembly line, computer numerical control, flexible assembly system (FAS), and laser cutting technology.

The information and computer category consisted of: computer aided design (CAD), computer aided engineering (CAE), manufacturing resource planning (MRP II), bar coding, inventory control systems, and management information systems.

The product technology category involved specific new technologies which the respondents had identified in terms of its area and did not, in general, mention the exact name of the individual technology. A few respondents coded the product technology such as RicmosLsic, Electronic 'T' systems, etc.

The categories of process and operations technologies involved: co-extrusion of metal/material, plasma melting, organic solvent based coating, induction melting, power coating, surface temperature additive systems, heat exchangers, high speed box rolling, film metalizing, scrap handling, spectroscopy, material handling, quality assuring, computer aided process planning (CAPP), advanced knitting, and neurological catheters. Similarly, the categories of energy cost reduction and miscellaneous technology were identified based on the information provided by the respondents.

A total of 55 new technologies were adopted while 49 other new technologies were not adopted. Out of the 49 new technologies that were not adopted, 30 new technologies were shelved and 19 were rejected. The frequency, and percentage of total for each identified category of new technology that was either adopted, shelved or rejected in the respondents' organizations are presented in Table II.

Demographic Data

Demographic data on the respondents of this study was not intended to serve as a particular variable or set of variables in the analysis, but rather to provide general background information on the respondents. The main purpose was to provide some idea about the validity of the information obtained via the mail survey. To ascertain their credibility, the respondents were asked to complete the demographic section of the questionnaire. The respondents were identified, from their current positions, as top managers involving in the technological decision making processes of their respective organizations.

A summary of demographic data about the individual respondents of participating companies is presented in Table III and Table IV.

TABLE II

CATEGORIES OF NEW TECHNOLOGIES ADOPTED SHELVED AND REJECTED

Category of New Technology	Adoption		Non-Adoption			
			Shelved		Rejected	
	Frequency	% of Total	Frequency	% of Total	Frequency	% of Total
Manufacturing Technology	16	29.1%	12	40.0%	7	36.9%
Information & Computer Technology	11	20.0%	6	20.0%	4	21.1%
Product Technology	5	9.1%	2	6.7%	2	10.5%
Process Technology	7	12.7%	3	10.0%	2	10.5%
Operations Technology	10	18.2%	1	3.3%	2	10.5%
Energy Cost Reduction Technology	2	3.6%	1	3.3%	0	0.0%
Miscellaneous Technology	4	7.3%	5	16.7%	2	10.5%
Total	55	100.0%	30	100.0%	19	100.0%

TABLE III

RESPONDENTS' NUMBER OF YEARS IN CURRENT POSITION

Years in Position	Frequency	% of Responses
Less than 1 Year	1	1.8
1 - 3 Years	11	20.0
4 - 7 Years	19	34.6
8 - 12 Years	11	20.0
12 - 16 Years	7	12.7
Over 16 Years	6	10.9
Total	N=55	100.0

TABLE IV

FORMAL EDUCATION OF RESPONDENTS

Education	Frequency	% of Responses
Graduate Degree	32	58.2
Bachelor Degree	18	32.7
Some College	5	9.1
High School	0	0.0
Total	N=55	100.0

Results of the Analyses

Data analyses for this study are presented in two segments. The first segment investigates the importance of the specific technological decision-process factors which have been widely mentioned in the current literature. The title importance varies from "very important" to "very unimportant". Results are given in tabulated form in the section 'Evaluation of Technological Decision-Process Factors' of this chapter. The second segment evaluates the data collected in order to test the stated hypotheses for this study. Results of the hypotheses testing are presented in Chapter V.

Evaluation of Technological Decision-Process Factors

The analyses discussed in this section were conducted to determine the title role that specified decision-process factors play in impacting the technological decision-making processes in the sample industrial organizations. Each of the indicated factor as rated by the respondents has been presented in a table with a discussion of the results.

CEO's Advocacy

As indicated in Table V, 41.8% of the respondents rated CEO's advocacy as a very important factor impacting the outcome of the technological decision process concerning the adoption or non-adoption of a proposed new technology. Further, 52.8%

of the respondents rated this factor as important. As a whole, 94.6% of the respondents indicated the role of CEO's advocacy as very important or important technological decision-process factor. These results confirm the importance of a CEO's advocacy in organizational decision making process as indicated in the management literature.

TABLE V

CEO's ADVOCACY

RATING	Frequency	% of Responses
1 Very Important	23	41.8
2 Important	29	52.8
3 Neutral	2	3.6
4 Unimportant	1	1.8
5 Very Unimportant	0	0.0
Total	N=55	100.0

Top Management Support

The literature on managerial decision making has strongly emphasized the key role of top management support as a determining factor of the outcome of organizational decisions.

Various researches have found that top management support was a key variable in the decisions about the approval and further implementation of new technologies in various organizations. Study results support this claim of the researchers.

Table VI shows that 64.6% of the respondents have rated the role of top management's support as a very important factor impacting the outcome of technological decisions. Further 27.3% of the respondents acknowledged that top management support to be important. As a whole, 91.9% of the respondents rated top management support as a very important or important technological decision-process factor.

TABLE VI

TOP MANAGEMENT SUPPORT

RATING	Frequency	% of Responses
1 Very Important	35	64.6
2 Important	15	27.3
3 Neutral	5	9.1
4 Unimportant	0	0.0
5 Very Unimportant	0	0.0
Total	N=55	100.0

Technology Strategy

The role of technology strategy in directing the technological decision making processes in organizations has been strongly emphasized in the literature on technology management and strategic management. However, very little empirical evidence had been accumulated on how much industrial organizations emphasize technology strategy during the technological decision process. Table VII indicates that 34.6% of the respondents rated the impact of technology strategy as very important while 54.5% rated it as important in technological decision making processes in their respective organizations. As a whole, 89.1% of the respondents considered technology strategy played a key role in the adoption or non-adoption of proposed new technologies.

TABLE VII

TECHNOLOGY STRATEGY

RATING	Frequency	% of Responses
1 Very Important	19	34.6
2 Important	30	54.5
3 Neutral	6	10.9
4 Unimportant	0	0.0
5 Very Unimportant	0	0.0
Total	N=55	100.0

Company Policy

Table VIII indicates that 54.6% of the respondents rated the impact of the company's policy as very important or important on the outcome of the technological decisions in their organizations. Some 23.6% of the respondents rated company's policy to be neutral while 20% of the respondents indicated company policy as unimportant in determining the outcome of technological decisions in their organizations. These results indicate that a company's policy plays an important role in the technological decisions concerning the choice of a new technology.

TABLE VIII

COMPANY POLICY

RATING	Frequency	% of Responses
1 Very Important	9	16.4
2 Important	21	38.2
3 Neutral	13	23.6
4 Unimportant	11	20.0
5 Very Unimportant	1	0.0
Total	N=55	100.0

Employees' Skills

The response to the impact of employees' skills on the technological decision outcome is shown in Table IX. A total of 61.9% of the respondents rated this factor as very important or important. Further, 38.1% of the respondents indicated that employees' skills play a neutral or unimportant role in impacting the adoption or non-adoption of a proposed new technology. These results support the importance of employee skills in technological decision making as found by researchers in the area of successful implementation of new technologies.

In-House Technical Expertise

As shown in Table X, 56.3% of the respondents indicated that in-house technical expertise is either very important or important in the technological decision making processes. Another 41.9% of the respondents indicated that this factor plays a neutral or unimportant role in these decision outcomes. It is contended that the presence of enhanced in-house expertise in an organization can be a facilitating factor in the technological decision process. The responses for this survey neither support nor disprove this contention of the role played by in-house technical expertise on the technological decision process.

TABLE IX

EMPLOYEES' SKILLS

RATING	Frequency	% of Responses
1 Very Important	4	7.3
2 Important	30	54.6
3 Neutral	18	32.7
4 Unimportant	1	1.8
5 Very Unimportant	2	3.6
Total	N=55	100.0

TABLE X

IN-HOUSE TECHNICAL EXPERTISE

RATING	Frequency	% of Responses
1 Very Important	8	14.5
2 Important	23	41.8
3 Neutral	20	36.4
4 Unimportant	3	5.5
5 Very Unimportant	1	1.8
Total	N=55	100.0

Company's Preparedness Level

Table XI shows that, as a whole, 69.1% of the respondents rated the impact of company's preparedness level as a very important or important factor in the technological decision process. Further, 27.3% of the respondents rated this factor as either playing a neutral or unimportant role in the decision outcome of proposed new technologies in their organizations. This finding support the importance of this factor in technological decision process, as indicated by other researchers.

TABLE XI

COMPANY's PREPAREDNESS LEVEL

RATING	Frequency	% of Responses
1 Very Important	9	16.4
2 Important	29	52.7
3 Neutral	12	21.8
4 Unimportant	3	5.5
5 Very Unimportant	2	3.6
Total	N=55	100.0

Attitude Towards Technology

As shown in Table XII, a total of 85.4% of the respondents rated the impact of management's attitude towards a proposed new technology as a very important or important factor in determining the decision outcome to adopt or not adopt a new technology. Only 14.6% of the respondents indicated that managements' attitude towards a proposed new technology do not impact the decision outcome of its adoption or non-adoption. These results support the importance of this factor as indicated in the literature.

Operational Compatibility of Technology

The impact of operational compatibility as a technological decision-process factor is presented in Table XIII. As indicated, 83.6% of the respondents rated the role of this factor on the adoption or non-adoption of a proposed new technology in their organizations as very important or important. Only 16.4% of respondents do not consider operational compatibility of a proposed new technology as a determining factor for the adoption of the new technology. Survey results support the importance of operational compatibility of a technology as indicated by other researchers.

TABLE XII

ATTITUDE TOWARDS TECHNOLOGY

RATING	Frequency	% of Responses
1 Very Important	24	43.6
2 Important	23	41.8
3 Neutral	3	5.5
4 Unimportant	3	5.5
5 Very Unimportant	2	3.6
Total	N=55	100.0

TABLE XIII

OPERATIONAL COMPATIBILITY OF TECHNOLOGY

RATING	Frequency	% of Responses
1 Very Important	18	32.7
2 Important	28	50.9
3 Neutral	4	7.3
4 Unimportant	2	3.6
5 Very Unimportant	3	5.5
Total	N=55	100.0

Strategic Importance of Technology

As shown in Table XIV, 81.1% of the respondents rated the strategic importance of a proposed new technology as a very important or important factor in the technological decision process concerning its adoption or non-adoption. The results show that only 3.6% of the respondents consider that the strategic importance of a proposed new technology play a very unimportant or unimportant role in the decision process. Further, 14.6% of the respondents indicated that this factor plays a neutral role in the technological decision making process. The results support the importance of this factor as indicated by other researchers.

Complexity of Technology

Table XV shows that only 12.7% of the respondents consider the complexity of a proposed new technology as a very important decision-process factor in its adoption or non-adoption. Further, 45.5% rated it as an important factor in the technological decision outcome of a proposed new technology. However, 41.8% of the respondents indicated that the complexity of a proposed new technology in their organizations does not impact the decision outcome relating to its adoption or non-adoption. The results of this survey neither support nor reject the importance as ascribed to this factor in the literature.

TABLE XIV

STRATEGIC IMPORTANCE OF TECHNOLOGY

RATING	Frequency	% of Responses
1 Very Important	27	49.1
2 Important	18	32.7
3 Neutral	8	14.6
4 Unimportant	1	1.8
5 Very Unimportant	1	1.8
Total	N=55	100.0

TABLE XV

COMPLEXITY OF TECHNOLOGY

RATING	Frequency	% of Responses
1 Very Important	7	12.7
2 Important	25	45.5
3 Neutral	17	30.9
4 Unimportant	5	9.1
5 Very Unimportant	1	1.8
Total	N=55	100.0

Technical Justification

Technical justification of a proposed new technology has been indicated by 78.2% of the respondents as a very important or important decision-process factor impacting the decision outcome in their organizations. However, 21.8% of the respondents as shown in Table XVI, do not consider this factor to play any role in the adoption or non-adoption of a proposed new technology in their organization. These results support the importance of technical justification as pointed out by other researchers.

TABLE XVI

TECHNICAL JUSTIFICATION

RATING	Frequency	% of Responses
1 Very Important	18	32.7
2 Important	25	45.5
3 Neutral	9	16.4
4 Unimportant	2	3.6
5 Very Unimportant	1	1.8
Total	N=55	100.0

Perceived Benefits of Technology

In organizations, various benefits of a proposed technology, as perceived by the decision makers, may impact the decision process. This survey solicited responses for only five perceived benefits of a proposed new technology that have been much emphasized in the literature. These are: (1) productivity improvement, (2) manufacturing cost reduction, (3) profitability, (4) competitive advantage, and (5) quality improvement. However, it was anticipated that industrial organizations may consider one or more of these perceived benefits as a decisive factor in the adoption or non-adoption of a proposed new technology.

The results of the responses for perceived benefits of a proposed new technology as a decision-process factor are shown in the next five tables, i.e., Table XVII through Table XXI. Table XVII indicates that 96.1% of the respondents rated productivity as a very important or important determinant in the adoption] of a new technology. Manufacturing cost reduction was considered by 85.4% of the respondents as a very important or important decision-process factor (Table XVIII). Profitability (Table XIX) and competitive advantage (Table XX) were rated as important or very important by 96.4%, and 94.5% of the respondents, respectively. Quality improvement (Table XXI) as a perceived benefit of a proposed new technology was indicated by 94.5% of the respondents to be a very important or important factor in impacting its adoption or non-adoption in

TABLE XVII

PERCEIVED BENEFITS OF TECHNOLOGY
(PRODUCTIVITY)

RATING	Frequency	% of Responses
1 Very Important	25	45.5
2 Important	24	43.6
3 Neutral	4	7.3
4 Unimportant	2	3.6
5 Very Unimportant	0	0.0
Total	N=55	100.0

TABLE XVIII

PERCEIVED BENEFITS OF TECHNOLOGY
(MANUFACTURING COST REDUCTION)

RATING	Frequency	% of Responses
1 Very Important	23	41.8
2 Important	24	43.6
3 Neutral	5	9.2
4 Unimportant	2	3.6
5 Very Unimportant	1	1.8
Total	N=55	100.0

TABLE XIX

PERCEIVED BENEFITS OF TECHNOLOGY
(PROFITABILITY)

RATING	Frequency	% of Responses
1 Very Important	36	65.5
2 Important	17	30.9
3 Neutral	1	1.8
4 Unimportant	0	0.0
5 Very Unimportant	1	1.8
Total	N=55	100.0

TABLE XX

PERCEIVED BENEFITS OF TECHNOLOGY
(COMPETITIVE ADVANTAGE)

RATING	Frequency	% of Responses
1 Very Important	35	63.6
2 Important	17	30.9
3 Neutral	3	5.5
4 Unimportant	0	0.0
5 Very Unimportant	0	0.0
Total	N=55	100.0

their organizations.

None of the respondents acknowledged competitive advantage, and quality improvement as unimportant factors in technological decision processes of their organizations. The respondents indicated that each of the five perceived benefits independently play an important role in the adoption or non-adoption of a proposed new technology in their organizations. These results corroborate findings of other researchers.

TABLE XXI

PERCEIVED BENEFITS OF TECHNOLOGY
(QUALITY IMPROVEMENT)

RATING	Frequency	% of Responses
1 Very Important	28	50.9
2 Important	24	43.6
3 Neutral	3	5.5
4 Unimportant	0	0.0
5 Very Unimportant	0	0.0
Total	N=55	100.0

Economic Justification Criteria

The prominent economic justification criteria for the selection of a new technology project as discussed in the Chapter II involve: (1) implementation cost, (2) return on investment (ROI), (3) cash flow constraints, and (4) payback period. This survey solicited a response from the participants for only above mentioned four economic justification criteria for their consideration. The results are shown in the next four tables i.e., Table XXII through Table XXV.

The respondents indicated that 81.8% of their organizations considered implementation cost (Table XXII) as a very important or important criteria for the economic justification of a new technology project. While 58.2% of the respondents considered cash flow constraints (Table XXIII) as a very important or important economic justification criterion for technological projects in their companies. However, 90.9% of organizations considered return on investment (Table XXIV) as a very important or important economic justification criteria for the choice of a proposed new technology. Further, 78.2% of the surveyed organizations rated payback period (Table XXV) as a very important or important economic justification criterion for the choice of a proposed new technology.

The results of this survey support the importance of each indicated economic justification criterion impacting the technological decisions as pointed out by other researchers.

TABLE XXII

ECONOMIC JUSTIFICATION CRITERION
(IMPLEMENTATION COST)

RATING	Frequency	% of Responses
1 Very Important	14	25.4
2 Important	31	56.4
3 Neutral	9	16.4
4 Unimportant	1	1.8
5 Very Unimportant	0	0.0
Total	N=55	100.0

TABLE XXIII

ECONOMIC JUSTIFICATION CRITERION
(CASH FLOW CONSTRAINTS)

RATING	Frequency	% of Responses
1 Very Important	11	20.0
2 Important	21	38.2
3 Neutral	18	32.7
4 Unimportant	3	5.5
5 Very Unimportant	2	3.6
Total	N=55	100.0

TABLE XXIV

ECONOMIC JUSTIFICATION CRITERION
(ROI: RETURN ON INVESTMENT)

RATING	Frequency	% of Responses
1 Very Important	24	43.6
2 Important	26	47.3
3 Neutral	3	5.5
4 Unimportant	2	3.6
5 Very Unimportant	0	0.0
Total	N=55	100.0

TABLE XXV

ECONOMIC JUSTIFICATION CRITERION
(PAYBACK PERIOD)

RATING	Frequency	% of Responses
1 Very Important	16	29.1
2 Important	27	49.1
3 Neutral	10	18.2
4 Unimportant	1	1.8
5 Very Unimportant	1	1.8
Total	N=55	100.0

Evaluation of the Mode of Implementation

As described in Chapter II, technologies which are adopted incur two sets of decisions. First, the decision to approve (accept) them. Second, the decision to implement them. Organizations, in general, face an important issue concerning the rate of implementation of an accepted new technology. Particularly, industrial organizations which have on-going operations find it a challenging problem in deciding whether implementation should be a one-time activity or there should be an incremental approach to the implementation of an approved new technology. The proponents of incremental implementation of a new technology argue that this approach is more effective in the successful implementation of new technologies. A number of case studies conducted in various organizations by implementation researchers have indicated that many factors such as the presence of a technology champion, training and skill improvement of workforce, and managing employee resistance to change play an important role in the decision concerning the rate of implementation of a new technology. Some researchers have indicated that the implementation cost of a new technology impacts significantly on the decision as to whether the implementation should be one-time activity or follow a step-wise (incremental) approach.

To investigate this issue a research question was posed relating to the mode of implementation of a new technology. One statement in the questionnaire (Section B, #29) asked the

TABLE XXVI

INCREMENTAL IMPLEMENTATION OF NEW TECHNOLOGIES

Respondent's Ratings	Frequency	% of Response	New Technology Areas
Agree Strongly	12	21.8	MT=2 , IT=4, PT=2 OT=2, Misc.=2
Agree	16	29.1	MT=1, IT=6, PT=2 OT=7
Agree Slightly	14	25.5	MT=6, IT=2, PT=4 ECRT=1, Misc.=1
Neutral	5	9.1	MT=3, ECRT=1, Misc.=1
Disagree Slightly	1	1.8	PT=1
Disagree	5	9.1	MT=1, PT=2 , OT=1 Misc.=1
Disagree Strongly	2	3.6	MT=1, PT=1
Total	55	100.0	

MT = Manufacturing Technology, IT = Information Technology

PT = Product/Process Technology, OT = Operations Technology

ECRT = Energy Cost Reduction Technology, Misc.= Miscellaneous respondents to indicate through their ratings, which approach their organizations had used for the implementation process of a specific new technology.

The response has been analyzed in Table XXVI. The results indicate that 55 different new technologies falling into six major categories were adopted in a variety of industrial organizations. About 76.4% of the respondents agreed that the new technologies adopted in their organizations were incrementally implemented. Only 14.5% of the respondents disagree to this mode of implementation. However, 9.1% of the respondents neither agree nor disagree to this mode of implementation.

These findings support the contention of a majority of the implementation researchers that incremental implementation of a new technology is the most used mode of adoption in organizations.

CHAPTER V

RESULTS OF HYPOTHESES TESTING

Introduction

This chapter presents the detailed analyses of the data acquired through the mail survey relating to the hypotheses stated for the study. The analyses outlined in this chapter provide the empirical results indicating a pattern of consensus in determining the impact of the decision-process predictors which are depicted in the framework developed to conduct this study. The stated hypotheses for the study were tested and the results of the test for individual hypothesis are presented and implications relevant to the outcome of the test for each hypothesis are also deliberated. The first section outlines the general procedure of testing individual hypothesis. Then, the results of the analysis pertaining to each hypothesis as well as implications are presented. In the last section of the chapter summary tables of the results are also provided.

Procedure for Hypotheses Testing

The procedure to test each stated hypothesis followed the two-sample t-test procedure (Devore, 1982; Newbold, 1991). The hypotheses from 1 to 17 were tested for the independent groups of adoption vs non-adoption. The hypotheses from 1a to 17a, were tested for the independent groups of adoption vs shelving, adoption vs rejection, and shelving vs rejection.

The pooled estimator of the common variance of the independent groups defined as pooled variance, denoted by S_p^2 in the results, was calculated by the following equation:

$$S_p^2 = \frac{(m - 1)\, S_1^2 + (n - 1)\, S_2^2}{m + n - 2}$$

Where:

- m is the sample size of group 1
- n is the sample size of group 2
- S_1^2 is the variance of group 1
- S_2^2 is the variance of group 2

The calculated value of the test statistic, denoted in the results by T_{cal}, was calculated by the following equation:

$$T_{cal} = \frac{(\bar{X}1 - \bar{X}2)}{S_p\,(1/m + 1/n)^{1/2}}$$

Where:

- $\bar{X}1$ is the average value of the factor for group 1
- $\bar{X}2$ is the average value of the factor for group 2
- S_p is the pooled standard deviation

The calculated value of the test statistic, (T_{cal}) was then further compared with the critical value of t based on level of significance and the degree of freedom. Three levels of significance were used for the test such that; $p < 0.005$, $p < 0.01$, and $p < 0.05$.

The degree of freedom for each two independent groups was calculated by the following equation:

Degree of freedom (df) = m + n - 2

For each stated hypothesis, if the value of T_{cal} was greater than the critical value of t (from the t-table) then the hypothesis was not rejected. On the other hand, if the value of T_{cal} was less than the critical value of t, then the hypothesis was rejected. In order to test all the hypotheses stated for this study, an interactive computer program in BASICA was written which was based on the above procedure. The computer program developed to test each hypothesis used logic to test each hypothesis first at $p < 0.005$ level of significance. If this level of significance was not achieved, the next pivoted significance value of $p < 0.01$ was used. The third level of the test for significance was set for $p < 0.05$.

Based on the level of significance at $p < 0.05$, the hypothesis should be accepted - a hypothesis that will not be rejected unless the data contain sufficient contrary evidence (Newbold, 1991). Moreover, fixing the significance level at the $p < 0.05$ level ensures that the chance is low that a true hypothesis will be rejected. Put differently, this level of significance test reduce the possibility of making a type I error to a minimum. Type I error is the rejection of a true hypothesis.

The pertinent test statistics for each of the hypotheses are summarized in the discussion presented in the next section.

Results of the Analyses

Each hypothesis test is presented in this section. In each presentation, the hypothesis is restated; the set of statements from the questionnaire soliciting information from respondents addressing to a hypothesis is reproduced; the pertinent statistics are provided; and the implications of the results of the test are provided.

The symbols used to represent the pertinent statistics for the test of each hypothesis are defined as follows:

- T_{cal} is the calculated value of the test statistic
- df is the degree of freedom
- S_p^2 is the pooled variance
- R is the range of the scores (from maximum to minimum) of the factor tested in each of the hypotheses
- $\bar{X}$ is the average value of the scores relating to a particular factor or predictor for each independent group
- S is the standard deviation of the scores relating to a particular factor or predictor for each independent group

Hypotheses Relating to Adoption and Non-adoption

Hypothesis #1

The degree of a CEO's advocacy will be significantly higher for a proposed new technology that is adopted than for one which is not adopted.

Statements Used:

2. The CEO of this organization directly advocated for this new technology.

4. The CEO of this organization supported the efforts to implement this new technology.

Statistics: One-tailed t-test for independent groups; degree of freedom; pooled variances.

(Adoption vs Non-adoption)

(T_{cal} = 9.22, df = 102, S_p^2 = 1.892)

Adoption: ($\overline{X}$ = 5.73 , R = 7.00 - 2.50, S = 1.09)

Non-Adoption: ($\overline{X}$ = 3.24 , R = 7.00 - 1.00, S = 1.65)

Result of the Hypothesis Test:

The hypothesis is not rejected for a test of significance level ($p < 0.005$).

Implications:

A proposed new technology that has the CEO's advocacy will have a greater prospect of being adopted in an industrial organization than a proposed new technology which is not strongly advocated by the CEO of the organization.

<u>Hypothesis #2</u>

The degree of top management support and commitment will be significantly higher for a proposed new technology that is adopted than for one which is not adopted.

Statements Used:

1. The top management of this organization actively supported this new technology with commitment of necessary resources.

3. The corporate planners and decision makers in this company clearly communicated their willingness to adopt this new technology.

Statistics: One-tailed t-test for independent groups; degree of freedom; pooled variances.

(Adoption vs Non-adoption)

(T_{cal} = 9.729, df = 102, S_p^2 = 1.386)

Adoption: ($\overline{X}$ = 5.79, R = 7.00 - 2.00, S = 0.88)

Non-Adoption: ($\overline{X}$ = 3.54, R = 6.50 - 1.00, S = 1.45)

Result of the Hypothesis Test:

The hypothesis is not rejected for a test of significance level ($p < 0.005$).

Implications:

A proposed new technology backed by a higher degree of top management support and commitment has greater prospect of being adopted in an industrial organization than a proposed new technology which does not have a strong support and commitment of the top management of the organization.

Hypothesis #3

A proposed new technology that is adopted will have a significantly higher degree of fit with organizational objectives than one which is not adopted.

Statements Used:

5. This organization believes that use of this new technology would provide our firm a competitive advantage in long run.

6. The top management is willing to use this new technology as means of achieving our corporate objectives.

7. This organization believes that this new technology fits within the scope of our company's technology strategy.

Statistics: One-tailed t-test for independent groups; degree of freedom; pooled variances.

(Adoption vs Non-adoption)

(T_{cal} = 8.267, df = 102, S_p^2 = 1.201)

Adoption: ($\overline{X}$ = 6.28, R = 7.00 - 3.33, S = 0.63)

Non-Adoption: ($\overline{X}$ = 4.50, R = 6.66 - 2.00, S = 1.46)

Result of the Hypothesis Test:

The hypothesis is not rejected for a test of significance level ($p < 0.005$).

Implications:

A proposed new technology which has a higher degree of fit with organizational objectives will have a greater prospect of being adopted in an organization than a proposed new technology which does not have a strong fit with the organizational objectives.

Hypothesis #4

The degree of technical skills will be significantly higher where a proposed new technology is adopted than where one is not adopted.

Statements Used:

8. This organization has the technical skills required to successfully implement this new technology.

9. This organization has a training program to match the technical skills of its workforce to utilize this new technology.

Statistics: One-tailed t-test for independent groups; degree of freedom; pooled variances.

(Adoption vs Non-adoption)

(T_{cal} = 5.319, df = 102, S_p^2 = 1.431)

Adoption: ($\overline{X}$ = 5.61, R = 7.00 - 2.50, S = 1.03)

Non-Adoption: ($\overline{X}$ = 4.36, R = 6.50 - 1.00, S = 1.37)

Result of the Hypothesis Test:

The hypothesis is not rejected for a test of significance level ($p < 0.005$).

Implications:

An industrial organization with a higher degree of technical skills compatible to a proposed new technology will have greater prospects to adopt this technology than the organization which lacks the required technical skills.

Hypothesis #5

The degree of organizational preparedness will be significantly higher for a proposed new technology that is adopted than for one which is not adopted.

Statements Used:

10. This organization has rewards systems to motivate its employees in learning new skills to implement this new technology.

11. This organization handled the problems of adapting to required change effectively while implementing this new technology.

12. The management of this organization perceived strong employee resistance to the use of this new technology.

Statistics: One-tailed t-test for independent groups; degree of freedom; pooled variances.

(Adoption vs Non-adoption)

(T_{cal} = 9.028, df = 102, S_p^2 = 0.952)

Adoption: ($\overline{X}$ = 5.57, R = 7.00 - 3.00, S = 0.86)

Non-Adoption: ($\overline{X}$ = 3.84, R = 6.00 - 1.00, S = 1.10)

Result of the Hypothesis Test:

The hypothesis is not rejected for a test of significance level ($p < 0.005$).

Implications:

An industrial organization which has a higher degree of preparedness will have more propensity to adopt a proposed new technology than an organization which has a lower degree of organizational preparedness.

Hypothesis #6

The degree of management's positive attitude towards a proposed new technology will be significantly higher for a technology that is adopted than for one which is not adopted.

Statements Used:

13. The management of this organization has a positive attitude towards this new technology.

14. The decision makers in this organization agreed fully to the merits of this new technology.

Statistics: One-tailed t-test for independent groups; degree of freedom; pooled variances.

(Adoption vs Non-adoption)

(T_{cal} = 8.066, df = 102, S_p^2 = 1.499)

Adoption: ($\overline{X}$ = 5.93, R = 7.00 - 4.00, S = 0.64)

Non-Adoption: ($\overline{X}$ = 3.99, R = 7.00 - 1.50, S = 1.66)

Result of the Hypothesis Test:

The hypothesis is not rejected for a test of significance level ($p < 0.005$).

Implications:

A proposed new technology that is adopted in an industrial organization will have a significantly higher degree of management's positive attitude towards this specific technology than for a proposed new technology which is not adopted.

Hypothesis #7

The degree of operational compatibility will be significantly higher for a proposed new technology that is adopted than for one which is not adopted.

Statements Used:

16. The adoption of this new technology did not impact drastically the company's relationships with its primary customers.

17. This organization was required to change much of its management control systems to implement this new technology.

18. This new technology was compatible with our firm's existing mode of operations.

19. This organization was required to replace or dislocate its workforce in order to implement this new technology.

Statistics: One-tailed t-test for independent groups; degree of freedom; pooled variances.

(Adoption vs Non-adoption)

(T_{cal} = 5.156, df = 102, S_p^2 = 0.843)

Adoption: ($\overline{X}$ = 5.33, R = 6.75 - 3.50, S = 0.73)

Non-Adoption: ($\overline{X}$ = 4.40, R = 6.50 - 2.00, S = 1.10)

Result of the Hypothesis Test:

The hypothesis is not rejected for a test of significance level ($p < 0.005$).

Implications:

A proposed new technology which has a higher degree of operational compatibility will have greater prospects of being adopted by an industrial organization than the proposed new technology which has a low level of operational compatibility. The operational compatibility of a proposed new technology is a significantly differentiating factor for the adoption or non-adoption of this new technology.

Hypothesis #8

A proposed new technology that is adopted will have a significantly higher degree of relatedness to the existing technological and business operations of the firm, than the one which is not adopted.

Statements Used:

20. This new technology is strategically important to the day-to-day operations of this organization.

21. This new technology has a strong fit with our firm's existing core technology.

22. The implementation of this new technology required major changes in the social and technical structure of this organization.

Statistics: One-tailed t-test for independent groups; degree of freedom; pooled variances.

(Adoption vs Non-adoption)

(T_{cal} = 7.094, df = 102, S_p^2 = 0.925)

Adoption: ($\bar{X}$ = 5.53, R = 6.66 - 4.00, S = 0.63)

Non-Adoption: ($\bar{X}$ = 4.19, R = 6.33 - 1.66, S = 1.24)

Result of the Hypothesis Test:

The hypothesis is not rejected for a test of significance level ($p < 0.005$).

Implications:

The degree of relatedness of a proposed new technology with the existing technological and business operations of an industrial organization will be a significantly differentiating factor for the adoption or non-adoption of this new technology. It implies that, the higher the degree of relatedness of a proposed new technology to the existing technological and business operations of a firm, the greater the prospects that this new technology will be adopted in that organization.

Hypothesis #9

A proposed new technology that is adopted will likely have more economic justification than the one which is not adopted.

Statements Used:

28. This new technology met the economic justification criteria of our firm.

Statistics: One-tailed t-test for independent groups; degree of freedom; pooled variances.

(Adoption vs Non-adoption)

(T_{cal} = 9.591, df = 102, S_p^2 = 1.719)

Adoption: ($\overline{X}$ = 5.96, R = 7.00 - 3.00, S = 0.86)

Non-Adoption: ($\overline{X}$ = 3.49, R = 7.00 - 1.00, S = 1.69)

Result of the Hypothesis Test:

The hypothesis is not rejected for a test of significance level ($p < 0.005$).

Implications:

A proposed new technology which strongly meets the economic justification criteria of the firm will have a greater prospect of being adopted than a proposed new technology which has a lower degree of economic justification.

Hypothesis #10

A proposed new technology that is adopted will have a significantly higher degree of perceived benefits to the firm than the one which is not adopted.

Statements Used:

26. The management of this organization believed that the use of this new technology would benefit our firm substantially.

27. This organization considered both tangible and intangible benefits of this new technology while making implementation decisions.

Statistics: One-tailed t-test for independent groups; degree of freedom; pooled variances.

(Adoption vs Non-adoption)

(T_{cal} = 6.537, df = 102, S_p^2 = 1.057)

Adoption: ($\overline{X}$ = 5.93, R = 7.00 - 4.00, S = 0.87)

Non-Adoption: ($\overline{X}$ = 4.61, R = 7.00 - 1.50, S = 1.19)

Result of the Hypothesis Test:

The hypothesis is not rejected for a test of significance level ($p < 0.005$).

Implications:

The degree of perceived benefits of a proposed new technology to an organization is a significantly differentiating factor for the adoption or non-adoption of this new technology. It implies that the proposed new technology with higher level of perceived benefit to a firm will have a greater prospect of being adopted than a proposed new technology which has lower degree of perceived benefits.

<u>Hypothesis #11</u>

A proposed new technology that is adopted will have a significantly higher degree of ease of integration than the one which is not adopted.

Statements Used:

23. This new technology was easily integrated with the existing core technology of our firm.

24. This organization was required to make substantial changes in its operating procedures to implement this new technology.

Statistics: One-tailed t-test for independent groups; degree of freedom; pooled variances.

(Adoption vs Non-adoption)

(T_{cal} = 3.469, df = 102, S_p^2 = 1.556)

Adoption: ($\overline{X}$ = 4.66, R = 7.00 - 1.50, S = 1.14)

Non-Adoption: ($\overline{X}$ = 3.81, R = 6.50 - 1.00, S = 1.37)

Result of the Hypothesis Test:

The hypothesis is not rejected for a test of significance level ($p < 0.005$).

Implications:

A proposed new technology that is easy to integrate with a firm's existing stock of technologies will have more prospects of being adopted than the proposed new technology which is difficult to integrate. It implies that for a proposed new technology that is adopted in an organization, the degree of ease of its integration with the firm's existing stock of technologies will be significantly higher than for a proposed new technology which is not adopted.

Hypothesis #12

A proposed new technology that is adopted will be less complex than one which is not adopted.

Statements Used:

25. This new technology is relatively more complex than the existing stock of other technologies in this organization.

30. This new technology demanded drastic adjustments in the layout of existing facility and modification of existing equipment.

Statistics: One-tailed t-test for independent groups; degree of freedom; pooled variances.

(Adoption vs Non-adoption)

(T_{cal} = 1.557, df = 102, S_p^2 = 2.071)

Adoption: ($\overline{X}$ = 3.91, R = 7.00 - 2.50, S = 1.46)

Non-Adoption: ($\overline{X}$ = 3.47, R = 7.00 - 1.00, S = 1.43)

Result of the Hypothesis Test:

The hypothesis is rejected for a test of significance level ($p < 0.05$).

Implications:

The degree of complexity of a proposed new technology is not a significantly differentiating factor for the adoption or non-adoption of this technology in an organization. It implies that if a proposed new technology is relatively more complex or less complex than the existing stock of operating technologies in an organization, there will be equal opportunities for this new technology to be either adopted or not-adopted.

Hypothesis #13

The degree of safety will be significantly higher for a proposed new technology that is adopted than for one which is not adopted.

Statements Used:

15. The use of this new technology posed substantial level of health hazards and environmental problems in our firm.

Statistics: One-tailed t-test for independent groups; degree of freedom; pooled variances.

(Adoption vs Non-adoption)

(T_{cal} = 1.884, df = 102, S_p^2 = 1.825)

Adoption: ($\overline{X}$ = 6.38, R = 7.00 - 2.50, S = 1.16)

Non-Adoption: ($\overline{X}$ = 5.88, R = 7.00 - 1.00, S = 1.55)

Result of the Hypothesis Test:

The hypothesis is not rejected for a test of significance level ($p < 0.05$).

Implications:

The degree of safety will be a significant differentiating factor for the adoption or non-adoption of a proposed new technology.

Hypothesis #14

Organizational factors will be a significant differentiating predictor to the adoption or non-adoption of a proposed new technology.

Aggregate Scores:

The aggregate scores for the five measured organizational factors; CEO's advocacy, top management support and commitment, organizational objectives, technical skills, and organizational preparedness were the sum of the normalized scores of individual factors. These scores were evaluated for two independent samples of industrial organizations which had either adopted or not adopted a proposed new technology. Total possible score attainable is thirty-five.

Statistics: Two-tailed t-test for independent groups; degree of freedom; pooled variances.

(Adoption vs Non-Adoption)

(T_{cal} = 12.116, df = 102, S_p^2 = 15.399)

Adoption : ($\overline{X}$ = 28.87, R = 33.50 - 19.83, S = 3.08)

Non-Adoption: ($\overline{X}$ = 19.53, R = 30.66 - 11.16, S = 4.73)

Result of the Hypothesis Test:

The hypothesis is not rejected for a test of significance level ($p < 0.005$).

Implications:

Organizational factors will be a significant differentiating predictor to the adoption or non-adoption of a proposed new technology in an organization. A new technology which is adopted has a significantly higher degree of aggregate organizational factors than for a technology which is not adopted.

Hypothesis #15

Organization-technology factors will be a significant differentiating predictor to the adoption or non-adoption of a proposed new technology.

Aggregate Scores:

The aggregate scores for the four measured organization-technology factors; management's attitude towards new technology, operational compatibility, relatedness, and economic justification, were the sum of the normalized scores of individual factors. These scores were evaluated for each two independent groups of industrial organizations which had either adopted or not adopted a proposed new technology. Total possible score attainable is twenty-eight.

Statistics: Two-tailed t-test for independent groups; degree of freedom; pooled variances.

(Adoption vs Non-Adoption)

(T_{cal} = 11.521, df = 102, S_p^2 = 8.738)

Adoption : ($\overline{X}$ = 22.75, R = 26.91 - 17.50, S = 1.94)

Non-Adoption: ($\overline{X}$ = 17.44, R = 22.75 - 8.16, S = 3.81)

Result of the Hypothesis Test:

The hypothesis is not rejected for a test of significance level ($p < 0.005$).

Implications:

Organization-technology factors will be a significant differentiating predictor to the adoption or non-adoption of a proposed new technology in an organization. A new technology which is adopted has a significantly higher degree of aggregate organization-technology factors than for a technology which is not adopted.

<u>Hypothesis #16</u>

Technology factors will be a significantly differentiating predictor to the adoption or non-adoption of a proposed new technology.

Aggregate Scores:

The aggregate scores for the four measured technology factors; perceived benefits, ease of integration, complexity, and safety were the arithmetic sum of the normalized scores of individual factors. These scores were evaluated for each two independent groups of industrial organizations which had either adopted or not adopted a proposed new technology. Total possible score attainable is twenty-eight.

Statistics: Two-tailed t-test for independent groups; degree of freedom; pooled variances.

(Adoption vs Non-Adoption)

(T_{cal} = 5.377, df = 102, S_p^2 = 9.005)

Adoption : ($\overline{X}$ = 20.88, R = 25.00 - 12.50, S = 2.52)

Non-Adoption: ($\overline{X}$ = 17.71, R = 24.00 - 9.00, S = 3.49)

Result of the Hypothesis Test:

The hypothesis is not rejected for a test of significance level ($p < 0.005$).

Implications:

The degree of aggregate technology factors is a significant differentiating predictor to the adoption or non-adoption of a proposed new technology in an organization. A new technology which is adopted has a significantly higher degree of aggregate technology factors than for a technology which is not adopted.

Hypothesis #17

The aggregate of the decision-process factors will be a significant differentiating predictor to the adoption or non-adoption of a proposed new technology.

Aggregate Scores:

The aggregate scores for the thirteen factors measured in the three categories of organizational factors, organization-technology factors, and technology factors were evaluated by arithmetical addition of individual scores pertaining to the each statements in the Section B, and Section C of the survey instrument. The aggregate scores for each section were evaluated for independent groups of the sample industrial organizations which had adopted, or not adopted a proposed new technology. Total possible attainable score in this category of the measurement is one hundred and eighty-nine.

Statistics: Two-tailed t-test for independent groups; degree of freedom; pooled variances.

(Adoption vs Non-Adoption)

(T_{cal} = 10.613, df = 102, S_p^2 = 304.151)

Adoption : ($\overline{X}$ = 147.71, R = 173.00 - 109.00, S = 13.51)

Non-Adoption: ($\overline{X}$ = 111.35, R = 153.00 - 68.00, S = 21.15)

Result of the Hypothesis Test:

The hypothesis is not rejected for a test of significance level ($p < 0.005$).

Implications:

The degree of the aggregate of all decision-process factors is a significant differentiating predictor to the adoption or non-adoption of a proposed new technology in an organization. A proposed new technology with a higher aggregate score on organizational factors, organization-technology factors, and technology factors will have more prospects of being adopted in an industrial organization in comparison to a proposed new technology which has a lower aggregate score on these factors.

Hypotheses Relating to Adoption, Shelving and Rejection

Hypothesis #1a

The degree of a CEO's advocacy will be a significant differentiating factor for a new technology proposal to be adopted, shelved or rejected.

Statements Used:

2. The CEO of this organization directly advocated for this new technology.

4. The CEO of this organization supported the efforts to implement this new technology.

Statistics: Two-tailed t-test for independent groups; degree of freedom; pooled variances.

(Adoption vs Shelving)
(T_{cal} = 6.386, df = 83, S_p^2 = 1.773)

Adoption : ($\overline{X}$ = 5.73, R = 7.00 - 2.50, S = 1.09)

Shelving : ($\overline{X}$ = 3.80, R = 7.00 - 1.00, S = 1.71)

(Adoption vs Rejection)
(T_{cal} = 10.669, df = 72, S_p^2 = 1.270)

Adoption : ($\overline{X}$ = 5.73, R = 7.00 - 2.50, S = 1.09)

Rejection: ($\overline{X}$ = 2.53, R = 6.00 - 1.00, S = 1.26)

(Shelving vs Rejection)
(T_{cal} = 2.818, df = 47, S_p^2 = 2.362)

Shelving : ($\overline{X}$ = 3.80, R = 7.00 - 1.00, S = 1.71)

Rejection: ($\overline{X}$ = 2.53, R = 6.00 - 1.00, S = 1.26)

Result of the Hypothesis Test:

The hypothesis is not rejected for a test of significance level ($p < 0.05$).

Implications:

The CEO's advocacy is a significant differentiating factor for each three independent groups: adoption vs shelving, adoption vs rejection, and shelving vs rejection.

Hypothesis #2a

The degree of top management support and commitment will be a significant differentiating factor for a new technology proposal to be adopted, shelved or rejected.

Statements Used:

1. The top management of this organization actively supported this new technology with commitment of necessary resources.

3. The corporate planners and decision makers in this company clearly communicated their willingness to adopt this new technology.

Statistics: Two-tailed t-test for independent groups; degree of freedom; pooled variances.

(Adoption vs Shelving)
(T_{cal} = 8.034, df = 83, S_p^2 = 1.155)

Adoption : ($\overline{X}$ = 5.79, R = 7.00 - 2.00, S = 0.88)

Shelving : ($\overline{X}$ = 3.83, R = 6.50 - 1.00, S = 1.38)

(Adoption vs Rejection)
(T_{cal} = 9.717, df = 72, S_p^2 = 1.098)

Adoption : ($\overline{X}$ = 5.79, R = 7.00 - 2.00, S = 0.88)

Rejection: ($\overline{X}$ = 3.08, R = 6.50 - 1.00, S = 1.46)

(Shelving vs Rejection)
(T_{cal} = 1.832, df = 47, S_p^2 = 1.949)

Shelving : ($\overline{X}$ = 3.83, R = 6.50 - 1.00, S = 1.38)

Rejection: ($\overline{X}$ = 3.08, R = 6.50 - 1.00, S = 1.46)

Result of the Hypothesis Test:

The hypothesis is rejected for a test of significance level ($p < 0.05$).

Implications:

The degree of management support and commitment will be a significantly differentiating factor between adoption vs shelving, and adoption vs rejection. However, the same factor will not play a significant differentiating role between the shelving and rejection of a proposed new technology.

Hypothesis #3a

The degree of fit between a proposed new technology and organizational objectives will be a significant differentiating factor for this new technology to be adopted, shelved or rejected.

Statements Used:

5. This organization believes that use of this new technology would provide our firm a competitive advantage in long run.

6. The top management is willing to use this new technology as means of achieving our corporate objectives.

7. This organization believes that this new technology fits within the scope of our company's technology strategy.

Statistics: Two-tailed t-test for independent groups; degree of freedom; pooled variances.

(Adoption vs Shelving)
(T_{cal} = 6.524, df = 83, S_p^2 = 0.795)

Adoption : ($\overline{X}$ = 6.28, R = 7.00 - 3.33, S = 0.63)

Shelving : ($\overline{X}$ = 4.96, R = 6.66 - 2.00, S = 1.25)

(Adoption vs Rejection)
(T_{cal} = 10.285, df = 72, S_p^2 = 0.841)

Adoption : ($\bar{X}$ = 6.28, R = 7.00 - 3.33, S = 0.63)

Rejection: ($\bar{X}$ = 3.77, R = 6.00 - 2.00, S = 1.49)

(Shelving vs Rejection)
(T_{cal} = 3.045, df = 47, S_p^2 = 1.776)

Shelving : ($\bar{X}$ = 4.96, R = 6.66 - 2.00, S = 1.25)

Rejection: ($\bar{X}$ = 3.77, R = 6.00 - 2.00, S = 1.49)

Result of the Hypothesis Test:

The hypothesis is not rejected for a test of significance level ($p < 0.05$).

Implications:

The degree of fit between a proposed new technology and organizational objectives is a significant differentiating factor for all the three independent groups: adoption vs shelving, adoption vs shelving, and shelving vs rejection.

Hypothesis #4a

The degree of technical skills will be a significant differentiating factor for a new technology proposal to be adopted, shelved or rejected.

Statements Used:

8. This organization has technical skills required to successfully implement this new technology.

9. This organization has a training program to match the technical skills of its workforce to utilize this new technology.

Statistics: Two-tailed t-test for independent groups; degree of freedom; pooled variances.

(Adoption vs Shelving)
(T_{cal} = 4.754, df = 83, S_p^2 = 1.321)

Adoption : ($\bar{X}$ = 5.61, R = 7.00 - 2.50, S = 1.03)

Shelving : ($\bar{X}$ = 4.38, R = 6.50 - 1.00, S = 1.36)

(Adoption vs Rejection)
(T_{cal} = 2.246, df = 72, S_p^2 = 1.303)

Adoption : ($\overline{X}$ = 5.61, R = 7.00 - 2.50, S = 1.03)

Rejection: ($\overline{X}$ = 4.32, R = 6.00 - 1.00, S = 1.45)

(Shelving vs Rejection)
(T_{cal} = 0.148, df = 47, S_p^2 = 1.906)

Shelving : ($\overline{X}$ = 4.38, R = 6.50 - 1.00, S = 1.36)

Rejection: ($\overline{X}$ = 4.32, R = 6.00 - 1.00, S = 1.45)

Result of the Hypothesis Test:

The hypothesis is rejected for a test of significance level ($p < 0.05$).

Implications:

The degree of technical skills will be a significantly differentiating factor between adoption vs shelving, and adoption vs rejection. However, the same factor will not play a significant differentiating role between the shelving and rejection of a proposed new technology.

Hypothesis #5a

The degree of organizational preparedness will be a significant differentiating factor for a new technology proposal to be adopted, shelved or rejected.

Statements Used:

10. This organization has rewards systems to motivate its employees in learning new skills to implement this new technology.

12. The management of this organization perceived strong employee resistance to the use of this new technology.

Statistics: Two-tailed t-test for independent groups; degree of freedom; pooled variances.

(Adoption vs Shelving)
(T_{cal} = 7.711, df = 83, S_p^2 = 0.878)

Adoption : ($\overline{X}$ = 5.57, R = 7.00 - 3.00, S = 0.86)

Shelving : ($\overline{X}$ = 3.93, R = 6.00 - 2.50, S = 1.08)

(Adoption vs Rejection)
(T_{cal} = 7.6019, df = 72, S_p^2 = 0.873)

Adoption : ($\bar{X}$ = 5.57, R = 7.00 - 3.00, S = 0.86)

Rejection: ($\bar{X}$ = 3.68, R = 6.00 - 1.00, S = 1.15)

(Shelving vs Rejection)
(T_{cal} = 0.778, df = 47, S_p^2 = 1.201)

Shelving : ($\bar{X}$ = 3.93, R = 6.00 - 2.50, S = 1.08)

Rejection: ($\bar{X}$ = 3.68, R = 6.00 - 1.00, S = 1.15)

Result of the Hypothesis Test:

The hypothesis is rejected for a test of significance level ($p < 0.05$).

Implications:

The degree of organizational preparedness will be a significantly differentiating factor between adoption vs shelving, and adoption vs rejection. However, the same factor will not play a significant differentiating role between the shelving and rejection of a proposed new technology.

Hypothesis #6a

The degree of management's positive attitude towards a proposed new technology will be a significant differentiating factor for this technology to be adopted, shelved or rejected.

Statements Used:

13. The management of this organization has a positive attitude towards this new technology.

14. The decision makers in this organization agreed fully to the merits of this new technology.

Statistics: Two-tailed t-test for independent groups; degree of freedom; pooled variances.

(Adoption vs Shelving)
(T_{cal} = 5.729, df = 83, S_p^2 = 0.999)

Adoption : ($\bar{X}$ = 5.93, R = 7.00 - 4.00, S = 0.64)

Shelving : ($\bar{X}$ = 4.63, R = 7.00 - 1.50, S = 1.46)

(Adoption vs Rejection)
(T_{cal} = 12.114, df = 72, S_p^2 = 0.843)

Adoption : ($\overline{X}$ = 5.93, R = 7.00 - 4.00, S = 0.64)

Rejection: ($\overline{X}$ = 2.97, R = 5.50 - 1.50, S = 1.48)

(Shelving vs Rejection)
(T_{cal} = 3.898, df = 47, S_p^2 = 2.109)

Shelving : ($\overline{X}$ = 4.63, R = 7.00 - 1.50, S = 1.46)

Rejection: ($\overline{X}$ = 2.97, R = 5.50 - 1.50, S = 1.48)

Result of the Hypothesis Test:

The hypothesis is not rejected for a test of significance level ($p < 0.05$).

Implications:

The degree of management's positive attitude towards a proposed new technology is a significant differentiating factor for each three independent groups: adoption vs shelving, adoption vs rejection, and shelving vs rejection.

Hypothesis #7a

The degree of operational compatibility of a proposed new technology will be a significant differentiating factor for this technology to be adopted, shelved or rejected.

Statements Used:

16. The adoption of this new technology did not impact drastically the company's relationships with its primary customers.

17. This organization was required to change much of its management control systems to implement this new technology.

18. This new technology was compatible with our firm's existing mode of operations.

19. This organization was required to replace or dislocate its workforce in order to implement this new technology.

Statistics: Two-tailed t-test for independent groups; degree of freedom; pooled variances.

(Adoption vs Shelving)
(T_{cal} = 3.742, df = 83, S_p^2 = 0.641)

Adoption : ($\bar{X}$ = 5.33, R = 6.75 - 3.50, S = 0.73)

Shelving : ($\bar{X}$ = 4.65, R = 6.50 - 3.00, S = 0.93)

(Adoption vs Rejection)
(T_{cal} = 5.596, df = 72, S_p^2 = 0.786)

Adoption : ($\bar{X}$ = 5.33, R = 6.75 - 3.50, S = 0.73)

Rejection: ($\bar{X}$ = 4.01, R = 6.25 - 2.00, S = 1.26)

(Shelving vs Rejection)
(T_{cal} = 2.064, df = 47, S_p^2 = 1.118)

Shelving : ($\bar{X}$ = 4.65, R = 6.50 - 3.00, S = 0.93)

Rejection: ($\bar{X}$ = 4.01, R = 6.25 - 2.00, S = 1.26)

Result of the Hypothesis Test:

The hypothesis is not rejected for a test of significance level ($p < 0.05$).

Implications:

The degree of operational compatibility of a proposed new technology is a significant differentiating factor for each of the three independent groups: adoption vs shelving, adoption vs rejection, and shelving vs rejection.

Hypothesis #8a

The degree of relatedness of a proposed new technology to the existing technological and business operations of a firm will be a significant differentiating factor for this technology to be adopted, shelved or rejected.

Statements Used:

20. This new technology is strategically important to the day-to-day operations of this organization.

21. This new technology has a strong fit with our firm's existing core technology.

22. The implementation of this new technology required major changes in the social and technical structure of this organization.

Statistics: Two-tailed t-test for independent groups; degree of freedom; pooled variances.

(Adoption vs Shelving)
(T_{cal} = 5.258, df = 83, S_p^2 = 0.688)

Adoption : ($\overline{X}$ = 5.53, R = 6.66 - 4.00, S = 0.63)

Shelving : ($\overline{X}$ = 4.54, R = 6.33 - 1.75, S = 1.12)

(Adoption vs Rejection)
(T_{cal} = 8.574, df = 72, S_p^2 = 0.679)

Adoption : ($\overline{X}$ = 5.53, R = 6.66 - 4.00, S = 0.63)

Rejection: ($\overline{X}$ = 3.65, R = 6.00 - 1.66, S = 1.25)

(Shelving vs Rejection)
(T_{cal} = 2.618, df = 47, S_p^2 = 1.344)

Shelving : ($\overline{X}$ = 4.54, R = 6.33 - 1.75, S = 1.12)

Rejection: ($\overline{X}$ = 3.65, R = 6.00 - 1.66, S = 1.25)

Result of the Hypothesis Test:

The hypothesis is not rejected for a test of significance level ($p < 0.01$).

Implications:

The degree of relatedness of a proposed new technology to existing technological and business operations of a firm will be a significant differentiating factor for each of the three independent groups: adoption vs shelving, adoption vs rejection, and shelving vs rejection.

<u>Hypothesis #9a</u>

The degree of economic justification will be a significant differentiating factor for a proposed new technology to be adopted, shelved or rejected.

Statements Used:

28. This new technology met the economic justification criteria of our firm.

Statistics: Two-tailed t-test for independent groups; degree of freedom; pooled variances.

(Adoption vs Shelving)
(T_{cal} = 8.163, df = 83, S_p^2 = 1.582)

Adoption : ($\bar{X}$ = 5.96, R = 7.00 - 3.00, S = 0.86)

Shelving : ($\bar{X}$ = 3.63, R = 7.00 - 1.00, S = 1.79)

(Adoption vs Rejection)
(T_{cal} = 9.473, df = 72, S_p^2 = 1.147)

Adoption : ($\bar{X}$ = 5.96, R = 7.00 - 3.00, S = 0.86)

Rejection: ($\bar{X}$ = 3.26, R = 6.00 - 1.00, S = 1.56)

(Shelving vs Rejection)
(T_{cal} = 0.748, df = 47, S_p^2 = 2.848)

Shelving : ($\bar{X}$ = 3.63, R = 7.00 - 1.00, S = 1.79)

Rejection: ($\bar{X}$ = 3.26, R = 6.00 - 1.00, S = 1.56)

Result of the Hypothesis Test:

The null hypothesis is rejected for a test of significance level ($p < 0.05$).

Implications:

The degree of economic justification will be a significant differentiating factor between adoption vs shelving, and adoption vs rejection. However, the same factor will not play a significant differentiating role between the shelving and rejection of a proposed new technology.

Hypothesis #10a

The degree of perceived benefits will be a significant differentiating factor for a proposed new technology to be adopted, shelved or rejected.

Statements Used:

26. The management of this organization believed that the use of this new technology would benefit our firm substantially.

27. This organization considered both tangible and intangible benefits of this new technology while making implementation decisions.

Statistics: Two-tailed t-test for independent groups; degree of freedom; pooled variances.

(Adoption vs Shelving)
(T_{cal} = 5.866, df = 83, S_p^2 = 1.043)

Adoption : ($\overline{X}$ = 5.93, R = 7.00 - 4.00, S = 0.87)

Shelving : ($\overline{X}$ = 4.57, R = 7.00 - 1.50, S = 1.27)

(Adoption vs Rejection)
(T_{cal} = 5.186, df = 72, S_p^2 = 0.848)

Adoption : ($\overline{X}$ = 5.93, R = 7.00 - 4.00, S = 0.87)

Rejection: ($\overline{X}$ = 4.66, R = 7.00 - 2.00, S = 1.08)

(Shelving vs Rejection)
(T_{cal} = - 0.258, df = 47, S_p^2 = 1.412)

Shelving : ($\overline{X}$ = 4.57, R = 7.00 - 1.50, S = 1.27)

Rejection: ($\overline{X}$ = 4.66, R = 7.00 - 2.00, S = 1.08)

Result of the Hypothesis Test:

The hypothesis is rejected for a test of significance level ($p < 0.05$).

Implications:

The degree of perceived benefits will be a significant differentiating factor between adoption vs shelving, and adoption vs rejection. However, the same factor will not play a significant differentiating role between the shelving and rejection of a proposed new technology.

<u>Hypothesis #11a</u>

The degree of the ease of integration will be a significant differentiating factor for a proposed new technology to be adopted, shelved or rejected.

Statements Used:

23. This new technology was easily integrated with the existing core technology of our firm.

24. This organization was required to make substantial changes in its operating procedures to implement this new technology.

Statistics: Two-tailed t-test for independent groups; degree of freedom; pooled variances.

(Adoption vs Shelving)
(T_{cal} = 2.480, df = 83, S_p^2 = 1.502)

Adoption : ($\bar{X}$ = 4.66, R = 7.00 - 1.50, S = 1.14)

Shelving : ($\bar{X}$ = 3.97, R = 6.50 - 1.00, S = 1.39)

(Adoption vs Rejection)
(T_{cal} = 3.5379, df = 72, S_p^2 = 1.391)

Adoption : ($\bar{X}$ = 4.66, R = 7.00 - 1.50, S = 1.14)

Rejection: ($\bar{X}$ = 3.55, R = 6.50 - 2.00, S = 1.32)

(Shelving vs Rejection)
(T_{cal} = 1.062, df = 47, S_p^2 = 1.821)

Shelving : ($\bar{X}$ = 3.97, R = 6.50 - 1.00, S = 1.39)

Rejection: ($\bar{X}$ = 3.55, R = 6.50 - 2.00, S = 1.32)

Result of the Hypothesis Test:

The hypothesis is rejected for a test of significance level ($p < 0.05$).

Implications:

The degree of ease of integration will be a significant differentiating factor between adoption vs shelving, and adoption vs rejection. However, the same factor will not play a significant differentiating role between the shelving and rejection of a proposed new technology. The results imply that a proposed new technology that has a significantly higher degree of ease of integration with the existing stock of a firm's technologies will have more prospects of being adopted than the proposed new technology which is either shelved or rejected in an organization.

<u>Hypothesis #12a</u>

The degree of complexity will be a significant differentiating factor for a proposed new technology to be adopted, shelved or rejected.

Statements Used:

25. This new technology is relatively more complex than the existing stock of other

technologies in this organization.

30. This new technology demanded drastic adjustments in the layout of existing facility and modification of existing equipment.

Statistics: Two-tailed t-test for independent groups; degree of freedom; pooled variances.

(Adoption vs Shelving)
(T_{cal} = 1.887, df = 83, S_p^2 = 2.028)

Adoption : ($\bar{X}$ = 3.91, R = 7.00 - 1.00, S = 1.46)

Shelving : ($\bar{X}$ = 3.30, R = 6.50 - 1.00, S = 1.38)

(Adoption vs Rejection)
(T_{cal} = 0.437, df = 72, S_p^2 = 2.139)

Adoption : ($\bar{X}$ = 3.91, R = 7.00 - 1.00, S = 1.46)

Rejection: ($\bar{X}$ = 3.74, R = 6.50 - 1.50, S = 1.51)

(Shelving vs Rejection)
(T_{cal} = -1.03, df = 47, S_p^2 = 2.006)

Shelving : ($\bar{X}$ = 3.30, R = 6.50 - 1.00, S = 1.38)

Rejection: ($\bar{X}$ = 3.74, R = 6.50 - 1.50, S = 1.51)

Result of the Hypothesis Test:

The hypothesis is rejected for a test of significance level ($p < 0.05$).

Implications:

The degree of complexity of a proposed new technology will not be a significant differentiating factor for the adoption, shelving or rejection of this specific new technology in an industrial organization.

Hypothesis #13a

The degree of safety will be a significant differentiating factor for a proposed new technology to be adopted, shelved or rejected.

Statements Used:

15. The use of this new technology posed substantial level of health hazards and environmental problems in our firm.

Statistics: Two-tailed t-test for independent groups; degree of freedom; pooled variances.

(Adoption vs Shelving)
(T_{cal} = 0.972, df = 83, S_p^2 = 1.611)

Adoption : ($\bar{X}$ = 6.38, R = 7.00 - 1.00, S = 1.16)

Shelving : ($\bar{X}$ = 6.10, R = 7.00 - 1.00, S = 1.47)

(Adoption vs Rejection)
(T_{cal} = 2.480, df = 72, S_p^2 = 1.659)

Adoption : ($\bar{X}$ = 6.38, R = 7.00 - 1.00, S = 1.16)

Rejection: ($\bar{X}$ = 5.53, R = 7.00 - 2.00, S = 1.64)

(Shelving vs Rejection)
(T_{cal} = 1.278, df = 47, S_p^2 = 2.314)

Shelving : ($\bar{X}$ = 6.10, R = 7.00 - 1.00, S = 1.47)

Rejection: ($\bar{X}$ = 5.53, R = 7.00 - 2.00, S = 1.64)

Result of the Hypothesis Test:

The hypothesis is rejected for a test of significance level ($p < 0.05$).

Implications:

The degree of safety will be a significant differentiating factor between the adoption and rejection of a proposed new technology. However, safety will not play a significant differentiating role between adoption vs shelving, and shelving vs rejection.

Hypothesis #14a

Organizational factors will be a significant differentiating predictor to the adoption, shelving or rejection of a proposed new technology.

Aggregate Scores:

The aggregate scores for the five measured organizational factors; CEO's advocacy, top management support and commitment, organizational objectives, technical skills, and organizational preparedness were the sum of the normalized scores of individual factors. The aggregate scores for organizational factors were evaluated for independent groups of the sample industrial organizations which had adopted, shelved or rejected a proposed new technology. Total possible attainable score in this category of the measure is thirty-five.

Statistics: Two-tailed t-test for independent groups; degree of freedom; pooled variances.

(Adoption vs Shelving)
(T_{cal} = 9.534, df = 83, S_p^2 = 13.531)

Adoption : ($\overline{X}$ = 28.87, R = 33.50 - 19.83, S = 3.08)

Shelving : ($\overline{X}$ = 20.91 R = 30.66 - 13.00, S = 4.64)

(Adoption vs Rejection)
(T_{cal} = 12.982, df = 72, S_p^2 = 11.082)

Adoption : ($\overline{X}$ = 28.87, R = 33.50 - 19.83, S = 3.08)

Rejection: ($\overline{X}$ = 17.37, R = 26.66 - 11.66, S = 4.06)

(Shelving vs Rejection)
(T_{cal} = 2.756, df = 47, S_p^2 = 19.189)

Shelving : ($\overline{X}$ = 20.91, R = 30.66 - 13.00, S = 4.64)

Rejection: ($\overline{X}$ = 17.37, R = 26.66 - 11.66, S = 4.06)

Result of the Hypothesis Test:

The hypothesis is not rejected for a test of significance level ($p < 0.05$).

Implications:

The degree of aggregate organizational factors is a significant differentiating predictor to the adoption, shelving, or rejection of a proposed new technology in an organization.

Hypothesis #15a

Organization-technology factors will be a significant differentiating predictor to the adoption, shelving or rejection of a proposed new technology.

Aggregate Scores:

The aggregate scores for the four measured organization-technology factors; management's attitude towards new technology, operational compatibility, relatedness, and economic justification were the sum of the normalized scores of individual factors. The scores were evaluated for the independent samples of adoption, shelving, and rejection groups. Total possible score attainable is twenty-eight.

Statistics: Two-tailed t-test for independent groups; degree of freedom; pooled variances.

(Adoption vs Shelving)
(T_{cal} = 9.841, df = 83, S_p^2 = 5.652)

Adoption : ($\bar{X}$ = 22.75, R = 26.91 - 17.50, S = 1.94)

Shelving : ($\bar{X}$ = 17.44, R = 22.75 - 10.83, S = 3.06)

(Adoption vs Rejection)
(T_{cal} = 12.929, df = 72, S_p^2 = 6.631)

Adoption : ($\bar{X}$ = 6.38, R = 26.91 - 17.50, S = 1.94)

Rejection: ($\bar{X}$ = 13.83, R = 20.91 - 8.16, S = 3.95)

(Shelving vs Rejection)
(T_{cal} = 3.569 df = 47, S_p^2 = 11.508)

Shelving : ($\bar{X}$ = 17.44, R = 22.75 - 10.83, S = 3.06)

Rejection: ($\bar{X}$ = 13.89, R = 20.91 - 8.16, S = 3.95)

Result of the Hypothesis Test:

The hypothesis is not rejected for a test of significance level ($p < 0.05$).

Implications:

The degree of aggregate organizational-technology factors is a significant differentiating predictor to the adoption, shelving, or rejection of a proposed new technology in an organization.

Hypothesis #16a

Technology factors will be a significant differentiating predictor to the adoption, shelving or rejection of a proposed new technology.

Aggregate Scores:

The aggregate scores for the four measured technology factors; perceived benefits, ease of integration, complexity, and safety were the arithmetic sum of the normalized scores of individual factors. These scores were evaluated for each two independent groups of industrial organizations which had adopted, shelved or rejected a proposed new technology. Total possible score attainable is twenty-eight.

Statistics: Two-tailed t-test for independent groups; degree of freedom; pooled variances.

(Adoption vs Shelving)
(T_{cal} = 4.593, df = 83, S_p^2 = 8.336)

Adoption : ($\overline{X}$ = 20.88, R = 25.00 - 12.50, S = 2.52)

Shelving : ($\overline{X}$ = 17.87, R = 24.00 - 9.00 S = 3.51)

(Adoption vs Rejection)
(T_{cal} = 4.582, df = 72, S_p^2 = 7.823)

Adoption : ($\overline{X}$ = 20.88, R = 25.00 - 12.50, S = 1.16)

Rejection: ($\overline{X}$ = 17.47, R = 25.50 - 11.50, S = 3.56)

(Shelving vs Rejection)
(T_{cal} = 0.391, df = 47, S_p^2 = 12.196)

Shelving : ($\overline{X}$ = 17.87, R = 24.00 - 9.00, S = 3.51)

Rejection: ($\overline{X}$ = 17.47, R = 25.50 - 11.50, S = 3.56)

Result of the Hypothesis Test:

The hypothesis is rejected for a test of significance level ($p < 0.05$).

Implications:

The aggregate of technology factors is a significant differentiating predictor to adoption vs shelving, and adoption vs rejection. However the aggregate of technology factors do not play a differentiating role between the shelving and rejection of a new technology proposal.

Hypothesis #17a

The aggregate of decision-process factors will be a significant differentiating predictor to the adoption, shelving or rejection of a proposed new technology.

Aggregate scores:

The aggregate scores for the thirteen factors measured in the three categories of organizational factors, organization-technology factors, and technology factors were evaluated by arithmetical addition of individual scores pertaining to the each statement in Section B, and Section C of the survey instrument. The aggregate scores for each section were evaluated for independent groups of the sample industrial organizations which had adopted, shelved or rejected a proposed new technology. Total possible attainable score in this category of the measurement is one hundred and eighty-nine.

Statistics: Two-tailed t-test for independent groups; degree of freedom; pooled variances.

(Adoption vs Shelving)
(T_{cal}= 8.669, df = 83, S_p^2 = 231.064)

Adoption : (X = 147.71, R = 173.00 - 109.00, S = 13.51)

Shelving : ($\bar{X}$ = 117.80, R = 153.00 - 82.00, S = 18.15)

(Adoption vs Rejection)
(T_{cal} = 10.976, df = 72, S_p^2 = 254.032)

Adoption : ($\bar{X}$ = 147.71, R = 173.00 - 109.00, S = 13.51)

Rejection: ($\bar{X}$ = 101.16, R = 137.00 - 68.00 S = 21.97)

(Shelving vs Rejection)
(T_{cal} = 2.911, df = 47, S_p^2 = 380.031)

Shelving : ($\bar{X}$ = 117.80, R = 153.00 - 82.00, S = 18.15)

Rejection: ($\bar{X}$ = 101.16, R = 137.00 - 68.00 S = 21.97)

Result of the Hypothesis Test:

The hypothesis is not rejected for a test of significance level ($p < 0.05$).

Implications:

The degree of the aggregate of decision-process factors is a significant differentiating predictor to the adoption, shelving or rejection of a proposed new technology in an organization. The statistically significant results imply that a proposed new technology with an aggregate higher level of organizational factors, organization-technology factors, and technology factors will have more prospect of being adopted in an organization in comparison to a proposed new technology with an aggregate lower level of these factors. The results indicate that as an aggregate impact of these factors the decision response of an industrial organization to either adopt, shelve or reject a proposed new technology may be predicted.

Summary of the Analysis of Data

The summary of the analyses of data for the stated hypotheses of this study is presented in Table XXVII through Table XXX. The relevant data and the level of significance of test for each factor and predictor addressed in the individual hypotheses is shown in terms of each two independent groups, that involves: adoption vs non-adoption, adoption vs shelving, adoption vs rejection, and shelving vs rejection.

TABLE XXVII

DESCRIPTIVE STATISTICS AND TEST RESULTS
ADOPTION VS NON-ADOPTION

Decision-Process Predictors	N=55 Adoption Means	s.d	N=49 Non-adoption Mean	s.d	df=102 T_{cal}
ORGANIZATIONAL FACTORS	28.87	3.08	19.53	4.73	12.12***
CEO's Advocacy	5.73	1.09	3.24	1.65	9.22***
Top Management Support	5.79	.88	3.54	1.45	9.73***
Organizational Objectives	6.28	.63	4.50	1.46	8.27***
Technical Skills	5.61	1.03	4.36	1.37	5.32***
Organizational Preparedness	5.57	.86	3.84	1.10	9.03***
ORGANIZATION-TECHNOLOGY FACTORS	22.75	1.94	16.06	3.81	11.52***
Attitude towards Technology	5.93	.64	3.99	1.66	8.07***
Operational Compatibility	5.33	.73	4.40	1.10	5.16***
Relatedness	5.53	.63	4.19	1.24	7.09***
Economic Justification	5.96	.86	3.49	1.69	9.59***
TECHNOLOGY FACTORS	20.88	2.52	17.71	3.49	5.38***
Perceived Benefits	5.93	.87	4.61	1.19	6.54***
Ease of Integration	4.66	1.14	3.81	1.37	3.47***
Complexity	3.91	1.46	3.47	1.43	1.56
Safety	6.38	1.16	5.88	1.55	1.88*
Total Score	147.71	13.51	111.35	21.15	10.61***

*** $p < .005$
** $p < .01$
* $p < .05$

TABLE XXVIII

DESCRIPTIVE STATISTICS AND TEST RESULTS
ADOPTION VS SHELVING

Decision-process Predictors	N=55 Adoption Mean	s.d	N=30 Shelving Mean	s.d	df=83 T_{cal}
ORGANIZATIONAL FACTORS	28.87	3.08	20.91	4.64	9.53***
CEO's Advocacy	5.73	1.09	3.80	1.71	6.39***
Top Management Support	5.79	.88	3.83	1.38	8.03***
Organizational Objectives	6.28	.63	4.96	1.25	6.52***
Technical Skills	5.61	1.03	4.38	1.36	4.75***
Organizational Preparedness	5.57	.86	3.93	1.08	7.71***
ORGANIZATION-TECHNOLOGY FACTORS	22.75	1.94	17.44	3.06	9.84***
Attitude towards Technology	5.93	.64	4.63	1.46	5.73***
Operational Compatibility	5.33	.73	4.65	.93	3.74***
Relatedness	5.53	.63	4.54	1.12	5.26***
Economic Justification	5.96	.86	3.63	1.79	8.16***
TECHNOLOGY FACTORS	20.88	2.52	17.87	3.51	4.59***
Perceived Benefits	5.93	.87	4.57	1.27	5.87***
Ease of Integration	4.66	1.14	3.97	1.39	2.48*
Complexity	3.91	1.46	3.30	1.38	1.89
Safety	6.38	1.16	6.10	1.47	.97
Total Score	147.71	13.51	117.80	18.15	8.67***

*** $p < .005$
** $p < .01$
* $p < .05$

TABLE XXIX

DESCRIPTIVE STATISTICS AND TEST RESULTS
ADOPTION VS REJECTION

Decision-process Predictors	N=55 Adoption Mean	s.d	N=19 Rejection Mean	s.d	df=72 T_{cal}
ORGANIZATIONAL FACTORS	28.87	3.08	17.37	4.06	12.98***
CEO's Advocacy	5.73	1.09	2.53	1.26	10.67***
Top Management Support	5.79	.88	3.08	1.46	9.72***
Organizational Objectives	6.28	.63	3.77	1.49	10.29***
Technical Skills	5.61	1.03	4.32	1.45	4.25***
Organizational Preparedness	5.57	.86	3.68	1.15	7.60***
ORGANIZATION-TECHNOLOGY FACTORS	22.75	1.94	13.89	3.95	12.93***
Attitude towards Technology	5.93	.64	2.97	1.48	12.11***
Operational Compatibility	5.33	.73	4.01	1.26	5.59***
Relatedness	5.53	.63	3.65	1.25	8.57***
Economic Justification	5.96	.86	3.26	1.56	9.47***
TECHNOLOGY FACTORS	20.88	2.52	17.47	3.56	4.58***
Perceived Benefits	5.93	.87	4.66	1.08	5.18***
Ease of Integration	4.66	1.14	3.55	1.32	3.54***
Complexity	3.91	1.46	3.74	1.51	.44
Safety	6.38	1.16	5.53	1.64	2.48*
Total Score	147.71	13.51	101.16	21.97	10.98***

*** $p < .005$
** $p < .01$
* $p < .05$

TABLE XXX

DESCRIPTIVE STATISTICS AND TEST RESULTS
SHELVING VS REJECTION

Decision-process Predictors	N=30 Shelving Mean	s.d	N=19 Rejection Mean	s.d	df=47 T_{cal}
ORGANIZATIONAL FACTORS	20.91	4.64	17.37	4.06	2.76**
CEO's Advocacy	3.80	1.71	2.53	1.26	2.82**
Top Management Support	3.83	1.38	3.08	1.46	1.83
Organizational Objectives	4.96	1.25	3.77	1.49	3.05**
Technical Skills	4.38	1.36	4.32	1.45	.15
Organizational Preparedness	3.93	1.08	3.68	1.15	.78
ORGANIZATION-TECHNOLOGY FACTORS	17.44	3.06	13.89	3.95	3.57***
Attitude towards Technology	4.63	1.46	2.97	1.48	3.89***
Operational Compatibility	4.65	.93	4.01	1.26	2.06*
Relatedness	4.54	1.12	3.65	1.25	2.62*
Economic Justification	3.63	1.79	3.26	1.56	.75
TECHNOLOGY FACTORS	17.87	3.51	17.47	3.56	.39
Perceived Benefits	4.57	1.27	4.66	1.08	-.26
Ease of Integration	3.97	1.39	3.55	1.32	1.06
Complexity	3.30	1.38	3.74	1.51	-1.03
Safety	6.10	1.47	5.53	1.64	1.28
Total Score	117.80	18.15	101.16	21.97	2.91**

*** $p < .005$
** $p < .01$
* $p < .05$

CHAPTER VI

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The purpose of this study was to identify and evaluate the critical factors which predominantly impact the technological decision processes in organizations culminating in the adoption, shelving, and rejection of proposed new technologies. A thorough review of the related literature was conducted to ascertain factors that have been identified as important factors affecting the technological decision processes in organizations. Thirteen factors were identified as prominent individual factors influencing the technological decision process in an organization. In order to guide the empirical research effort to this study a theoretical and practical framework was developed based on the support of the current literature and the findings of related studies. The framework became the basis for the development of the hypotheses for this study.

Two basic dimensions of an organizational decision response to proposed new technologies were identified, i.e., adoption, and non-adoption. The non-adoption of a proposed new technology was further distinguished into two decision outcomes, i.e., shelving and rejection.

Information obtained during the literature review was also used to develop a questionnaire. The questionnaire was designed to collect quantifiable data from the participants to evaluate the importance of the specified factors that impact the outcome of technological decision processes in industrial organizations. Additional data in terms of the adoption, shelving, and rejection of proposed new technologies was collected to test each of the stated hypothesis of this study.

The purposive sample for this study consisted of 215 medium-to large industrial organizations across the United States. The questionnaire was addressed to the top management of the selected companies. The managers selected were assumed to be involved in the technological decision making processes of their respective companies. There were 67 returned questionnaires, of which 12 were unusable. This yielded 55 useable questionnaires or a 25.6 percent response rate.

The data collected had indicated a total of 104 proposed new technologies that had been adopted, shelved, or rejected in the sample organizations across the United States. These new technologies were grouped into six general categories such as: manufacturing technologies, information technologies, product technologies, process technologies, operations technologies, and energy cost reduction technologies. A seventh area comprising of those new technologies specific to a particular organization was categorized as miscellaneous. Of the 104 representative new technologies 55 were adopted and

49 were not adopted over the last two years. Of the 49 not-adopted proposed technologies 30 were shelved and 19 technologies were rejected.

Data from the questionnaire was evaluated and statistical analysis was conducted to provide the descriptive results as well as to test the stated hypotheses for this study. Prior to testing the hypotheses an analysis was performed to ascertain the importance of the set of decision-process factors described in the literature as impacting the outcome of technological decision processes in organizations. The results for analysis found that all of the 13 factors selected for this study were important across organizations.

Thirty-four hypotheses were derived to test the relationship suggested by the theoretical framework for this study. A set of 17 hypotheses addressed the impact of factors on the adoption and non-adoption of a proposed new technology in an organization. A set of another 17 hypotheses addressed the differentiating role of these factors relating to the adoption, shelving, and rejection of a new technology proposal. The test results indicate that only one out of 17 hypotheses relating to adoption and non-adoption was rejected. However, nine of the 17 hypotheses relating to adoption, shelving, and rejection of a new technology proposal were rejected.

A summary of all the hypotheses tested, along with the test results and the decision-process factor or predictor addressed in each hypothesis, is presented in Table XXXI and Table XXXII.

TABLE XXXI

SUMMARY RESULTS OF HYPOTHESES RELATING TO ADOPTION AND NON-ADOPTION OF A NEW TECHNOLOGY

Hypothesis #	Factor Addressed	Status of Test
1	CEO's Advocacy	Failed to reject the hypothesis
2	Top Management support and commitment	Failed to reject the hypothesis
3	Organizational objectives	Failed to reject the hypothesis
4	Technical Skills	Failed to reject the hypothesis
5	Organizational preparedness	Failed to reject the hypothesis
6	Management's attitude towards technology	Failed to reject the hypothesis
7	Operational compatibility	Failed to reject the hypothesis
8	Relatedness	Failed to reject the hypothesis
9	Economic Justification	Failed to reject the hypothesis
10	Perceived Benefits	Failed to reject the hypothesis
11	Ease of Integration	Failed to reject the hypothesis
12	Complexity	Rejected the hypothesis
13	Safety	Failed to reject the hypothesis
14	Organizational Factors	Failed to reject the hypothesis

TABLE XXXI (Continued)

Hypothesis #	Factor Addressed	Status of Test
15	Organization-Technology Factors	Failed to reject the hypothesis
16	Technology Factors	Failed to reject the hypothesis
17	Aggregate of all Factors	Failed to reject the hypothesis

TABLE XXXII

SUMMARY RESULTS OF HYPOTHESES RELATING TO ADOPTION SHELVING AND REJECTION OF A NEW TECHNOLOGY

Hypothesis #	Factor Addressed	Adopt vs Shelve	Adopt vs Reject	Shelve vs Reject	Status of Test
1a	CEO's Advocacy	S	S	S	Failed to reject the hypothesis
2a	Top management support and commitment	S	S	NS	Rejected the hypothesis
3a	Organizational objectives	S	S	S	Failed to reject hypothesis
4a	Technical Skills	S	S	NS	Rejected the hypothesis
5a	Organizational preparedness	S	S	NS	Rejected the hypothesis
6a	Attitude towards technology	S	S	S	Failed to reject hypothesis

TABLE XXXII (Continued)

Hypothesis #	Factor Addressed	Adopt vs Shelve	Adopt vs Reject	Shelve vs Reject	Status of Test
7a	Operational compatibility	S	S	S	Failed to reject hypothesis
8a	Relatedness	S	S	S	Failed to reject hypothesis
9a	Economic Justification	S	S	NS	Rejected the hypothesis
10a	Perceived benefits	S	S	NS	Rejected the hypothesis
11a	Ease of Integration	S	S	NS	Rejected the hypothesis
12a	Complexity	NS	NS	NS	Rejected the hypothesis
13a	Safety	NS	S	NS	Rejected the hypothesis
14a	Organizational Factors	S	S	S	Failed to reject hypothesis
15a	Organization-technology Factors	S	S	S	Failed to reject hypothesis
16a	Technology Factors	S	S	NS	Rejected the hypothesis
17a	Aggregate of all Factors	S	S	S	Failed to reject hypothesis

S indicates statistically significant

NS indicates not statistically significant

Conclusions

The main objective of this study was to investigate the critical factors which impact the technological decision process in industrial organizations. Further efforts were focused to determine any possible commonality of factors accountable for impacting the decisions to adopt, shelve or reject a proposed new technology across organizations. The conclusions reported herein were based upon the population studied, and should be applied with caution in any attempts to generalize to other populations.

Based on the analyses of data and testing of the stated hypotheses for this study, the following conclusions were reached:

1. The respondents reported that all of the factors shown as decision-process predictors in the framework of technological decision making (figure 1) were important in impacting the outcome of technological decisions processes in their organizations. However, in an individual organization or in the case of a specific new technology, their relevant importance may differ.

2. The first major conclusion derived from this study is that the degree of the aggregate of all decision-process factors is a significant differentiating predictor to the adoption or non-adoption of a proposed new technology in an industrial organization. The results also indicate that as an aggregate impact of these factors the decision response of an industrial organization to either adopt, shelve or reject a

proposed new technology may be predicted.

3. The findings indicate that there is a discernable pattern of the decision-process factors across the spectrum of decision outcomes. Such a pattern may provide a general set of factors which predominantly impact the outcome of technological decision making in industrial organizations culminating in the adoption, shelving or rejection of a proposed new technology. The results show that 12 out of the 13 decision-process factors were found to be the significant differentiating predictors to the adoption and non-adoption of a proposed new technology. It was found that 11 out of 13 factors were statistically significant in differentiating between the adoption or shelving. The same 12 factors which differentiated between adoption and non-adoption were found also to be the significant differentiating predictors to the adoption or rejection. However, only five out of 13 factors were found to be statistically significant in differentiating the shelving or rejection of a proposed new technology in industrial organizations.

4. In terms of comparison of the independent groups of adoption vs non-adoption, adoption vs shelving, adoption vs rejection, and shelving vs rejection the study concludes the following:

Adoption vs Non-adoption. The findings indicate that a proposed new technology with higher levels of organizational factors, organization-technology factors, and technology factors will have more prospects of being adopted in comparison to the one which has lower levels of these factors. The degree of all the individual factors except complexity, was higher for the new technology which was adopted than the one which was not adopted.

Adoption vs Shelving. The degree of each organizational factor, i.e., CEO's advocacy, top management support and commitment, organizational objectives, technical skills, and organizational preparedness for a proposed new technology which is adopted is significantly higher than for one which is shelved. Similarly, the degree of each of the organization-technology factors, i.e., attitude towards technology, operational compatibility, relatedness, and economic justification for a proposed new technology which is adopted is significantly higher than for the one which is shelved. However, among the technology factors only perceived benefits and ease of integration have a higher value for a new technology which is adopted than for one which is shelved. Complexity, and safety are not significant in differentiating between a new technology which is adopted and one which is shelved.

Adoption vs Rejection. Each decision-process factor, except complexity, has a significantly higher degree for a proposed new technology which is adopted than the one which is rejected. The findings indicate that except for complexity all 12 other factors are statistically significant predictors to the adoption and rejection of a new technology proposal.

Shelving vs Rejection. The results show that only five decision-process factors were statistically significant in differentiating a proposed new technology which was shelved compared to the one which was rejected. These five factors include: CEO's advocacy, organizational objectives, management's attitude towards technology, operational compatibility, and relatedness. Among the organizational factors the top management support and commitment, technical skills, and organizational preparedness are not significant differentiating predictors between the shelving and rejection. Similarly, among the organization-technology factors the economic justification is not a statistically significant predictor among shelving and rejection. However, none of the technology factors play any differentiating role between the new technology which is either shelved or rejected.

5. On the basis of the 55 adopted new technologies across the respondent organizations the results indicated that about seventy-six percent of organizations incrementally implement an approved new technology. These findings support the contention of a majority of the implementation researchers that incremental implementation of a new technology is the most used mode of adoption in an organization.

Recommendations for Practice

The recommendations proposed for practice are based on the findings and conclusions of this study. The empirical evidence arrived at in this study attempted to identify the critical factors that explain why organizations adopt, shelve or reject proposed new technologies. It is recommended that those industrial organizations planning to incorporate new technologies in their operations should give due attention to the critical factors outlined in this study.

It is expected that the findings of this study will serve as useful input to the followings individuals:

1. To top management in an organization, this study provides a better understanding of the factors of importance in decision process when new technologies are proposed.

2. To managers and technology decision-makers, they should monitor carefully the impact of those decision-process factors which predominantly facilitate the adoption of a proposed new technology. To successfully adopt a new technology the factors of importance to managers and decision-makers involve: CEO's advocacy, top management support and commitment, availability of technical skills, organizational preparedness, operational compatibility, and relatedness.

3. To project initiators in an organization, this study aids in determining the priorities on the set of activities that need to be undertaken in order to successfully adopt the proposed new technologies. The factors of importance include: organizational objectives, management's attitude towards technology, perceived benefits, and economic justification of the proposed new technology.

4. To the technical staff of an organization, while

considering the adoption of a new technology, they should focus on the factors of their interest, which involve: technical skills, operational compatibility, ease of integration, complexity, and safety.

5. To proposers of new technologies, both a firm's internal staff as well as an organization's external agents such as consultants or vendors, the findings in this study provide information on the critical factors that can either facilitate or hinder the adoption of a new technology proposal in an organization. They should give due considerations to all the decision-process factors outlined in this study while proposing a new technology for adoption.

Recommendations for Future Research

This study suggests that further empirical work in the area of technological decision making may be fruitful both to researchers in the discipline of organizational decision making as well as decision-makers in industrial organizations. Opportunities for the expansion of this research exist in the following five areas:

1. It is recommended that similar research be conducted using a wider scope of companies and more industry representations to determine if specified decision-process factors have any significant differences in their impact on the technological decision outcomes in different industries. Furthermore, this study may also be extended with an international scope to determine if there are significant

differences in technological decision factors among industrial organizations based in different countries.

2. A comparative study may also be conducted for a specific set of new technologies which were adopted, shelved or rejected in different industries to determine the propensity of certain industrial groups in adoption or non-adoption of a particular new technology.

3. This study may also be extended to explore details on the interaction among the specified factors identified as independent decision-process factors.

4. Refinements in both theory and factor definitions may help improve the discriminatory power of the framework presented in this study.

5. Of special interest to organizational scientists will be research that more closely examines the relationships of the proposed framework presented in this study with the literatures on organizational decision making, organizational decision processes, and the information processing view of organizations.

Concluding Thoughts

The absence of a systematic empirical study and analysis in the decision literature concerning the adoption, shelving, and rejection of proposed new technologies did not reflect a consensus that the issue was uninteresting or unimportant. It seems that the focus of researchers from particular disciplines had compartmentalized the approach to this issue.

The question of how proposed new technologies are adopted, shelved and rejected in the institutional framework of organizations involves a multidisciplinary approach and understanding. Moreover, the dearth of current empirical studies in this area also reflects the unavailability of the data required to study this issue. Further, even if data existed, managerial scientists and engineering researchers have not agreed on how to go about measuring the impact of decision-process factors in terms of the organizational decision response to proposed new technologies. This situation may change rapidly in the coming few years, when a number of data sets become available to researchers and decision scientists. This will help in developing new methodologies that allow a straightforward analysis of this important issue facing the decision makers in industrial organizations.

The conclusions suggested by the related empirical evidence in this study are likely to be controversial, as many other researchers would direct their efforts to identify more decision-process factors impacting an organization's technological decision response to proposed new technologies. Nevertheless, while there may be myriads of other factors that influence the outcome of an organizational decision, there should be a few common factors that may be generalizable across the organizations. It is difficult to quantify or even identify many of these factors in the context of an individual organization and no study can truly claim to incorporate all possible factors impacting decision outcome across all organizations. It is hoped that this effort and the further interest of other researchers in this area would help the decision makers as well as technology proposers in organizations. It is anticipated that the methodological arsenal of modern statistical tools would also help in convincingly detecting empirical evidence to arrive at a consensus on those factors which predominantly impact the organizational decision processes culminating in the adoption, shelving, and rejection of proposed new technologies.

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APPENDIXES

APPENDIX A

QUESTIONNAIRE

ASSESSING THE ADOPTION, SHELVING, AND REJECTION OF NEW TECHNOLOGIES IN INDUSTRIAL ORGANIZATIONS

Oklahoma State University
SCHOOL OF INDUSTRIAL ENGINEERING
AND MANAGEMENT
STILLWATER, OKLAHOMA 74078-0540

ASSESSING THE ADOPTION, SHELVING, AND REJECTION OF NEW TECHNOLOGIES IN INDUSTRIAL ORGANIZATIONS

The following questions are designed to identify the importance of various factors that affect the organizational decision processes culminating into the adoption, shelving or rejection of proposed new technologies. Adoption of a new technology is considered to be comprised of two decisions: first, the decision to approve a new technology proposal, and second, the decision to implement the proposed new technology. Shelving is described as an outcome of the decision processes where decision makers have neither fully accepted nor outright rejected a proposed new technology. Rejection of a new technology is considered to be an outcome of the decision processes where decision makers clearly disapprove the proposed new technology.

It is anticipated that some of the factors mentioned in this questionnaire may be more important in your organization than in other companies. Please indicate your perception of these factors concerning the technological decision processes in your organization. Your response to all items in this survey will assist in the development of a set of factors for predicting the successful adoption of new technologies in industrial organizations. The result of this development will help managers who are faced with decisions concerning the incorporation of new technologies in their organizations' operations.

PLEASE ANSWER ALL THE QUESTIONS IN THE FOLLOWING SECTIONS

THIS QUESTIONNAIRE REQUIRES APPROXIMATELY 15 MINUTES TO COMPLETE

IN APPRECIATION OF YOUR TIME IN COMPLETING THIS SURVEY, A SUMMARY OF THIS STUDY WILL BE MADE AVAILABLE TO YOU WHEN THE STUDY IS COMPLETED. IF YOU WANT A COPY OF THE SUMMARY, PLEASE CHECK THE SPACE HERE: ____

NOTE: RESPONSES TO THIS INSTRUMENT ARE STRICTLY CONFIDENTIAL. THE DATA CAN NOT BE LINKED TO YOU OR YOUR COMPANY WHEN THE SURVEY IS ANALYZED.

A. EVALUATION OF TECHNOLOGICAL DECISION-PROCESS FACTORS

INSTRUCTIONS: Your company may have adopted, shelved, and rejected several proposed new technologies to date. The assimilation of a new technology into an organization is a process unfolding in a series of decision processes to evaluate, approve, and implement this new technology. In connection to the decisions concerning acceptance, shelving or rejection of proposed new technologies in your organization the following factors might have played an important role during the decision processes.

NOTE: For every factor listed below, please rate by checking [X] the appropriate box to the right, as it would impact your company's decision outcome about a proposed new technology.

	FACTOR	VERY IMPORTANT	FAIRLY IMPORTANT	NEUTRAL	NOT SO IMPORTANT	NOT AT ALL IMPORTANT
Example						
0.	Top Management Support	☐	☒	☐	☐	☐
1.	Top Management Support	☐	☐	☐	☐	☐
2.	Chief Executive Officer's Advocacy	☐	☐	☐	☐	☐
3.	Technology Strategy	☐	☐	☐	☐	☐
4.	Company's Policy	☐	☐	☐	☐	☐
5.	Employees's Skills	☐	☐	☐	☐	☐
6.	In-house Technical Expertise	☐	☐	☐	☐	☐
7.	Company's Preparedness Level	☐	☐	☐	☐	☐
8.	Attitude Towards Technology	☐	☐	☐	☐	☐
9.	Operational Compatibility of Technology	☐	☐	☐	☐	☐

		VERY IMPORTANT	FAIRLY IMPORTANT	NEUTRAL	NOT SO IMPORTANT	NOT AT ALL IMPORTANT
10.	Strategic Importance of Technology	☐	☐	☐	☐	☐
11.	Complexity of Technology	☐	☐	☐	☐	☐
12.	Technical Justification	☐	☐	☐	☐	☐
13.	Perceived Benefits of Technology					
	Improving Productivity	☐	☐	☐	☐	☐
	Manufacturing Cost Reduction	☐	☐	☐	☐	☐
	Profitability	☐	☐	☐	☐	☐
	Competitive Advantage	☐	☐	☐	☐	☐
	Quality Improvement	☐	☐	☐	☐	☐
14.	Financial Justification Criteria					
	Implementation Cost	☐	☐	☐	☐	☐
	Cash Flow Constraints	☐	☐	☐	☐	☐
	Return on Investment	☐	☐	☐	☐	☐
	Pay Back Period	☐	☐	☐	☐	☐
15.	Other (s) (Please List)					
15 a.	--------------------------------	☐	☐	☐	☐	☐
16.	--------------------------------	☐	☐	☐	☐	☐
17.	--------------------------------	☐	☐	☐	☐	☐

B. NEW TECHNOLOGY ADOPTION SURVEY

INSTRUCTIONS: This part of the questionnaire is concerned with your company's decision processes relevant to ADOPTION of a new technology. Adoption is defined as the decision outcome to accept and successfully implement a proposed new technology in an organization's operations.

Your company may have adopted several new technologies to date. For the purpose of this survey, please fill in the information on one <u>specific new technology</u> that your organization has adopted within last two years. The questions in this section are related to this particular technology. [If you feel that this new technology is proprietary or confidential to your company's business operations, you may code it in terms of the broad areas of technologies such as; manufacturing technology (MT), information technology (IT), energy cost reduction technology (ECRT), operational technology (OT), etc.]

Specific New Technology: -----------------------------------

Please carefully read each statement below, then check [X] one box to the right that most accurately represents your company's situation concerned to adoption of this new technology.

	AGREE STRONGLY	AGREE	AGREE SLIGHTLY	NEUTRAL	DISAGREE SLIGHTLY	DISAGREE	DISAGREE STRONGLY
1. The top management of this organization actively supported this new technology with commitment of necessary resources.	☐	☐	☐	☐	☐	☐	☐
2. The CEO of this organization directly advocated for this new technology.	☐	☐	☐	☐	☐	☐	☐
3. The corporate planners and decision makers in this company clearly communicated their willingness to adopt this new technology.	☐	☐	☐	☐	☐	☐	☐
4. The CEO of this organization supported the efforts to implement this new technology.	☐	☐	☐	☐	☐	☐	☐
5. This organization believes that use of this new technology would provide our firm a competitive advantage in long run.	☐	☐	☐	☐	☐	☐	☐
6. The top management is willing to use this new technology as means of achieving our corporate objectives.	☐	☐	☐	☐	☐	☐	☐
7. This organization believes that this new technology fits within the scope of our company's technology strategy.	☐	☐	☐	☐	☐	☐	☐

	AGREE STRONGLY	AGREE	AGREE SLIGHTLY	NEUTRAL	DISAGREE SLIGHTLY	DISAGREE	DISAGREE STRONGLY
8. This organization has technical skills required to successfully implement this new technology.	☐	☐	☐	☐	☐	☐	☐
9. This organization has a training program to match the technical skills of its workforce to utilize this new technology.	☐	☐	☐	☐	☐	☐	☐
10. This organization has rewards systems to motivate its employees in learning new skills to implement this new technology.	☐	☐	☐	☐	☐	☐	☐
11. This organization handled the problems of adapting to required change effectively while implementing this new technology.	☐	☐	☐	☐	☐	☐	☐
12. The management of this organization perceived strong employee resistance to the use of this new technology.	☐	☐	☐	☐	☐	☐	☐
13. The management of this organization has a positive attitude towards this new technology.	☐	☐	☐	☐	☐	☐	☐
14. The decision makers in this organization agreed fully to the merits of this new technology.	☐	☐	☐	☐	☐	☐	☐
15. The use of this new technology posed substantial level of health hazards and environmental problems in our firm.	☐	☐	☐	☐	☐	☐	☐
16. The adoption of this new technology did not impact drastically the company's relationships with its primary customers.	☐	☐	☐	☐	☐	☐	☐
17. This organization was required to change much of its management control systems to implement this new technology.	☐	☐	☐	☐	☐	☐	☐
18. This new technology is compatible to our firm's existing mode of operations.	☐	☐	☐	☐	☐	☐	☐

	AGREE STRONGLY	AGREE	AGREE SLIGHTLY	NEUTRAL	DISAGREE SLIGHTLY	DISAGREE	DISAGREE STRONGLY
19. This organization was required to replace or dislocate its workforce in order to implement this new technology.	☐	☐	☐	☐	☐	☐	☐
20. This new technology is strategically important to the day-to-day operations of this organization.	☐	☐	☐	☐	☐	☐	☐
21. This new technology has a strong fit with our firm's existing core technology.	☐	☐	☐	☐	☐	☐	☐
22. The implementation of this new technology required major changes in the social and technical structure of this organization.	☐	☐	☐	☐	☐	☐	☐
23. This new technology was easily integrated with the existing core technology of our firm.	☐	☐	☐	☐	☐	☐	☐
24. This organization was required to make substantial changes in its operating procedures to implement this new technology.	☐	☐	☐	☐	☐	☐	☐
25. This new technology is relatively more complex than the existing stock of other technologies in this organization.	☐	☐	☐	☐	☐	☐	☐
26. The management of this organization believed that the use of this new technology would benefit our firm substantially.	☐	☐	☐	☐	☐	☐	☐
27. This organization considered both tangible and intangible benefits of this new technology while making implementation decisions.	☐	☐	☐	☐	☐	☐	☐
28. This new technology met the economic justification criteria of our firm.	☐	☐	☐	☐	☐	☐	☐
29. This organization took a step-wise approach to adopt this new technology incrementally as it required substantial implementation cost.	☐	☐	☐	☐	☐	☐	☐
30. This new technology demanded drastic adjustments in the layout of existing facility and modification of existing equipment.	☐	☐	☐	☐	☐	☐	☐

C. NEW TECHNOLOGY NON-ADOPTION SURVEY

INSTRUCTIONS: This part of the survey is concerned with your company's decision processes relevant to non-adoption of a proposed new technology. A new technology proposal which is not adopted in an organization is either shelved or rejected. SHELVING outcome is defined here as the outcome of the decision processes where the proposed new technology is neither accepted nor rejected by an organization. REJECTION outcome is defined here as the outcome of decision processes where the proposed new technology is clearly disapproved by an organization.

Your organization may have shelved or rejected several new technology proposals to date. For the purpose of this survey, please fill in information on one specific proposed new technology that was shelved or rejected in your company within last two years. The following questions should be answered for this particular technology.

Specific New Technology: ------------------------------------

Please indicate below whether the above proposed new technology was either shelved or rejected in your organization.

SHELVED ☐ REJECTED ☐

Please carefully read each statement below, then check [X] one box to the right that most accurately represents your company's situation concerned to this new technology not adopted in your organization.

Statement	AGREE STRONGLY	AGREE	AGREE SLIGHTLY	NEUTRAL	DISAGREE SLIGHTLY	DISAGREE	DISAGREE STRONGLY
1. This new technology is relatively more complex than the existing stock of other technologies in this organization.	☐	☐	☐	☐	☐	☐	☐
2. This new technology has a strong fit with our firm's existing core technology.	☐	☐	☐	☐	☐	☐	☐
3. This organization is required to change much of its management control systems to implement this new technology.	☐	☐	☐	☐	☐	☐	☐
4. The CEO of this organization directly advocated for this new technology.	☐	☐	☐	☐	☐	☐	☐

	AGREE STRONGLY	AGREE	AGREE SLIGHTLY	NEUTRAL	DISAGREE SLIGHTLY	DISAGREE	DISAGREE STRONGLY
5. The use of this new technology poses substantial level of health hazards and environmental problems in our firm.	☐	☐	☐	☐	☐	☐	☐
6. The adoption of this new technology would impact drastically the company's relationships with its primary customers.	☐	☐	☐	☐	☐	☐	☐
7. The top management of this organization actively supported this new technology with commitment of necessary resources.	☐	☐	☐	☐	☐	☐	☐
8. This organization would be required to replace or dislocate its workforce in order to implement this new technology.	☐	☐	☐	☐	☐	☐	☐
9. This new technology is strategically important to the day-to-day operations of this organization.	☐	☐	☐	☐	☐	☐	☐
10. This organization would be required to make substantial changes in its operating procedures to implement this new technology.	☐	☐	☐	☐	☐	☐	☐
11. This organization has rewards systems to motivate its employees in learning new skills to implement this new technology.	☐	☐	☐	☐	☐	☐	☐
12. The management of this organization believes that the use of this new technology would benefit our firm substantially.	☐	☐	☐	☐	☐	☐	☐
13. The management of this organization perceived strong employee resistance to the use of this new technology.	☐	☐	☐	☐	☐	☐	☐
14. The corporate planners and decision makers in this company clearly communicated their willingness to adopt this new technology.	☐	☐	☐	☐	☐	☐	☐
15. This organization believes that use of this new technology would provide our firm a competitive advantage in long run.	☐	☐	☐	☐	☐	☐	☐

	AGREE STRONGLY	AGREE	AGREE SLIGHTLY	NEUTRAL	DISAGREE SLIGHTLY	DISAGREE	DISAGREE STRONGLY
16. This new technology demands drastic adjustments in the layout of existing facility and modification of existing equipment.	☐	☐	☐	☐	☐	☐	☐
17. The top management believes that use of this new technology would help in achieving our corporate objectives.	☐	☐	☐	☐	☐	☐	☐
18. This organization believes that this new technology fits within the scope of our company's technology strategy.	☐	☐	☐	☐	☐	☐	☐
19. The use of this new technology demands major changes in the social and technical structure of this organization.	☐	☐	☐	☐	☐	☐	☐
20. This organization has technical skills required to successfully implement this new technology.	☐	☐	☐	☐	☐	☐	☐
21. This organization has a training program to match the technical skills of its workforce to utilize this new technology.	☐	☐	☐	☐	☐	☐	☐
22. The management of this organization has a positive attitude towards this new technology.	☐	☐	☐	☐	☐	☐	☐
23. The decision makers in this organization agreed fully to the merits of this new technology.	☐	☐	☐	☐	☐	☐	☐
24. This new technology is compatible with our firm's existing mode of operations.	☐	☐	☐	☐	☐	☐	☐
25. This new technology can be easily integrated with the existing core technology of our firm.	☐	☐	☐	☐	☐	☐	☐
26. This organization considered both tangible and intangible benefits of this new technology while making decision.	☐	☐	☐	☐	☐	☐	☐
27. This new technology met the economic justification criteria of our firm.	☐	☐	☐	☐	☐	☐	☐

D. DEMOGRAPHICS

Instructions: This part of the questionnaire is concerned with information about the background of the individual respondent that will help to place proper perspective on the study.

1. Please indicate the time you have spent in your present position in this organization [ ].

___a. Less than 1 year ___d. 8 to 12 years

___b. 1 to 3 years ___e. 12 to 16 years

___c. 4 to 7 years ___f. Over 16 years

2. Please check the level of formal education you have completed [ ].

___a. High School ___c. Bachelors Degree

___b. Some College ___d. Graduate Degree(s)

3. Have you been involved in decision making processes of selecting or recommending new technologies in this organization recently?

___ Yes ___ No

4. If your response to #3 above is Yes, what are (were) your duties?

5. Please list the top three activities that you spend most of your time during the processes of technological decision making in this organization.

1.

2.

3.

NOTE: IF YOU ARE INTERESTED TO RECEIVE A SUMMARY REPORT OF THE RESEARCH, PLEASE FILL IN THE FOLLOWING:

NAME: --------------------------------

ADDRESS: --------------------------------

PLEASE FOLD ALONG THIS LINE

THANK YOU VERY MUCH

APPENDIX B

QUESTIONNAIRE PRE-TEST FORM

INSTRUCTIONS TO CRITIQUE

THE SURVEY INSTRUMENT

The critiquing of this survey instrument is divided into three parts. The first part deals with the individual questions/statements, the second part deals with the overall survey instrument, and the third part asks for some specific opinions, ideas, and suggestions from each participant.

PART I. Please read each question/statement in the attached survey instrument, then answer the critiquing questions below. If the answer to critiquing question is yes, do nothing. if the answer is no, write the section number and question/statement number (for example C-10: for section C, statement number 10) in the space to the right below.

CRITIQUING QUESTIONS

1. Is it clear? -------------------
2. Is it complete? -------------------
3. Does it deal with a single idea? -------------------
4. Is it brief? -------------------
5. Do you understand precisely what the question/statement is soliciting? ------------------
6. Is it objective, without suggesting a response? -------------------
7. Is it courteous without adverse connotations? -------------------
8. Any other comments? (Please include the section and question statement to which they pertain.)

PART II. Please review the overall survey instrument and answer the questions below. Circle only one response to each question.

1. The design of the overall questionnaire is logically arranged?

Yes No Do not Know

2. Directions for completing the survey instrument are clear and complete?

Yes No

3. The overall length of the survey instrument is ... ?

Too Long | Okay | Too Short

4. Questions and statements are presented in good psychological order, proceeding from general to specific responses?

Yes | No | Do not Know

5. Any additional comments and suggestions?

PART III. Please answer the following questions briefly, in your own words.

1. What is the length of time it would take to complete the survey instrument if you were not evaluating each question?

2. Which areas could be regarded as being overly sensitive?

3. Which statements, questions or areas were confusing?

4. Any additional comments or suggestions?

Name______________________________ Address__________________

Phone No. ______________________ __________________

Department _____________________ __________________

APPENDIX C

SURVEY REQUEST LETTER

Oklahoma State University

INDUSTRIAL ENGINEERING AND MANAGEMENT

STILLWATER OKLAHOMA 74078-0540
ENGINEERING NORTH ROOM 322
(405) 744-6055
FAX (405) 744-7673

April 9, 1991

ASSESSING THE ADOPTION, SHELVING, AND REJECTION OF NEW TECHNOLOGIES IN INDUSTRIAL ORGANIZATIONS.

Dear Executive,

We are conducting research on the technological decision processes that culminate in the Adoption, Shelving, or Rejection of proposed new technologies in industrial organizations in the United States. Your company has been selected to be included in the sample for this study. Based on the extent of operations of your company, it is most likely that you and your staff organization would have been extensively involved in the processes of technological decision making.

Since we are making this request of only a small selected group of companies across the United States, your organization's response is most important to make this study useful and reliable. Understanding your experiences would be very valuable to us in completing this research.

We are hopeful that this study will help provide U.S. managers and decision makers with an improved understanding of the critical factors that can either facilitate or hinder the adoption of new technologies in industrial organizations. We would be pleased to send you a copy of the summary results at the conclusion of this research. Completion is expected to be accomplished in August of this year.

The attached questionnaire should take about ten to fifteen minutes to complete. If at all possible, please return the completed survey to us within the next week. A return envelope with postage is provided for your convenience.

We want to assure you that your response to the entire questionnaire will be kept strictly confidential and will not be linked to you or your organization when the data is analyzed. If you have any questions about this survey, please call us at (405)-744-6055. We thank you very much for your effort.

Sincerely,

David E. Mandeville, Ph.D.
Research Director

Masood A. Rahman
Principal Investigator

VITA

Masood Ahmad Rahman

Candidate for the Degree of

Doctor of Philosophy

Thesis: A FRAMEWORK FOR TECHNOLOGICAL DECISION MAKING: AN INVESTIGATION INTO THE ADOPTION SHELVING AND REJECTION OF NEW TECHNOLOGIES IN INDUSTRIAL ORGANIZATIONS.

Major Field: Industrial Engineering and Management

Biographical:

Personal Data: Born in Faisalabad, Pakistan, February 6, 1953, the son of Khalil and Sofia Rahman. Married to Ye-Qiong Zhu, April, 1989.

Education: Graduated from Government Islamia High School, Faisalabad, Pakistan in 1968; received Bachelor of Science Degree in Electrical Engineering from University of Engineering and Technology, Lahore, Pakistan in 1975; received Master of Science Degree in Industrial Engineering and Management from Oklahoma State University, Stillwater, Oklahoma in December 1987; completed the requirements for the Doctor of Philosophy Degree in Industrial Engineering and Management from Oklahoma State University in May 1992.

Professional Experience: Sales Engineer, Isomat Business Corp., Pakistan, 1974-1975; Lecturer in Electrical Engineering, University of Engineering & Technology, Lahore, Pakistan, 1975-1978; Planning Engineer, Saudi Electric Corp., Mecca, Saudi Arabia, 1978-1980; Director of Technical Office, Electricity of Western Region, Mecca Branch, Saudi Arabia, 1980-1985; Research Associate, Energy Analysis and Diagnostic Center, Oklahoma State University, 1987-1989; Research Assistant, Center for Computer Integrated Manufacturing, Oklahoma State University, 1989-1990, Graduate Teaching Associate, School of Industrial Engineering & Management, Oklahoma State University, Fall 1990 to Fall 1991.

Professional Organizations: Member of: American Institute of Industrial Engineers, American Institute of Electrical & Electronic Engineers, Alpha Pi Mu (Industrial Engineering Honorary), Tau Beta Pi (National Engineering Honorary); National Talent Scholar and P.E., (Pakistan).