

An Internal Auditing Innovation Decision:

Statistical Sampling

by

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(ABSTRACT)

In planning an effective and efficient audit examination, the auditor has to choose appropriate auditing technologies and procedures. This audit choice problem has been explored from several perspectives. However, it has not been viewed as an innovation process.

This dissertation reports the results of an innovation decision study in internal auditing. Hypotheses of associations between the internal auditor's decision to use statistical sampling and the perceived characteristics of statistical sampling are derived from Rogers' *Innovation Diffusion* model (Everett Rogers, *Diffusion of Innovations*, 1983). Additional hypotheses relating the decision to use statistical sampling to personal and organizational characteristics are derived from the innovation adoption and implementation research literature.

Data for this study were gathered by mailing a questionnaire to a sample of internal audit directors. Incorporated into the questionnaire are several scales for measuring (1) innovation attributes, (2) professionalism, (3) professional and organizational commitment, (4) management support for innovation, and (5) creativity decision style. The useable response rate was 32.5% (n = 260).

The primary finding of this study is that the extent of use of attributes, dollar unit, and variables sampling techniques is positively associated with the respondents' perceptions of their relative advantage, trialability, compatibility, and observability, and negatively associated with the techniques' perceived complexity. A secondary finding is that there is no overall association between the extent of use of statistical sampling by the internal auditors and their (1) professionalism, (2) professional and organizational commitment, (3) decision style, and (4) organizational support for innovation.

Further exploration using multiple regression and logistic regression analyses indicate that several of the personal and organizational characteristics add to the ability of the regression models to explain the extent of use of statistical sampling. Evidence that organization types do have an effect upon the innovation decision process is presented.

The study concludes by discussing its implications for understanding the innovation decision process of internal auditors, for designing and managing future innovation processes in auditing, and for further research into audit choice problems and innovation decisions of auditors and accountants.

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Chapter 1

Introduction and Summary of the Study

Introduction

Accounting professionals are being challenged by rapidly changing environmental conditions. Faced with new and expanding capabilities of information processing technologies, an increasingly complex economic climate, and the dynamic nature of business and nonbusiness entities, accountants and auditors must be alert to innovative technologies that can help meet the challenges of change.

Corporate accountants seek to find new ways of capturing and reporting information to management and to other interested parties. New types of transactions create a need to develop creative accounting techniques. Any increase in the scope of accountants' work creates additional demands for innovative techniques to offset the increased workload. Auditors, both internal and external, also find the nature of their practice changing rapidly. The changes implemented by their clients create new opportunities for innovative approaches in auditing. New technologies present auditors

with new challenges for increasing their effectiveness. There is increased recognition of the need to address problems previously unexamined and to develop new approaches to old problems.

It is widely recognized that accountants must be innovative in the changing environment of today. But missing in the discussion of change and its impact on accounting and auditing is consideration of the innovation processes existant in the accounting environment. There has been little discussion regarding the process by which accountants develop, diffuse, and adopt innovations. Knowledge of these processes could be useful to those who are concerned with the ability of the accounting profession to respond to change. Understanding the processes allows for the possibility of managing them.

However, there has been little analysis of the innovation process in accounting and auditing. Basically unanswered are such questions as:

- How are innovations developed?
- Who generates accounting innovations?
- How are innovations diffused among members of the accounting community?
- Why are some innovations rapidly integrated into practice while others are slow to gain acceptance?
- Are there ways to facilitate the innovation process in accounting and auditing so that innovation can be managed?

There are theoretical and authoritative guidelines for auditors concerning the choice of an auditing technology relative to the competence and sufficiency of the evidence. However, little evidence has been provided as to how those guidelines are applied. In addition, limited knowledge is available as to how auditors make decisions regarding innovative technologies. Bamber and Bylinski suggest that the process of choosing an audit technology is an important area of research that has been ignored by auditing researchers.¹

¹ E. Michael Bamber and Joseph H. Bylinski, "The Audit Team and the Audit Review Process: An Organizational Approach," *Journal of Accounting Literature* 1 (Spring 1982): 52-53.

The importance of understanding the innovation process in auditing and the lack of available information leads to the major research question of this study:

- What factors affect the internal auditor's decision to choose an innovative technology?

The research discussed in this dissertation explores the innovation decision process by means of an empirical analysis of factors relating to the use of statistical sampling techniques by internal auditors. A general hypothesis of the study is that the extent of use of statistical sampling is related to the auditor's perceptions of key attributes of the techniques and certain personal and organizational characteristics. These hypothesized relationships were derived from the research studies about the diffusion and implementation of innovations.

This research can provide some insight into the process of technology choice of internal auditors. Findings of this study will contribute to an initial understanding of the innovation decision process of internal auditors. If empirical support is found for the research model, auditing innovators may be able to utilize the methodologies that have been developed to facilitate and manage innovation.

Summary of the Study

The study reported in this dissertation is organized into five chapters. The first chapter introduces the motivation for the study and the research questions addressed. The second chapter provides an overview of the diffusion and implementation of innovations research. The research into diffusion explores the process of diffusing information about an innovation to members of the group of potential adopters. Diffusion researchers have generally been interested in factors that explain the adoption decision. Implementation researchers have explored the process of implementing innovations after the initial adoption decision. Both diffusion researchers and implementation researchers have identified key variables that are related to adoption and implementation. The

innovation decision has been found to be related to (1) perceived attributes of innovations, (2) personal characteristics, and (3) organizational characteristics.

Chapter 3 of this dissertation presents the methodology and hypotheses that are tested. An empirical study is developed in order to explore the internal auditing innovation decision. Data is collected through a mail survey of internal audit directors selected from the membership list of the Institute of Internal Auditors. The questionnaire includes several scales for measuring (1) the innovation attributes, (2) the professionalism of the respondents, (3) the respondents' decision styles, (4) the respondents' organizational and professional commitment, and (5) the organizational support for innovation. The innovation attributes scale is developed for this study. The other scales are adaptations of instruments reported in the innovation research literature.

In Chapter 4, the results of the data analysis are presented. The chapter begins with an analysis of the reliability and validity of the measurement scales. All of the scales are found to have satisfactory properties.

The second section of Chapter 4 presents an analysis of the distributional properties of the dependent and independent variables. This is followed by the bivariate analysis testing for an association between the extent of use of statistical sampling and each of the independent variables. The results of multivariate tests are also presented. The results indicate a strong association between the perceived characteristics of statistical sampling and the extent of use of the techniques. The findings regarding the association between the extent of use of statistical sampling and the personal and organizational variables are mixed.

Chapter 5 provides a summary of the findings and discusses the implications of this dissertation for understanding the internal auditing innovation process and for further research.

Chapter 2

Background

Introduction

There is a long tradition of research on the relationship between technological innovation and significant historic events. One conclusion that can be drawn from the historical research is that innovation and progress are closely related. In fact, without innovations, there would be no progress. Recognizing this relationship, scientists from many disciplines have studied the process by which innovations are developed and diffused to members of a society. A goal of the research is the understanding and potential control of the innovation process in order to increase or continue progress in a given domain.

A model of the stages in the innovation development process is presented in Figure 1 on page 7.² This model describes the process as flowing from the recognition of problems or needs through

² Everett M. Rogers, *Diffusion of Innovations* (New York: The Free Press, 1983), p. 136.

research efforts to come up with solutions to the problems. When a new idea is generated, it passes through a development stage and a commercialization stage. At this point, knowledge of the innovation is diffused to potential users who may adopt the innovation. After extensive adoption has occurred, evaluation of the innovation's consequences takes place to determine whether the original problems have been solved and whether new problems have been created by the innovation.

Clearly, these stages do not necessarily occur in a linear fashion for all innovations. In many cases, stages may be skipped, they may occur simultaneously, or the chronological order of the stages may differ from the model. The model has been presented in order to identify the relevant literature for this research study. Research has been performed for each phase of the innovation process. The first stages of the process, needs and problem recognition, and research and development, are beyond the scope of this study. This study is concerned with the adoption and implementation of innovations in internal auditing. Rogers, a leading scholar in this area, defines the innovation decision process as "the process through which an individual (or decision making unit) passes from first knowledge of an innovation, to forming an attitude toward the innovation, to a decision to adopt or reject, to implementation of the new idea, and to confirmation of this decision."³ A model of the innovation decision process is presented in Figure 2 on page 8.

This model consists of five stages.⁴

- *Knowledge* occurs when an individual (or other decision making unit) is exposed to the innovation's existence and gains some understanding of how it functions.
- *Persuasion* occurs when an individual (or other decision making unit) forms a favorable or unfavorable attitude toward the innovation.
- *Decision* occurs when an individual (or other decision making unit) engages in activities that lead to a choice to adopt or reject the innovation.
- *Implementation* occurs when an individual (or other decision making unit) puts an innovation into use.

³ Ibid., p. 165.

⁴ Ibid., p.164.



Figure 1. The Innovation Process

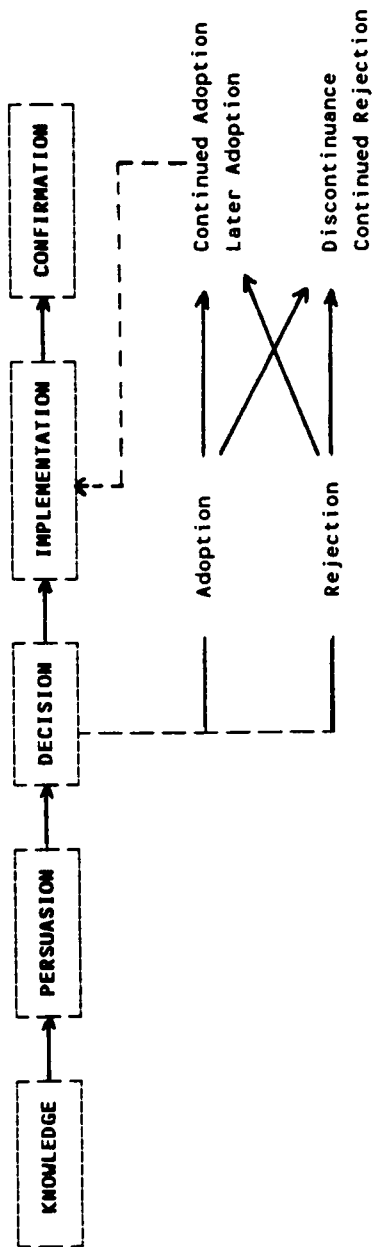


Figure 2. Model of Stages in the Innovation Decision Process

- *Confirmation* occurs when an individual (or other decision making unit) seeks reinforcement of an innovation-decision already made, or reverses the previous decision if exposed to conflicting messages.

This model serves as a framework for the following discussion of the research that is relevant to this research study.

Researchers have found several relationships that help to explain the outcomes at each of the different stages of the innovation decision process. The next section of this chapter presents the findings of the innovation diffusion researchers. They have studied both the diffusion stage of the innovation development process and the innovation decision process through the decision stage. There are two groups of diffusion researchers. One group has studied the diffusion to individual decision makers. Of particular interest to this researcher is their findings regarding the relationships between the innovation characteristics and the characteristics of the decision makers in the persuasion and decision stages. The other group of diffusion researchers has studied the organizational decision maker. The findings have emphasized the importance of organizational factors on the decision process.

Following the discussion of diffusion research, the findings of a second school of research, implementation research, is reviewed. Implementation researchers have found that the relationships identified by diffusion researchers in the persuasion and decision stages are also important in the implementation stage. However, the impact of the factors is different in later stages of the process.

Diffusion of Innovations Research

Early diffusion research was characterized by similar studies carried out in different disciplines with

little or no recognition by the researchers of other research efforts.⁵ Rural sociologists studied agricultural innovations and education researchers studied innovations in education. Rogers' observation that these independent research efforts were coming to similar conclusions motivated him to publish in 1962 a book entitled *Diffusion of Innovations*.⁶ In this work, Rogers analyzed 400 research reports and constructed what has become known as the "classical" theory of the diffusion of innovations.

When Rogers' book was first published, most research to date had been carried out by rural sociologists and anthropologists. Publication of his book stimulated interest in several other disciplines. In 1971, Rogers updated his review of the research with Shoemaker, and together they found that the number of research studies had grown to over 1400.⁷ In his latest book, Rogers refers to 3100 studies, and cites nine research traditions that account for most of the research; anthropology, early sociology, rural sociology, education, public health and medical sociology, communications, marketing, geography, and general sociology.⁸

Rogers notes:

The status of diffusion research today is impressive. During the 1960's and 1970's, the results of diffusion research have been incorporated into basic textbooks in social psychology, communications, public relations, advertising, marketing, consumer behavior, rural sociology, and other fields. Both practitioners (like change agents) and theoreticians have come to regard the diffusion of innovations as a useful field of social science knowledge. Many U.S. government agencies have a division devoted to diffusing technological innovations to the public or to local governments; examples are the U.S. Department of Transportation, The National Institutes of Health, the U.S. Department of Agriculture, and the U.S. Department of Education. These same federal agencies also sponsor research on diffusion, as does the National Science Foundation and a number of private foundations.... Fur-

⁵ Elihu Katz, "Traditions of the Research on the Diffusion of Innovations," *American Sociological Review* 28: 237-253.

⁶ Everett M. Rogers, *Diffusion of Innovations* (New York: The Free Press, 1962).

⁷ Everett M. Rogers and Floyd F. Shoemaker, *Communications of Innovations: A Crosscultural Approach* (New York: The Free Press, 1971).

⁸ There are several bibliographies of diffusion research available. For example see, James F. Orr and Judith L. Wolfe, *Technology Transfer and the Diffusion of Innovations: A Working Bibliography with Annotations* (Monticello, Ill.: Vance Bibliographies: Public Administration Series, #P-232, 1979).; Patrick Kelly and Melvin Kranzberg, *Technological Innovation: A Critical Review of Current Knowledge* (Atlanta: Advanced Technology and Science Studies Group, Georgia Tech, 1975) published by the National Technical Information Service (PB-242-550).; William D. Crano, Suellen Ludwig and Gary W. Selnow, eds. *Annotated Archive of Diffusion References: Empirical and Theoretical Works* (U.S. Department of Energy Project DE-AC01-80R610347, 1981).

ther, most commercial corporations have a marketing department that is responsible for diffusing new products and a marketing research activity that conducts diffusion investigations in order to aid the company's marketing efforts.⁹

Rogers' work provides a thorough overview of the research and serves as the primary source of theoretical support for most diffusion research in the social sciences.

Attributes of Innovations and their Rate of Adoption

Rogers' model of the innovation decision process describes the decision as being contingent upon certain relevant characteristics of the innovation. One line of empirical research has been to identify characteristics of innovations that are related to the adoption of innovations. The assumption of these researchers has been that if a common set of relationships can be found, then, given an innovation and its characteristics, one could predict its rate of adoption or manipulate its characteristics so as to manage its rate of adoption.

This relationship has been explored by several researchers and has resulted in a lengthy list of innovation characteristics that are related to the adoption decision. The list in Figure 3 on page 12 contains the most commonly studied characteristics.¹⁰ Scanning this list, one notices that several of the "characteristics" are merely different terms for a common concept. Rogers recognized that there is a set of attribute dimensions which the potential adopter evaluates. He proposes reducing the list of attributes to five dimensions.

Relative advantage is the degree to which an innovation is perceived as better than the idea it supersedes. **Compatibility** is the degree to which an innovation is perceived as being consistent with existing values, past experiences, and needs of potential adopters. **Complexity** is the degree to which

⁹ Rogers, *Diffusion* 1983, p. 88.

¹⁰ The list in Figure 3 on page 12 is taken from Gerald Zaltman, Robert Duncan and Jonny Holbeck, *Innovations and Organizations* (New York: John Wiley & Sons, 1973) p.47. and Louis G. Tornatzky and Katherine J. Klein, "Innovation Characteristics and Innovation Adoption Implementation: A Meta-analysis of Findings," *IEEE Transactions on Engineering Management* EM-29 (February 1982): 28-45.

Financial cost	Complexity	Impact on inter- personal relation- ships
Social cost	Perceived relative advantage	Publicness
Returns to investment	Demonstratability	Susceptibility to successive modification
Efficiency	Terminality	Gateway capacity
Risk and uncertainty	Reversability	Number of gate- keepers
Communicability	Divisibility	Flexibility
Clarity of results	Degree of commitment	Payoff
Compatibility	Continuing cost	Reliability
Pervasiveness	Observability	Trialability
Initial cost	Radicalness	Immediacy of reward
Importance	Social approval	Visibility
Profitability	Rate of cost recovery	
Saving of time		

Figure 3. Attributes of Innovations

an innovation is perceived as difficult to understand and use. **Trialability** is the degree to which an innovation may be experimented with on a limited basis. **Observability** is the degree to which the results of an innovation are visible to others.¹¹ Rogers finds that the rate of adoption of an innovation is positively related to the innovation's compatibility, trialability, observability, and relative advantage and is negatively related to the innovation's complexity. According to Rogers, researchers have been able to explain from 60 to 85 percent of the variance in rates of adoption of innovations with this model.

Rogers' model has been subjected to empirical tests in many disciplines. In a meta-analytic analysis of 75 diffusion studies of the attributes model, Tornatzky and Klein were able to find that compatibility, relative advantage, and complexity have consistently been found to have the hypothesized relationship with adoption across studies. They were unable to confirm or reject the relationships hypothesized for observability and trialability due to poor reporting of results by the researchers.¹² Lancaster and Taylor find that the majority of the research concerning differential perceptions of the attributes of innovations concentrated on these five attributes.¹³

Adding to the validity of Rogers' model is recent research that integrates the perceived attributes of innovations into innovation diffusion forecasting models. These models forecast the number of adopters of innovations over time or they forecast the time at which the innovation will reach maximum adoption. The models are based on assumptions regarding the properties of the distributions of adopters over time, the initial number of adopters, and estimates of parameters representing innovators and imitators. Model extensions allow for repeat purchasers of the innovation.¹⁴

¹¹ Rogers, *Diffusion*, 1983, pp. 15-16.

¹² Tornatzky and Klein, "Innovation Characteristics," pp. 28-45.

¹³ G. A. Lancaster and C. T. Taylor, "The Diffusion of Innovations and their Attributes: A Critical Review," *The Quarterly Review of Marketing* (Summer 1986): 13-18.

¹⁴ For a review of these models see Vijay Mahajan and Robert A. Peterson, *Models for Innovation Diffusion* Sage University Paper Series on Quantitative Applications in the Social Sciences, 07-048 (Beverly Hills and London: Sage Publications, 1985).

Srivastava, et al. show that the addition of perceived relative advantage to the innovation diffusion forecasting model improves the forecasts of the adoption of investment innovations.¹⁵ Rao and Yamada demonstrate the use of perceptions of relative advantage, trialability, and observability as a means of improving forecasts of the sales of ethical drugs before any sales data is available.¹⁶ Holek reports that relative advantage and compatibility were very successful predictors of innovation success.¹⁷

Given the success of Rogers' model in explaining rates of adoption of innovations and the continuing interest in the model on the part of innovation researchers, it appears that this model could provide a useful explanation of the innovation decision process of internal auditors. Of interest to this research study is whether the characteristics of innovations that have been found to affect their rates of adoption are significantly related to the innovation decision making processes of internal auditors. Therefore, the following question is investigated:

- Is the internal auditor's innovation decision positively related to the compatibility, trialability, observability, and relative advantage of innovations and negatively related to their complexity?

Characteristics of Individuals

Diffusion researchers have studied decision makers in order to identify socioeconomic, personality, and communication behavior variables common to "innovative" individuals. The basic assumption of the researchers is that individuals with characteristics common to innovative individuals are more likely to adopt an innovation. Positive associations have been found between level of education,

¹⁵ Rajendra K. Srivastava et al., "A Multi-Attribute Diffusion Model for Forecasting the Adoption of Investment Alternatives for Consumers," *Technological Forecasting and Social Change* 28 (December 1985): 325-33.

¹⁶ Ambar G. Rao and Masataka Yamada, "Forecasting with a Repeat Purchase Diffusion Model," *Management Science* 34 (June 1988): 734-52.

¹⁷ Susan L. Holek, "Determinants of Innovative Durables Adoption: An Empirical Study with Implications for Early Product Screening," *Journal of Product Innovation Management* (March 1988): 50-69.

work experience, social status, age, personal wealth and innovativeness. In addition, innovative individuals have favorable attitudes toward science and change. They have more communications with change agents, seek information about innovations more actively, have more interpersonal communications and are more cosmopolitan than less innovative individuals. Professionalism, professional commitment, and organizational commitment, discussed in more detail in a later section of this chapter, have also been shown to be related to innovative behavior.¹⁸

Lucas' series of studies of the implementation of management information systems have provided support for the suggestion that personal characteristics and successful implementation are related. One variable included in his model of the innovation process is the user's decision style. The decision style of an individual represents a predisposition to attack a problem from a given perspective. Lucas refers to this as "technical orientation".¹⁹ Joseph and Vyas demonstrate that an open cognitive style was positively related to the innovativeness of a sample of consumers of new food, household, and personal care products.²⁰ People with an open cognitive style are "open to new experiences and often go out of their way to experience different and novel stimuli."²¹ Kirton proposes that individuals display differences in their cognitive styles of problem solving, decision making, and creativity. He believes that there is a continuum of cognitive style with one end being adaptors who attempt to do things better and the other end being innovators who attempt to do things differently.²²

Personal characteristics may also be important in the internal auditing setting. While characteristics such as social status and wealth were important in the rural settings studied by sociologists, they

¹⁸ Rogers, *Diffusion*, 1983, Chapter 7.

¹⁹ Henry C. Lucas, "Empirical Evidence for a Descriptive Model of Implementation," *MIS Quarterly* (June 1978): 30.

²⁰ Benoy Joseph and Shailesh J. Vyas, "Concurrent Validity of a Measure of Innovative Cognitive Style," *Journal of the Academy of Marketing Science* 12 (Spring 1984): 159-75.

²¹ Clark Leavitt and John Walton, "Personality and Adoption Behavior," Unpublished Working Paper. The Ohio State University, 1976, cited in Joseph and Vyas, p. 159.

²² Michael Kirton, "Adaptors and Innovators: A Description and Measure," *Journal of Applied Psychology* 61 (October 1976): 622.

do not appear likely to contribute significantly to explaining the innovation decision-making behavior of internal auditors. However, several of the personal characteristics have been found to be important descriptors of innovation decision-making in organizational settings similar to that of internal auditing. Two research questions of interest derived from this research area are:

- Is there a relationship between the internal auditors' innovation decisions and their levels of education, work experience, and age?
- Is there an association between the decision style of internal auditors and their innovation decisions?

Organizational Characteristics

Early diffusion research concentrated on diffusion among individuals. Little attention was paid to diffusion among organizations. Often, the organization was treated as if it were an individual and the methodologies and findings of previous research were assumed to apply to organizations. As late as 1976, only 373 of 2700 diffusion studies dealt with organizations.²³ During the 1970's, organization theorists and researchers did turn their attention to how organization characteristics relate to innovation and innovativeness.

Organizational researchers have looked at the effect of organization structure on the innovative behavior of organizations. One of these structural variables, size, has been found to be positively associated with innovative behavior in several studies.²⁴ The findings of these studies are contrary

²³ Everett M. Rogers and Rekha Agarwala-Rogers, *Communications in Organizations* (New York: The Free Press, 1976).

²⁴ Michael Aiken and Jerald Hage, "The Organic Organization and Innovation", *Sociology* 5 (January 1971): 63-82.; Ronald Corwin, "Strategies for Organization Innovation: An Empirical Comparison", *American Sociological Review*, 37 (August 1972): 441-54.; Lawrence B. Mohr, "Determinants of Innovations in Organizations", *American Political Science Review*, 63 (1969): 111-26.; John R. Kimberly, "Hospital Adoption of Innovations: The Role of Integration into External Informational Environments," *Journal of Health and Social Behavior* 19 (1978): 361-73.; Michael K. Moch and Edward V. Morse, "Size, Centralization and Organizational Adoption of Innovations," *American Sociological Review* 92 (October 1977): 716-25.; and Keith G. Provan, "Environmental and Organizational Predictors of Adoption of Cost Containment Policies in Hospitals," *Academy of Management Journal* 30 (June 1987): 210-29.

to studies that have found that smaller firms have been the leading innovators in the U.S. economy. Kennedy suggests that the relationship between size and innovative behavior may in fact result from the positive relationship between size and other structural variables. She stresses that the influence of size must be recognized when examining other structural factors.²⁵ Since size has been used as a control variable in nearly every study reviewed for this project, the following research question is addressed:

- Is the innovation decision of internal auditors associated with the size of their organization?

Professionals and Innovation in Organizations

Diffusion researchers consistently find that individuals who are more cosmopolitan or professional are more innovative than less cosmopolitan or professional individuals.²⁶ These findings have been based upon behavioral studies of individuals making personal decisions about innovations. Two questions are raised by organization researchers. Do professionals continue to be innovative when they join organizations and if so, are organizations that are more professional than others more innovative?

Conceptually, at least, it seems that professionals should be innovators in organizations. Thompson believes that professionals have a depth of knowledge that allows them to work at the perimeters of their fields where innovations occur. He believes that professionals have internalized values that are related to innovativeness.²⁷ Pierce and Delbecq describe professionals as bringing a richness of experience, ideational inputs from external sources, increased boundary spanning activ-

²⁵ Anita M. Kennedy, "The Adoption and Diffusion of New Industrial Products: A Literature Review," *Management Bibliographies and Review* 9 (1983): 31-88.

²⁶ Rogers, *Diffusion*, 1983, Chapter 7.

²⁷ Victor A. Thompson, "Bureaucracy and Innovation", *Administrative Science Quarterly* 10 (June 1964): 1-20.

ity, professional standards, and a psychological commitment to moving beyond the status quo to the organization.²⁸

Many studies at the organizational level have found that the professionalism of an organization is positively related to its innovativeness.²⁹ Other studies, using the "professionalism" of the organization as a control variable, have attempted to identify variables that help to explain different rates of innovativeness across organizations. Structural and environmental characteristics seem to be related to innovativeness, but conclusions as to the direction and strength of the relationships are tentative due to limited numbers of studies and inconsistent findings.

Although no specific studies of the individual professional's innovativeness in organizations were found, there is research available from which hypotheses about the innovative behavior of professionals in organizational settings can be drawn. This research deals with the behavior of professionals in organizations and specifically focuses on the effect of organization structure on the professional's attitudes, job satisfaction, and productivity.

In early research of professions, researchers attempted to identify characteristics of professions which distinguish them from other vocations.³⁰ It was thought that a professional's needs for autonomy and self-regulation, commitment to a service ethic, and interest in expanding the specialized knowledge base would conflict with the requirements of an organization. Organizational characteristics such as formalization and centralization would lead to alienation from the organization, low job satisfaction, and dysfunctional behaviors. Research has been reported which both supports and

²⁸ Jon L. Pierce and Andre L. Delbecq, "Organizational Structure, Individual Attitudes, and Innovation," *Academy of Management Review* 2 (January 1977): 27-37.

²⁹ John R. Kimberly and Michael J. Evanisko, "Organizational Innovation: The Influence of Individual, Organizational, and Contextual Factors on Hospital Adoption of Technological and Administrative Innovations," *Academy of Management Journal* 24 (December 1981): 689-713; Moch and Morse, "Size, Centralization and Organizational Adoption," pp. 716-25; and Fariborz Damanpour, "The Adoption of Technological, Administrative, and Ancillary Innovations: The Impact of Organizational Factors," *Journal of Management* 13 (Winter 1987): 675-85.

³⁰ Richard H. Hall, "Professionalization and Bureaucratization," *American Sociological Review* 33 (February 1968): 62-64.

contradicts this assumption. One conclusion that can be drawn is that structural characteristics do affect a professional's commitment to the organization, job satisfaction, and productivity, but the direction and significance of the effect is contingent upon other factors.

This leads to the question of how structural characteristics affect the innovative behavior of professionals. Hage and Aiken propose that innovative behavior of individuals in organizations is positively related to job satisfaction.³¹ Katz suggests that innovative behavior is positively associated with organizational commitment.³² Therefore, even though professionals tend to be innovative, factors which lower their job satisfaction and commitment to their organizations may inhibit innovative behaviors.

Research into the effects of structural characteristics on public accountants has found that they have a high level of commitment to both their professions and to their organizations.³³ Also, there is some indication that job satisfaction is related to organizational commitment. One study of internal auditors finds that organizational commitment and professional commitment are positively correlated and that organizational commitment is related to job satisfaction.³⁴

In this study, the potential effects of structural variables were recognized raising two interesting questions.

- Is the innovation decision of auditors related to their degree of professionalism?

³¹ Hage and Aiken, *Complex Organizations*, pp. 52-54.

³² Katz, p. 250.

³³ Paul D. Montagna, "Professionalization and Bureaucratization in Large Professional Organizations," *American Journal of Sociology* 74 (September 1968): 138-45; Kenneth R. Ferris, "Organizational Commitment and Performance in a Professional Accounting Firm," *Accounting, Organizations, and Society* 6 (1981): 317-25.; N. Aranya, J. Pollock and J. Amernic, "An Examination of Professional Commitment in Public Accounting," *Accounting, Organizations, and Society* 6 (1981): 271-280.; Dwight R. Norris and Robert E. Niebuhr, "Professionalism, Organizational Commitment and Job Satisfaction in an Accounting Organization," *Accounting, Organizations, and Society* 9 (1983): 49-59.; and Nissim Aranya and Kenneth R. Ferris, "A Reexamination of Accountants' Organizational-Professional Conflict," *The Accounting Review* 59 (January 1984): 1-15.

³⁴ Adrian Harrell, Eugene Chewning, and Martin Taylor, "Organizational-Professional Conflict and the Job Satisfaction and Turnover Intentions of Internal Auditors," *Auditing: A Journal of Theory and Practice* 5 (Spring 1986): 109-21.

- Is the innovation decision of internal auditors related to their level of organizational commitment?

Implementation Research

Most diffusion of innovations researchers focus on the processes leading to a decision to adopt or reject an innovation. Their assumption, although not always explicitly stated, has been that once the decision to adopt has been made, implementation automatically proceeds as planned and the innovation becomes part of the routine. Implementation researchers do not make that assumption. They have studied the implementation process and find it to be as complex as the adoption decision process. Implementation research has been carried out primarily in four fields - education, information systems, public administration, and operations research/management science (OR/MS).³⁵

Implementation researchers have taken approaches similar to those followed by diffusion researchers. The primary objective of their research has been to identify factors that are related to successful implementation of innovations. In a series of studies, Lucas has found that four categories of variables are associated with the successful implementation of management information systems (MIS).³⁶ He has found that system characteristics, organizational attitudes, situational factors, and personal factors interact in a complex manner resulting in personal attitudes of the user toward the new MIS. These attitudes ultimately affect the success of the implementation. Schultz and Slevin hypothesized that the probability of successful implementation of an innovation was related to the

³⁵ Robert K. Wysocki, "OR/MS Implementation Research: A Bibliography," *Interfaces* 9 (February 1979): 37-41.

³⁶ Henty C. Lucas, Jr., *The Implementation of Computer-Based Models* (New York: National Association of Accountants, 1976); *Why Information Systems Fail* (New York: Columbia University Press, 1975); "The Implementation of an Operations Research Model in the Brokerage Industry." *TIMS Studies in the Management Sciences* 13 (1979): 139-54.

innovation's technical validity and its organizational validity.³⁷ They found that individual attitudes were the most important factors in predicting organizational validity.

One area studied by implementation researchers which was not addressed by diffusion researchers, was the organizational climate effect on the innovation decision. Implementation researchers have consistently found that a major impact is imparted by the implementor's perceptions of management support for innovation and change.³⁸

Of importance to the dissertation was the recognition that implementation research has reached conclusions similar to those reached by the diffusion of innovation researchers. That is, the innovation decision process at any stage appears to be affected by innovation characteristics, personal characteristics, and organizational characteristics. One additional question was derived from this area of research.

- Does management support for innovation affect the auditor's innovation decision?

Innovation Research in Accounting

Rogers' model has been subjected to limited tests by accounting researchers. In a study of accounting method choices, Tritschler introduces the diffusion of innovations research findings, suggesting that the five attributes of innovations may also provide explanations for the adoption or rejection of accounting methods.³⁹ Subsequently, Copeland and Shank, using Rogers' five attributes

³⁷ Randall L. Schultz and Dennis P. Slevin, "Implementation and Organizational Validity: An Empirical Investigation," *Implementing Operations Research/Management Science* eds. Randall L. Schultz and Dennis P. Slevin, (New York: American Elsevier Publishing Company, Inc., 1975), pp.153-81.

³⁸ Lucas, "Descriptive Model of Implementation," pp. 27-42.

³⁹ Charles A. Tritschler, "A Sociological Perspective on Accounting Innovations," *The International Journal of Accounting* (Spring 1970): 39-67.

in an attempt to explain reasons for changing inventory methods to LIFO, were unsuccessful in their attempt to describe accounting methods as innovations and suggest that the model is not appropriate for the financial accounting setting.⁴⁰ Hicks, however, was successful in finding systems effects in the financial accounting environment.⁴¹ Although this is not an attribute study, Hicks' findings suggest that the diffusion of innovations model may be useful in describing the accounting policy setting process. Hussein follows this line of thought. He successfully uses the attributes of accounting innovations to explain Financial Accounting Standards Board research staff positions.⁴²

Younkins attempts to determine whether the perceptual attributes of financial accounting innovations are related to their level of acceptance by members of several groups interested in the accounting policy process.⁴³ He surveyed accounting professors, CPA's, bank loan officers, corporate financial executives, financial analysts, and management accountants. The questionnaire was designed to capture the respondents' perceptions of the attributes of current-value accounting, big GAAP vs. little GAAP, capitalized advertising expenditures, and published audited financial forecasts. The attributes examined were the five Rogers attributes plus reliability, perceived risk, and practicability. Younkins finds a statistically significant relationship between the participants attitudinal acceptance of the accounting innovations and their perceptions of the innovations' levels of relative advantage, compatibility, observability, perceived risk, and practicability.

⁴⁰ Ronald M. Copeland and John R. Shank, "LIFO And the Diffusion of Innovations," *Empirical Research in Accounting: Selected Studies* (1971): 196-230.

⁴¹ James O. Hicks, Jr., "An Examination of Accounting Interest Groups' Differential Perceptions of Innovations," *The Accounting Review* (April 1978): 371-88. Systems effects are the influences of the structure and/or composition of a system on the behavior of the members of the system. In the classic diffusion model, these effects impede the diffusion of innovations.

⁴² Mohamed E. Hussein, "The Innovation Process in Financial Accounting Standard Setting," *Accounting, Organizations, and Society* (Winter 1981): 27-37.

⁴³ Edward W. Younkins, "An Examination of Perceptions and Acceptance of Accounting Innovations and Changes by Accounting Interest Groups: Implications for the Financial Accounting Standards-setting Process" (Ph.D. Dissertation, The University of Mississippi, 1984).

While there have been a few studies of the accounting choice and accounting policy setting process as innovation processes, no studies to date have attempted to use the diffusion of innovations research findings in the management accounting or auditing environments.

Chapter 3

Methodology

This research is an exploratory analysis of the innovation decision process of internal auditors. Three areas of inquiry are pursued in this study. The first area of inquiry, based upon Rogers' diffusion model, is designed to determine whether internal auditors' perceptions of the attributes of an auditing innovation are related to the extent of application of the innovation. The second area of inquiry seeks to determine whether the professionalism, organizational commitment, professional commitment, or innovative decision style of internal auditors is related to their use of an auditing innovation. Finally, an attempt is made to analyze the impact of organizational characteristics on the innovation decision process. Data for this study were gathered by means of a mail questionnaire survey of internal audit directors.

This chapter contains four sections. The first section discusses the research model and hypotheses to be studied. The second section discusses the population, sample selection, and survey procedures. The third section discusses the development of the questionnaire and measurement of the variables of interest. The final section of this chapter concludes with an overview of the data analysis techniques.

The Innovation, Research Model and Hypotheses

The Innovation - Statistical Sampling

In order to pursue research into the innovation decision process in auditing, the study focused on the internal auditor's innovation decision process regarding the use of statistical sampling in auditing practice. Auditors were asked to respond to questions regarding their use of (1) dollar unit sampling, (2) the attributes sampling techniques - attributes sampling, stop or go sampling, and discovery sampling, and (3) the variables sampling techniques - ratio estimation, mean per unit estimation, and difference estimation.

On the meaning of the term "innovation", Rogers writes:⁴⁴

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

Although statistical sampling techniques in auditing have a history of over 50 years,⁴⁵ there is evidence that the extent of use of the techniques varies considerably across auditors. Surveys of internal auditors suggest that the implementation of these technologies is far from completed. In a 1978 survey of internal audit managers, 71% of the respondents used statistical sampling, but the extent of use was low. The percentage of managers who used statistical sampling less than 35% of the time ranged from 55% for attributes sampling to 89% for variables sampling.⁴⁶ In a 1981 survey, 18% of the respondents never used statistical sampling and 57% of them used the tech-

⁴⁴ Rogers, *Diffusion*, p. 11.

⁴⁵ William R. Kinney, Jr., ed. *Fifty Years of Statistical Auditing* (New York and London: Garland Publishing, 1986).

⁴⁶ Larry E. Rittenberg and Bradley J. Schweiger, "The Use of Statistical Sampling Tools - Parts I and II," *The Internal Auditor* (August 1978): 27-44.

niques less than one-third of the time.⁴⁷ In a survey of internal auditors in commercial banking, two-thirds of the respondents used statistical sampling techniques, but 70% of them used the techniques less than 50% of the time.⁴⁸ The studies demonstrate a wide range of usage of statistical sampling by internal auditors. There are no recent surveys to indicate whether the status of statistical sampling usage has changed.

If the current study confirms that the wide variation in usage continues to exist, then a cross-sectional survey should capture information from individual organizations having a broad range of experience with the techniques. This was important to the research objectives. The models of the diffusion process that serve as the basis for this study describe processes that take place over time. In lieu of a longitudinal study of an innovation process, a cross-sectional study was chosen. Tests of the relationships can only be made if there is a variation in the extent of usage of the innovation(s) under study. These differences in the extent of use serve as a proxy for the time variable.

The Research Model and Hypotheses

The research discussed in the background section indicates that the innovation decision process is related to the perceived characteristics of the innovation, personal characteristics of the individual decision maker, and the effects of organizational variables on the decision maker. One issue that has not been extensively addressed in the research to date is how these variables together affect the innovation decision. The predominant view appears to be that the decision is a result of the interaction of the variables.

⁴⁷ Blaine A. Ritts and Timothy L. Ross, "How Well Do Internal Auditors Know and Use Statistical Sampling?" *The Internal Auditor* (February, 1983): 27-34.

⁴⁸ Richard A. Scott, Julie L. Garrison, and John H. McCray, "The State of the Art in Internal Auditing in Commercial Banking," *The Internal Auditor* 40 (October 1983): 53-56.

One reviewer of diffusion literature concludes that there is little profit to be gained in studying the characteristics of the innovation without studying the characteristics of the individuals and the interactive effects of both sets.⁴⁹ Downs and Mohr are critical of diffusion research that does not consider the possible effects of interactions between individual characteristics and the characteristics of innovations. Their criticism is related to their belief that the characteristics of innovations are relative concepts and that each adopting unit is likely to have different perceptions of the characteristics of the innovation.⁵⁰ Downs and Mohr criticize research that does not recognize the interaction between organizational characteristics and innovation characteristics.⁵¹ Lancaster and Taylor emphasize that studies have not been comprehensive enough. They find that innovation research has been one-dimensional. That is, the research has focused on the characteristics of the individuals or on the characteristics of the innovations.⁵² In a study of the implementation of a management information system, Markus finds that the resistance to the system is the result of an interaction between characteristics related to people and characteristics related to the system.⁵³ Schultz and Slevin's concept of organizational validity is composed of an interaction of organizational and personal variables.⁵⁴ Souder, et al. propose that the willingness to adopt an OR/MS model is directly related to model characteristics, but the evaluation of characteristics is affected by organizational factors and personal factors.⁵⁵ Lucas' model describes the decision maker as formulating attitudes toward the model. The attitude formulation is affected by personal and situational factors. Successful implementation is related to the attitudes formed as a result of the interaction process.⁵⁶

⁴⁹ Kennedy, p. 88.

⁵⁰ George W. Downs and Lawrence B. Mohr, "Conceptual Issues in the Study of Innovation," *Administrative Science Quarterly* 21 (December 1976): 700-14.

⁵¹ *Ibid.*, pp. 701-707.

⁵² Lancaster and Taylor, p. 18.

⁵³ M. Lynne Markus, "Power, Politics, and MIS Implementation," *Communications of the ACM* 26 (June 1983) p. 431.

⁵⁴ Schultz and Slevin, "Organizational Validity," pp. 153-81.

⁵⁵ W. E. Souder, et al., "An Organizational Intervention Approach to the Design and Implementation of R & D Project Selection Models," in Schultz and Slevin, *Implementing OR/MS* pp. 133-62.

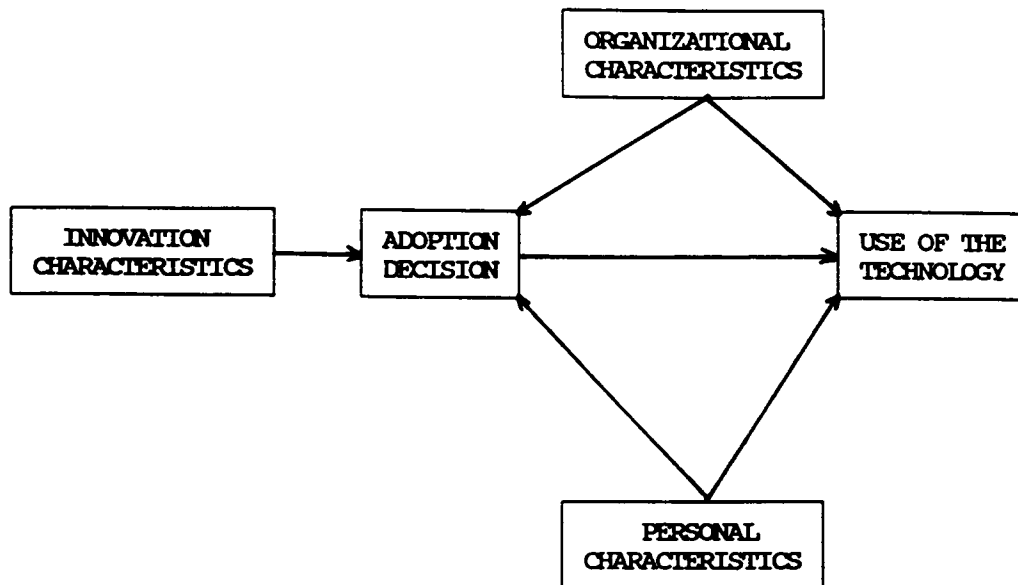
⁵⁶ Lucas, "Empirical Evidence for a Descriptive Model", pp. 27-42.

A research model incorporating the relationships found by previous research is depicted in Figure 4 on page 29. This model is an adaptation of the model proposed by Lucas.⁵⁷ It depicts the use of the new technology as being directly related to the attitude that the decision maker has formulated toward the technology. This attitude is directly related to the decision maker's perceptions regarding the characteristics of the technology. The formulation of the attitude takes place in the persuasion stage of Rogers' innovation decision process model. The process of proceeding from the attitude formulation to the use of the technology corresponds to the decision and implementation stages.

The effect of personal and organizational variables is shown in both stages of the research model. How or when these variables affect the process is not apparent from the literature. In the attitude formulation process, the model suggests that personal characteristics could affect the decision maker's perception formulation. For example, a professionally oriented individual may consistently evaluate innovations as being lower in complexity than a nonprofessional. Or, personal characteristics may affect the attitude formulation after the decision maker has evaluated the characteristics of the innovation. For example, both professional and nonprofessional individuals may perceive the same level of complexity, but the professional may have a more favorable attitude toward innovations in general. The same relationships may hold for the effects of organizational variables.

Once an attitude has been formed regarding the new technology, the behavior (use or nonuse) follows. However, the model provides for the possibility that personal and organizational characteristics will affect the implementation process. Therefore, favorable attitudes toward the new technology may not necessarily lead to extensive use. For example, the decision maker may have a favorable attitude toward the technique, but lack of organizational resources may prevent him or her from using it.

⁵⁷ Ibid., p. 28.



Innovation Characteristics:

Relative Advantage
 Trialability
 Observability
 Complexity

Organizational Characteristics:

Management Support for
 Innovation
 Organization Size
 Audit Staff Size

Personal Characteristics:

Professionalism
 Cosmopolitanism
 Creativity Decision Style
 Organizational Commitment
 Age, Education, Experience
 Professional Commitment

Figure 4. Research Model

The aim of this research is to test whether the suggested relationships between innovation characteristics, personal characteristics, organizational characteristics, and the use of innovations are present in internal auditing settings. Specifically, the research attempts to determine whether the internal auditors' use of statistical sampling techniques can be explained by these variables. The following hypotheses will be tested:

- H1₀:** There is no association between the extent of use of statistical sampling techniques and their perceived relative advantage, compatibility, trialability, and observability or the association is negative. There is no association between the extent of use of statistical sampling techniques and their perceived complexity or the association is positive.
- H1A:** The extent of use of statistical sampling is positively associated with its perceived relative advantage, compatibility, trialability, and observability and negatively associated with its perceived complexity.
- H2₀:** There is no association between the extent of use of statistical sampling techniques and the degree of professionalism and level of professional commitment of the auditor or the association is negative.
- H2A:** The extent of use of statistical sampling is positively related to the degree of professionalism and to the level of professional commitment of the auditor.
- H3₀:** The extent of use of statistical sampling is not associated with the level of organizational commitment of the auditor or the association is negative.
- H3A:** The extent of use of statistical sampling is positively related to the level of organizational commitment of the auditor.
- H4₀:** The extent of use of statistical sampling is not associated with the decision maker's innovation decision style.
- H4A:** The extent of use of statistical sampling is associated with the decision maker's innovation decision style.
- H5₀:** The extent of use of statistical sampling is not associated with the perceived support for innovation in the auditor's organization or the association is negative.
- H5A:** The extent of use of statistical sampling is positively related to the perceived support for innovation in the auditor's organization.
- H6₀:** The extent of use of statistical sampling is not associated with the size of the auditor's organization.
- H6A:** The extent of use of statistical sampling is associated with the size of the auditor's organization.

In addition to the specific relationships tested, a number of variables were measured and tested for association with the use of statistical sampling. These variables included industry affiliation, staff size, auditor experience, and education levels. These variables were identified in the innovation research literature as having been found to be related to innovative behavior. They are used as controlling variables in the data analysis.

Testing the first hypothesis provides evidence about the validity of Rogers' model relating the attributes of innovations to their use in internal auditing settings. Testing the remaining hypotheses provides evidence concerning the relationships of key individual and organizational variables to the extent of use of an innovative auditing technology.

Research Design

Bigoness and Perreault, Jr. suggest that innovativeness is a relative construct that can be characterized along three dimensions. The innovativeness domain is similar to the concepts used in many studies, i.e. some measurement of innovativeness. The content domain refers to the nature of the innovation of interest ranging from very specific innovations to very general innovations. The reference domain refers to the boundaries defining the social system within which the organization's innovativeness will be compared or contrasted.⁵⁸

Downs and Mohr criticize many organizational studies for their approach to measuring innovativeness. Many researchers have measured innovativeness by determining the percentage of a set of innovations adopted by an organization. This measurement results in the treatment of innovations as being homogeneous, which they argue is not the case. To correct this deficiency,

⁵⁸ William J. Bigoness and William D. Perreault, Jr., "A Conceptual Paradigm and Approach for the Study of Innovators," *Academy of Management Journal* 24 (March 1981): 68-82.

Downs and Mohr suggest that researchers adopt the innovation decision design that treats an organizational decision about a particular innovation as one observation. This design enables the researcher to analyze the homogeneity of the set of innovations, and to determine the characteristics of the organization related to the innovation decision.⁵⁹

The suggestions of Downs and Mohr and Bigoness and Perrault, Jr. are incorporated into this study. First, the innovation decision design is followed by asking the individual auditors to evaluate each statistical sampling technique's characteristics, and to report his or her use of the technique. Secondly, the three domains of innovativeness are defined. The innovativeness domain refers to the extent of use of the statistical sampling techniques. The content domain is a set of specific audit technologies, statistical sampling, and the reference domain is the set of internal audit departments. This allows for conclusions about the innovativeness of internal audit departments relative to statistical sampling technologies and similar types of technologies. It does not, however, allow generalizations to be made regarding the overall innovativeness of internal auditors with respect to all types of innovations.

Data Collection Methodology

The findings of the innovation research discussed in Chapter 2 were based on data collected primarily through the use of two data collection methodologies - field studies and surveys. A field study was rejected as the data collection methodology for this study. This project is an exploratory study of an innovation process in auditing, a field that has not been previously studied. An objective of this research is to attempt to draw conclusions about the innovation process in the field of internal auditing. A field study of the scope that would be sufficient to meet that objective would

⁵⁹ Downs and Mohr, "Conceptual Issues", pp. 706-07.

have been prohibitively costly. Therefore, a survey was selected as the means of data collection. The choice between an interview survey and a mail survey was based primarily upon the amount of data that would be collected. As will be discussed later, the questionnaire requires over 200 responses from each participant. It is difficult to imagine being able to recruit enough participants willing to endure a lengthy telephone interview, and it was too expensive for the researcher to visit participants and administer interviews. Therefore, a mail survey is used as the data collection methodology.

The following sections discuss the data gathering process. The topics discussed are the identification of the population and sample, the development of the questionnaire, and the schedule followed in the survey mailings.

Population and Sample

A research issue that has been debated in the studies of diffusion in organizations is the question of where and how the adoption decision is made. Since most organizational decisions are the product of interactions of individuals, the validity of studies that have relied upon the responses of one member of the organization have been challenged. The respondent is often an executive at an upper level of management who may be far removed from the actual decision-making process.

Data for this study were gathered by means of a mail survey of internal audit managers. A survey of audit managers mitigates some of the criticisms of diffusion research in organizational settings mentioned above. An internal audit department is assumed to be autonomous, particularly when it comes to selecting appropriate audit procedures. Therefore, little or no involvement in this type of decision by members of the organization outside the department is expected. In addition, the latest survey of internal audit practice reported that the median staff size is seven auditors and over

70% of the departments had staffs of fewer than ten auditors.⁶⁰ Professional standards require that proper planning and review be performed in an audit examination.⁶¹ The combined effects of professional standards, small staff size, and organizational autonomy lead to the expectation that the internal audit manager is involved in the decision to select new auditing techniques and is the appropriate respondent to this survey. In the event that the internal audit director was not currently involved in the development, review, or approval of audit programs and procedures, directions were given to the director to pass the questionnaire on to an individual with those responsibilities. The questionnaire included five questions asking the respondent to indicate the extent of his or her involvement with decisions regarding the use of auditing procedures and the development of auditing programs. The items are presented in Figure 5 on page 35. The response is made on a five point scale with 1 = always and 5 = never. Responses to these items serve to provide some assurance as to the appropriateness of the respondent.⁶²

A mailing list was obtained from the Institute of Internal Auditors (IIA) which included all of the internal audit directors who were members of the IIA as of August 28, 1987. The list was restricted to directors from the United States. There were 3,401 directors on this list. This mailing list served as the population for this study.

The sample size was determined in the following manner. Standard formulas for determining sample sizes require an estimate of the variance of the item being sampled. In this study, there are fourteen significant variables being measured. In addition, since this is an exploratory study, estimates of the variances were likely to be unreliable. Also, the sampling formulas assume 100% participation in the sample by the sample units. It is known with certainty that the participation

⁶⁰ Kenneth R. White and James A. Xander, *Survey of Internal Auditing: Trends and Practices* (Altamonte Springs, FL: Institute of Internal Auditors, 1984).

⁶¹ The Institute of Internal Auditors, Inc., *Standards for the Professional Practice of Internal Auditing* (Altamonte Springs, FL: The Institute of Internal Auditors, Inc., 1978)

⁶² These items are an adaption of the measure of centralization developed by Jerald Hage and Michael Aiken reported in Robert D. Dewar, David A. Whetten, and David Boje, "An Examination of the Reliability and Validity of the Aiken and Hage Scales of Centralization, Formalization, and Routineness," *Administrative Science Quarterly* 25 (March 1980): 120-128.

1. How frequently do you participate in the decision to adopt new audit procedures?
2. How frequently do you participate in the decision to audit new areas?
3. How frequently do you participate in the development of new audit programs?
4. How frequently do you participate in the decision to hire new audit staff?
5. How frequently do you participate in the decisions on promotion of any of the professional staff?

Figure 5. Decision-Level Items

rate will be considerably lower than 100%. Therefore, the sample size was determined based upon the desire to have a sufficient number of responses to perform the desired statistical analyses. Consideration was also given to the ability to generalize the results. While the number of individual respondents was expected to be small, each of them represents an organization. It was hoped that the range of organizations represented will increase the generalizability of the results.

The response rates for the population of internal audit directors was not expected to be very high. This expectation was based on two facts. First, reported response rates from survey studies using the same population have ranged from 8% to 50%, with most studies having response rates around 20% to 25%. Secondly, the questionnaire is relatively long. It is 14 pages long and takes a respondent approximately one hour to complete.

A target number of responses of 200 was established as the basis for the number of questionnaires to be mailed. Using an expected response rate of 25%, 800 names were randomly selected from the IIA mailing list. A package was sent to the named individual that included a cover letter explaining the nature of the study, a two page description of the questionnaire,⁶³ the questionnaire and a pre-paid return address envelope. The questionnaire design and mailing procedures were patterned after the "Total Design Method" of Dillman.⁶⁴ The entire package is reproduced and included in Appendix A.

In order to minimize postage costs, a mailing was made to only 500 of the selected names on October 28, 1987. This mailing was followed by a postcard requesting that the recipients of the original questionnaire please respond. The postcards were sent two weeks after the original mailings. It was hoped that the response rate would be 40% or higher, thereby eliminating the need to survey the remaining 300 audit directors. After six weeks, only 160 responses were received.

⁶³ This description was added to the final mailing in response to complaints received from a couple of respondents to the pilot study. Their comments indicated that they felt that several of the sections were irrelevant to the subject of the study. Therefore, a more lengthy description of the instrument was added to the package with the hope that it would increase the response rate.

⁶⁴ Don A. Dillman, *Mail and Telephone Surveys: The Total Design Method* (New York: John Wiley & Sons, 1978).

The mailing to the remaining 300 directors was delayed until after the holiday season and year-end. The mailing was sent on February 4, 1988. In addition, a second mailing was made to 100 of the nonrespondents from the first mailing. Both the new mailing and the follow-up mailing included a complete package of materials. Post cards were sent to the new list of directors two weeks after the mailing. Responses were received until March 11, 1988. A summary of the mailing and response rates is in Figure 6 on page 38. In Figure 7 on page 39, an analysis of the sample and response rates is presented by industry type. This summary was used as one means of evaluating the amount of bias that was introduced into the results as a result of nonresponse. Response rates ranged from a low of 14.7% for heavy manufacturing to a high of 45% for utilities and transportation companies. The only organization type that appears to be affected by the nonresponse is the heavy manufacturing industry. These companies represented 8.5% of the original 800 targeted participants, but make up only 3.9% of the final sample. In addition, the number of insurance companies increased from 7.4% of the original 800 to 10% of the final responses. Service industries showed a similar increase. When the composition of the original random sample of 800 is compared to the composition of the 260 respondents, there does not appear to be any significant amount of bias introduced to the results as a result of nonresponse.

A second method for evaluating nonresponse bias was to treat late respondents as nonrespondents and compare their responses to those of early respondents. The mean responses for the dependent and independent variables were compared between the 30 earliest respondents and the 30 latest respondents. No statistically significant differences were noted, adding strength to the conclusion that nonresponse has not significantly affected the analysis of the results.

MAILING	DATE	NO. MAILED	RESPONSES	%
1st	10/28/87	500	164	32.8
Follow-up	2/4/88	100	18	18.0
2nd	2/4/88	300	78	26.0
Totals		800	260	32.5

Figure 6. Summary of Mailing Dates and Response Rates

<u>Industry Classification</u>	<u>No. Mailed</u>	<u>% of total Mailed</u>	<u>No. Received</u>	<u>% of total Received</u>	<u>Response Rate</u>
Mining, Oil, & Gas	28	3.5	6	2.2	21.4%
Food Products	24	3.0	9	3.5	37.5
Textiles, Lumber, Paper	18	2.3	4	1.7	22.2
Publications, Communications	27	3.4	8	3.0	29.6
Chemical, Pharmaceutical	21	2.6	7	2.6	33.3
Equipment Manufacturing	68	8.5	10	3.9	14.7
Utilities, Transportation	40	5.0	18	6.9	45.0
Wholesale & Retail	44	5.5	10	3.9	22.7
Banks, Savings & Loan, Credit Unions	227	28.4	70	26.8	30.8
Financial Services	26	3.2	7	2.6	26.9
Insurance	59	7.4	25	10.0	42.4
Services	69	8.6	29	11.3	42.0
Government Agencies	82	10.3	33	12.6	40.2
Non-profit	46	5.7	18	6.9	39.1
Other Manufacturing	<u>21</u>	<u>2.6</u>	<u>6</u>	<u>2.2</u>	<u>28.6</u>
Totals	800	100.0	260	100.0	32.5%

Figure 7. Original Mailings and Responses by Industry

Questionnaire Development

The following sections provide a discussion of the questionnaire design issues addressed in this research. The objective of the questionnaire development was to develop an instrument capable of providing measures of the key variables being investigated. The task was constrained by the secondary objective of designing an instrument that would generate a reasonable rate of response at a reasonable cost. Therefore, the tradeoff between the number of questionnaire items, the anticipated response rate, and the cost of data collection were continually evaluated.

The questionnaire was developed in three stages. First, sections of the questionnaire were developed based upon the review of the innovation research literature. The sections were designed to measure the relevant variables for the tests of the hypothesized relationships. In order to minimize the possibility that the study's conclusions might be confounded by weaknesses in the variable measurement, an attempt was made to adapt existing instruments for this study.

Upon its completion, the initial instrument was pretested for clarity and relevance with 8 internal audit managers. The questionnaire was then mailed to 100 internal audit managers. The usable response rate to the pilot study mailing was 40 per cent. The pilot study results were analyzed and modifications were made to the questionnaire. The revised questionnaire was used to gather the data for this study.

The Dependent Variable - Extent of Use

The dependent variable in innovation research has been defined and measured in several different ways. The dependent variable has been defined as (1) adoption or nonadoption of a particular in-

novation, (2) the number of innovations adopted, (3) the intention to adopt innovations, (4) the extent of use of an innovation(s), and (5) the degree of successful implementation of an innovation.

For this study, two measures are chosen for the dependent variable. The adoption decision is examined by defining the dependent variable as the adoption or nonadoption of the statistical sampling technique(s). The innovation decision process is examined by defining the dependent variable as the extent of use (EOU) of statistical sampling techniques. Downs and Mohr argue that operationalizing innovation by the extent of implementation is what researchers want to explain.⁶⁵ This measure would reflect the organizational commitment to the innovation.

A key methodological problem was the measurement of the extent of use of the innovation. In a review of 74 implementation studies performed for the National Science Foundation, Scheirer and Rezmovic found that applied researchers have not developed standard methodologies for measuring the implementation of innovations.⁶⁶ They found the most objective measures in the studies of MIS and policy implementations where there was documented evidence of the use of the new system or policy. Where documentation of the extent of use is not available, an alternative is to gather self-reported measures of the degree of satisfaction or the level of success with an innovation.⁶⁷ Another alternative is to have the respondents report either the extent of use of the innovations or the stage in the innovation process that they perceive their organization to be in relative to a particular innovation. It is this approach that was followed for the measurement of the dependent variable of this research study.

⁶⁵ Downs and Mohr, "Conceptual Issues", p. 709.

⁶⁶ Mary Ann Scheirer and Eva Lantos Rezmovic, "Measuring the Degree of Program Implementation: A Methodological Review," *Evaluation Review* 7 (October 1983): 599-633.

⁶⁷ Michael J. Ginzberg, "A Study of the Implementation Process," *TIMS Studies in the Management Sciences* 13 (1979): 85-102. Alden S. Bean, et al., "Structural and Behavioral Correlates of Implementation in U.S. Business Organizations," Chapter 5 in Schultz and Slevin, pp. 77-131.

The measure used in the pilot study instrument was a six point scale developed by Zmud.⁶⁸ This scale, reproduced in Figure 8 on page 43, was designed to identify users located in two stages of the process. Statements 1 and 2 are the adoption stage and statements 3 through 6 are in the implementation stage.

In the pilot study questionnaire, respondents were asked to identify the appropriate level of their organization's use of attributes sampling, stop or go sampling, discovery sampling, difference sampling, mean per unit sampling, ratio sampling, dollar unit sampling, and regression sampling. They were asked to identify the level of use in financial and operational audits. In addition, they were asked to identify the level of use of the techniques in eight audit areas, e.g. the audit of purchases and disbursements or the audit of sales and collections.

Analysis of the pilot study results indicated that the attempt to measure the extent of use of statistical sampling in specific audit areas would not be successful. There was little variation in the responses, with a significant number of zero or nonresponses. Comments received from participants also indicated that the task was too difficult to answer without the individuals doing some research into their audit practice. Since it was believed that this section would negatively affect the response rate and provide little useful information, it was dropped from the final instrument.

Analysis of the responses to the level of use in financial and operational auditing were more promising and were incorporated into the final instrument. The Zmud scale was modified, however, for the final questionnaire. It was decided that the 6-point scale was not extensive enough to describe the levels of use for a wide range of participants such as the internal audit groups being surveyed. Therefore, a nine-point scale was included in the final questionnaire. This scale was adapted from the scales used by Ettlie.⁶⁹ The scales used in the Ettlie studies were composed of

⁶⁸ Robert W. Zmud, "Diffusion of Modern Software Practices: Influence of Centralization and Formalization," *Management Science* 28 (December 1982): 1427, and "An Examination of 'Push-Pull' Theory Applied to Process Innovation in Knowledge Work," *Management Science* 30 (June 1984): 731.

⁶⁹ John E. Ettlie, William P. Bridges, and Robert D. O'Keefe, "Organization Strategy and Structural Differences for Radical Versus Incremental Innovation," *Management Science* 30 (June 1984): 686.; John E. Ettlie, "The Impact of Interorganizational Manpower Flows on the Innovation Process," *Management*

Please circle the number corresponding to your level of use of the statistical sampling technique.

LEGEND:

0= Not an Audit Area

1= Never Used

2= Occasional Use

3= Frequent Use

4= Regular Use

5= Routine Use

Figure 8. Zmud's Extent of Use Measure

descriptions of innovation behaviors. They were developed for use in personal interviews. The participants were asked to determine which stage they were in based upon the descriptions. Even though the scales were originally developed for interview surveys, they appear to be equally appropriate for mail surveys.

The measurement scale used in the final questionnaire is shown in Figure 9 on page 45. The respondents' were provided with descriptions of behaviors representing each stage in the innovation process and were then asked to respond as to which level best described their level of use of the eight statistical sampling techniques in both financial audits and operational audits. The cutoff used to identify adopters was response number 6. Respondents indicating an EOU of 6 or greater were considered to have adopted the technique. Responses of 5 or less were nonadopters.

Perceived Characteristics of Statistical Sampling

Research Hypothesis One concerns the relationships between the auditor's perceptions of the characteristics of statistical sampling and his or her extent of use of the techniques. In this section, the development of the scale designed to measure the perceived characteristics of the sampling procedures is presented.

This section of the questionnaire was designed to measure the relative advantage, complexity, compatibility, observability, and trialability of three classes of statistical sampling techniques - variables sampling, attributes sampling, and dollar unit sampling. The review of previous studies where attempts were made to measure these variables indicated that nearly all of the studies used a single item measure of the respondent's perceptions. For example, the respondent would be asked to evaluate an innovation in terms of its complexity.

Science 31 (September 1985): 1058. Original materials used in these studies were provided by the first author.

Item Number	Explanation
1 = REJECTED	We have decided that the technique is not for us.
2 = LESS THAN VERY FAMILIAR	We are aware of the technique, but we do not have full understanding of it.
3 = VERY FAMILIAR	We understand the basic concepts of using the technique, but we are not actively considering its use.
4 = CONSIDERING	We have gathered specific information necessary to make decisions about whether or not to use the technique.
5 = EXPERIMENTING	We have decided to try the technique in limited applications, and are evaluating its acceptability to us.
6 = USED ON A FEW AUDITS	We have decided that the technique is appropriate for our use and are using it on less than one-third of the potential applications.
7 = USED ON SEVERAL AUDITS	We are using the technique of 1/3 to 1/2 of the potential audit applications.
8 = USED ON MOST AUDITS	We are using the technique on 1/2 to 3/4 of the potential audit applications.
9 = STANDARD PRACTICE	We now use this technique in every application where we believe it is appropriate.

Figure 9. Extent of Use Section of Final Questionnaire

Single-item measures of perceptions have serious limitations. Nunnally explains that single items usually have a low degree of relationship with the particular attribute of interest.⁷⁰ This is especially true when the definition of the attribute is at an early stage of development. In addition, one item divided into a five or seven step scale means that, at most, only five levels of that attribute can be distinguished.⁷¹ More levels of distinction can be derived by combining responses to more items. The most important weakness of using the single-item scale is that single items have considerable measurement error and are very unreliable.⁷² Given these limitations, it was decided that multiple item scales were needed to measure the auditors' perceptions of the characteristics of the statistical sampling techniques.

The literature was reviewed to identify studies where multi-item scales were used with the objective of adapting those scales for use in the current study. No study was identified that utilized the methodology intended to be used for this study. Therefore, a multi-item scale was created for each of the five attributes variables.

Each of the variables of interest are abstract constructs. In developing a scale to measure these variables, the objective was to generate a number of items that would encompass a substantial portion of the content domain of each variable. For example, the complexity of an innovation is defined as the degree to which it is perceived to be difficult to understand or use. The first step in developing items for this variable was to attempt to identify different aspects of the content domain of this term. Complexity could refer to the difficulty in understanding, learning, or using the innovation or to the difficulty of instructing subordinates as to its proper use. The generation of items intended to cover some of these connotations was begun by reviewing the existent innovation research to identify statements descriptive of some aspect of the variables of interest. One study that

⁷⁰ Jum C. Nunnally, *Psychometric Theory* (New York: McGraw-Hill, 1978), p. 66.

⁷¹ *Ibid.*, p. 67

⁷² *Ibid.*, p. 67.

used a similar approach to this was Holloway.⁷³ In this study of the diffusion of an educational program, Holloway began with 42 items and factor analyzed the responses, identifying five factors that were similar to the Rogers variables. Items from Holloway were selected on the basis of how well they describe the characteristics of statistical sampling. Other sources of items came from Zmud⁷⁴ and from Deshpande and Zaltman.⁷⁵ Another source of items was the survey research reporting the extent of use of statistical sampling in the auditing profession.⁷⁶ Open ended questions in these studies asked the participants to indicate why they were or were not using statistical sampling techniques. These responses often reflected perceptions of complexity, compatibility, relative advantage, trialability, and observability.

The original generation of items resulted in 52 items. There were 15 relative advantage items, 5 trialability items, 7 complexity items, 7 observability items, and 17 compatibility items. The items are reproduced in Figure 86 on page 193. In order to evaluate the content validity of the items, an instrument was prepared listing the 52 items in random order. The instructions of the instrument included definitions of the five variables, and directed the participants to classify each item by matching it with its closest definition. This instrument was completed by 43 senior accounting students at Virginia Tech. The responses were summarized and the level of consensus was examined. The highest five items in terms of consensus of classification for each variable were selected for use in the construction of the measurement scale.

In order to reduce the length of the questionnaire, it was decided to use four items for each variable in the pilot study. Respondents were asked to respond according to their level of agreement to each statement on a scale of 1 to 5, anchored by strongly agree and strongly disagree. They were asked

⁷³ Robert E. Holloway, "Perceptions of an Innovation: Syracuse University Project Advance," Ph.D. dissertation, Syracuse University, 1977.

⁷⁴ Zmud, "Push-pull Theory" and "Modern Software".

⁷⁵ Rohit Deshpande and Gerald Zaltman, "Factors Affecting the Use of Market Research: A Path Analysis", *Journal of Marketing Research* 19 (February 1982): 14-31.

⁷⁶ Rittenberg & Schweiger; Ritts and Ross; Scott, et al.

to respond to each item as they perceived it relative to attributes sampling, variables sampling, and dollar unit sampling. Twenty items were answered for each sampling technique giving a total of 60 responses to this section.

The pilot study results were analyzed in order to determine whether the scales that had been created had a reasonable level of reliability. Cronbach Alpha was calculated for each scale. Using .65 as a reasonable factor, compatibility, complexity, and relative advantage were acceptable. The observability scale was marginally acceptable for attributes sampling and dollar unit sampling, but unacceptable for variables sampling. The trialability scale was unreliable.

Since adding items is one way to increase reliability, it was decided to add one item to the five scales. It was hoped that the marginally acceptable factors would be higher as a result. The trialability scale was recreated for the final instrument. There were 25 items, resulting in 75 responses. The measure for each variable is the average of the responses for each of the five items of the scale. Averages were used in order to make use of questionnaires with missing item responses.

Creativity Style

The creativity style of the respondent is measured using the Kirton Adaptor-Innovator Inventory (KAI).⁷⁷ Kirton proposed that:

... everyone can be located on a continuum ranging from an ability to "do things better" to an ability to "do things differently," and the ends of the continuum are labeled *adaptive* and *innovative*, respectively. It is further contended that adaption-innovation is a basic dimension of personality relevant to the analysis of organizational change, in that some people characteristically adapt while some characteristically innovate.⁷⁸

Kirton developed a 32 item scale. Directions included in the instrument ask subjects to imagine having to project a certain image of themselves consistently and over a long period of time. They

⁷⁷ Michael Kirton, "Adaptors and Innovators: A Description and Measure", *Journal of Applied Psychology* 61 (October 1976): 622-629.

⁷⁸ *Ibid.*, p. 622.

are to state how difficult a task that would be using a five point scale anchored by very easy and very hard. The scores are summed, providing a range of 32 to 160 with a theoretical mean for all individuals of 96. Individuals with scores below 96 are adaptors, and those with scores above 96 are innovators. Kirton validated and tested the reliability of the scale using a heterogeneous sample of 532 individuals from the London area. He reported reliability of .88 using the Kuder Richardson Formula 20 and .82 test-retest reliability based on a smaller sample with a seven month interval between the first and second tests. A principal-factor analysis with a varimax rotation yielded three factors. The three factors were labelled originality, methodical Weberianism, and Mertonian conformist.⁷⁹

The KAI has been found to be a robust measure with high reliability levels. Several studies have reported results that indicate the scale has high criterion validity.⁸⁰ The actual instrument is reproduced and included in Appendix A, Figure 59 on page 164.

Professionalism

The professionalism variable is measured using an adaptation of the measure developed by Richard Hall.⁸¹ This scale is designed to measure the attitudinal attributes of professionalism. The five attitudinal attributes are:⁸²

1. The use of the professional organization as a major reference.

⁷⁹ Ibid., pp. 624-25.

⁸⁰ Michael Kirton, "Adaptors and Innovators in Organizations," *Human Relations* 33 (1980): 213-224.; Robert T. Keller and Winford E. Holland, "A Cross-Validation Study of the Kirton Adaption Inventory in Three Research and Development Organizations," *Applied Psychological Measurement* 4 (Fall 1978): 563-570.; George Hayward and Chris Everett, "Adaptors and Innovators: Data from the Kirton Adaptor-Innovator Inventory in a Local Authority Setting," *Journal of Occupational Psychology* 56 (December 1983): 339-342.; and Gordon R. Foxall, "Managers in Transition: An Empirical Test of Kirton's Adaption-Innovation Theory and Its Implications for the Mid-Career MBA," *Technovation* 4 (1986): 219-232.

⁸¹ Richard H. Hall, "Professionalization and Bureaucratization," pp. 92-103.

⁸² Ibid., p.93.

2. A belief in service to the public.
3. Belief in self-regulation.
4. A sense of calling to the field.
5. Autonomy.

Hall developed a 50-item scale composed of 10 items for each attribute of professionalism. He reported reliability levels above .80 for a wide variety of samples of individuals from many occupations. In addition, the professionalism measure was associated in the predicted manner with several bureaucratic measures.

In a subsequent study, Snizek⁸³ reexamined the Hall scale using different sample groups. Snizek's analysis of the factor analysis solutions suggested that the 50 item scale could be reduced to 25 items with little reduction in the scale reliabilities.

Initially, it was thought that the scale developed by Hall would be an appropriate one to measure the professionalism of the internal audit directors. In the pilot study instrument, items from the scales measuring the attributes "belief in self-regulation" and "use of the profession as a major reference" were selected. The exclusion of the other Hall scales was based upon a desire to control the questionnaire length. In addition to the items from the Hall instrument, several items were included in the pilot study that were adapted from Drazin.⁸⁴ Drazin adapted instruments from Storm's⁸⁵ discussion that attempted to identify innovative specialists and innovative generalists. Analysis of the pilot study results showed the Drazin scales to be unreliable and the measure was dropped from consideration for the final questionnaire. After dropping these items, a decision was made to utilize the full 25 item scale of Hall's as suggested by Snizek. This scale is reproduced in Appendix A, Figure 61 on page 166, questions 11 through 35. In the questionnaire, the items were

⁸³ William E. Snizek, "Hall's Professionalism Scale: An Empirical Reassessment," *American Sociological Review* 37 (February 1972): 109-114.

⁸⁴ Robert Drazin, "Professional Orientation and Innovation Preference: A Comparison of Two Models," (Ph.D. dissertation, University of Pennsylvania, 1982).

⁸⁵ Peter M. Storm, "A Developmental Perspective of the Nature of Professionalism and the Effectiveness of Professionals in Complex Organizations," *Proceedings of the 39th Annual Meeting of The Academy of Management* (1979): 210-14.

randomly sorted. The respondents were asked to respond to each statement in terms of their level of agreement or disagreement on a five point scale anchored by strongly agree and strongly disagree.

Another approach to studying professionals in organizations is to locate them along the cosmopolitan-local continuum. This scale is based upon the early work of Gouldner⁸⁶ who suggested that cosmopolitans are individuals who are low on loyalty to the employing organization, high on commitment to specialized role skills, and likely to use an outer reference group orientation. Locals would exhibit opposite characteristics. The cosmopolitan-local construct has been very productive for organizational researchers. Therefore, there are many published studies investigating the properties of the instrument.⁸⁷ The dimensions of the construct that have been most consistently found are professional commitment, organizational commitment, commitment to role skills, and reference group orientation.

Reference group orientation is one of the dimensions of the Hall instrument and is measured using that scale. Professional commitment is measured using the scales adapted from Porter, et al.⁸⁸ This scale has been used by several researchers to study the question of whether there is a conflict between professional and organizational commitment.⁸⁹ The professional commitment scale is reproduced in Appendix A, Figure 60 on page 165, questions 1 through 10. The commitment to

⁸⁶ Alvin W. Gouldner, "Cosmopolitans and Locals: Toward an Analysis of Latent Social Roles - I," *Administrative Science Quarterly* 2 (December 1957): 281-306.; and "Cosmopolitans and Locals: Toward an Analysis of Latent Social Roles - II," *Administrative Science Quarterly* 2 (March 1958): 444-80.

⁸⁷ See for example P. K. Berger and A. J. Grimes, "Cosmopolitan-Local: A Factor Analysis of the Construct," *Administrative Science Quarterly* 18 (June 1973): 223-35.; Victor E. Flango and Robert B. Brumbaugh, "The Dimensionality of the Cosmopolitan-Local Construct," *Administrative Science Quarterly* 19 (June 1974): 235-48; Louis Goldberg, et al., "Local-Cosmopolitan: Unidimensional or Multidimensional?," *American Journal of Sociology* 70 (May 1965): 704-09; Richard G. Schroeder and Leroy F. Imdieke, "Local- Cosmopolitan and Bureaucratic Perceptions in Public Accounting Firms," *Accounting, Organizations, and Society* 2 (1977): 39-45.

⁸⁸ L. W. Porter, R. Steers, R. T. Mowday, and P. V. Boulian, "Organizational Commitment, Job Satisfaction, and Turnover of Psychiatric Technicians," *Journal of Applied Psychology* (October 1974): 603-609.

⁸⁹ Examples of uses of this instrument in accounting and auditing research are N. Aranya, J. Pollock, and J. Amernic, "An Examination of Professional Commitment in Public Accounting," *Accounting, Organizations, and Society* 6 (1981): 271-280.; Nissim Aranya and Kenneth R. Ferris, "A Reexamination of Accountants' Organizational-Professional Conflict," *The Accounting Review* 59 (January 1984): 1-15.; and Adrian Harrell, Eugene Chewning, and Martin Taylor, "Organizational-Professional Conflict and the Job Satisfaction and Turnover Intentions of Internal Auditors," *Auditing: A Journal of Theory and Practice* 5 (Spring 1986): 111-123.

specialized role skills was measured by asking specific questions regarding professional certification, participation in continuing professional education, reading of professional journals, and attendance at professional meetings.

Organizational commitment was measured using the Porter, et al. organizational commitment scale (OCM). The fifteen items of this scale differ from the professional commitment scale by substituting "organization" for "profession".

Additional personal characteristics that are expected to be related to innovative behavior are measured by asking the respondents their age, sex, education level, professional certification, and years of experience.

Organizational Variables

The instrument used for measuring the perceived support for innovation is an adaptation of the Siegel Scale for Support for Innovation (SSSI).⁹⁰ The SSSI was developed to measure the dimensions of organizational climate present in innovative organizations. The five dimensions are:

- The perceived leadership support for innovation.
- The perception of ownership or direct involvement in origination or development of new ideas.
- The perception of a degree of tolerance for diversity.
- The perception of an ongoing commitment to innovation.
- The perception of a consistency between the organization's processes and its desired product.

Siegel and Kaemmerer report the results of a test of the instrument. Factor analyses resulted in a three-factor solution. The first factor consisted of items indicating organizational members' perceptions of the level of support for innovation by management, and a perception that the organization is open and adaptive to change. The items in Figure 10 on page 54 were selected from the

⁹⁰ Saul M. Siegel and William F. Kaemmerer, "Measuring the Perceived Support for Innovation in Organizations," *Journal of Applied Psychology* 63 (October 1978): 553-62.

first factor reported by Siegel and Kaemmerer based upon the highest factor loadings.⁹¹ In addition to management support for innovation, measures of organization size and audit staff size are elicited from the respondents.

Statistical Methodology

This section includes a discussion of the statistical methodology used to analyze the responses from the questionnaire. First, measurement scales are examined in order to draw conclusions regarding their validity and reliability. Subsequently, a discussion of the statistical methodology used to test the research hypotheses is provided.

Properties of Measurement Scales

The measurement of the perceived characteristics of statistical sampling techniques was done through the use of an instrument created for this research. Therefore, it was important to evaluate the properties of the instrument that was developed.

Validity

Three types of validity are discussed in the psychometric literature. The first, content validity, is the "representativeness or sampling adequacy of the content - the substance, the matter, the topics

⁹¹ A portion of this instrument was used by Zmud in a study of the successful implementation of modern software practices. See Robert W. Zmud, "Diffusion of Modern Software Practices: Influence of Centralization and Formalization," *Management Science* 28 (December 1982): 1421-31.

1. Management acts as if we are not very creative.
2. Creativity is encouraged here.
3. Creativity efforts are usually ignored here.
4. People in this department are encouraged to develop their own interests, even when they deviate from those of the department.
5. Our ability to function creatively is respected by the management.
6. Individual independence is encouraged in this department.
7. The role of the leader in this department can be described as supportive.
8. Assistance in developing new ideas is readily available in this organization.
9. Around here, people are allowed to solve the same problem in different ways.
10. People around here are expected to deal with problems in the same way.

Figure 10. Items from Siegel Scale for Support for Innovation

- of a measuring instrument.⁹² Predictive validity refers to the ability of an instrument to predict an attribute external to the instrument itself. Predictive validity is determined by the degree of correlation between the two measures involved.⁹³ Construct validity refers to how well an instrument explains or describes a theoretical construct.⁹⁴ Properties of the scales used to measure professionalism, creative style, organizational commitment, and organizational support for innovation were discussed in the sections concerning the measurement of the independent variables. These scales have been found to have satisfactory levels of validity. The demonstrated validity of the scales was a primary reason for using them in this study.

The scales used to measure the perceived characteristics of innovations were created for this study. One of the objectives of the instrument development was to achieve a satisfactory level of content validity. The methodology followed to construct the scales was discussed earlier in this chapter. The steps followed in the construction of the scales should provide some assurance of content validity.

If the items of each scale do have content validity, then each of the items should correlate positively with the other items and with the overall scale score. The inter-item correlations and correlations between the items and the scale scores are examined for this relationship. In addition, factor analyses of the 25 items are performed. If the items have content validity, then the factor solutions will show five factors.

Since this is a new instrument, predictive and construct validity cannot be evaluated. Several studies with different samples and different variables are needed to begin to draw conclusions regarding the predictive or construct validity of the characteristic instrument.

⁹² Fred N. Kerlinger, *Foundations of Behavioral Research* (New York: Holt, Rinehart, and Winston, 1973), p.458.

⁹³ Nunnally, p. 88.

⁹⁴ Kerlinger, p. 469.

Reliability

Reliability refers to the accuracy or precision of the measuring instrument. Coefficient alpha is commonly used to determine the reliability of a multi-item scale. It is based on both the average correlation among items and the number of items. Nunnally states that coefficient alpha "provides a good estimate of reliability in most situations, since *the major source of measurement error is because of the sampling of content.*"⁹⁵ The formula used to calculate the coefficient alpha was:

$$\alpha = \frac{k(\bar{r}_{ij})}{(k-1)(1-\bar{r}_{ij})}$$

where:

k = The number of items on the scale, and

\bar{r}_{ij} = The average inter-item correlation.

The reliabilities were determined for each of the five characteristic scales, the adaption/innovation scale, the professionalism scale, the support for innovation scale, and the organizational commitment scale.

The final test performed on the adapted instruments is a factor analysis of the item responses. The factor solutions are compared to the results of previously reported validation studies. This provides a basis for evaluating whether the properties of the scales are sample dependent.

⁹⁵ Nunnally, p. 230.

Hypotheses Tests

Before performing the statistical tests of the hypotheses, the distributional properties of the variables are examined. The variables represent concepts that have continuous measurement domains. However, the measurement scales were crude, allowing the possibility that the measurements could be discontinuous. For the dependent variable, extent of use (EOU), a consensus was not reached in previous studies regarding whether it is continuous. Therefore, frequency distributions and descriptive statistics are examined for each of the variables in order to draw conclusions concerning the appropriate levels of statistical analysis.

The first hypothesis concerns the relationship between the extent of use (EOU) of statistical sampling and the perceived attributes of the sampling techniques. The first tests of the association are done in a series of bivariate tests, testing the association between each EOU measure and the level of each perceived innovation attribute.

The tests of the association of EOU and innovation attributes are performed using both Pearson correlations and Spearman rank order correlations. Measures of association for nominal level data are used to examine the adoption decision. The same procedure is followed for each of the other hypotheses.

After analyzing the bivariate relationships between the independent variables and the EOU of the statistical sampling techniques, several multivariate relationships are analyzed. The innovation decision process is complex and several variables are needed to explain it. However, models of the relative strength of the relationships between the adoption and implementation of innovations and the explanatory variables have not been formally developed. In addition, there has been little investigation of causal relationships. Therefore, the multivariate tests are performed at an exploratory level. No hypothesized models are tested. The objective of these tests is to determine if there are

combinations of explanatory variables that explain the innovation decision process of this group of respondents.

The first multivariate tests performed are partial correlations to test the strength of the relationships between the individual variables and the EOU's. The second approach is to build multiple regression and logistic regression models that explain the relationships. The relative strength of the independent variables is then evaluated by their presence in the final models.

Chapter Summary

This chapter includes a discussion of the methodology of this research project. Major topics covered are (1) the research model and hypotheses, (2) the data collection methodology, (3) the development of the variable measurement scales, (4) the procedures for testing the validity and reliability of the scales, and (5) the statistical methodology for testing the hypotheses. In the next chapter, the results of the validity and reliability tests and the tests of the hypotheses are presented.

Chapter 4

Analysis of Results

Introduction

The analysis of the responses to the questionnaire is presented in this chapter. The main topics discussed are the characteristics of the survey respondents, the evaluations of the quality of the data measurement, and the statistical tests of the research hypotheses.

Characteristics of the Respondents

A concern was raised in chapter three about identification of the appropriate individual within an organization to participate in this survey. Justification for approaching audit directors was based on indications that the average size of audit staffs was sufficiently small that the director would

probably be directly involved in audit decision making processes. In addition, the audit director probably has the autonomy to make decisions regarding the adoption and implementation of innovations.

In the final section of the questionnaire, several questions were used in order to gather data to provide a basis for determining whether the appropriate individuals responded to the questionnaire. A summary of the responses to these questions is presented in Figure 11 on page 61. The important findings are that 76% of the respondents were audit directors and that an additional 12% were managers. In addition, the mean decision level, a measure of the respondents' participation in the decisions to adopt new audit procedures, extend audit scopes, adopt new audit programs, and hire and promote audit staff, was 1.34. A response of one was a response that the individual always participated in the decisions.⁹⁶ In addition, the average number of internal auditors in the respondents' organizations was 12, and the average number of professionals supervised by the respondents was 5. It appears that the individuals responding to the questionnaire are at the appropriate decision making levels to be informed and capable of responding to the questionnaire.

Validity and Reliability of Innovation Attributes Scales

The innovation attributes scales were developed for this study. The steps taken and the nature of the scale are discussed in chapter three. In this section, the analysis of the properties of the scales is presented. This analysis is essential to the interpretation of the results of the hypothesis tests.

⁹⁶ See Figure 5 on page 35 and the related discussion of this scale.

Position	% of Respondents
----------	------------------

Director	76.0
Manager	12.2
Supervisor	4.7
Other	7.1

Audit Activities	Mean % of time allocated to task
------------------	----------------------------------

Administrative	40
Financial Auditing	25
EDP Auditing	15
Operational	30

	No. Professionals Supervised	No. Internal Auditors In Organization	Decision Level
--	------------------------------	---------------------------------------	----------------

Mean	5	12	1.34
1st quartile	1	2	1.00
Median	3	5	1.00
3rd quartile	7	10	1.40

	Years in Internal Auditing	Years in Current Organization
--	----------------------------	-------------------------------

Mean	9.9	4.7
1st quartile	4.0	1.5
Median	8.0	3.0
3rd quartile	14.0	6.0

Figure 11. Characteristics of Respondents and their Audit Staffs

Relative Advantage

The relative advantage of the three classes of statistical sampling techniques was measured by having the auditor respond to five statements according to his or her level of agreement with that statement. An average of the five item scores was used as the perceived relative advantage of each of the techniques. The participants responded to each statement three times, giving their level of agreement to each statement for dollar unit sampling, attributes sampling, and variables sampling. The items included in the relative advantage scale are reproduced in Figure 12 on page 63 and the inter-item correlations of the five items of the relative advantage scale are presented in Figure 13 on page 65.

There were 258 responses used for this analysis. All of the inter-item correlations are significant at the .001 level. The coefficient alpha's, the computed measure of reliability, range from .751 for variables sampling to .793 for attributes sampling. The reliability of these scales is acceptable for exploratory studies.⁹⁷

The validity of this scale is difficult to examine. As explained in chapter three, a panel was used in order to evaluate the construct validity of the items. Another method for evaluating construct validity is examining the correlation of each scale item with the definition of relative advantage that was included in the questionnaire as a single item. Respondents were asked to agree or disagree on a five point scale as to whether or not statistical sampling was relatively advantageous. The correlations between responses to this single item and the individual items on the relative advantage scale are reported in the column labeled RA in Figure 13 on page 65. The correlations are all significant at the .001 level, and are relatively large. A second indication of a valid scale is that the individual scale items will be highly correlated with the scale score. The final column of the exhibit,

⁹⁷ Nunnally, p. 245.

RELATIVE ADVANTAGE ITEMS

- | <u>Item No.</u> | <u>Item</u> |
|-----------------|---|
| 1 | The cost of using _____ is greater than its benefits. |
| 2 | Use of _____ saves time and money. |
| 3 | _____ does not offer any relative advantage over previous sampling methods. |
| 4 | Using _____ rather than judgmental sampling reduces our risk of drawing incorrect conclusions about the item being sampled. |
| 5 | After initial applications, _____ is relatively inexpensive to apply. |

TRIALABILITY ITEMS

- | | |
|---|--|
| 1 | _____ can be instituted on a limited basis. |
| 2 | _____ must be used extensively or not at all. |
| 3 | It is not necessary to commit to full scale use of _____ before experimenting with it. |
| 4 | It is possible to try using _____ in limited applications without having to make major commitments of audit resources. |
| 5 | Resources needed to properly apply _____ prevent its use in an experimental basis. |

Figure 12. Items of Relative Advantage and Trialability Scales

labeled "score", shows the correlations between each of the items and the scale score.⁹⁸ These correlations are all significant at the .001 level and they are large.

Trialability

The items used in the trialability scale are reproduced in Figure 12 on page 63. The inter-item correlations, the correlations between the individual items and their definition, and the correlations between each item and the scale score are presented in Figure 14 on page 66. The coefficient alpha's range from .59 for dollar unit sampling to .68 for variables sampling. The reliability of this scale is somewhat low. Further analysis indicates that item one is weakly associated with items three, four, and five. The correlations between the individual items and the trialability definition are all significant at the .01 level. However, they are small. The correlations of the individual items with the scale scores are significant at the .001 level and they are reasonably large.

Observability

The items used in the observability scale are reproduced in Figure 15 on page 68. The inter-item correlations and coefficient alpha's for this scale are presented in Figure 16 on page 69. The coefficient alpha's for this scale are acceptable, ranging from .72 to .77. The correlations between the individual items and the observability definition item are all significant at the .01 level. The correlations between the individual items and the overall scale score are large and significant at the .001 level.

⁹⁸ The scale score is the average of the five item scores.

<u>DOLLAR UNIT SAMPLING</u>						
Item No.	2	3	4	5	RA	SCORE
1	.55	.48	.45	.31	.53	.76
2		.51	.48	.39	.44	.80
3			.36	.49	.52	.78
4				.20	.49	.66
5					.30	.67

Coefficient Alpha = .78

<u>VARIABLES SAMPLING</u>						
Item No.	2	3	4	5	RA	SCORE
1	.42	.36	.44	.34	.47	.72
2		.36	.52	.33	.46	.75
3			.33	.46	.49	.71
4				.21	.49	.68
5					.30	.69

Coefficient Alpha = .75

<u>ATTRIBUTES SAMPLING</u>						
Item No.	2	3	4	5	RA	SCORE
1	.50	.40	.47	.42	.40	.75
2		.41	.59	.38	.43	.79
3			.36	.50	.42	.72
4				.30	.43	.72
5					.29	.72

Coefficient Alpha = .79

Sample size=258

Figure 13. Inter-item Correlations - Relative Advantage

DOLLAR UNIT SAMPLING

Item No.	2	3	4	5	TR	SCORE
1	.24	.15	.13	.13	.18	.53
2		.22	.30	.29	.30	.68
3			.25	.15	.18	.57
4				.39	.41	.66
5					.43	.65

Coefficient Alpha = .59

VARIABLES SAMPLING

Item No.	2	3	4	5	TR	SCORE
1	.26	.19	.21	.25	.16	.58
2		.26	.34	.31	.36	.66
3			.40	.32	.33	.65
4				.47	.45	.73
5					.45	.71

Coefficient Alpha = .68

ATTRIBUTES SAMPLING

Item No.	2	3	4	5	TR	SCORE
1	.27	.21	.20	.09	.09	.59
2		.27	.32	.33	.41	.70
3			.31	.19	.21	.61
4				.39	.39	.61
5					.44	.61

Coefficient Alpha = .64

Sample size= 258

Figure 14. Inter-item Correlations - Trialability

Complexity

The items used in the complexity scale are reproduced in Figure 15 on page 68. The inter-item correlations and coefficient alpha's are presented in Figure 17 on page 70. The reliability factors are greater than .80 as measured by coefficient alpha for all three sampling techniques. In addition, the individual item correlations with the one item definition are all significant at the .01 level, and the correlations between the individual items and the scale score are large and significant at the .001 level.

Compatibility

The items of the compatibility scale are reproduced in Figure 18 on page 71. The inter-item correlations and coefficient alpha's are presented in Figure 19 on page 72. The coefficient alpha's are all above .75 and the correlations between the single items and the definition of compatibility are all significant at the .01 level. The correlations between the individual items and the scale score are also large and significant at the .001 level.

Innovation Attributes Scales - Factor Analysis

The diffusion of innovation literature suggests that the perceptual attributes of innovations measured in this study are relatively independent. The results of innovation studies do not suggest that the attributes are independent in a statistically testable sense, but rather that they are concepts distinct enough to be measured as separate dimensions.

OBSERVABILITY ITEMS

<u>Item No.</u>	<u>Item</u>
1	Benefits of _____ are clearly observable by recipients of audit reports.
2	The advantages and disadvantages of _____ have been clearly demonstrated.
3	The effect that _____ has on the audit process is difficult to observe and communicate.
4	The issue of whether the benefits of using _____ exceed the cost has not been demonstrated.
5	The results of implementing _____ are not observable to nonaudit management.

COMPLEXITY ITEMS

1	_____ is a complex auditing procedure.
2	_____ is easy to understand and apply.
3	Any auditor can learn to apply _____ with ease.
4	_____ is difficult to understand.
5	The principles underlying the use of _____ are easily understood.

Figure 15. Items of the Observability and Complexity Scales

DOLLAR UNIT SAMPLING

Item No.	2	3	4	5	OB	SCORE
1	.19	.41	.21	.51	.47	.69
2		.36	.42	.17	.26	.62
3			.37	.39	.39	.74
4				.30	.32	.66
5					.51	.70

Coefficient Alpha = .71

VARIABLES SAMPLING

Item No.	2	3	4	5	OB	SCORE
1	.08	.33	.27	.52	.46	.64
2		.36	.51	.24	.28	.63
3			.40	.37	.36	.71
4				.37	.40	.74
5					.57	.73

Coefficient Alpha = .72

ATTRIBUTES SAMPLING

Item No.	2	3	4	5	OB	SCORE
1	.18	.44	.35	.50	.46	.70
2		.47	.46	.29	.27	.65
3			.44	.47	.46	.77
4				.40	.38	.73
5					.61	.75

Coefficient Alpha = .77

Sample size = 258

Figure 16. Inter-item Correlations - Observability

DOLLAR UNIT SAMPLING

Item No.	2	3	4	5	CX	SCORE
1	.55	.44	.45	.31	.35	.72
2		.51	.53	.48	.41	.80
3			.51	.47	.38	.77
4				.54	.31	.79
5					.30	.74

Coefficient Alpha = .82

VARIABLES SAMPLING

Item No.	2	3	4	5	CX	SCORE
1	.52	.43	.48	.39	.40	.71
2		.58	.57	.47	.49	.80
3			.58	.48	.44	.80
4				.54	.49	.83
5					.35	.75

Coefficient Alpha = .84

ATTRIBUTES SAMPLING

Item No.	2	3	4	5	CX	SCORE
1	.57	.48	.50	.45	.44	.74
2		.60	.59	.59	.49	.83
3			.65	.61	.44	.83
4				.59	.49	.82
5					.40	.81

Coefficient Alpha = .86

Sample size = 258

Figure 17. Inter-item Correlations - Complexity

COMPATIBILITY ITEMS

<u>Item No.</u>	<u>Item</u>
1	To use _____ we do not have to radically change our audit approach.
2	Our audit populations are not suitable for the use of _____.
3	_____ can easily be adapted to fit our particular needs.
4	_____ is inconsistent with our current audit approach, past experiences, and/or present needs.
5	We do not have enough staff auditors with sufficient technical expertise to apply _____.

Figure 18. Items of Compatibility Scale.

DOLLAR UNIT SAMPLING

Item No.	2	3	4	5	CP	SCORE
1	.28	.41	.27	.33	.29	.63
2		.58	.45	.30	.41	.72
3			.55	.36	.41	.80
4				.41	.42	.74
5					.24	.69

Coefficient Alpha = .76

VARIABLES SAMPLING

Item No.	2	3	4	5	CP	SCORE
1	.17	.37	.33	.35	.29	.62
2		.58	.52	.32	.44	.73
3			.53	.35	.46	.78
4				.31	.48	.75
5					.24	.68

Coefficient Alpha = .76

ATTRIBUTES SAMPLING

Item No.	2	3	4	5	CP	SCORE
1	.29	.35	.30	.35	.28	.66
2		.61	.42	.33	.39	.73
3			.43	.32	.40	.76
4				.31	.42	.70
5					.31	.67

Coefficient Alpha = .75

Sample size = 258

Figure 19. Inter-item Correlations - Compatibility

Factor analysis is a method for testing whether there are underlying factors to which a subset of the variables are related. As Harmon writes:⁹⁹

The principal concern of factor analysis is the resolution of a set of variables linearly in terms of (usually) a small number of categories or "factors." This resolution can be accomplished by the analysis of the correlations among the variables. A satisfactory solution will yield factors which convey all the essential information of the original set of variables. Thus, the chief aim is to attain scientific parsimony or economy of description.

Because of this objective, factor analysis is often used in order to evaluate the content validity of attitude scales. If the scale has content validity, a parsimonious description of the data is expected.

The factor loadings resulting from varimax rotations of a principal factors solution are presented in Figure 20 on page 75. The principal factors method attempts to extract the maximum variance from the observed variables, and the varimax rotation is an orthogonal rotation of the initial factor solution that emphasizes the simplification of the factors.¹⁰⁰ The highest factor loadings for each item are highlighted in the figures. For dollar unit sampling, the relative advantage, trialability, compatibility, and complexity items load on separate factors. The observability scale items do not load on one factor. The first three factors, which could be labeled complexity, compatibility, and relative advantage, account for 89% of the variance. The other two factors, observability and trialability, do not explain any significant amount of the variance and appear to be unnecessary in this data.

For attributes sampling, relative advantage is not a single factor, but the other attributes are essentially loading on single factors. The first three factors, complexity, relative advantage/observability, and compatibility account for 90% of the variance. The fourth factor, trialability, does not appear to be necessary in this data set.

⁹⁹ Harry H. Harmon, *Modern Factor Analysis* (Chicago:University of Chicago Press,1976) p. 4.

¹⁰⁰ *Ibid.*, pp. 133 and 290.

For variables sampling, the first factor is a mixture of relative advantage items and compatibility items. The second factor is composed of the complexity items, and the third factor is trialability. Once again, the three factors account for 89% of the variance.

Conclusions Regarding Validity and Reliability

Coefficient alpha's for the five innovation attributes scales were found to be of good to excellent levels for this type of exploratory research. The inter-item correlations and item-score correlations were also significant. The item-score correlations were large in magnitude. The factor analysis showed that the items load separately for dollar unit sampling showing evidence of four factors. For attributes sampling there are only three pure factors, and for variables sampling there are only two pure factors. The factor analysis indicates that there is a possibility that the innovation attributes measured in this study are not unique. This finding has implications for the multivariate tests described in a later section of this chapter. However, it does not indicate that the scales are invalid. Overall, the reliability and validity analysis supports the use of these scales in the subsequent hypotheses tests.

Validity and Reliability of Personal and Organizational Scales

As discussed in chapter three, the scales used to measure the personal and organizational variables are adaptations of scales that were reported in the research literature. The decision to use the scales in this study was based upon two criteria. First, the scales were originally designed to measure the attitudes or perceptions of interest to this project. Second, the reported validity and reliability of

	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5
Relative Advantage	-.15	.46	<u>.48</u>	.11	.20
	-.18	<u>.42</u>	<u>.56</u>	.18	.10
	.00	.24	<u>.59</u>	.27	.23
	-.25	<u>.49</u>	.30	.08	.15
	-.10	.10	<u>.51</u>	.20	.14
Triability	.02	.07	.11	.13	<u>.36</u>
	-.19	.10	.07	-.06	<u>.45</u>
	-.03	-.04	.03	-.03	<u>.46</u>
	-.28	.18	.20	-.01	<u>.47</u>
	<u>-.39</u>	.20	<u>.35</u>	.04	.31
Observability	-.14	.18	.11	<u>.64</u>	.12
	-.33	.14	<u>.42</u>	.18	.16
	-.22	.14	.28	<u>.53</u>	.11
	-.36	.24	<u>.51</u>	.16	-.00
	-.06	.04	.21	<u>.63</u>	.08
Complexity	<u>.54</u>	.45	-.03	.00	-.08
	<u>.69</u>	.30	-.08	-.09	-.01
	<u>.64</u>	.19	-.23	-.09	-.04
	<u>.69</u>	.16	-.13	-.14	-.17
	<u>.63</u>	.07	-.09	-.12	-.16
Compatibility	-.23	<u>.35</u>	.06	.16	.30
	-.22	<u>.54</u>	.25	.08	.03
	-.33	<u>.70</u>	.21	.14	.09
	-.22	<u>.50</u>	.33	.29	.07
	<u>-.48</u>	<u>.21</u>	.17	.14	.25
Eigenvalue	7.35	1.39	.93	.77	.42
Cum. Proportion Explained	.67	.80	.89	.96	.99

Figure 20. Factor analysis- Varimax rotation - Dollar Unit Sampling

	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5
Relative Advantage	-.19	.39	<u>.51</u>	.16	.27
	-.21	.38	.34	.08	<u>.52</u>
	-.08	<u>.57</u>	.23	.14	.23
	-.25	.32	.21	.27	<u>.52</u>
	-.10	<u>.44</u>	.25	.17	.22
Triability	-.02	-.02	.07	<u>.40</u>	.09
	-.07	.19	.08	<u>.53</u>	.07
	-.08	.04	-.04	<u>.52</u>	.04
	-.26	.27	.11	<u>.51</u>	.17
	-.22	<u>.51</u>	.16	.35	.04
Observability	-.43	.20	.07	-.16	<u>.45</u>
	-.35	<u>.52</u>	.21	.16	.05
	-.48	<u>.53</u>	.23	-.06	.14
	-.30	<u>.53</u>	.23	.04	.24
	-.36	<u>.34</u>	.13	-.03	.29
✓ Complexity	<u>.46</u>	.15	-.39	-.24	-.15
	<u>.64</u>	.08	-.31	-.21	-.24
	<u>.72</u>	.24	-.13	-.13	-.17
	<u>.71</u>	.33	-.21	-.14	-.02
	<u>.66</u>	.14	-.20	-.18	-.12
Compatibility	-.31	.10	.39	.23	.10
	-.21	.23	<u>.65</u>	.04	.03
	-.28	.20	<u>.67</u>	.18	.12
	-.11	.26	<u>.55</u>	-.09	.13
	-.39	<u>.42</u>	.25	.14	.03
Eigenvalue	8.40	1.12	.98	.73	.48
Cum. Proportion Explained	.72	.81	.90	.96	1.00

Figure 21. Factor analysis - Varimax Rotation - Attributes Sampling

	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTORS 5
Relative Advantage	<u>.56</u>	-.18	.18	.12	.24
	<u>.52</u>	-.19	.15	.16	.39
	<u>.30</u>	-.07	.13	<u>.50</u>	.30
	<u>.49</u>	.32	.34	.04	.21
	<u>.30</u>	.01	.14	.31	.30
✓ Trialability	.17	-.02	<u>.44</u>	-.10	.15
	.05	-.07	<u>.49</u>	-.07	.02
	-.02	-.18	<u>.52</u>	.11	-.12
	.22	-.24	<u>.59</u>	.19	.08
	.24	-.19	<u>.53</u>	.23	.10
Observability	.10	-.17	-.04	.05	<u>.66</u>
	.25	-.30	.12	<u>.48</u>	.07
	.24	-.34	.07	<u>.49</u>	.26
	<u>.41</u>	-.27	.19	.36	.29
	<u>.20</u>	-.09	.10	.26	<u>.56</u>
✓ Complexity	-.39	<u>.52</u>	-.23	.04	-.05
	-.28	<u>.69</u>	-.10	-.01	-.15
	-.15	<u>.69</u>	-.13	-.13	-.18
	-.15	<u>.67</u>	-.31	-.30	-.05
	-.11	<u>.60</u>	-.16	-.24	-.07
Compatibility	<u>.33</u>	-.32	.25	.16	.04
	<u>.59</u>	-.16	.07	.26	.06
	<u>.67</u>	-.30	.16	.15	.06
	<u>.63</u>	-.14	.08	.26	.14
	.19	-.29	.30	<u>.34</u>	.03
Eigenvalue	7.66	1.34	.93	.70	.56
Cum. Proportion Explained	.69	.81	.89	.96	1.00

Figure 22. Factor Analysis - Varimax Rotation - Variables Sampling

the scales appeared to be satisfactory for adaptation for this study. However, scale testing has not been sufficient to conclude that the scales are appropriate for all research settings. Therefore, before reporting the results of the hypothesis tests, it is necessary to report the analysis of the validity and reliability of the scales.

Kirton Adaption/Innovation Inventory

The Kirton Adaption/Innovation Inventory (KAI) has been the subject of validation studies. In order to evaluate its use for this study, a factor analysis with varimax rotation was performed on the sample of 248 responses to this section of the questionnaire. The factor loadings of two previous studies¹⁰¹ are included in Figure 23 on page 79, along with the factor loadings of the current study. Only the highest loading is shown for each item. Any items with loadings of less than .30 are not shown.

Kirton found that the 32 items loaded on three factors. He identified the factors as "originality", "methodical", and "conformist". Keller and Holland identified two factors, called "originality" and "efficiency and conformity". The current study responses are more similar to the Keller and Holland study than to the Kirton study. Of importance to this study is that the factor analysis of the current study is similar to those reported in earlier studies.

Hall's Professionalism Instrument

¹⁰¹ Kirton, "Adaptors and Innovators", and Keller and Holland, "Cross-Validation Study".

Items	-- Current Study --			-- Keller & Holland --			-- Kirton --		
	I	II	III	I	II	III	I	II	III
Has original ideas	.62			.74			.77		
Proliferates ideas	.69			.62			.74		
Is stimulating	.51			.60			.64		
Copes with several ideas at the same time	.33			.62			.60		
Will always think of something when stuck				.50			.52		
Would sooner create than improve	.46			.58			.52		
Has fresh perspectives on old problems	.38			.45			.51		
Often risks doing things differently	.33			.68			.47		
Likes to vary set routines at a moment's notice	.62			.57			.37		
Prefers to work on one problem at a time		.43		.48			.36		
Can stand out in disagreement				.59			.34		
Needs the stimulation of frequent change	.50			.41			.33		
Prefers changes to occur gradually		.62						.77	
Is thorough					.44			.75	
Masters all details painstakingly					.37			.74	
Is methodical and systematic			.55		.49			.63	
Enjoys detailed work		.45			.54			.48	
Is a steady plodder		.51			.47			.35	
Is consistent					.42				
Imposes strict order on matters within own control		.64			.49				.75
Fits readily into the "system"		.45			.50				.68
Conforms			.59		.44				.60
Readily agrees with the team at work		.33			.54				.57
Never seeks to bend or break the rules		.66			.61				.54
Never acts without proper authority		.52			.45				.51
Is prudent when dealing with authority									.48
Likes the protection of precise instructions	.46								.44
Is predictable									.44
Prefers colleagues who never "rock the boat"			.59						.36
Likes bosses and work patterns which are consistent		.37							.34
Works without deviation in a prescribed way									.30
Holds back ideas until obviously needed	.37								

Figure 23. Factor Analysis - Kirton Adaption/Innovation Inventory

The professionalism scale developed by Hall¹⁰² was the subject of validation testing by Snizek¹⁰³ and, more recently, by Morrow and Goetz.¹⁰⁴ Hall's original study and evaluation of the instrument was based on a sample of 328 professionals from a cross-section of occupations. Included in his sample were accountants, lawyers, physicians, teachers, engineers, social workers, and nurses. Snizek's validation study was based on a sample of 566 engineers, physicists, and chemists. The Morrow and Goetz study was based on a sample of 325 accountants in public practice. A comparison of the factor loadings resulting from a varimax rotated factor solution from each of the previous studies and the current study are presented in Figure 24 on page 81.

Only those factor loadings that are both the highest loading for an individual item and greater than .30 are included in the exhibit. There is a consistent finding of a five factor solution, with the items included in subscales of the instrument loading together on separate factors. In addition, the coefficient alpha's are consistent among the studies.

Professional Commitment

The professional commitment scale is an adaptation of the organizational commitment scale and was used in several studies discussed in chapter three. Since the scale has not been subjected to validation studies, a comparison of the current study results and prior studies' results cannot be made. The reliability factor for the professional commitment scale is .70 for this study. This is comparable to prior studies. Since the scale has not been subjected to validation, and the reliability is somewhat low, interpretations of findings concerning professional commitment may be difficult to make.

¹⁰² Hall, "Professionalization", pp. 92-103.

¹⁰³ William E. Snizek, "Hall's Professionalism Scale: An Empirical Reassessment," *American Sociological Review* 37 (February 1972): 109-14.

¹⁰⁴ Paula C. Morrow and Joe F. Goetz, Jr., "Professionalism as a Form of Work Commitment", *Journal of Vocational Behavior* 32 (February 1988): 92-111.

Professionalism Items	Current Study					Hall					Snizek					Morrow & Goetz																			
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5															
Profession as a referent																																			
Read the journals	.74					.56																													
Attend local meetings	.34					.58																													
Support prof. orgs.	.47					.55																													
Orgs. do little for members	.30					.52																													
Don't read journals	.62					.54																													
Belief in public service																																			
Other prof. more vital	.61					.68																													
Profession is essential	.59					.55																													
Importance overaddressed	.38					.47																													
Other occ. more important	.61					.70																													
Occupation is indispensable	.63					.63																													
Belief in self-regulation																																			
Peers know competence	.51																																		
No knowledge of others	.61																																		
No way to judge	.69																																		
No opportunity to judge	.59																																		
Colleagues know our work	.49																																		
Sense of calling																																			
Calling for work	.52																																		
Dedication gratifying	.55																																		
Idealism maintained	.58																																		
Stay with a low income	.34																																		
Few don't believe in work																																			
Autonomy																																			
No judgement opportunity																																			
Decision reviewed	.38																																		
My own boss	.57																																		
Decisions reviewed by others	.67																																		
Make own decisions	.65																																		
Make own decisions	.60																																		
Coefficient Alpha - subscales	.64	.69	.73	.60	.69	.69	.74	.73	.70	.76	.62	.64	.70	.58	.74	.69	.70	.75	.49	.66															
Coefficient Alpha - overall scale	.79					.84										.75																			

Figure 24. Factor Analysis - Hall's Professionalism Scale

Organizational Commitment.

The fifteen item scale to measure organizational commitment (OCM) has been widely used and subjected to validation and reliability tests. It has been demonstrated that a factor analysis results in the fifteen items of the OCM consistently loading on a single factor. In addition, coefficient alpha's have been reported in the .80 to .95 range.¹⁰⁵ A factor analysis of the data from this study resulted in a single factor solution with the factor accounting for 92% of the variance of the observations. In addition, the coefficient alpha is .92. Both results are consistent with previous research.

Siegel Scale of Support for Innovation.

The Siegel Scale of Support for Innovation (SSSI) was designed to measure an individuals' perceptions of their organization's support for innovation. As explained in chapter three, the ten items in this study's instrument were selected from 61 items used by Siegel and Kaemmerer. The ten items loaded highest on the factor they labeled "support for creativity". The items were expected to be descriptive of two perceptual dimensions of organizational support for innovation: (1) leadership support for creativity and innovative behavior, and (2) organizational norms promoting diversity, creativity, and innovativeness.

The factor analysis solution from the current study is presented in Figure 25 on page 83. The factor analysis indicates that the ten items are indicative of one dimension which will be referred to as "support for innovation". The overall reliability measure of .82 is acceptable for this study.

¹⁰⁵ Harold L. Angle and James L. Perry, "An Empirical Assessment of Organizational Commitment and Organizational Effectiveness," *Administrative Science Quarterly* 26 (March 1981): 1-14.

Item	Subscale	Factor 1	Factor 2
1	Norms for diversity	.79	-.11
2	Norms for diversity	.73	-.24
3	Norms for diversity	.62	-.15
4	Norms for diversity	.50	-.06
5	Leadership	.64	.13
6	Leadership	.20	.15
7	Leadership	.74	.07
8	Leadership	.37	.42
9	Leadership	.38	.38
10	Leadership	.66	-.19
Eigenvalues		3.50	.47

Coefficient alpha - Overall scale = .82

Figure 25. Factor Analysis - Siegel Scale of Support for Innovation

Organizational and Personal Scales - Summary of Results

The scales adapted from other research disciplines demonstrate properties similar to those reported in the literature. The Kirton Adaption/Innovation Inventory, Hall's Professionalism Scale and the Organizational Commitment Scale appear to have characteristics similar to those in reported studies. For professional commitment, the reliability is good, but the instrument's validity has not been tested to date. The adaptation of the Siegel Scale for Support for Innovation may present problems. Only ten of the original 61 items were selected for this study. While the reliability was good, the expected two factor solution was not found. Given these results, with the possible exception of the SSSI, any limitations resulting from the use of the scales would seem to be attributable to the inherent nature of the scales themselves, and not due to the current research setting.

Descriptive Analysis of Variables

In the previous section the measurement scales displayed satisfactory properties for their use in the analysis. In this section, descriptive statistics of the responses are discussed in order to evaluate the appropriateness of the statistical methods used to test the research hypotheses.

Extent of Use

The extent of use (EOU) of statistical sampling was measured using a nine-point scale with each point representing a stage in the continuum of the innovation decision process. The development of this instrument is discussed in chapter three and the actual scale used is presented in Figure 9 on page 45.

A score of one on the EOU scale indicates that the respondent has decided that the technique will not be used. A score of two indicates that the respondent has little or no knowledge of the technique. Scores of three through five represent stages of knowledge gathering and testing activity. Scores from six through nine represent levels of implementation after the decision has been made to adopt the technique.

The innovation decision process is continuous over time. The cross-sectional data collection methodology of this study was used in order to capture information from individuals who were at different stages of the process of adopting statistical sampling procedures. It was anticipated that the resultant cross-sectional measurements of the EOU variable would be continuous and that interval level statistical methodologies for hypothesis testing would be appropriate. In order to evaluate the validity of that assumption, descriptive statistics presented in Figure 26 on page 86 and frequency histograms presented in Figure 68 on page 174 in Appendix B were analyzed.

Comparing the EOU of the various statistical techniques, attributes sampling is the most extensively used technique while the three variables sampling techniques are the least extensively used. The differences in the extent of use are significant. Over 60% of the respondents are adopters of attributes sampling for financial audits. On the other hand, 65-70% of the respondents have either rejected the use of the variables sampling techniques, or they have little or no knowledge of the ratio, difference and mean per unit estimation techniques. For dollar unit sampling, 46% of the respondents are adopters for financial audits.

Looking at the means, modes, and quartiles along with the frequency histograms, one finds that the assumption of interval level measurement may be inappropriate for some of the techniques. The dollar unit sampling EOU's for both financial and operational auditing are not symmetrically distributed. They appear to be bimodal with a lower mode of 3 for financial auditing and 2 for operational auditing and upper modes of 6 for both types of audits. The EOU's are distributed across all of the stages of the process providing evidence of a continuous variable. However, the distribution is not normal in appearance. The attributes sampling EOU's also display a bimodal distrib-

Sampling Technique	n	mean	S.D.	med.	Lower Quart.	Upper Quart.
Dollar unit						
Financial	222	4.72	2.54	5	2	7
Operational	226	3.84	2.53	3	2	6
Attributes						
Financial	235	5.67	2.52	6	3	8
Operational	230	5.44	2.66	6	3	8
Stop or go						
Financial	233	3.84	2.37	3	2	6
Operational	228	3.77	2.34	3	2	6
Discovery						
Financial	231	4.28	2.44	4	2	6
Operational	226	4.16	2.48	3	2	6
Mean per unit						
Financial	228	2.60	1.72	2	2	6
Operational	222	2.48	1.80	2	1	3
Ratio						
Financial	231	2.92	2.07	2	2	3
Operational	225	2.71	1.98	2	2	3
Difference						
Financial	230	2.80	2.03	2	2	3
Operational	225	2.67	1.96	2	1	3

Figure 26. Descriptive statistics - Extent of Use

ution with modes of 3 and 6 for both financial and operational auditing. The EOU's are distributed across all of the stages, but the frequency is skewed toward the adoption stages, and the frequency for stages 4 and 5 is only 2% and 3% for financial audits. This indicates that the frequency of the extent of use variable for attributes sampling may be dichotomous - adopters or nonadopters.

Discovery sampling and stop or go sampling EOU distributions show properties similar to attributes sampling, except that the frequency of nonadopters is greater. Seventy per cent of the respondents responded with a five or less for stop or go sampling and 65% responded with a five or less for discovery sampling. The distributions are also bimodal with one mode at 3 and the other at 6.

The distributions of the EOU's for the three variables sampling techniques are very similar. There are relatively few adopters of the techniques. The percentage of respondents with reported usage above 5 ranges from 7% for mean per unit estimation to 14% for ratio estimation. For all techniques in both financial and operational auditing, 40% to 50% of the respondents report that they have little knowledge of the techniques.

One concern raised in the development of the questionnaire was whether the auditors used the statistical sampling techniques to greater or lesser extents in financial auditing as opposed to operational auditing. The differences in the means and medians of the EOU's were tested. The t-tests of the difference in the means were all significant at the .05 level. The medians were not significantly different. It does appear that it is necessary to analyze the financial and operational auditing EOU's separately.

In chapter three, the need to test the hypotheses with both a continuous and a dichotomous dependent variable was discussed. The properties of the extent of use distributions discussed in the previous section indicate that the analysis of the adoption decision (adopters vs. nonadopters as the dependent variable) may be more appropriate than the analysis of the innovation decision (extent of use as the dependent variable). This observation may be more appropriate for variables sampling

and attributes sampling than for dollar unit sampling. However, while the distribution of the EOU of dollar unit sampling is continuous, it appears to be non-normal. As a result, interval level statistics may be invalid. Therefore, the hypotheses were tested using statistics that require interval, ordinal, and nominal level measures of the dependent variable. Presentation of all levels of the tests is justified for this study based upon its exploratory nature and the need for comparing the results of this study to previous research in the innovation decision area.

Innovation Attributes Scales.

The descriptive statistics for the innovation attributes variables are presented in Figure 27 on page 89. The frequency histograms are presented in Figure 75 on page 181 in Appendix B. The innovation attributes variables for dollar unit sampling, attributes sampling and variables sampling have frequency distributions with similar characteristics. All of the distributions appear to be continuous, and the distributions are generally unimodal and bell shaped. Based on these observations, treatment of the variables as interval level data appears to be appropriate.

A basic assumption of the questionnaire design was that there are differences in the perceived attributes of the three types of statistical sampling. The question raised is whether to analyze the three techniques as separate innovations or to analyze statistical sampling as one innovation. Several tests were performed to determine whether there were perceptual differences between the three techniques. Analysis of variance (ANOVA) was performed with the type of statistical sampling technique being the treatment and each of the innovation attributes being the effects. The results of this analysis, included in Figure 27 on page 89, show that there are significant differences between the respondents' mean perceptions of the statistical sampling techniques' attributes. This holds for all of the five innovation attributes scores. In addition, Scheffe and Duncan multiple comparison tests were performed. These tests indicate that the mean innovation attribute scores for attributes sampling are significantly different from dollar unit sampling and variables sampling,

	n	mean	S.D.	med.	Lower Quart.	Upper Quart.
Relative Advantage						
Dollar unit	245	3.33	.84	3.4	2.8	3.8
Attributes	248	3.58 *	.81	3.6	3.0	4.0
Variables	246	3.28	.76	3.4	2.8	3.8
Trialability						
Dollar unit	245	3.61	.68	3.6	3.2	4.0
Attributes	248	3.81 *	.69	3.8	3.4	4.4
Variables	246	3.60	.74	3.6	3.1	4.2
Observability						
Dollar unit	245	2.96	.79	3.0	2.6	3.6
Attributes	245	3.18 *	.87	3.2	2.6	3.8
Variables	246	2.91	.79	2.8	2.4	3.4
Complexity						
Dollar unit	245	2.97	.86	3.0	2.4	3.6
Attributes	248	2.37 *	.88	2.2	1.6	3.0
Variables	246	2.94	.83	3.0	2.4	3.6
Compatibility						
Dollar unit	245	3.21	.86	3.2	2.6	3.8
Attributes	248	3.63 *	.83	3.6	3.2	4.2
Variables	246	3.17	.83	3.2	2.6	3.8

* Significantly different from other means at .05 level

Figure 27. Descriptive Statistics - Innovation Attributes

however, dollar unit sampling and variables sampling mean perceptions are not significantly different.

A final test of the differences between the respondents' perceptions of the innovation attributes of the three statistical sampling techniques was performed using the Kruskal-Wallis test for differences in ranks between the three groups and the Brown-Mood test for differences in the medians.¹⁰⁶ These nonparametric methods provide conclusions similar to the ANOVA analysis in that there are statistically significant differences between the three groups.

Conclusions based upon the analyses discussed in this section are that the innovation attributes variables are continuous and that interval level data analysis may be appropriate. There are significant differences between the mean, median, and rank of the respondents' innovation attributes scores for each of the five attributes. The ANOVA multiple comparison tests indicate that attributes sampling's attributes are different from dollar unit sampling and variables sampling. These results indicate that it would be inappropriate to collapse the innovation attributes scores into one score for statistical sampling and analyze the relationship between the extent of use of statistical sampling and the perceived attributes of statistical sampling.

Personal/Organizational Scales

The descriptive statistics of professionalism, professional commitment, organizational commitment, management support for innovation and the adaption/innovation inventory are presented in Figure 28 on page 92. The frequency distributions are presented in Figure 83 on page 189 in Appendix B. The respondents' scores for professionalism have a mean and median of 3.24. If a score of 3 indicates a neutral professional attitude then this indicates that the respondents have a

¹⁰⁶ Wayne W. Daniel, *Applied Nonparametric Statistics* (Boston: Houghton Mifflin, 1978), pp. 76-80 and pp. 200-05.

positive professional attitude. The frequency distribution of the sample scores shows that 75% of the respondents have a professionalism score above 3. Professional commitment is very high with a mean and median of 3.8. The frequency distribution indicates that 75% of the respondents have professional commitment scores above 3.5. The range of scores for professionalism and professional commitment is narrow (2.2 and 2.5).

The adaption/innovation inventory score mean is 83.83. This is significantly below the hypothetical mean of 96. This means that this group is composed of individuals who are adaptors. A score above 96 is indicative of an innovator, and only 15% of this sample had KAI scores above 96.

It appears that the respondents as a group find their organizations somewhat unsupportive of innovative behavior. This is represented by the mean SSSI score of 2.45 and the median score of 2.3. The frequency distribution for the SSSI variable has a very sharp peak at the mode of 2.4, and the right tail area is longer than the left tail. The level of organizational commitment indicates that this group of respondents is not highly committed to their organizations. The mean score for organizational commitment is 2.45 with a median score of 2.33. The frequency distribution of the sample scores for organizational commitment shows that over 75 % of the respondents' scores were below 2.90 and that the right tail area is longer than the left area. For both the SSSI and the organizational commitment variables, the scores could have ranged from 1 to 5.

As explained in chapter three, cosmopolitanism was measured by adding together responses to several items representing both attitudes and actions. The summary of the responses to the items of the cosmopolitanism scale is presented in Figure 29 on page 94. Interpretation of the descriptive statistics for cosmopolitanism is difficult since the score is a combination of attitudes and actions. However, the frequency histogram does have the appearance of a continuous variable with normal distribution properties.

Sampling Technique	n	mean	S.D.	med.	Lower Quart.	Upper Quart.
Perceived Support for Innovation	258	2.45	.59	2.3	2.1	2.8
Organizational Commitment	258	2.45	.70	2.3	2.0	2.9
Adaption / Innovation Inventory	248	83.83	10.05	85.0	78.0	91.0
Professional Commitment	258	3.79	.48	3.8	3.5	4.1
Professionalism	258	3.24	.37	3.4	3.0	3.5
Cosmopolitanism	254	12.45	1.91	12.5	11.1	13.8

Figure 28. Descriptive statistics - Personal / Organizational scales

The personal and organizational variables display properties of continuous variables over a tight range. The small variation in scores may make it difficult to detect relationships between these variables and the extent of use of the statistical sampling techniques.

Hypotheses Tests

The results of the statistical tests of the hypotheses developed in chapter three are discussed in this section. The hypotheses suggest that there is an association between the extent of use of the innovations (statistical sampling techniques) and three types of attitudinal or perceptual variables - (1) innovation attributes, (2) organizational attributes, and (3) personal attributes. The discussion of the data analysis that follows begins by reviewing the evidence regarding the several hypothesized bivariate relationships. The discussion then continues with a review of the evidence regarding multivariate relationships.

Tests of Hypothesis One - Bivariate Analysis

Hypothesis One is:

- H1₀:** There is no association between the extent of use of statistical sampling techniques and their perceived levels of relative advantage, trialability, observability, and compatibility or the association is negative. There is no association between the extent of use of statistical sampling techniques and their perceived level of complexity or the association is positive.
- H1A:** The extent of use of statistical sampling is positively associated with its perceived relative advantage, trialability, observability, and compatibility and negatively associated with its perceived complexity.

This hypothesis is tested by first examining each of the bivariate associations. The results of the bivariate tests for the association are discussed in the next section. Additional tests are performed

1. Are you an IIA member ? Yes 228 no 28 Yes=1 no = 0
2. Are you certified ? Yes 208 no 48 Yes = 1 no = 0
3. How often do you attend chapter meetings?

Never	<u>47</u>	1/4	<u>85</u>	1/3	<u>24</u>	1/2	<u>24</u>	2/3	<u>19</u>	3/4	<u>55</u>
(0)		(1)		(2)		(3)		(4)		(5)	
4. How many international meetings have you attended ?

0	<u>202</u>	1	<u>32</u>	2	<u>8</u>	3	<u>6</u>	4	<u>3</u>	5	<u>6</u>
---	------------	---	-----------	---	----------	---	----------	---	----------	---	----------
5. For how many of the last five years have you served as a director or chairperson of your IIA chapter?

1	<u>21</u>	2	<u>9</u>	3	<u>4</u>	4	<u>2</u>	5	<u>3</u>
---	-----------	---	----------	---	----------	---	----------	---	----------
6. For how many of the last five years have you served as an officer of your IIA chapter?

1	<u>18</u>	2	<u>11</u>	3	<u>3</u>	4	<u>3</u>	5	<u>2</u>
---	-----------	---	-----------	---	----------	---	----------	---	----------
7. For how many of the last five years have you served as a committee member of your IIA chapter?

1	<u>24</u>	2	<u>9</u>	3	<u>2</u>	4	<u>1</u>	5	<u>1</u>
---	-----------	---	----------	---	----------	---	----------	---	----------
8. How many hours of continuing professional education do you complete each year?

mean 34.7 median 40 1 = < 40 hours 2 = > 40 hours
9. How often do you submit articles to professional journals for publication?

0 never 233 1 every couple of years 20 2 one per year 1
10. To how many professional journals do you subscribe?

mean = 3.93 median = 3 1 = < 3 2 = >= 3
11. How many of the journals do you regularly read?

mean = 3.4 median = 3 1 = < 3 2 = >= 3

Note: Cosmopolitanism = the sum of these items plus professional commitment, professional referent and organizational commitment scores from their respective scales

Figure 29. Item Responses - Cosmopolitanism Scale

on the possible multivariate relationships. Details of the multivariate tests are presented in the last section of this chapter.

Zero Order and Rank Order Correlations

In Figure 30 on page 96, the Pearson zero order correlation coefficients (r) between the extent of use of the statistical sampling techniques and their perceived innovation attributes are presented. The correlation coefficients' significance levels are based upon the standard t-statistic with degrees of freedom equal to the number of observations minus two.

The correlation coefficients for the association between each of the innovation attributes and the extent of use (EOU) of dollar unit sampling, attributes sampling, and stop-or-go sampling are significant for both financial and operational auditing. In addition, a significant negative association is found for the association between complexity and EOU. For discovery sampling, only complexity is insignificantly associated with EOU in financial audits, and both trialability and complexity are insignificant for discovery sampling in operational auditing. The EOU of difference estimation and the five innovation attributes are significantly correlated. The EOU of mean per unit estimation in financial auditing is significantly correlated with complexity and compatibility, and for operational auditing it is significantly correlated with all of the innovation attributes except trialability. The EOU of ratio estimation is not significantly correlated with relative advantage and trialability in financial auditing, but is significantly associated with the others. For operational auditing, the EOU of ratio estimation is significantly correlated with the levels of perceived complexity and compatibility.

While most of the correlations between the EOU and the levels of innovation attributes are statistically significant, the magnitude of the relationships is not very large. For example, the largest r , for EOU of dollar unit sampling with compatibility in financial audits, is .538. This means that the level of compatibility of dollar unit sampling explains approximately 29 per cent of the variation in

..... Sampling Technique

Innovation Attribute	Dollar Unit	Attributes	Stop or go	Discovery	Mean per unit	Difference	Ratio
Financial Audits	n=222	n=232	n=230	n=228	n=223	n=225	n=226
Relative advantage	.459 ^a	.487 ^a	.294 ^a	.243 ^a	.048	.125 ^c	.024
Trialability	.304 ^a	.168 ^b	.132 ^b	.120 ^b	.043	.123 ^c	.062
Observability	.319 ^a	.395 ^a	.172 ^b	.112 ^b	.054	.155 ^b	.093 ^d
Complexity	-.504 ^a	-.370 ^a	-.103 ^d	-.061	-.089 ^d	-.174 ^b	-.181 ^b
Compatibility	.538 ^a	.493 ^a	.263 ^a	.205 ^a	.170 ^b	.240 ^a	.179 ^b
Operational Audits	n=228	n=227	n=225	n=223	n=218	n=221	n=221
Relative advantage	.315 ^a	.504 ^a	.342 ^a	.248 ^a	.095 ^d	.091 ^d	-.020
Trialability	.282 ^a	.266 ^a	.160 ^b	.081	.048	.114 ^c	.052
Observability	.250 ^a	.444 ^a	.215 ^a	.126 ^c	.148 ^c	.188 ^b	.076
Complexity	-.383 ^a	-.385 ^a	-.151 ^b	-.038	-.164 ^b	-.181 ^b	-.169 ^b
Compatibility	.461 ^a	.503 ^a	.255 ^a	.212 ^a	.244 ^a	.235 ^a	.129 ^c

a p > .001 b p > .01 c p > .05 d p > .10

Figure 30. Correlation Coefficients - EOU with Innovation Attributes

the EOU. It is possible that the associations are actually larger than those reported in Figure 30 on page 96. Measurement error in the variables attenuates the computed relationships. One approach to evaluating the strength of an association is to adjust the correlation coefficients to take into account the measurement error and recompute the "true" correlation coefficient if no measurement error existed. The formula for adjusting the correlation coefficient is:¹⁰⁷

$$\hat{r} = \frac{r_{12}}{(\sqrt{r_{11}} \sqrt{r_{22}})}$$

where:

\hat{r} = Corrected correlation coefficient

r_{12} = Sample correlation coefficient

r_{11} = Reliability of variable 1

r_{22} = Reliability of variable 2

The reliabilities of the innovation attributes variables were reported in Figure 13 on page 65. The extent of use measure is a single item measure. Therefore, it is not possible to evaluate its reliability. Assuming that EOU is perfectly measured, the correction for attenuation due to the measurement error in the innovation attributes can be computed. The effect of the attenuation of the correlation coefficients can be seen in Figure 31 on page 98. If the EOU reliability were as low as .60, then the adjustments for attenuation would be multiplied by 1.3.

The Pearson correlation coefficients and the related significance tests are based upon the assumption that the two variables follow a bivariate normal distribution.¹⁰⁸ When this assumption is violated, an appropriate alternative measure is the Spearman rank order correlation coefficient. This coefficient is based upon the assumption that the data consist of a random sample of pairs of observations. Each pair of observations represents two measurements on the unit of association,

¹⁰⁷ Nunnally, pp. 219-20.

¹⁰⁸ Elazar J. Pedhazur, *Multiple Regression in Behavioral Research* (New York: Holt, Rinehart, & Winston: 1982) p. 40.

Innovation Attributes	Dollar Unit	Attributes	Variables
Relative Advantage	1.13	1.13	1.15
Trialability	1.30	1.25	1.21
Observability	1.19	1.14	1.18
Complexity	1.10	1.08	1.09
Compatibility	1.15	1.15	1.15

Figure 31. Attenuation Factors for Innovation Scales

where the measurements can be rank ordered.¹⁰⁹ The earlier observations regarding the distribution of the extent of use variables calls into question the assumption of bivariate normal distributions. However, the assumptions underlying the rank order statistic appear to be met. Therefore, Spearman rank order correlations were calculated for the innovation attributes and the extent of use of statistical sampling.

In Figure 32 on page 100, the Spearman rank correlations between the innovation attributes and the extent of use of each of the statistical sampling techniques are reproduced. The association between the innovation attributes and the EOUs of dollar unit sampling, attributes sampling, stop or go, and discovery sampling are highly significant. The rank order correlations between the EOU of mean per unit and difference estimation and the innovation attributes are significant in financial audits. The EOU of difference estimation in operational audits is significantly correlated with each of the innovation attributes. Trialability is not significantly correlated with the EOU of mean per unit estimation in operational auditing or with the EOU of ratio estimation in financial and operational auditing.

Comparing the rank order correlations with the zero order correlations, the results are similar for the dollar unit sampling and attributes sampling techniques. There are several more significant correlations between the EOU of variables sampling and the innovation attributes when rank orders are correlated.

Contingency Table Analysis

In the previous chapter, it was explained that the research into the innovation decision process has primarily focused on studies of factors related to the adoption/nonadoption decision. As a result, it is necessary to analyze the hypothesized relationships with the extent of use of statistical sampling

¹⁰⁹ Daniel, *Nonparametric* p. 300.

Innovation Attribute	Sampling Technique							Ratio
	Dollar Unit	Attributes	Stop or go	Discovery	Mean per unit	Difference		
Financial Audits	n=228	n=232	n=230	n=228	n=223	n=225	n=226	
Relative advantage	.457 ^a	.464 ^a	.278 ^a	.257 ^a	.197 ^b	.200 ^a	.116 ^c	
Trialability	.312 ^a	.161 ^b	.150 ^b	.132 ^c	.090 ^d	.142 ^c	.061	
Observability	.327 ^a	.383 ^a	.148 ^b	.102 ^d	.155 ^b	.187 ^b	.109 ^c	
Complexity	-.519 ^a	-.372 ^a	-.088 ^d	-.073	-.163 ^b	-.202 ^a	-.196 ^a	
Compatibility	.551 ^a	.486 ^a	.249 ^a	.218 ^a	.211 ^b	.268 ^a	.229 ^a	
Operational Audits	n=222	n=227	n=225	n=228	n=218	n=221	n=221	
Relative advantage	.341 ^a	.498 ^a	.311 ^a	.235 ^a	.165 ^b	.155 ^b	.103 ^c	
Trialability	.284 ^a	.249 ^a	.173 ^b	.092 ^d	.038	.121 ^c	.040	
Observability	.280 ^a	.437 ^a	.188 ^b	.120 ^c	.171 ^b	.224 ^a	.122 ^c	
Complexity	-.387 ^a	-.394 ^a	-.137 ^c	-.048	-.160 ^b	-.202 ^a	-.194 ^a	
Compatibility	.479 ^a	.522 ^a	.261 ^a	.227 ^b	.279 ^a	.280 ^a	.188 ^b	

a p > .001 b p > .01 c p > .05 d p > .10

Figure 32. Rank Order Correlations - Innovation Attributes with EOU

as a continuous variable and with the dependent variable being the adoption or nonadoption of statistical sampling. In addition, in an earlier section of this chapter, analysis of the frequency distributions of the EOU variable indicated that the EOU may actually reflect a discrimination between adopters and nonadopters. Therefore, responses were dichotomized by designating responses less than 6 as nonadopters and greater than or equal to 6 as adopters.

Examination of the frequency distributions of the EOU measures shows that there are significantly more nonadopters of the individual variables sampling techniques than there are adopters. The same applies for stop or go and discovery sampling. Categorical data analysis does not work well when there are no (or relatively few) items in a category. In order to minimize the data analysis problems, the statistical sampling techniques were collapsed into three classes - dollar unit sampling, attributes sampling, and variables sampling. For attributes sampling techniques and variables sampling techniques, the determination of whether the respondent was an adopter or nonadopter was based upon the highest EOU reported for each of the three techniques of the class of techniques. That is, the EOU for attributes sampling is equal to the highest EOU of attributes, stop or go, or discovery sampling.

In order to analyze the relationships between the dichotomous dependent variable and the innovation attributes variables, the innovation attributes were categorized into 4 levels; those responses between one and two, two and three, and so on. Contingency tables were prepared for each of the three statistical sampling techniques and measures of association based on these cross tabulations are reported in Figure 33 on page 102.

The exhibit includes the chi-square statistic for testing the independence of the sampling technique and an innovation attribute. A significant statistic indicates that there is association between the variables. The results for the relationship between the adoption or nonadoption of statistical sampling and the innovation attributes is similar to those reported above when analyzing the correlation coefficients. All of the innovation attributes are significantly associated with adoption of dollar unit sampling in financial and operational auditing. All of the associations between the adoption of at-

	Relative Advantage	Triability	Observability	Complexity	Compatibility
Dollar unit					
chi-square	27.190****	14.773****	14.962****	40.407****	39.113****
gamma	.517****	.407****	.394****	-.593****	-.602****
tau _b	.304	.229	.229	-.362	.364
tau _c	.345	.253	.261	-.418	.420
Lambda R ² /C	.217	.113	.104	.283	.245
Variables					
chi-square	12.740****	7.738***	4.594*	4.162*	11.548***
gamma	.145	.194	.251*	-.254*	.364***
tau _b	.064	.083	.110*	-.110*	.162
tau _c	.053	.069	.094	-.094	.137
Lambda R ² /C	.000	.000	.000	.000	.000
Attributes					
chi-square	22.388****	5.378	24.306****	12.009***	22.310****
gamma	.476****	.209**	.473****	-.339****	-.492****
tau _b	.288	.115	.304	-.212	.298
tau _c	.296	.116	.323	-.224	.308
Lambda R ² /C	.140	.000	.118	.043	.097

**** p > .001 *** p > .01 ** p > .05 * p > .10

(Note: There is no statistical test for the significance of tau_c or Lambda)

Figure 33. Innovation Attributes and Adoption - Financial Audits: Measures of Association

	Relative Advantage	Triability	Observability	Complexity	Compatibility
Dollar unit					
chi-square	11.719***	14.162***	12.856***	25.057***	27.102***
gamma	.374***	.425***	.375***	-.518***	.579***
tau _b	.188***	.216***	.195***	-.282***	.308***
tau	.196	.213	.199	-.291	.318
lambda R ² C	.000	.000	.000	.030	.000
Variables					
chi-square	14.006***	1.289	4.567	5.004***	8.469**
gamma	.111	.108	.218*	-.328*	.262**
tau _b	.045	.042	.092*	-.133**	.112**
tau	.036	.033	.074	-.107	.090
lambda R ² C	.000	.000	.000	.000	.000
Attributes					
chi-square	32.811****	8.331**	33.290****	18.084****	25.407****
gamma	.545****	.316***	.543****	-.414****	.510****
tau _b	.320****	.173***	.333****	-.249****	.299****
tau	.359	.185	.392	-.211	.335
lambda R ² C	.245	.055	.245	.164	.155

**** p > .001 *** p > .01 ** p > .05 * p > .10

(Note: There is no test of significance for tau_c)

Figure 34. Innovation Attributes and Adoption - Operational Audits: Measures of Association

tributes sampling and the perceived innovation attribute levels are significant except for trialability in operational audits. Relative advantage, trialability, and compatibility are significantly associated with the adoption of variables sampling in financial auditing, but only the association between relative advantage and compatibility and the adoption of variables sampling is significant in operational auditing.

While the chi-square statistics are significant, the significance is dependent upon the sample size. Therefore, a measure of the strength of the relationship is needed. The four statistics reported in addition to the chi-square are used for the evaluation of the strength of the relationship.

Gamma is the ratio of the difference between the number of concordant pairs of observations and discordant pairs of observations to the total concordant and discordant pairs of observations. The significance level is a one-sided test.¹¹⁰ The gamma's are high and significant for the relationships between innovation attributes and the adoption or nonadoption of dollar unit sampling and attributes sampling (except for trialability with attributes sampling in financial audits). The strength of the relationship between complexity and compatibility and the adoption of variables sampling as measured by gamma is significant for both financial and operational auditing. The gamma for the relationship between observability and the adoption of variables sampling in operational audits is also significant.

Tau-b and tau-c are measures similar to gamma, except that gamma ignores all tied pairs. Tau-b and tau-c differ in that tau-b is not a good measure where there are a large number of tied pairs. There is no test of significance for tau-c.¹¹¹ The tau-b statistics are highly significant for all of the dollar unit and attributes sampling relationships. The significant tau-b statistics for variables sampling are the associations between the adoption or nonadoption and the observability, complexity, and compatibility of variables sampling.

¹¹⁰ Hubert M. Blalock, Jr., *Social Statistics* (New York: McGraw Hill, 1979). pp. 441-42.

¹¹¹ *Ibid.*, pp. 436-41.

The lambda statistic is a proportional reduction in error (PRE) statistic and can be interpreted as the amount of improvement one could make in properly classifying the dependent variable if the independent variable were known.¹¹² For example, knowing the respondents' levels of perceived relative advantage of dollar unit sampling would improve the ability to properly predict whether or not respondents are adopters or nonadopters by 21.7%. Knowing the level of the perceived innovation attributes would also help in the prediction of whether dollar unit sampling has been adopted in financial auditing. For dollar unit sampling, the lambda ranges from .283 for complexity to .113 for trialability. However, the knowledge would not help for operational auditing. The lambda's are zero for variables sampling. For attributes sampling the lambda ranges from zero for trialability in financial auditing to 14% for relative advantage. In operational audit applications, knowing the level of relative advantage and observability would reduce the prediction errors by 24.5%

Summary of Results of Bivariate Tests of Hypothesis One

At all levels of data analysis the results for the relationships between perceived innovation attributes and the extent of use of dollar unit sampling in both financial and operational auditing support the alternative hypothesis. Relative advantage, trialability, observability, complexity, and compatibility are associated with the extent of use of dollar unit sampling in the expected direction. The relationships are fairly strong, although the proportion of unexplained variation remains at a high level.

The alternative hypothesis is also supported for the attributes sampling techniques. The zero order and rank order correlations are significant in all cases for attributes sampling, stop or go sampling, and discovery sampling. The only exceptions are nonsignificant correlations between complexity

¹¹² Ibid., pp.310-11.

and the extent of use of discovery sampling. The adoption of attributes sampling is also highly associated with the perceived innovation attributes.

The results for variables sampling are mixed. At the interval level, there is evidence that relative advantage, observability, and complexity are associated with the EOU of difference estimation and complexity is associated with the EOU of ratio estimation. At the ordinal level, the relationships between the EOU of difference estimation and the five innovation attributes is stronger. All of the Spearman correlations are significant for financial auditing. The Spearman correlations indicate a significant negative relationship between the EOU of mean per unit and ratio estimation methods and the perceived level of complexity. At the nominal level of analysis, the chi-square test of the association of relative advantage, trialability, and compatibility with the adoption of variables sampling is significant for financial audit applications. For operational audit applications, the chi-square tests indicate significant associations for relative advantage and compatibility. The measures of the strength of the association between adoption of variables sampling and the perceived levels of innovation attributes indicate that the strongest relationships are between adoption and complexity and compatibility.

The mixed results of the analysis of the bivariate relationships for variables sampling may be partially explained by the observations made earlier in this chapter that the EOUs of variables sampling techniques were not continuous. There are relatively few adopters of variables sampling techniques in this sample. Therefore, the sample may be too homogeneous in the dependent variable when it is defined as adopter or nonadopter. This minimizes the likelihood of finding a significant association at the nominal level of data analysis. However, there is a dispersion of the nonadopters over the 5 levels of adoption decision behavior leading up to the adoption decision. It appears that the rank order statistics provide the best indication of the potential relationships and, based on the Spearman correlations, the alternative hypothesis is supported for variables sampling.

Tests of Hypotheses Two through Six - Bivariate Analysis

The hypotheses regarding the relationships between the extent of use of statistical sampling and personal characteristics are:

- H2₀: The extent of use of statistical sampling is not associated with the degree of professionalism and the level of professional commitment of the auditor or the association is negative.
- H2A: The extent of use of statistical sampling is positively associated with the degree of professionalism and to the level of professional commitment of the auditor.
- H3₀: The extent of use of statistical sampling is not associated with the level of organizational commitment of the auditor or the association is negative.
- H3A: The extent of use of statistical sampling is positively associated with the level of organizational commitment of the auditor.
- H4₀: The extent of use of statistical sampling is not associated with the innovation decision style of the auditor.
- H4A: The extent of use of statistical sampling is associated with the innovation decision style of the auditor.

The hypotheses regarding the relationship between the organizational characteristics and the extent of use of statistical sampling are as follows:

- H5₀: The extent of use of statistical sampling is not associated with the auditor's perception of the organization's level of support for innovation or the association is negative.
- H5A: The extent of use of statistical sampling is positively associated with the auditor's perception of the organization's level of support for innovation.
- H6₀: The extent of use of statistical sampling is not associated with organization size.
- H6A: The extent of use of statistical sampling is positively associated with organization size.

The statistical tests of the relationships between the personal and organizational characteristics and the extent of use are similar to those used in the preceding section. The rank order correlations between the professional and organizational variables and the extent of use are reproduced in Figure 35 on page 109. Significant rank order correlations of the perceived support for innovation with the EOU of statistical sampling are found for mean per unit estimation in financial auditing and dollar unit sampling and difference estimation in operational auditing. However, the relationship is inverse rather than the hypothesized direct association. Organizational commitment, the creativity decision style (KAI), and professionalism show no significant correlations with the EOUs

of any of the statistical sampling techniques. Professional commitment is negatively correlated with the variables sampling techniques in both financial and operational audits and is positively correlated with stop or go sampling in financial and operational auditing and discovery sampling in operational auditing. Cosmopolitanism is positively correlated with the EOU of discovery and stop or go sampling in both financial and operational audits.

The associations between company size as measured by total assets is reproduced in Figure 36 on page 110. None of the measures of association between the organizational size (total assets) and the EOUs are significant. The same results were found when the organization size was measured by sales and profits. The measures of size were elicited for commercial enterprises, banks and savings and loans, and government and nonprofit enterprises. When the respondent organizations were analyzed by these categories, size variables were found to be significantly associated with several of the EOUs in the banking and savings and loan group. Both rank correlation coefficients and Kendall tau measures indicate a significant negative association between bank size and the adoption of difference and mean per unit techniques in financial audits and a positive association between the adoption of attributes sampling and bank size in financial and operational auditing.

The data also included responses regarding the respondents age, sex and education. Measures of association for these variables indicated; (1) that males were more likely to use statistical sampling extensively, (2) that there is a negative association between the extent of use of statistical sampling and age, and (3) that there was no significant relationship between education levels and the extent of use of statistical sampling.

Two other items of interest were the use of computer assisted audit practices and the use of micro-computers in audit practice. As expected, both items were significantly associated with the extent of use of statistical sampling.

..... Sampling Technique						
Variable	Dollar Unit	Attributes	Stop or go	Discovery	Mean per unit	Ratio
					Difference	
Financial Audits						
Support for Innovation (n=245)	-.067	.027	-.040	-.086	-.125 ^d	-.041
Organizational Commitment (n=236)	-.001	.026	-.040	-.092	-.085	-.030
Adaption/Innovation (n=236)	-.017	-.084	-.003	-.068	-.026	-.074
Professionalism (n=228)	.033	.071	.104	.107 ^d	-.049	-.014
Professional Commitment (n=228)	.034	.018	.109 ^d	.148 ^c	-.121 ^d	-.148 ^c
Cosmopolitanism (n=228)	.014	-.012	.173 ^b	.135 ^c	.021	-.012
Operational Audits						
Support for Innovation (n=245)	-.114 ^d	-.040	-.055	-.092	-.099	-.013
Organizational Commitment (n=236)	-.036	.036	-.035	-.088	-.055	.024
Adaption/Innovation (n=236)	-.057	.000	.040	.025	-.002	-.100
Professionalism (n=228)	-.013	-.014	.097	.037	-.016	-.016
Professional Commitment (n=228)	.040	.018	.155 ^c	.092	-.112 ^d	-.110 ^d
Cosmopolitanism (n=228)	.051	.008	.167 ^b	.106	-.002	-.021

a p > .001 b p > .01 c p > .05 d p > .10

Figure 35. Personal/Organizational Variables with EOU: Rank Order Correlations

Statistic	Dollar unit	Attributes	Variables
Financial audits			
chi-square	3.788	.315	4.982
gamma	.067	.026	-.228
tau _b	.041	.015	-.109
lambda R C	.021	.000	.000
Operational audits			
chi-square	4.970	.830	4.003
gamma	.043	.050	-.166
tau _b	.024	.031	-.072
lambda R C	.000	.000	.000

Figure 36. Measures of Association - Organization Size with EOU

Summary of Results - Bivariate Tests of Hypotheses Two through Six

The null hypothesis of no association between professionalism and EOU as measured by the Hall scale cannot be rejected in this sample. When professionalism is defined as cosmopolitanism, there is support for rejecting the null hypothesis for two of the statistical sampling techniques. The alternative hypothesis of the relationship between professional commitment and the extent of use of statistical sampling is not supported. While the rank correlations are significant for the variables sampling techniques, the relationship is negative rather than the expected positive one. Overall, there is no strong basis for rejecting hypothesis two.

Organizational commitment is not significantly associated with the EOU of statistical sampling in this sample leading to the conclusion that the third hypothesis cannot be rejected in this study. The fourth hypothesis of no relationship between decision style and the extent of use of statistical sampling cannot be rejected. The bivariate data analysis also indicates that the null hypothesis for the relationship between management support for innovation and the extent of use of statistical sampling cannot be rejected. Hypothesis six tests are mixed. The null hypothesis cannot be rejected for the overall sample. However, for banking and savings and loan institutions, size is positively associated with the adoption of attributes sampling for operational auditing. The association is negative for variables sampling. This is pursued further in the next section of this chapter.

Multivariate Relationships

In this section, the statistical analyses for tests of multiple relationships between the extent of use of statistical sampling and the independent variables are presented. The section begins with a dis-

discussion of the innovation attributes and extent of use (EOU) associations and concludes with a discussion of the effects of the other variables.

The tests of the first hypothesis provide evidence supporting the relationship between the innovation attributes and the EOU of statistical sampling. The questions addressed in this section are:

- Does each innovation attribute variable independently explain a significant portion of the variation in the EOU of statistical sampling?
- Is there a combination of the innovation attributes that best explains the variation in the extent of use of statistical sampling?

In addition, evidence was described in the last section indicating that there may be differences in the innovation decision process between different organization types. Therefore, the multivariate relationships are examined for the entire sample and for the sample categorized into three enterprise groups.

Test of Hypothesis One - Partial Correlations

The five innovation attributes measures are highly correlated in this sample. Therefore, although each of the variables was found to be significantly correlated with the EOUs of the statistical sampling techniques, the correlations may have been indirect and actually have been due to the inter-correlations between the various attributes. The first test for this was the calculation of all first, second, third and fourth order partial correlations between the EOUs of the statistical sampling techniques and the appropriate innovation attribute variables. The fourth order partial correlations are presented in Figure 37 on page 114. When correlating the EOU of each statistical sampling technique with each of the innovation attributes while controlling for the effects of the other four attributes, relative advantage and compatibility continue to be significantly correlated with all of the EOUs (except compatibility with stop or go in operational auditing). In addition, complexity is significantly correlated with dollar unit, discovery, and ratio sampling techniques. Trialability and observability are not significantly correlated with the EOUs (except for trialability with attributes

sampling in financial auditing and observability with difference estimation in operational auditing). Although not presented here, the lack of significance for trialability and observability was found when all second order partial correlations were calculated.

The fourth order partial coefficients can be used to construct a functional relationship between the EOUs of statistical sampling and the innovation attributes. For example, the extent of use of dollar unit sampling is seen as a function of relative advantage, complexity, and compatibility. Each EOU is a function of the innovation attributes with significant partial coefficients. This analysis leads to an observation that the perceived trialability and observability of statistical sampling techniques do not add to the ability to explain their extent of use given the internal auditor's perceptions of relative advantage, complexity, and compatibility of statistical sampling.

Test of Hypothesis One - Multiple Regression

Based upon the examination of the partial correlation coefficients, it was concluded that a limited set of the innovation attributes is needed to explain the variation in the extent of use of statistical sampling. The partial correlations cannot explain the extent of the variation that can be explained by the significant variables. The next question addressed is how much of the variance in EOU can be explained when the variables are used in combination. In order to examine this relationship, multiple regression models were developed with the EOUs as dependent variables and the innovation attributes as independent variables.

Based upon the original correlation matrix of the independent variables, it was expected that there would be problems of multicollinearity associated with the use of multiple regression. This was confirmed when examining the multicollinearity diagnostics for the models as they were developed. All of the models had a high condition index and showed the presence of at least one linear com-

----- Sampling Technique -----

Innovation Attribute	Dollar Unit	Attributes	Stop or go	Discovery	Mean per unit	Difference	Ratio
Financial Audits	n=222	n=226	n=224	n=222	n=217	n=219	n=220
Relative advantage	.157 ^b	.227 ^a	.181 ^b	.170 ^b	-.064	-.065	-.133 ^c
Triability	.022	-.085 ^d	.023	.039	-.021	.021	-.020
Observability	-.070	.015	-.021	-.044	-.018	.039	.024
Complexity	-.244 ^a	-.034	.115	.110 ^c	-.015	-.038	-.114 ^c
Compatibility	.223 ^a	.238 ^a	.143 ^b	.114 ^c	.169 ^b	.164 ^b	.152 ^b
Operational Audits	n=216	n=221	n=219	n=217	n=212	n=215	n=221
Relative advantage	.018	.198 ^b	.226 ^a	.183 ^b	-.093 ^d	-.132 ^c	-.141 ^c
Triability	.079	.040	.031	-.004	-.061	.023	-.011
Observability	-.053	.078	-.012	-.026	.042	.108 ^d	.034
Complexity	-.112 ^c	.009	.077	.151	-.049	-.037	-.128 ^c
Compatibility	.261 ^a	.223 ^a	.083	.140 ^c	.204 ^a	.166 ^b	.105 ^d

a p > .001 b p > .01 c p > .05 d p > .10

Figure 37. Partial Correlations - Innovation Attributes with EOU: Correlation of each attribute with EOU after controlling for other attributes

bination of two or more of the independent variables.¹¹³ This created two problems. First, the presence of multicollinearity inflates the absolute value of the regression coefficients. This means that the magnitude of the coefficients cannot be compared in order to evaluate the relative importance of one variable over another. Secondly, the standard t-tests for the significance of the individual regression coefficients are affected by the multicollinearity due to the inflation of the standard errors of the regression coefficients.¹¹⁴

The approach to model selection follows the suggestions of Montgomery and Peck.¹¹⁵ All possible regression models were examined. The best of the one variable, two variable, three variable, etc. models were selected by examining the coefficient of multiple determination, R^2 , the adjusted R^2 , the residual mean square error, and Mallows' C_p statistic. The determination of whether a one, two, three, or four variable model is better is based on the partial F-test for the significance of the increase in R^2 by the addition of a variable.

The variables included in the best regression models, the regression coefficients and related statistics are presented in Figure 38 on page 117. The results concur with what is found when examining the partial correlations. Relative advantage and compatibility are found in nearly all of the models and complexity is found in several models. Trialability is not present in any of the models and observability is present in only one model. The R^2 's for dollar unit sampling and attributes sampling are reasonably large indicating that the models do help in explaining the variation of the EOUs of these techniques in this study. The R^2 's for the other models are relatively small, and while the models are statistically significant, they contribute very little towards explaining the variance in the EOUs of the other statistical techniques.

¹¹³ Douglas C. Montgomery and Elizabeth A. Peck, *Introduction to Linear Regression Analysis* (New York: John Wiley & Sons, 1982), pp. 296-306.

¹¹⁴ *Ibid.*, pp. 291-296.

¹¹⁵ *Ibid.*, pp. 244-55.

The possibility that there are different relationships between the EOU of statistical sampling and the innovation attributes due to characteristics peculiar to certain types of organizations is examined by developing multiple regression models for three organizational groups. A summary of the significant innovation attributes variables for each of the groups is presented in Figure 40 on page 119. The actual regression models are presented in Figure 90 on page 198. Differences appear in the significant variables that are present in each group's models. The models for commercial enterprises are dominated by relative advantage, complexity, and compatibility. This is similar to the sample wide findings discussed in the previous section. However, observability appears in the models explaining the EOU of the three variables sampling techniques and discovery sampling in operational auditing. For the financial enterprises, compatibility appears to be the dominant variable, however, trialability and observability are significant for the explanation of the variance in the EOU of the variables sampling techniques. Trialability appears in almost half of the models for the nonprofit group.

It should be noted that the signs on several variables are not as expected. This is particularly the case in the commercial group for the variables sampling techniques where the sign on relative advantage is negative. As noted earlier, multicollinearity is a problem with this data and one of its effects is that the sign of the regression coefficients can be wrong. The smaller number of observations in the grouped data increases the impact of the multicollinearity on the ordinary least squares results. Therefore, the beta coefficients in these models should not be used to evaluate the relative strength of the relationships between the innovation attributes and their respective extent of use measure.

Rogers' model is partially confirmed by the multiple regression results. Relative advantage, compatibility, and complexity help to explain the variance in the extent of use of dollar unit sampling in financial auditing, discovery sampling in both financial and operational auditing, ratio estimation in both types of auditing, and stop or go sampling in financial auditing. These three variables are the most important of the innovation attributes in this sample. For attributes sampling, the two variable model including relative advantage and compatibility is the best. This is also true for mean

----- Sampling Techniques -----							
Coefficients	Dollar unit	Attributes	Discovery	Stop or go	Ratio	Mean per unit	Difference
Intercept	3.14 (2.50)	-.98 (-1.41)	-1.10 (-.76)	-1.97 (-1.45)	3.97 (3.37)	1.50 (3.45)	.98 (1.92)
B ₁ (RA)	.46 (2.10)	.91 (4.03)	.72 (2.69)	.76 (3.02)	-.51 (-2.13)		
B ₃ (OB)							
B ₄ (CX)	-.85 (-3.96)		.47 (1.98)	.44 (1.98)	-.37 (-1.82)		
B ₅ (CP)	.80 (3.26)	.93 (4.25)	.46 (1.70)	.56 (2.18)	.53 (2.35)	.34 (2.57)	.57 (3.70)
R ²	.367	.293	.079	.111	.061	.029	.058
R ² - Adj.	.358	.287	.067	.112	.048	.025	.054
n	228	232	228	230	226	223	225
Model F-stat.	40.46	47.56	6.40	9.40	4.78	6.60	13.66

(t-statistic for coefficient)

LEGEND:
 RA Relative advantage
 OB Observability
 CX Complexity
 CP Compatibility

t .001 = 3.090
 t .01 = 2.326
 t .05 = 1.645
 t .10 = 1.282

Figure 38. Innovation Attributes and EDU: Financial audits

----- Sampling Techniques -----									
Coefficients	Dollar unit	Attributes	Discovery	Step or go	Ratio	Mean per unit	Difference		
Intercept	1.68 (1.28)	-1.67 (-2.31)	-2.11 (-1.44)	.30 (.46)	4.34 (3.78)	.83 (1.73)	1.11 (1.83)		
B ₁ (RA)		1.00 (4.33)	.77 (2.90)	.97 (5.43)	-.49 (-2.15)	.58 (3.69)	-.48 (-1.91)		
B ₃ (OB)							-.41 (1.79)		
B ₄ (CX)	-.46 (-1.96)		.63 (2.62)		-.41 (-2.09)				
B ₅ (CP)	1.11 (4.75)	.97 (4.26)	.56 (2.05)		.37 (1.65)	.53 (3.69)	.62 (2.97)		
R ²	.236	.310	.094	.117	.051	.059	.075		
R ² - Adj.	.228	.304	.082	.099	.037	.055	.062		
n	222	227	223	225	221	218	221		
Model F-stat.	31.91	50.40	7.61	29.48	3.84	13.64	5.86		

(t-statistic for coefficient) LEGEND:

- t_{.001} = 3.090 RA Relative advantage
- t_{.01} = 2.326 OB Observability
- t_{.05} = 1.645 CX Complexity
- t_{.10} = 1.282 CP Compatibility

Figure 39. Regression Models - Innovation Attributes and EOU: Operational audits

Extent of Use of:	Commercial	Banks / S&L's	Non-profit
Dollar unit - financial	-CX +CP	+RA -CX +CP	+TR +CP
- operational	-CX +CP	+CP	+TR +CP
Attributes - financial	+RA	+CP	+RA
- operational	+RA +CP	+CP	+RA +CP
Stop or go - financial	+RA	+CP	+TR +CX +CP
- operational	+RA	+RA	+RA
Discovery - financial	+RA -CX		+TR
- operational	+RA -OB		+TR
Ratio - financial	+RA +OB -CX	-TR +CP	+CP
- operational	-RA +OB -CX		+RA
Mean per unit - financial	+TR		
- operational	-RA +OB +CP	-TR +OB +CP	+RA
Difference - financial	-CX	-TR -OB +CP	+CX +CP
- operational	-RA +OB +CP	+OB +CP	+TR

LEGEND:

- RA Relative advantage
- TR Trialability
- OB Observability
- CX Complexity
- CP Compatibility

Figure 40. Significant Attributes from Group Regressions

per unit in operational auditing. However, only for dollar unit sampling and attributes sampling do the models explain a significant portion of the variance in their respective EOU's. It is important to note that these models may not be replicated in a different sample due to the presence of the multicollinearity.

The regressions on the data grouped by organization type indicate that observability and trialability are present in models for banking and nonprofit groups. This may indicate that while Rogers' model hypothesizes five innovation attributes as a general description of the innovation decision model, different user groups will place different levels of significance on each of the attributes. This has implications for the design of future research that will be discussed in the next chapter.

Test of Hypothesis One - Logistic Regression

As discussed earlier, the extent of use measures appear to be dichotomous for some of the techniques. In addition, the previous research into the innovation decision process has predominately focused on the factors explaining adoption or nonadoption of an innovation. Therefore, as was done in the bivariate analyses, the adoption or nonadoption of the statistical sampling methods was analyzed relative to the explanatory power of the innovation attributes.

Two techniques are appropriate for data where the dependent variable is dichotomous and the independent variables are continuous - discriminant analysis or logistic regression. Discriminant analysis requires that the variables used to classify individuals into one of the two populations be multivariate normally distributed. It has been demonstrated that whenever this assumption is violated, logistic regression is preferred over discriminant analysis.¹¹⁶

¹¹⁶ James Press and Sandra Wilson, "Choosing between Logistic Regression and Discriminant Analysis," *Journal of the American Statistical Association* 73 (December 1978): 699-705; and Frank E. Harrell and Kerry L. Lee, "A Comparison of the Discrimination of Discriminant Analysis and Logistic Regression under Multivariate Normality," in *Biostatistics: Statistics in Biomedical, Public Health, and Environmental Sciences*, ed. by P. K. Sen (New York and Amsterdam: North Holland for Elsevier Science: 1985), pp. 333-43.

Logistic regression is a method for estimating the probability of occurrence of an event from dichotomous data as a function of independent variables with quantitative and qualitative values. Logistic regression models were developed in a manner similar to the model building discussed in the previous section. The best models are presented in Figure 41 on page 123. Presented in this exhibit are the coefficients, the chi-square statistics for the significance of each coefficient, the R-statistic (a measure of the predictive ability of the model similar to the multiple correlation coefficient), and two measures of the predictive ability of the models, *c* and Somer's *Dyx*. The index, *c*, compares the predicted and observed values and is equal to the fraction of concordant pairs plus one-half of the ties. The *c* index takes on a value of one for perfect discrimination and one-half for random prediction.¹¹⁷ Somer's *D* is an index of the rank correlation between the predicted probabilities and the observed outcomes.¹¹⁸ The test for determining whether to add a variable to the model is based on the increase in the *R*.

The SAS procedure *Logistic* was used to develop the models that appear in Figure 41 on page 123.¹¹⁹ The procedure fits a model such that the probability that the respondent is an adopter ($P[\text{adopt}]$) is a function of the independent variables as follows:

$$P(\text{Adopt}) = 1/(1 + \exp(-\alpha - X_i\beta))$$

Interpretation of the coefficients of the models are somewhat difficult due to the exponential form of the model. However, the larger the number in the exponent, the closer the probability of being an adopter is to one. Therefore, the interpretation of the coefficients in Figure 41 on page 123 is similar to the multiple regression coefficients. For example, the model for predicting the probability of adopting dollar unit sampling in financial auditing shows that increasing complexity decreases the probability and increasing compatibility increases the probability of adopting.

¹¹⁷ Harrell and Lee, p. 336.

¹¹⁸ Frank E. Harrell, Jr., "The LOGIST Procedure," in SAS Institute Inc., *SUGI Supplemental Library User's Guide, Version 5 Edition* (Cary, N.C.: SAS Institute Inc., 1986), pp. 271-73.

¹¹⁹ *Ibid.*, p. 273.

The results of the logistic regression analysis indicate: (1) that compatibility and complexity explain the probability of adoption or nonadoption of dollar unit sampling, (2) that relative advantage and compatibility explain the adoption/nonadoption of attributes sampling in financial auditing, (3) that relative advantage, observability, and compatibility explain the probability of adoption of attributes sampling in operational auditing, and (4) that compatibility explains the adoption/nonadoption of variables sampling. When comparing these results to the multiple regression results, there are strong similarities.

A summary of the significant innovation attributes variables of the logistic regression models for each organization group is presented in Figure 42 on page 124. The actual logistic regression models are presented in Figure 93 on page 201. Results are not extremely different from the overall sample. Compatibility and/or complexity is present in most of the models. Relative advantage is significant only for attributes sampling and dollar unit sampling in operational audits of commercial enterprises. Trialability is the only significant variable for helping to predict the probability of adopting variables sampling in operational auditing in nonprofit enterprises. When examining the statistics to determine how well the models fit the data, (Figure 93 on page 201) it is clear that none of the models for explaining the probability of adopting variables sampling are strong. This is most likely due to the small number of adopters of the variables sampling techniques that has been discussed in earlier sections of this dissertation.

Multivariate Tests of Hypotheses Two through Six

In the earlier discussion of the bivariate tests for association between the extent of use of statistical sampling and the personal and organizational variables, only professional commitment was found to have a significant correlation with the variables sampling techniques. All other relationships were nonsignificant. First order partial correlations were calculated between each of the innovation attributes and the EOUs controlling for each of the personal/organizational variables. In all cases,

----- Sampling Techniques -----						
Coefficients & Statistics	DUSF	DUSO	ATTF	ATTO	VARF	VARO
Intercept	-1.33 (1.19)	-2.52 (3.57)	-3.41 (20.19)	-4.77 (32.27)	-3.70 (21.54)	-3.34 (17.07)
B ₁ (RA)			.56 (6.40)	.56 (4.77)		
B ₃ (OB)				.45 (3.72)		
B ₄ (CX)	-.68 (9.18)	-.46 (3.77)				
B ₅ (CP)	.932 (15.67)	.833 (11.17)	.542 (6.53)	.439 (3.49)	.621 (7.55)	.467 (4.07)
R	.420	.347	.296	.359	.167	.106
c	.775	.738	.712	.757	.642	.606
Somer D _{yx}	.550	.497	.423	.513	.285	.211
Model chi-square	63.20	40.55	32.76	50.15	8.11	4.25
n	229	229	235	235	231	231

chi-square .005 = 7.88
 chi-square .01 = 6.63
 chi-square .05 = 3.84
 chi-square .10 = 2.71

LEGEND: DUS Dollar unit sampling
 ATT Attributes sampling
 VAR Variables sampling
 F Financial auditing
 O Operational auditing
 RA Relative advantage
 OB Observability
 CX Complexity
 CP Compatibility

Figure 41. Logistic regression coefficients and statistics: Innovation attributes and adoption

Probability of adoption of:	Commercial	Banks / S&L's	Non-profit
Dollar unit - financial	-CX +CP	+CP	+CP
- operational	-RA -CX +CP	-CX	+CP
Attributes - financial	+RA	+CP	
- operational	+RA +OB	+OB	+CP
Variables - financial	-CX	+CP	
- operational	-CX		+TR

LEGEND:

- RA Relative advantage
- TR Trialability
- OB Observability
- CX Complexity
- CP Compatibility

Figure 42. Significant Variables from Logistic Regression by Groups

the partial correlations between the innovation attributes and the EOUs had similar magnitudes and levels of statistical significance to the zero order correlations discussed above. The partial correlation results indicate that the strength of the associations between the EOUs and the innovation attributes is not attributable to correlations with the organizational and personal variables. The same conclusions were made based upon the use of organizational size as a control variable.

In order to determine whether the addition of the personal and organizational variables to the models relating the EOUs and the innovation attributes would add to the explanatory power of the models, several regression models were created following the same procedures as described in the preceding section. The final regression models are presented in Figure 43 on page 127. For financial auditing, the ability to explain the extent of use of dollar unit sampling is not improved when the other hypothesized explanatory variables are added. The explanatory power of the model is increased when the extent of use of computer assisted auditing is added and when a dummy variable indicating membership in the nonprofit enterprise group is added. The relationship for the latter variable is negative meaning that nonprofit enterprises are using dollar unit sampling less extensively than the other organizations. Similar findings regarding the use of computer auditing are found for the EOU of dollar unit sampling in operational auditing. Membership in the financial enterprise group means that the respondent uses dollar unit sampling more extensively in operational auditing.

The ability to explain the EOU of attributes sampling techniques in this sample of auditors is increased when the extent of use of microcomputer assisted auditing is added to the models for attributes sampling and discovery sampling in financial auditing and when the extent of use of computer assisted auditing is added to the model for attributes sampling in operational auditing. The use of attributes sampling is negatively related to membership in the financial enterprise group for operational auditing. Of the hypothesized explanatory variables, professional commitment for discovery sampling in financial audits, age and organization size for discovery sampling in operational audits, and cosmopolitanism, organizational commitment, and organization size for stop or go sampling in operational auditing increase the ability to explain the EOUs of the statistical sam-

pling techniques. Note that the coefficients have the expected signs except for size. The larger an organization, the less extensively it uses discovery and stop or go sampling in operational auditing.

The EOU of ratio estimation for financial audits is better explained when the dummy variable indicating membership in the commercial enterprise group is added. The sign indicates that commercial enterprises use ratio estimation more extensively. No additional variables improve the models that include only innovation attributes for difference sampling. In financial auditing, the addition of professional commitment, management support for innovation, and organization size improve the ability to explain the EOU of mean per unit estimation. The model for mean per unit sampling in operational auditing is improved when professional commitment is added. The signs of the coefficients, however are negative instead of positive. In addition, the overall explanatory power of the models is not high.

Multiple regression models were developed for each of the enterprise groups. A summary of the significant variables from each of the models is presented in Figure 45 on page 129, and the actual models are presented in Figure 96 on page 204. Looking at the summary, differences between the enterprise groups appear. For commercial enterprises, cosmopolitanism is significant in seven of the fourteen models. For nonprofit enterprises, the perceived management support for innovation is a significant negative variable in eight of the models. Cosmopolitanism or professionalism is present in eight of the models for nonprofit organizations. Creativity decision style is also significant in three models for nonprofit enterprises.

This break down of the overall sample has increased the number of hypothesized explanatory variables that help to explain the EOU of statistical sampling. While earlier bivariate and multiple regression analysis found no support for the hypothesized relationships between the innovation decision and professionalism, management support for innovation, and creativity decision style, this analysis indicates that the relationships may exist at the enterprise level. This possibility is discussed in the next chapter when the implications of this study are addressed.

Model	R2	R2 - adj.	F
DUS = 4.82 + .46RA - .74CX + .63CP + .44CAA - 1.14GOV	.433	.419	25.14
ATT = 4.47 + .96RA - .33CP + .42MAA	.126	.112	9.80
DIS = -2.42 + .65RA + .49CX + .44CP + .29MAA + .74PCOM	.138	.109	6.18
SOG = -1.78 + .73RA + .40CX + .57CP	.118	.104	8.89
RAT = 4.74 - .64RA - .49CX + .44CP + .63COMM	.104	.086	5.73
DIF = .98 + .57RA	.058	.053	12.20
MPU = 5.99 + .22CP - .66PCOM - .45SSSI - .19SIZE	.077	.057	6.34

LEGEND:

DUS = Dollar Unit Sampling
 ATT = Attributes Sampling
 DIS = Discovery Sampling
 SOG = Stop or go Sampling
 RAT = Ratio Sampling
 DIF = Difference Sampling
 MPU = Mean per unit Sampling

RA = Relative advantage
 CX = Complexity
 CP = Compatibility
 CAA = Computer assisted auditing
 MAA = Micro-computer assisted auditing
 GOV = Dummy variable - Governmental Org.
 COMM = Dummy variable - Commercial Org.
 SSSI = Management support for innovation
 PCOM = Professional Commitment
 SIZE = Total Assets

Figure 43. Multiple Regression Models - All Variables - Financial Audits

Model	R ²	R ² - adj.	F
DUS = 3.53 - .42CX + .79CP + .43CAA + .73BANK	.263	.257	16.88
ATT = .16 + .98RA + .80CP + .40CAA - .67BANK	.308	.293	25.30
DIS = .37 + .88RA + .62CX + .40CP - .05AGE - .26SIZE	.141	.117	7.97
SOG = -3.21 + .96RA + .22CAA + .27COSMO + .41OCOM - .21SIZE	.186	.163	16.21
RAT = 4.77 - .72RA - .42CX + .45CP	.076	.062	5.45
DIF = 1.30 - .62RA + .41OB + .69CP	.084	.078	6.07
MPU = 3.38 + .35CP - .55PCOM	.059	.049	8.86

LEGEND:

DUS = Dollar Unit Sampling
 ATT = Attributes Sampling
 DIS = Discovery Sampling
 SOG = Stop or go Sampling
 RAT = Ratio Sampling
 DIF = Difference Sampling
 MPU = Mean per unit Sampling

RA = Relative advantage
 OB = Observability
 CX = Complexity
 CP = Compatibility
 MAA = Micro-computer assisted auditing
 CAA = Computer assisted auditing
 BANK = Dummy variable - Bank/S&L Org.
 COSMO = Cosmopolitanism
 PCOM = Professional Commitment
 SIZE = Total Assets
 OCOM = Organizational Commitment

Figure 44. Multiple Regression Models - All Variables - Operational Audits

Extent of Use of:	Commercial	Banks / S&L's	Non-profit
Dollar unit - financial	-CX +CP	-CX +CP -PROF	+CP +KAI +COSMO
- operational	-CX +CP +OCOM	+CP -PROF	+CP +KAI +COSMO -SSSI
Attributes - financial	+RA	+CP	+RA -SSSI +PROF
- operational	+RA +CP	+CP	+RA -OCOM
Stop or go - financial	+RA +COSMO	+CP	+TR -KAI
- operational	+RA +COSMO	+RA +OCOM	+RA
Discovery - financial	+RA -SIZE +COSMO		+TR -SSSI
- operational	+RA -SIZE +COSMO		+TR -SSSI -PROF
Ratio - financial	+RA +OB -CX	+CP -PCOM	+CP -COSMO
- operational	-PCOM +OCOM +COSMO		+RA -SSSI
Mean per unit - financial	+TR -PCOM +COSMO	-TR +CP -SIZE -PCOM -OCOM	-PROF
- operational	-RA +OB +CP -PCOM	-TR -CX +CP	+RA -SSSI
Difference - financial	-CX	-TR +CP -SIZE -PCOM -OCOM	+CX +CP -SSSI -COSMO
- operational	-RA +OB -PCOM +COSMO	+CP -SIZE	+TR -SSSI -COSMO

LEGEND:

- RA Relative advantage
- TR Trialability
- OB Observability
- CX Complexity
- CP Compatibility
- PROF Professionalism
- COSMO Cosmopolitanism
- KAI Adaption/Innovation
- SSSI Management support for innovation
- PCOM Professional commitment
- OCOM Organizational commitment
- SIZE Total assets

Figure 45. Summary of Significant Variables - Multiple Regression Models: Organization groups - All variables

The analysis of the adoption decision is also extended to include all of the possible variables. The overall logistic regression models are presented in Figure 46 on page 131. A summary of the significant variables of the logistic models for the organization groups is presented in Figure 47 on page 132, and the actual logistic regression models are presented in Figure 102 on page 210. For all companies, the ability to explain the probability of adopting dollar unit sampling in financial audits is improved when the extent of use of computer assisted auditing, professionalism, management support for innovation, and membership in nonprofit enterprises is added to the logistic regression models. The ability to explain the probability of adopting dollar unit sampling in operational auditing is improved when computer assisted auditing and professionalism are added to the model. The model for attributes sampling in operational auditing is improved when the extent of use of microcomputer assisted auditing and membership in the nonprofit enterprise group is added. Membership in the financial enterprise group improves the model for attributes sampling in operational auditing. The model for variables sampling in financial auditing is improved when membership in the commercial enterprise group is added, and in operational auditing it is improved when professionalism is added.

The most interesting observation from this analysis is that professionalism helps in three of the models, even though it was not significantly associated with any of the EOUs of statistical sampling on a bivariate basis. Note that the signs of the coefficients are negative. Also, the clear differences in the rate of adoption of statistical sampling techniques across industries is seen by the presence of enterprise group membership variables in four of the models.

In Figure 47 on page 132, several variables in addition to the innovation attributes variables are seen in the logistic regression models. Professionalism is present in four of the models for financial enterprises and in the models for variables sampling in operational auditing by commercial and nonprofit enterprises. Cosmopolitanism is present in six models. Support for innovation is in three models for nonprofit enterprises and decision style is present in two models for financial enterprises and two models for nonprofit enterprises. Professional commitment and organizational commit-

Model	R	c	D	chi-square
DUSF = 2.46 + .791CP - .83CX - 1.33GOV + .41CAA - .84PROF + .46SSSI	.471	.820	.641	69.06
DUSO = 2.57 + .59CP - .65CX + .42CAA - .86PROF	.381	.782	.564	41.01
ATTF = -2.22 + .52CP + .49RA + .27MAA - .80GOV	.309	.737	.475	35.68
ATTO = -3.15 + .63RA + .69OB + .38RA - .72BANK	.372	.767	.535	47.38
VARF = -3.89 + .53CP + .93COMM	.196	.676	.352	11.44
VARO = .87 + .49CP - 1.37PROF	.182	.654	.307	9.41

LEGEND:

DUS	Dollar Unit Sampling	RA	Relative advantage
ATT	Attributes sampling techniques	CX	Complexity
VAR	Variables sampling techniques	CP	Compatibility
F	Financial audits	CAA	Computer assisted auditing
O	Operational audits	MAA	Micro-computer assisted auditing
		GOV	Dummy variable - Governmental Org.
		COMM	Dummy variable - Commercial Org.
		SSSI	Management support for innovation
		BANK	Dummy variable - Bank/savings & loan

Figure 46. Logistic Regression Models - All Variables

Probability of adoption of:	Commercial	Banks / S&L's	Non-profit
Dollar unit - financial	-CX +CP *	+CP -PROF -KAI	+CP +KAI
- operational	-CX +COSMO +OCOM *	-CX -PROF -KAI	+CP +KAI +COSMO
Attributes - financial	+RA **	+CP -PROF	-SSSI -PCOM
- operational	+RA +OB +PCOM **	+OB -PROF +COSMO	+TR +COSMO -SIZE
Variables - financial	-CX +COSMO -PCOM	+CP -PCOM -SIZE	-SSSI
- operational	-CX +OCOM +COSMO -PROF	NO MODEL	+TR -SSSI -PROF

* Model improved when use of computer assisted auditing added
 ** Model improved when use of micro-computer assisted auditing added

LEGEND:

RA	Relative advantage	PROF	Professionalism
TR	Trialability	COSMO	Cosmopolitanism
OB	Observability	KAI	Adaption/Innovation
CX	Complexity	SSSI	Management support for innovation
CP	Compatibility	PCOM	Professional commitment
		OCOM	Organizational commitment
		SIZE	Total assets

Figure 47. Significant Variables from Logistic Regression Models: Organization groups - All variables

ment are present in six models. As was the case for the multiple regression models, the signs of the coefficients for professionalism and support for innovation are negative.

Summary of Results of Multivariate Tests

The multiple regression and logistic regression analyses indicate that compatibility is a significant variable for explaining the variance in the extent of use of statistical sampling. In addition, relative advantage and complexity are significant in several models. The only innovation attribute variable that was not significant in any multiple regression model was trialability. The most significant additional variable is the extent of use of computer auditing or micro computers. Indicator variables for organization type were included in 25% of the multiple regression models and two-thirds of the logistic regression models. Analysis of the sample by organization type produced several models that differed between groups. Several of the group models included professionalism, cosmopolitanism, and support for innovation.

The findings that the personal and organizational variables add to the explanatory power of the multiple and logistic regression models indicate that they may be indirectly related to the innovation decision. Suggested extensions of this research based upon these results are discussed in Chapter 5.

Chapter 5

Summary and Implications of the Research Project

The purpose of this chapter is to summarize the research project, discuss the implications of the empirical results, and suggest directions for future research. The chapter contains an assessment of the research problem, a summary of the literature review, a summary of the data collection phase, and an analysis of the research methodologies. It concludes with a discussion of the implications of the empirical results and suggestions for future research.

Review of the Research

This research is an exploratory empirical study of one innovation decision process in internal auditing - the decision to use statistical sampling techniques. Auditors, both internal and external, are currently faced with dramatically changing environments that create the need for creative and innovative approaches to auditing problems. In reaction to this changing environment, auditing researchers have developed a number of innovative auditing technologies and auditing approaches.

Areas where important developments can be seen are in the use of computers in audit practice, the use of sophisticated forecasting models, the use of various quantitative tools, and the development and use of statistical sampling techniques. The most significant development in approaches to auditing is the increasing emphasis placed on the analysis of audit risk areas and the development of decision aids for risk analysis.

The problem that motivated this research study is two-fold. First, while there is an abundant literature describing the research, development, and implementation of new auditing technologies and approaches, there is little evidence regarding the extent of use of the innovations by practitioners. Secondly, there is even less information regarding the process of innovation diffusion, adoption, and implementation in auditing. This creates two problems. One is that the profession has little knowledge of the extent of use of innovative approaches. The second problem is that audit directors, audit managers, and leaders in the profession have no well developed knowledge base for guiding the planning and management of innovation.

This project was undertaken in an attempt to begin the process of providing the auditing change agents with some understanding of the innovation process in internal auditing. A wealth of information exists regarding innovation processes in many different environments. This project draws from this knowledge and attempts to determine whether the internal auditing innovation process is similar to other innovation processes.

Chapter 1 of this dissertation describes the research setting, the need for this research, the objectives of the research project, and the expected contribution of this research.

Chapter 2 provides a review of the innovation literature to introduce the findings of innovation researchers and to establish a framework for the current research project. Two major areas of innovation research are identified. One area deals with the diffusion of innovations. The second area examines the process of implementing innovations.

The diffusion of innovation research has attempted to identify factors related to the decision to adopt or reject an innovation. Three directions have been followed in the study of innovation diffusion. One approach is to identify characteristics of adopting units, either individuals or organizations, that are related to the adoption of innovations or to innovative behavior. A second approach is to examine the characteristics of innovations in order to identify differences that exist between innovations that are adopted and innovations that are not adopted. The third approach recognizes the interaction of the characteristics of the innovation and the adopting unit and attempts to explain this interaction.

The review of the diffusion literature identified one research model that is widely accepted and has been extensively used as a basis for innovation research. This model describes the innovation decision as being related to the adopting unit's perceptions regarding certain attributes of the innovation. The model suggests that the decision to adopt an innovation is related to the innovation's perceived levels of relative advantage, trialability, observability, complexity, and compatibility. Additional relationships have been found between the adopter's degree of professionalism, professional commitment, organizational commitment, and decision style and the adoption decision. Also, organizational factors, such as size and organizational climate, have been found to be related to the organizational innovation decision.

The implementation research is concerned with the process after the adoption decision has been made. Implementation researchers have found that the models that describe the adoption decision also apply to the implementation process. The major modification to the model is that different factors become important at different stages of implementation.

The final section of the literature review discusses accounting innovation research. Research into the accounting method choice problem and the accounting policy setting process has been conducted to determine whether innovation models help to explain those processes. However, no attempt has been made to apply the models in the managerial accounting or auditing areas.

Chapter 3 includes a discussion of the research hypotheses and data collection and analytical methodologies. The research hypotheses are derived from the literature reviewed in chapter 2. The data were collected by means of a questionnaire mailed to a sample of 800 internal audit directors in the United States. Two hundred sixty useable responses were received for a response rate of 32.5%. This response rate is normal for this population and quite good when the length of the questionnaire is considered. Tests for the effect of nonresponse bias did not indicate any significant problems.

The questionnaire was developed in two stages. In the first stage, the measurement scales were developed, a test instrument was reviewed for clarity, and a pilot study was undertaken. The questionnaire was appropriately modified after analysis of the pilot study results.

One measurement scale, innovation attributes, was created for this project. The objective of this scale is to measure respondent perceptions regarding the levels of relative advantage, trialability, observability, complexity, and compatibility present in each statistical sampling technique. The other scales used to measure the extent of use of statistical sampling, the professionalism and professional and organizational commitment of the respondents, the creativity decision style of the respondents, and the organizational support for innovation, were adapted from existing scales.

Chapter 4 describes the results of the analysis of the data collected through the use of the questionnaire. The first section provides an analysis of the properties of the various measurement scales. Both reliability and validity of the instruments are evaluated. In addition, the distributional properties of the responses are examined in order to determine the appropriate statistical techniques for use in the data analysis. The major conclusions of this section are (1) that the adapted scales demonstrate levels of reliability and validity consistent with that reported by other researchers, (2) that the innovation attributes scales are sufficiently reliable, (3) that the independent variables appear to be continuous variables with sample distributions that approach normality, and (4) that the dependent variable, extent of use, appears to be dichotomous for some of the statistical sampling

techniques. The last observation lead to a decision to be cautious in the data analysis and analyze the data at interval, ordinal, and nominal levels of measurement.

The second section of chapter four discusses the results of the statistical tests of the hypotheses. The interpretation of the results of the data analysis and the implications of this research project are discussed in the next three sections of this chapter.

Implications of the Research Project

The implications of this research project are presented in the following three sections. First, the interpretation and implications of this study for the understanding of the innovation decision process of internal auditors regarding their use of statistical sampling techniques is presented. This is followed by a discussion of this study's implications for the design and management of innovation processes in internal auditing. The final section includes a discussion of the implications of this study for future research into innovation processes in auditing and other accounting areas.

Six hypotheses were tested in chapter 4. The alternate form of these hypotheses are:

- H1A:** The use of statistical sampling techniques is positively associated to their perceived relative advantage, compatibility, trialability, and observability and negatively associated to their perceived complexity.
- H2A:** The use of statistical sampling techniques is positively associated with the degree of professionalism and the level of professional commitment of the auditor.
- H3A:** The use of statistical sampling techniques is positively associated with the level of organizational commitment of the auditor.
- H4A:** The use of statistical sampling techniques is positively associated with the perceived support for innovation in the auditor's organization.
- H5A:** The use of statistical sampling is associated with the decision maker's innovation decision style.
- H6A:** The use of statistical sampling is associated with the size of the auditor's organization.

Implications for Understanding Innovation Processes in Auditing

Implications of Tests of the First Hypothesis

The approach taken to test the first hypothesis was to begin with an analysis of the bivariate relationships of each innovation attribute with each of the extent of use (EOU) measures. For the analysis of the innovation decision process, Pearson zero order correlational analyses and Spearman rank order correlational analyses were performed. For the analysis of the adoption decision, the bivariate relationships were examined using categorical measures of association. The results of these tests provide strong support for the first hypothesis. With very few exceptions, the individual correlations between each innovation attribute and each EOU measure were statistically significant in the hypothesized direction. The same results were found in the analysis of the nominal level data except for variables sampling in operational audit settings. Only relative advantage and compatibility were significantly associated with the adoption of variables sampling in operational auditing.

Based upon these results, it appears that the classical diffusion model of Rogers provides a good description of the innovation process of statistical sampling in auditing. Both the extent of use of statistical sampling and the adoption of statistical sampling by internal auditors responding to the survey are positively associated with the perceived levels of relative advantage, trialability, observability, and compatibility and negatively associated with the perceived level of complexity. However, these individual associations do not account for all of the variation in the extent of use of statistical sampling across the sample of internal auditors. In fact, the most significant association explains only 25% of the variation in the extent of use. The multivariate analysis of the first hypothesis sought to determine if there are combinations of the innovation attributes that could increase the ability to explain the variance in the extent of use of the statistical sampling techniques across the sample of respondents.

The first multivariate approach was to determine whether each of the innovation attributes is directly related to the EOU of statistical sampling. Fourth order partial correlations between each EOU measure and each of the innovation attributes, controlled for the effects of the remaining four innovation attributes, were analyzed. The major conclusion from this analysis is that some of the bivariate relationships that were significant are not statistically significant when the effect of the other four variables is controlled. Trialability and observability are not significantly related to the EOU of statistical sampling in 13 of a possible 14 associations. Compatibility is significant in 13 of 14 possible associations, relative advantage is significant in 11 of 14 associations, and complexity is significant in 5 of 13 associations.

The implications of this analysis for the understanding of the innovation process with regards to statistical sampling is that in order to explain the extent of use, it is not necessary to evaluate all five innovation attributes. In most cases, knowing the levels of relative advantage and compatibility is sufficient. The addition of the knowledge of the level of complexity is most helpful in explaining the EOU of dollar unit sampling. This is also consistent with the findings reported by Tornatzky and Klein that only relative advantage, complexity, and compatibility have consistently been found to be significantly related to the innovation decision.¹²⁰

Because it is not possible to evaluate the proportion of variance explained by the combination of innovation attributes using partial correlation analysis, a third approach to exploring the first hypothesis was to develop multiple linear regression models of the innovation decision process and logistic regression models of the adoption decision. The approach followed in the model development was to attempt to find the combination of independent variables that explained the largest proportion of variance in EOU across the sample group. The findings from these analyses were similar to the ones from the partial correlation analysis. Trialability was not significant in any of the innovation or adoption decision models. Observability was present in only one of a possible fourteen innovation decision models and one of a possible six adoption decision models. Com-

¹²⁰ Tornatzky and Klein, "Meta-analysis," pp. 28-45.

patibility is present in all of the models. Relative advantage is present in 11 of 14 innovation decision models, but it is only present in 2 of 6 adoption decision models. Complexity is present in 7 of 14 innovation decision models and 2 of 6 adoption decision models.

The major implications of this analysis for the understanding of the innovation process of statistical sampling can be seen by examining the overall explanatory power of the models. The largest adjusted coefficient of multiple determination, R^2 , is .367 for the model explaining the EOU of dollar unit sampling in financial auditing. The adjusted R^2 for attributes sampling is also reasonably large at .287 for financial audits and .304 for operational audits. These R^2 's are good for this type of exploratory research. For the other statistical sampling techniques, the R^2 's are relatively small ranging from .099 to .025. The same pattern is found for the adoption decision. When the results of the regression analyses are compared to the results of the bivariate analyses, combining knowledge of the levels of relative advantage, complexity, and compatibility does improve the ability to explain the EOU of dollar unit sampling and combining knowledge of the levels of relative advantage and compatibility increases the ability to explain the EOU of attributes sampling. The same results are found for the adoption decision.

A final approach to the analysis of the first hypothesis was to develop multivariate models of the relationship between the EOU's and the innovation attributes of each of the statistical sampling techniques for each of three organization types. The organizations were classified as commercial, financial, or nonprofit based upon a response to one of the questionnaire items. The multivariate models developed for each group were then compared in order to determine whether there are differences in the multivariate relationships between groups. Both multiple linear regression and logistic regression models were developed following the procedures described above.

There are several interesting findings from this analysis. First, significant models were developed for 38 of 42 possible models of the innovation process and 15 of 18 possible models of the adoption decision. Even at the group level, where there are smaller sample sizes, the innovation attributes are able to explain a significant proportion of the variance in the EOU of statistical sampling. A

second observation is that, unlike the overall sample models, trialability and observability are present in several models. Trialability is present in six models of the innovation decision in the nonprofit group and four of the models in the financial group. Observability is in five models in the commercial group and four models in the financial group. Relative advantage is found in 17 of 42 models and compatibility is in 21 of 42 models. Complexity is in 10 of the 42 models. The third observation is that the number of single independent variable models increases when the analysis is performed at the organization group level. In the overall sample, three of fourteen models of the innovation decision process and two of the six adoption decision models included a single independent variable. In the group models, 18 out of 42 of the innovation decision models and 12 out of 18 of the adoption decision models include a single independent variable. A final observation is that in many cases, the R^2 is higher for the group models than for the overall sample models.

In summary, the implications of the results of the first hypothesis tests for understanding the innovation decision and adoption decision regarding the use of statistical sampling by internal auditors are:

- The adoption and implementation of each of the statistical sampling techniques is positively associated with the auditor's perceptions of the relative advantage, trialability, observability, and compatibility of the technique and negatively associated with the technique's perceived level of complexity.
- It is not necessary to evaluate all five of the perceptual attributes of statistical sampling in order to explain the adoption or implementation of the techniques by internal auditors.
- Relative advantage and compatibility are the most significant innovation attributes that explain the adoption and implementation of statistical sampling. The addition of complexity helps to explain the adoption and implementation of dollar unit sampling.
- For the overall sample, trialability and observability are redundant in the presence of the other three innovation attributes.
- There appears to be an organizational factor creating differences in the relationships between the innovation attributes and adoption or implementation of statistical sampling. When the sample is classified by organizational types, different innovation attributes become important for different groups. Trialability and observability are significant at the group level.
- The overall ability to explain the adoption and implementation of statistical sampling by internal auditors is directly related to the level of use of the techniques. Models for the two most widely used techniques (dollar unit and attributes sampling) explain more of the variance in the EOU than do the models of lesser used techniques.

Implications of Tests of Hypotheses Two through Six

The approach for the testing of hypotheses two through six was similar to the one described above. Initially, the bivariate associations between the adoption or extent of use of each sampling technique and each personal or organizational variable were examined. Few significant bivariate relationships were found between the extent of use of statistical sampling and the auditor's professionalism, organizational commitment, or creative decision style. Organization size was not significantly associated with any of the statistical sampling techniques. Professional commitment does appear to be related to the use of variables sampling, however the relationship is inverse. The impact of the personal and organizational variables on the ability to explain the adoption and implementation of statistical sampling is minimal.

Even though the bivariate relationships were found to be weak, it is possible that the organizational and personal variables in combination with the innovation attributes variables add to the ability to explain the adoption and innovation decisions of internal auditors. Following the procedures discussed in previous sections of this chapter, the best multiple linear and logistic regression models were developed. The following personal and organizational variables were included in the final multiple regression models:

- Professional commitment is found in 3 of 14 EOU models.
- Cosmopolitanism is found in 1 model.
- Organizational size is found in 3 models.
- Age is in 1 model.
- Management support for innovation is included in 1 model.

The following personal and organizational variables were included in final logistic regression models:

- Professionalism is included in 3 models.
- Management support for innovation is included in 1 model.

There is moderate support for hypotheses two through six based upon this analysis. For some of the statistical sampling techniques the personal and organizational variables do add explanatory

power to the innovation attributes models. However, in many cases, the signs of the coefficients are not in the expected direction. The signs of the coefficients for size, professionalism, and professional commitment are negative.

When the models developed in the analysis of the first hypothesis by enterprise groups were expanded to include the personal and organizational variables, some of the final models included personal and organizational variables. The following observations were discussed:

- Cosmopolitanism was significant in half of the EOU and adoption models for commercial enterprises.
- Management support for innovation was significant in 8 of 14 EOU models and 3 of 6 adoption models in the nonprofit group.
- Creative decision style is found in the dollar unit sampling models for both the EOU models and the adoption models of the nonprofit group.
- Size is included in the models of the adoption and implementation of variables sampling in financial enterprises.
- Professionalism is included in 5 of the 6 adoption models for financial enterprises.
- Professional commitment and organizational commitment are found in several models.

Again, many of the signs of the coefficients are not in the expected direction. Professionalism, management support for innovation, professional commitment and organizational size have negative coefficients.

In summary, the following observations may be made with regards to the results of the tests of hypotheses two through six:

- Bivariate relationships between the adoption and implementation of statistical sampling by internal auditors and personal and organizational variables are weak and insignificant.
- When the personal and organizational variables are added to the innovation attributes models, there is improvement in some of the models' ability to explain the adoption or innovation decision.
- The greatest impact of the personal and organizational variables is seen at the organization group level. Specific patterns appear within and between groups. For example, management support for innovation is significant for nonprofit enterprises, professionalism is significant for financial enterprises, and cosmopolitanism is significant for commercial enterprises.

Conclusions Regarding the Understanding of the Innovation Decision

Support for the research model as a descriptive model of the innovation decision process of internal auditors has been found in this study. The process is a complex interaction of the perceptual attributes of the statistical sampling techniques and personal and organizational variables.

The finding that compatibility is useful in explaining the extent of use of all of the statistical sampling techniques is encouraging. The literature regarding the use of statistical sampling in auditing emphasizes the fact that all statistical sampling approaches are not appropriate in all auditing applications. For example, dollar unit sampling is a conservative test that does not work well when there are several errors in the sample selected. The variables sampling techniques are based on classical sampling techniques and assume the distributions of the items being sampled are normal. Many audit populations violate this assumption. Therefore, one would expect that issues of compatibility would be important to the auditor in choosing to use a particular statistical technique.

The finding that complexity is negatively related to the extent of use of statistical sampling is also encouraging. It is intuitively appealing that the low usage of sophisticated techniques in auditing practice is related to the perceived complexity of the techniques. The finding that relative advantage is important is consistent with the traditional view that auditors must always consider the costs versus the benefits of auditing procedures.

The fact that trialability and observability attributes were not significant when considered in combination with the other attributes seems to indicate that they are not as important for this type of innovation. It should be clear to almost any auditor that statistical sampling is subject to experimentation on a limited basis. The distribution of responses to the trialability of statistical sampling indicates this. The mean level of trialability was high and the range of scores was narrow. Therefore, while trialability is significant by itself, in combination it is not as significant as the other attributes.

The lack of significance of the observability attribute is more difficult to explain. It was noted in the tests of validity and reliability that this was the least reliable variable in the innovation attribute instrument and it created the most difficulty in the scale development. Perhaps, measurement error is affecting the test.

The weakest support for the innovation model was seen for the relationship between personal and organizational factors and the innovation decision. One reason for this may be that the sample of respondents is too homogeneous for the statistical tests applied to the data. The respondents were professional auditors. Most of them were members of the Institute of Internal Auditors. The sample frequency distributions of the personal and organizational variables showed that the range of responses was small.

There are some anomalies in the present study. Several of the relationships are inverse when they were expected to be direct. The perceived level of management support for innovation is negatively related to the extent of use of statistical sampling by auditors of nonprofit organizations. The data suggest that this is due to another organization effect. Although sample sizes are too small for statistical tests, it appears that government auditors are more likely to use statistical sampling than nongovernmental auditors in the nonprofit sector. However, governmental auditors perceive that their organizations are not supportive of innovation, while the auditors of other types of nonprofit enterprises perceive a higher level of support for innovation. This could account for the negative relationship found in this study.

Other negative relationships are found between the degree of professionalism and the adoption decision for financial enterprises and between professional commitment and the extent of use of statistical sampling in several cases. This may be due to the very high negative correlation between professional commitment and professionalism and organizational commitment. The impact of the multicollinearity present in the regression models may also account for the negative coefficients.

Limitations of the Study

One should be aware of the limitations of this study. First, the data were collected by means of a mailed survey. The researcher had no control over the quality of the responses. The problems of nonresponse are well documented and every effort was made to minimize them in this study. However, there is potential for bias in both the population and the sample. This should be considered before attempting to generalize the results of this study. The population for this study are internal audit directors who are members of the Institute of Internal Auditors. Their membership is an indication of their professional commitment. Therefore, the respondents are likely to have high levels of professionalism and professional commitment. This is demonstrated by the narrow range of scores for those scales. Any conclusions regarding the relationships between the innovation decision and professionalism may be confounded by this bias. A second potential bias is due to the cover letter and questionnaire's emphasis on innovation. This may have encouraged innovators to respond at a larger rate than non-innovators. Therefore, there is a possibility that the results reflect the attitudes and perceptions of innovators.

A second limitation is that the variables measured were perceptual. While attempts were made to control the reliability of the instruments, there is no certainty that the same responses would be received if the respondents were to answer the questionnaire a second time. Third, the data do not always fit the model assumptions of the statistical tests. However, the fact that analysis was done at three levels of measurement with essentially the same results implies that there are no serious problems in drawing the conclusions that have been drawn. The major weakness of the data is that they do not allow for conclusive analysis of the relative strength of the independent variables' relationships to the adoption decision and they are not conducive to causal analysis.

The final limitation was by design. This is a study of the adoption decision regarding the use of statistical sampling by internal auditors. The only generalization of the results that is possible is to

the internal audit population (i.e., members of the Institute of Internal Auditors) relative to the innovation decision process regarding statistical sampling or similar types of innovations.

Implications for Designing Innovation Processes

One implication of this study for the design of innovation processes in internal auditing is that the behavioral side of the innovation decision must be addressed. Generally, auditing literature tends to focus on the technical merits of new auditing technologies. This study's findings suggest that advocates of innovative auditing technologies should attempt to deal with all of the perceived characteristics of the innovations that affect the innovation decision. Efforts should be made to increase the levels of perceived relative advantage, compatibility, observability, and trialability and to decrease the perceived level of complexity. e.g.,

Another implication of this study is that internal audit managers interested in promoting innovations can focus on the innovation diffusion literature for guidance in promoting innovations. Techniques from marketing, particularly the marketing of technological innovations, may help auditors to position auditing innovations so that the potential adopters perceive them as being high in relative advantage, trialability, observability, and compatibility and low in complexity.

An approach to managing an innovation process is to identify the innovative members of a population of potential adopters and concentrate early efforts on those individuals. Generally, the most professional members of a group tend to be the most innovative. In this study, cosmopolitanism, professionalism and professional commitment are found to be related to the innovation decision of internal auditors. Therefore, it may be beneficial to follow similar strategies in managing the innovation process in internal auditing.

An additional finding from this sample is that the extent of use of microcomputers and computer assisted auditing techniques is significantly associated with the extent of use of several of the sta-

tistical sampling techniques. It may be that statistical sampling is part of a technology cluster for some of the internal auditors.¹²¹ Since the application of statistical sampling, particularly variables sampling and dollar unit sampling, can be time consuming when done manually, it may be that statistical sampling was not given serious consideration for use until computer assistance was included in the decision. This suggests that innovation planners and managers should consider the hardware and software needs of potential adopters and attempt to promote a total package.

One final implication of this study for the design of innovation processes in internal auditing is that there is evidence that different approaches may be needed for different types of audit practices.

Implications for Future Research

In order to determine whether the innovation model applies to other fields of accounting and auditing, studies of the innovation process in other fields is recommended. This model would appear to be particularly appropriate in managerial accounting settings. A second area into which the research could be extended is field studies of internal audit organizations in order to identify the characteristics of innovative audit organizations. Replications of this study using other innovations would add to the strength of the findings. Particular attention should be paid to the development of the innovation attributes scale. Longitudinal studies would provide significant information to the professional community. The innovation process is a time ordered one, and a longitudinal study would capture the process better than a cross-sectional study.

In order to control the scope of this research project, several innovation research approaches were not pursued. Three of these appear to have particular merit for understanding innovation in auditing and accounting. The first is the research, described in chapter two, that has attempted to

¹²¹ Rogers defines a "technology cluster" as one or more distinguishable elements of technology that are perceived as being closely interrelated.; Rogers, *Diffusion*, p. 226.

derive mathematical models of the innovation diffusion process. Pursuing this research in accounting and auditing may provide the accounting community with a better understanding of how new technologies diffuse among accountants and auditors, and how creative accounting methods diffuse through the accounting community.

The second area that shows promise deals with organizational characteristics that have been found to be related to the innovation decision. Organizational structure has often been identified as an important factor affecting the innovation decision in organizational settings. Recently, auditing researchers have begun to explore the effects of audit structure on aspects of audit practice. Kinney finds that accounting firms' audit structure is related to its preferences for auditing standards.¹²² Bamber and Snowball report that their findings from an experimental setting indicate that audit structure is related to audit judgments of auditors.¹²³ The concept of audit structure is very similar to organizational structure.¹²⁴ Therefore, it may be that audit structure is related to the innovation decision of both internal and external auditors. This approach may provide an explanation for the findings of this study that show differences between organization types.

The third area of innovation research that appears to have potential for auditing and accounting research is the study of mandated innovations. Researchers have studied the process of making innovation decisions when the innovation is imposed upon the user groups. This literature may provide a strong framework for studying the implementation of accounting and auditing standards promulgated by the Financial Accounting Standards Board and the Auditing Standards Board.

¹²² William R. Kinney, Jr., "Audit Technology and Preferences for Auditing Standards," *Journal of Accounting and Economics* 8 (March 1986): 73-89.

¹²³ E. Michael Bamber and Doug Snowball, "An Experimental Study of the Effects of Audit Structure in Uncertain Task Environments," *The Accounting Review* 63 (July 1988): 490-504.

¹²⁴ For a detailed description of audit structure and how it is measured see Barry E. Cushing and James K. Loebbecke, *Comparison of Audit Methodologies of Large Accounting Firms* (Sarasota, FL, American Accounting Association, 1986) pp. 32-46.

Conclusion

The innovation development, diffusion, adoption, and implementation processes in internal auditing are extremely complex ones. The evidence provided from innovation researchers indicates that combinations of personal attitudes, personal characteristics, economic factors, organizational characteristics, and environmental conditions affect the innovation decision process.

It is hoped that this study will provide a beginning to the process of understanding the innovation decision process in internal auditing. The need for understanding the process is documented by the frequent call for auditors to be creative and innovative in their approaches to solving new auditing problems as they develop.

Appendix A
Questionnaire, Letters, and Instructions



SYRACUSE UNIVERSITY

SCHOOL OF MANAGEMENT / SYRACUSE, NEW YORK 13244-2130

October 28, 1987

Dear Internal Audit Director:

The need for innovation in internal auditing has been widely acknowledged in recent years. New technologies, complex economic conditions, and increased competition have created challenging problems for the internal auditing profession that require innovative solutions.

In many professional fields, managers can find useful guidance for managing innovation that is derived from extensive studies of the innovation process in their respective fields. The audit manager, however, will find that the innovation process in internal auditing has not been examined to any great extent.

You have been selected to participate in a study of the innovation process in internal auditing. Enclosed is a questionnaire designed to gather information from a cross-section of internal auditors that will provide an initial description of the innovation process. Specifically, the study focuses upon one auditing technology - statistical sampling and a number of attitudinal and perceptual variables. The study is designed to test whether or not manageable relationships that exist in other professions exist in the internal auditing profession.

A more complete description of the questionnaire is enclosed. This questionnaire should be completed by an individual who is developing audit programs and who has the authority to develop, implement, and approve innovative auditing approaches. If you are not involved in this aspect of auditing at the present time, please pass this letter and questionnaire to an appropriate individual in your organization.

The results of this research will be made available to the Institute of Internal Auditors. You may receive a summary of the results by writing "copy of results requested" on the back of the return envelope, and printing your name and address below it. Please do not put this information on the questionnaire itself.

I would be most happy to answer any questions you might have. Please write or call. The telephone number is (315) 423-2804.

Thanks for your assistance.

Sincerely,

Jerrell W. Habegger
Assistant Professor
of Accounting

JWH/cm

Figure 48. Cover Letter

Innovations in Auditing Technology:
The Case of Statistical Sampling

Overview of the Questionnaire Objectives

Studies of the innovation adoption process have found that the adoption and implementation of innovations is related to perceptions that potential and actual adopters have regarding certain characteristics of the innovations. These perceptions are in turn, related to the personal decision styles and professional attitudes of the adopters, and to the organizational environment in which the adoption decision is made. Using the knowledge gained from the research, a manager of an innovation can position the innovation so that potential adopters' perceptions of its characteristics will be favorable. This can lead to more efficient and successful adoption and implementation of an innovative technology.

This questionnaire is designed to gather data that will enable us to determine whether or not similar relationships exist in the internal auditing profession. Data is being gathered regarding one group of auditing technologies - statistical sampling techniques. Statistical sampling has been selected as the innovation for this study because it is expected that, in a representative sample of internal auditors, a wide range of levels of use will be found. This expected variation will enable us to test our hypotheses. Anticipated outcome of this research are:

- A description of an innovation process in internal auditing
- Guidance useful for audit managers who want to promote innovation within their audit staff
- Guidance to the profession for promoting innovation
- An updated report of the extent of use of statistical sampling in internal audit practice

The questionnaire should be completed by an individual who is currently involved in developing audit programs, and who has the authority to develop, implement, and approve innovative auditing approaches. Since you are part of a representative sample of internal auditors selected for the study, it would be appreciated if you would return the questionnaire even if you are unable to respond to all of the items. Your response will be included in the analysis.

You may be assured of complete confidentiality. The questionnaire has an identification number for mailing purposes only. This is so that your name can be checked off the mailing list when your questionnaire is returned. Neither your name nor your company's name will ever be placed on the questionnaire or referred to in any analyses of the data.

This questionnaire should take approximately 45 minutes to an hour to complete. It is divided into seven sections. A summary of the nature and rationale for each section follows.

Figure 49. Instructions - Page One

Description of Questionnaire Sections

- Section I : Perceptions regarding the characteristics of statistical sampling techniques
- This section asks you to respond to several statements describing characteristics of attributes sampling, variable sampling, and dollar unit sampling. Please note that we are interested in your perceptions, therefore there are no right or wrong answers. Also, this section is to be completed even if you never used statistical sampling.
- Section II : Perceptions regarding specific qualities of statistical sampling techniques
- This section is similar to Section I, only you are asked to evaluate the techniques in terms of five specific qualities.
- Section III: Extent of Use
- This section is designed to gather data regarding the extent of your use of various statistical sampling techniques in financial and operational auditing.
- Section IV : Decision making style
- Previous studies have found that there are relationships between decision making styles and the perceptions the decision maker has regarding the characteristics of an innovation. This section is designed to capture a component of your decision making style. Again, there are no right or wrong answers.
- Section V : Professional orientation
- Professional orientation and the perception regarding the characteristics of an innovation have also been found to be related. In this section you are asked to express your feelings of agreement or disagreement with several statements about the profession and professional relationship.
- Section VI : Organizational Environment
- The organizational environment has been found to be related to the innovation process. This section asks for your level of agreement with statements regarding your attitude about your organization.
- Section VII: General Information
- This section is designed to gather factual data that may be used for classifying and summarizing the data gathered in this study.

Thank you for your participation.

Figure 50. Instructions - Page Two

Two weeks ago a questionnaire seeking information about your organization's use of statistical sampling was mailed to you. Your name was drawn in a random sample of internal audit directors who are members of the Institute of Internal Auditors.

If you have already completed and returned it to us please accept our sincere thanks. If not, please do so today. Because it has been sent to only a small, but representative, sample of internal auditors it is extremely important that yours be included in the study.

Jerrell W. Habegger, Assistant Professor
Syracuse University, School of Management
Syracuse, NY 13244
315-423-2804

Figure 51. Follow-up Postcard

INNOVATIONS IN AUDITING TECHNOLOGY

THE CASE OF STATISTICAL SAMPLING

This survey is being done to better understand what factors may affect internal auditors' decisions to use innovative auditing methods. Specifically, this study focuses on the extent of your use of statistical sampling techniques. Please try to answer all of the questions. Many of the questions ask for your perceptions, therefore there are no right or wrong answers. *Even if you are a non-user of statistical sampling, your responses are needed.* If you wish to comment on any questions or qualify your answers, please feel free to use the space in the margins and on the back of this questionnaire. Your comments will be read and taken into account.

Thank you for your help.

Please send completed questionnaire to:

Innovations in Auditing Project
School of Management
Syracuse University
Syracuse, NY 13244

Figure 52. Cover of Questionnaire

1. Listed below are statements concerning your perceptions about three types of statistical sampling procedures. Please circle the number which best describes your agreement or disagreement with each statement. The three sampling techniques include the following methods:

- ATTRIBUTES SAMPLING** Statistical methods used to estimate the occurrence rate of a characteristic in the population. Includes discovery and stop or go sampling.
- VARIABLES SAMPLING** Statistical methods used to estimate the quantity of a particular characteristic in the population. Includes mean per unit, ratio, and difference estimation methods, both stratified and unstratified.
- DOLLAR UNIT SAMPLING** Includes probability proportionate to size (PPS), cumulative monetary amount (CMA), and combined attribute and variable (CAV) sampling procedures.

		STRONGLY AGREE			STRONGLY DISAGREE
1.	The cost of using _____ is greater than its benefits.				
	Attributes sampling	1	2	3	4 5
	Variables sampling	1	2	3	4 5
	Dollar unit sampling	1	2	3	4 5
2.	_____ can be instituted on a limited basis.				
	Attributes sampling	1	2	3	4 5
	Variables sampling	1	2	3	4 5
	Dollar unit sampling	1	2	3	4 5
3.	Benefits of _____ are clearly observable by recipients of audit reports.				
	Attributes sampling	1	2	3	4 5
	Variables sampling	1	2	3	4 5
	Dollar unit sampling	1	2	3	4 5
4.	_____ is a complex auditing procedure.				
	Attributes sampling	1	2	3	4 5
	Variables sampling	1	2	3	4 5
	Dollar unit sampling	1	2	3	4 5
5.	To use _____ we do not have to radically change our audit approach.				
	Attributes sampling	1	2	3	4 5
	Variables sampling	1	2	3	4 5
	Dollar unit sampling	1	2	3	4 5

Figure 53. Questionnaire - Page One

		STRONGLY AGREE			STRONGLY DISAGREE	
6.	_____ is easy to understand and apply.					
	Attributes sampling	1	2	3	4	5
	Variables sampling	1	2	3	4	5
	Dollar unit sampling	1	2	3	4	5
7.	_____ must be used extensively or not at all.					
	Attributes sampling	1	2	3	4	5
	Variables sampling	1	2	3	4	5
	Dollar unit sampling	1	2	3	4	5
8.	Our audit populations are not suitable for the use of _____.					
	Attributes sampling	1	2	3	4	5
	Variables sampling	1	2	3	4	5
	Dollar unit sampling	1	2	3	4	5
9.	_____ can be easily adapted to fit our particular needs.					
	Attributes sampling	1	2	3	4	5
	Variables sampling	1	2	3	4	5
	Dollar unit sampling	1	2	3	4	5
10.	The advantages and disadvantages of _____ have been clearly demonstrated.					
	Attributes sampling	1	2	3	4	5
	Variables sampling	1	2	3	4	5
	Dollar unit sampling	1	2	3	4	5
11.	Use of _____ saves time and money.					
	Attributes sampling	1	2	3	4	5
	Variables sampling	1	2	3	4	5
	Dollar unit sampling	1	2	3	4	5
12.	Any auditor can learn how to apply _____ with ease.					
	Attributes sampling	1	2	3	4	5
	Variables sampling	1	2	3	4	5
	Dollar unit sampling	1	2	3	4	5

Figure 54. Questionnaire - Page Two

		STRONGLY AGREE			STRONGLY DISAGREE	
13.	_____ does not offer any relative advantage over previous sampling methods.					
	Attributes sampling	1	2	3	4	5
	Variables sampling	1	2	3	4	5
	Dollar unit sampling	1	2	3	4	5
14.	_____ is inconsistent with our current audit approach, past experiences, and/or present needs.					
	Attributes sampling	1	2	3	4	5
	Variables sampling	1	2	3	4	5
	Dollar unit sampling	1	2	3	4	5
15.	The effect that _____ has on the audit process is difficult to observe and communicate.					
	Attributes sampling	1	2	3	4	5
	Variables sampling	1	2	3	4	5
	Dollar unit sampling	1	2	3	4	5
16.	It is not necessary to commit to full scale use of _____ before experimenting with it.					
	Attributes sampling	1	2	3	4	5
	Variables sampling	1	2	3	4	5
	Dollar unit sampling	1	2	3	4	5
17.	After initial applications, _____ is relatively inexpensive to apply.					
	Attributes sampling	1	2	3	4	5
	Variables sampling	1	2	3	4	5
	Dollar unit sampling	1	2	3	4	5
18.	We do not have enough staff auditors with sufficient technical expertise to apply _____.					
	Attributes sampling	1	2	3	4	5
	Variables sampling	1	2	3	4	5
	Dollar unit sampling	1	2	3	4	5

Figure 55. Questionnaire - Page Three

		STRONGLY AGREE			STRONGLY DISAGREE	
19.	_____ is difficult to understand.					
	Attributes sampling	1	2	3	4	5
	Variables sampling	1	2	3	4	5
	Dollar unit sampling	1	2	3	4	5
20.	It is possible to try using _____ in limited applications without having to make major commitments of audit resources.					
	Attributes sampling	1	2	3	4	5
	Variables sampling	1	2	3	4	5
	Dollar unit sampling	1	2	3	4	5
21.	The issue of whether the benefits of using _____ exceed the cost has not been demonstrated.					
	Attributes sampling	1	2	3	4	5
	Variables sampling	1	2	3	4	5
	Dollar unit sampling	1	2	3	4	5
22.	The principles underlying the use of _____ are easily understood.					
	Attributes sampling	1	2	3	4	5
	Variables sampling	1	2	3	4	5
	Dollar unit sampling	1	2	3	4	5
23.	Using _____ rather than judgmental sampling reduces our risk of drawing incorrect conclusions about the item being sampled.					
	Attributes sampling	1	2	3	4	5
	Variables sampling	1	2	3	4	5
	Dollar unit sampling	1	2	3	4	5
24.	Resources needed to properly apply _____ prevent its use in an experimental basis.					
	Attributes sampling	1	2	3	4	5
	Variables sampling	1	2	3	4	5
	Dollar unit sampling	1	2	3	4	5

Figure 56. Questionnaire - Page Four

		STRONGLY AGREE			STRONGLY DISAGREE	
25.	The results of implementing _____ are not observable to non-audit management.					
	Attributes sampling	1	2	3	4	5
	Variables sampling	1	2	3	4	5
	Dollar unit sampling	1	2	3	4	5

II. Please answer the following section based upon your perceptions. This section is to be completed even if you or your department have never used the techniques.

RELATIVE ADVANTAGE is the degree to which an innovation is perceived as being better than the idea it supercedes. Rate each of the following statistical sampling techniques according to your perception of its degree of relative advantage.

		VERY HIGH			VERY LOW	
	Attributes sampling	1	2	3	4	5
	Variables sampling	1	2	3	4	5
	Dollar unit Sampling	1	2	3	4	5

COMPATIBILITY is the degree to which an innovation is perceived as consistent with existing values, past experiences, and needs of potential users. Rate each of the statistical sampling techniques according to your perception of its degree of compatibility.

		VERY HIGH			VERY LOW	
	Attributes sampling	1	2	3	4	5
	Variables sampling	1	2	3	4	5
	Dollar unit sampling	1	2	3	4	5

COMPLEXITY is the degree to which an innovation is perceived to be difficult to understand or use. Rate each of the statistical sampling techniques according to your perception of its degree of complexity.

		VERY HIGH			VERY LOW	
	Attributes sampling	1	2	3	4	5
	Variables sampling	1	2	3	4	5
	Dollar unit sampling	1	2	3	4	5

TRIALABILITY is the degree to which an innovation may be experimented with on a limited basis. Rate each of the statistical sampling techniques according to your perception of its trialability.

		VERY HIGH			VERY LOW	
	Attributes sampling	1	2	3	4	5
	Variables sampling	1	2	3	4	5
	Dollar unit sampling	1	2	3	4	5

Figure 57. Questionnaire - Page Five

OBSERVABILITY is the degree to which the results of an innovation are visible to others. Rate each of the statistical sampling techniques according to your perception of its degree of observability.

	VERY HIGH					VERY LOW				
Attributes sampling	1	2	3	4	5					
Variables sampling	1	2	3	4	5					
Dollar unit sampling	1	2	3	4	5					

III. 1. For each of the statistical techniques listed below, indicate the extent to which you and the staff you supervise use them according to the following legend.

- 1 = REJECTED We have decided that the technique is not for us.
- 2 = LESS THAN VERY FAMILIAR We are aware of the technique, but we do not have full understanding of it.
- 3 = VERY FAMILIAR We understand the basic concepts of using the technique, but we are not actively considering its use.
- 4 = CONSIDERING We have gathered specific information necessary to make decisions about whether or not to use the technique.
- 5 = EXPERIMENTING We have decided to try the technique in limited applications, and are evaluating its acceptability to us.
- 6 = USED ON A FEW AUDITS We have decided that the technique is appropriate for our use and are using it on less than one-third of the potential applications.
- 7 = USED ON SEVERAL AUDITS We are using the technique on one-third to one-half of the potential audit applications.
- 8 = USED ON MOST AUDITS We are using the technique on 1/2 to 3/4 of the potential audit applications.
- 9 = STANDARD PRACTICE We now use this technique in every application where we believe it is appropriate.

TECHNIQUE	----- EXTENT OF USE -----																		
	FINANCIAL AUDITS									OPERATIONAL AUDITS									
Attributes sampling	1	2	3	4	5	6	7	8	9		1	2	3	4	5	6	7	8	9
Stop-or-go sampling	1	2	3	4	5	6	7	8	9		1	2	3	4	5	6	7	8	9
Discovery sampling	1	2	3	4	5	6	7	8	9		1	2	3	4	5	6	7	8	9
Mean-per-unit	1	2	3	4	5	6	7	8	9		1	2	3	4	5	6	7	8	9
Difference estimation	1	2	3	4	5	6	7	8	9		1	2	3	4	5	6	7	8	9
Ratio estimation	1	2	3	4	5	6	7	8	9		1	2	3	4	5	6	7	8	9
Dollar unit sampling	1	2	3	4	5	6	7	8	9		1	2	3	4	5	6	7	8	9
Regression estimation	1	2	3	4	5	6	7	8	9		1	2	3	4	5	6	7	8	9

Figure 58. Questionnaire - Page Six

2. How satisfied are you with the results of the use of statistical sampling procedures?

	VERY SATISFIED			VERY UNSATISFIED		
Attributes sampling	1	2	3	4	5	
Variables sampling	1	2	3	4	5	
Dollar unit sampling	1	2	3	4	5	

3. How frequently do you participate in the decision to adopt new audit procedures? ALWAYS 1 2 3 4 5 NEVER
4. How frequently do you participate in the decision to audit new areas? ALWAYS 1 2 3 4 5 NEVER
5. How frequently do you participate in the development of new audit programs? ALWAYS 1 2 3 4 5 NEVER
6. How frequently do you participate in the decision to hire new staff? ALWAYS 1 2 3 4 5 NEVER
7. How frequently do you participate in the decisions on promotions of any of the professional staff? ALWAYS 1 2 3 4 5 NEVER

IV. In this section you are presented with images of personal traits or characteristics. You are to imagine that you have been asked to present yourself in each of these images consistently over a long period of time. For each image, please respond as to how easy or difficult you believe it would be for you to project this image.

HOW DIFFICULT WOULD IT BE FOR YOU TO PROJECT YOURSELF AS A PERSON WHO:	VERY EASY			VERY DIFFICULT		
1. Likes the protection of precise instructions.	1	2	3	4	5	
2. Would sooner create than improve.	1	2	3	4	5	
3. Often risks doing things differently.	1	2	3	4	5	
4. Never acts without proper authority.	1	2	3	4	5	
5. Prefers changes to occur gradually.	1	2	3	4	5	
6. Has fresh perspectives on old problems.	1	2	3	4	5	
7. Is prudent when dealing with authority.	1	2	3	4	5	
8. Is thorough.	1	2	3	4	5	
9. Can stand out in disagreement against the group.	1	2	3	4	5	
10. Likes to vary set routines at a moment's notice.	1	2	3	4	5	
11. Is predictable.	1	2	3	4	5	
12. Has original ideas.	1	2	3	4	5	

Figure 59. Questionnaire - Page Seven

HOW DIFFICULT WOULD IT BE FOR YOU TO PROJECT YOURSELF AS A PERSON WHO:	VERY EASY					VERY DIFFICULT				
	1	2	3	4	5	1	2	3	4	5
13. Copes with several new ideas at the same time.	1	2	3	4	5					
14. Holds back ideas until obviously needed.	1	2	3	4	5					
15. Prefers colleagues who never "rock the boat".	1	2	3	4	5					
16. Works without deviation in a prescribed way.	1	2	3	4	5					
17. Masters all details painstakingly.	1	2	3	4	5					
18. Readily agrees with the team at work.	1	2	3	4	5					
19. Will always think of something when stuck.	1	2	3	4	5					
20. Is a steady plodder.	1	2	3	4	5					
21. Imposes strict control on matters that are within your own control.	1	2	3	4	5					
22. Proliferates ideas.	1	2	3	4	5					
23. Is methodic and systematic.	1	2	3	4	5					
24. Enjoys detailed work.	1	2	3	4	5					
25. Is stimulating.	1	2	3	4	5					
26. Prefers to work on one problem at a time.	1	2	3	4	5					
27. Likes supervisors and work patterns which are consistent.	1	2	3	4	5					
28. Conforms.	1	2	3	4	5					
29. Fits readily into the "system".	1	2	3	4	5					
30. Needs the stimulation of frequent change.	1	2	3	4	5					
31. Is consistent.	1	2	3	4	5					
32. Never seeks to bend or break the rules.	1	2	3	4	5					

V. Listed below are statements concerning your perceptions about the internal auditing profession. Please circle the number corresponding to your level of agreement with each statement.

	STRONGLY AGREE					STRONGLY DISAGREE				
	1	2	3	4	5	1	2	3	4	5
1. I could just as well be associated with another profession as long as the type of organization in which I worked was similar.	1	2	3	4	5					
2. A professional should make every attempt to promote the highest possible level of practice standards.	1	2	3	4	5					
3. It would take very little change in my present circumstances to cause me to leave this profession.	1	2	3	4	5					

Figure 60. Questionnaire - Page Eight

	STRONGLY AGREE			STRONGLY DISAGREE	
	1	2	3	4	5
4. Substantial adherence to the IIA's Standards for the Professional Practice of Internal Auditing should be required.	1	2	3	4	5
5. Often, I find it difficult to agree with this profession's policies on important matters relating to its members.	1	2	3	4	5
6. If there is a conflict between professional standards and organizational standards, professional standards should be followed.	1	2	3	4	5
7. I am proud to tell others that I am a member of the profession.	1	2	3	4	5
8. One of the problems of this profession is that professional standards are not enforceable.	1	2	3	4	5
9. I find that my values and the profession's values are very similar.	1	2	3	4	5
10. I feel very little loyalty to this profession.	1	2	3	4	5
11. I systematically read the professional journals.	1	2	3	4	5
12. Other professions are actually more vital to society than mine.	1	2	3	4	5
13. I regularly attend professional meetings at the local level.	1	2	3	4	5
14. I think that my profession, more than any other, is essential for society.	1	2	3	4	5
15. My fellow professionals have a pretty good idea about each other's competence.	1	2	3	4	5
16. People in this profession have a real "calling" for their work.	1	2	3	4	5
17. The importance of my profession is sometimes overstressed.	1	2	3	4	5
18. The dedication of people in this field is most gratifying.	1	2	3	4	5
19. I don't have much opportunity to exercise my own judgment.	1	2	3	4	5
20. I believe that the Institute of Internal Auditors should be supported.	1	2	3	4	5
21. Some other occupations are actually more important to society than is mine.	1	2	3	4	5
22. A problem in this profession is that no one really knows what his colleagues are doing.	1	2	3	4	5
23. It is encouraging to see the high level of idealism which is maintained by people in this field.	1	2	3	4	5

Figure 61. Questionnaire - Page Nine

	STRONGLY AGREE			STRONGLY DISAGREE	
24. The Institute for Internal Auditors doesn't really do too much for the average internal auditor.	1	2	3	4	5
25. We really have no way of judging each other's competence.	1	2	3	4	5
26. Although I would like to, I really don't read the professional journals too often.	1	2	3	4	5
27. Most people would stay in this profession even if their incomes were reduced.	1	2	3	4	5
28. My own decisions are subject to review.	1	2	3	4	5
29. There is not much opportunity to judge how another person does his work.	1	2	3	4	5
30. I am my own boss in almost every work-related situation.	1	2	3	4	5
31. If ever an occupation is indispensable, it is this one.	1	2	3	4	5
32. My colleagues pretty well know how well we all do in our work.	1	2	3	4	5
33. There are very few people who don't really believe in their work.	1	2	3	4	5
34. Most of my decisions are reviewed by other people.	1	2	3	4	5
35. I make my own decisions in regard to what is to be done in my work.	1	2	3	4	5

VI. Listed below are statements concerning your perceptions about your organization or department. Please circle the number corresponding to the strength of your agreement or disagreement with each statement. The organization refers to your employer and the department refers to your audit department. Management refers to individuals who are in higher positions of authority over audit activities than you.

	STRONGLY AGREE			STRONGLY DISAGREE	
1. Management acts as if we are not very creative.	1	2	3	4	5
2. I find that my values and the organization's values are very similar.	1	2	3	4	5
3. There is not too much to be gained by sticking with this organization indefinitely.	1	2	3	4	5
4. Creativity is encouraged here.	1	2	3	4	5
5. Creative efforts are usually ignored here.	1	2	3	4	5
6. It would take very little change in my present circumstances to cause me to leave this organization.	1	2	3	4	5

Figure 62. Questionnaire - Page Ten

	STRONGLY AGREE					STRONGLY DISAGREE				
7. People in this department are encouraged to develop their own interests, even when they deviate from those of the department.	1	2	3	4	5					
8. Our ability to function creatively is respected by the management.	1	2	3	4	5					
9. This organization really inspires the very best in me in the way of job performance.	1	2	3	4	5					
10. I would accept almost any type of job assignment in order to keep working for this organization.	1	2	3	4	5					
11. Individual independence is encouraged in this department.	1	2	3	4	5					
12. I am proud to tell others that I am part of this organization.	1	2	3	4	5					
13. I am extremely glad that I chose this organization to work for over others I was considering at the time I joined.	1	2	3	4	5					
14. The role of the leader in this department can be described as supportive.	1	2	3	4	5					
15. I could just as well be working for a different organization as long as the type of work was similar.	1	2	3	4	5					
16. I really care about this organization.	1	2	3	4	5					
17. Often, I find it difficult to agree with this organization's policies on important matters relating to its employees.	1	2	3	4	5					
18. Assistance in developing new ideas is readily available in this organization.	1	2	3	4	5					
19. I feel very little loyalty to this organization.	1	2	3	4	5					
20. For me, this is the best of all possible organizations for which to work.	1	2	3	4	5					
21. Around here, people are allowed to solve the same problem in different ways.	1	2	3	4	5					
22. I am willing to put in a great deal of effort beyond that normally expected in order to help this organization be successful.	1	2	3	4	5					
23. Deciding to work for this organization was a definite mistake on my part.	1	2	3	4	5					
24. I talk up this organization to my friends as a great organization to work.	1	2	3	4	5					
25. People around here are expected to deal with problems in the same way.	1	2	3	4	5					

Figure 63. Questionnaire - Page Eleven

VII. GENERAL INFORMATION

1. The position I hold can best be described as (please circle the most appropriate description only):
 - 1 **DIRECTOR OF AUDITING** (I am authorized to direct a broad, comprehensive program of internal auditing within my organization.)
 - 2 **AUDIT MANAGER** (I administer the internal auditing activity of an assigned location within the general guidelines provided by the Director of Auditing.)
 - 3 **AUDIT SUPERVISOR** (I develop a comprehensive, practical program of audit coverage for assigned areas of audit under the general guidance of the Manager of Internal Auditing.)
 - 4 **OTHER** (Please specify title and duties performed.) _____

2. Approximately how much of your time is spent working in the following functional areas of internal auditing? (Please note percent in the space.)

_____ Auditing department administration	_____ Operational auditing
_____ Financial auditing	_____ Other (Specify)
_____ EDP auditing	_____

3. I formally supervise the activities of (please specify number) _____ professional level internal auditing personnel.
4. How many of those you supervise are certified? _____
5. For how many years have you held this position? _____
6. For how many years have you been employed by your present employer? _____
7. For how many years have you been working in internal auditing? _____
8. What is your formal educational background? (list the degree(s) earned and major area of study)

DEGREE _____	MAJOR _____
DEGREE _____	MAJOR _____

9. Do you hold any of the following designations? (Circle as many as apply)

1	CIA	2	CPA	3	CBA	4	OTHER _____	5	NONE
---	-----	---	-----	---	-----	---	-------------	---	------

10. How many professional internal auditors are employed by your organization? _____ individuals.

11. What is the average length of time that the staff members you supervise have been with your department? (Circle number)

1	LESS THAN TWO YEARS	3	THREE TO FIVE YEARS
2	TWO TO THREE YEARS	4	MORE THAN FIVE YEARS

Figure 64. Questionnaire - Page Twelve

21. Does your organization have a formal continuing education requirement?
 1 YES 2 NO
22. How many hours of continuing education do you complete each year? ____ hours
23. Have you ever taken any specialized courses on statistical sampling?
 1 YES 2 NO
24. How often do you submit articles for publication to professional journals?
 0 NEVER 1 ONE ARTICLE EVERY COUPLE OF YEARS 3 ONE OR MORE PER YEAR
25. To how many professional journals (related to auditing and accounting) do you or your organization subscribe? ____ journals
26. How many of those journals do you regularly read? (At least one article or feature per issue) ____ journals
27. What is the approximate size of your organization? (Select the classification which best describes your organization and indicate the amount)
- | | | | |
|---|------------------------------------|----------|---------------------|
| 1 | General Commercial Enterprise | \$ _____ | gross annual sales |
| | | \$ _____ | total assets |
| 2 | Bank/Savings & Loans | \$ _____ | annual gross profit |
| | | \$ _____ | total assets |
| 3 | Governmental/Non-profit Enterprise | \$ _____ | annual budget |
28. Approximately how many individuals are employed by your organization? ____ individuals.
29. What is your age? ____
30. Are you 1 MALE 2 FEMALE

Figure 66. Questionnaire - Page Fourteen

Is there anything else that you would like to tell us about your use of statistical sampling or other innovative auditing methods? Please add any comments you wish to make below.

Your contribution to this effort is greatly appreciated. If you would like a summary of results, please print your name and address on the back of the return envelope (NOT on this questionnaire). We will see that you get it.

Figure 67. Questionnaire - Back Page

Appendix B

Frequency Histograms

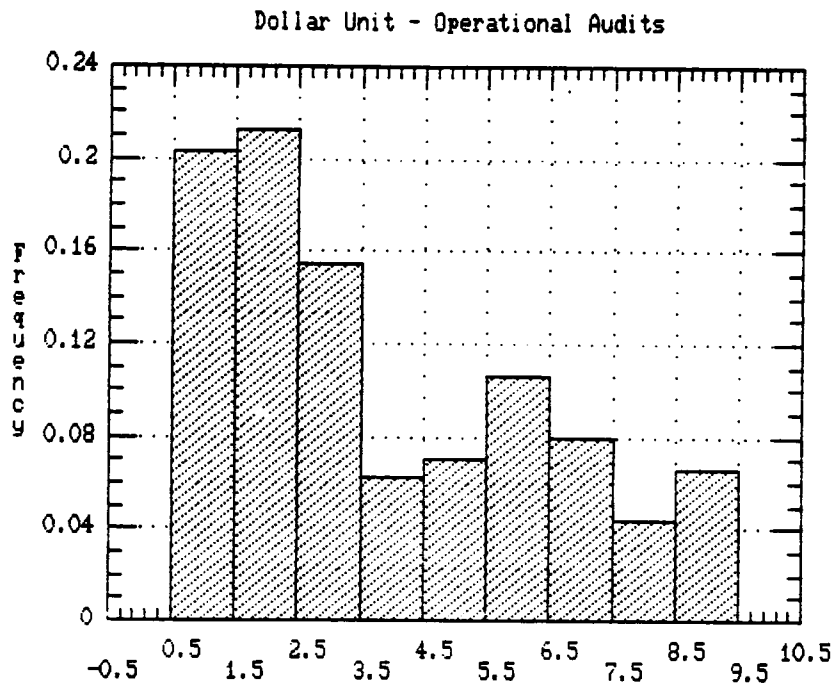
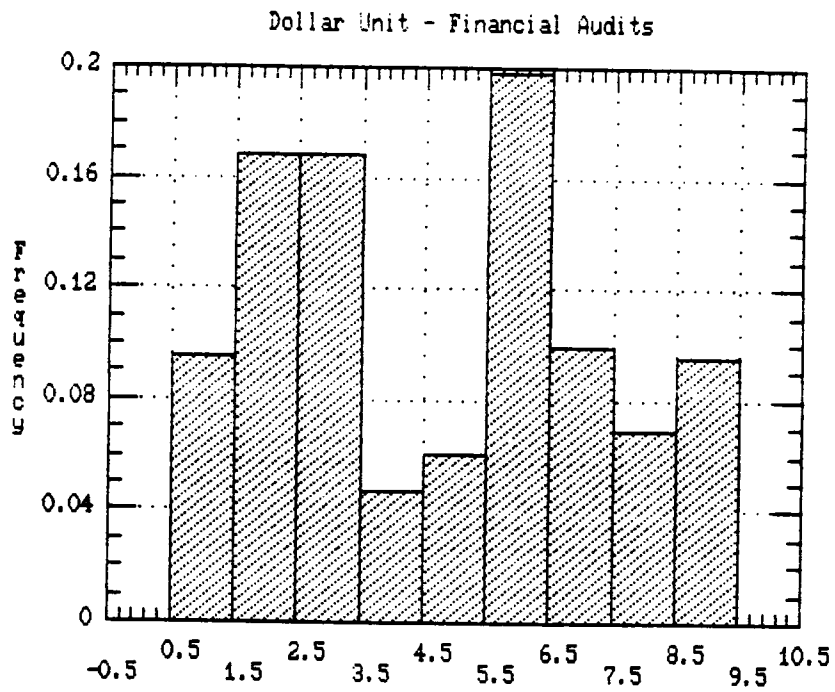


Figure 68. Frequency Histograms - Extent of Use of Dollar Unit Sampling

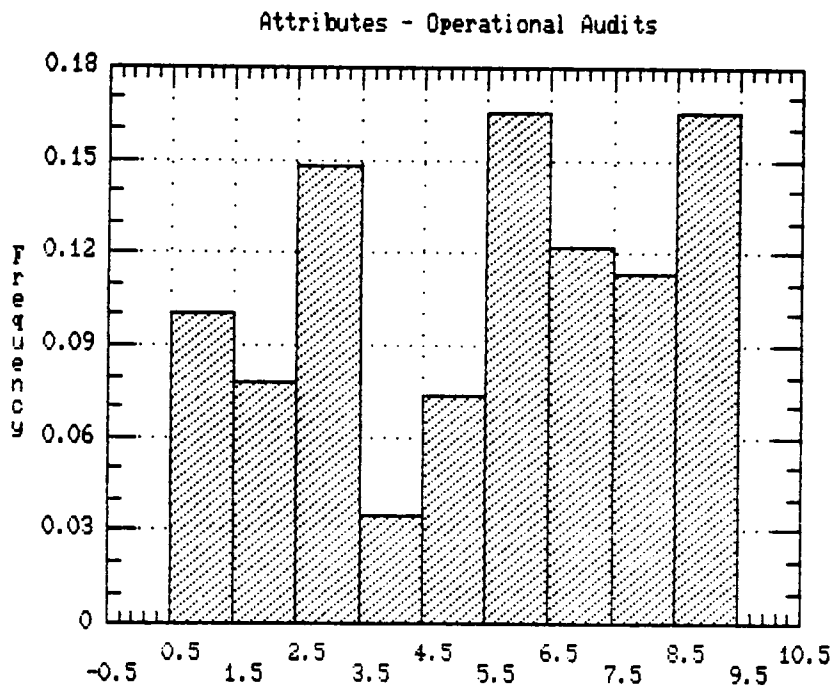
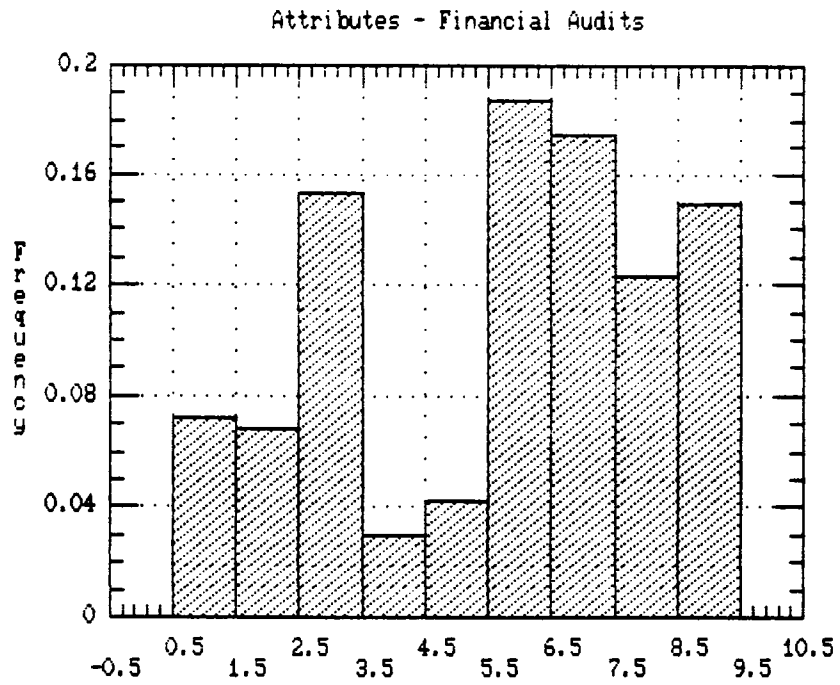


Figure 69. Frequency Histograms - Extent of Use of Attributes Sampling

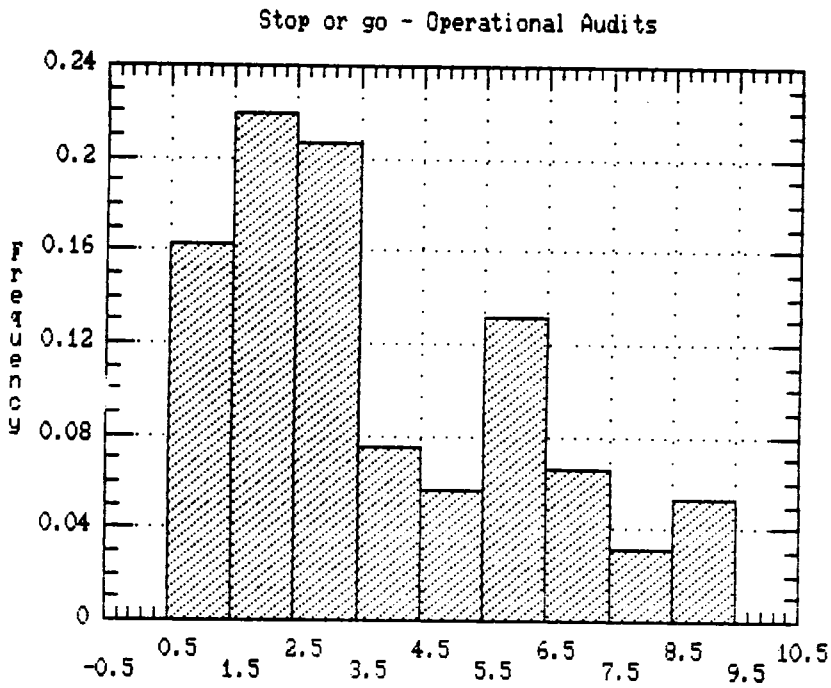
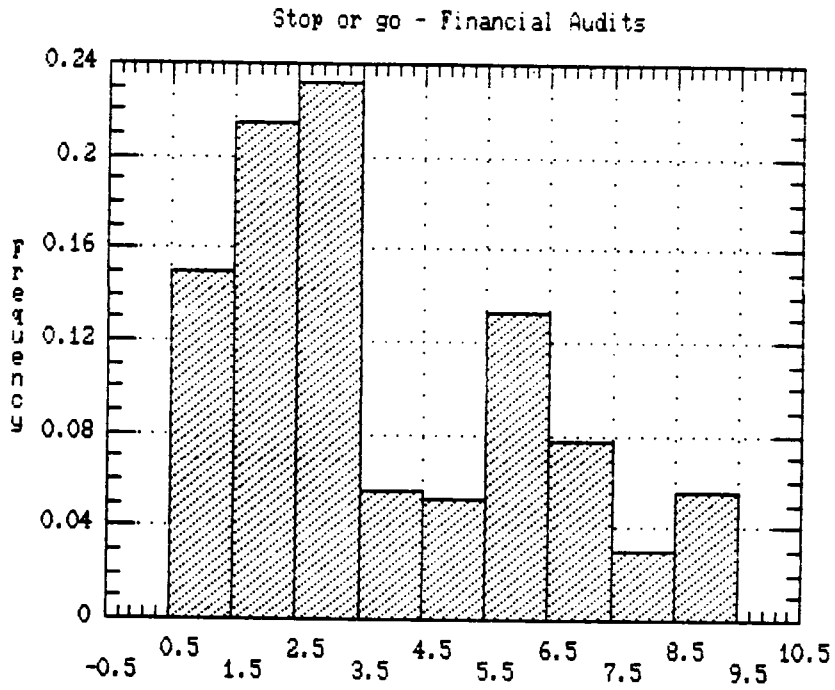


Figure 70. Frequency Histograms - Extent of Use of Stop or Go Sampling

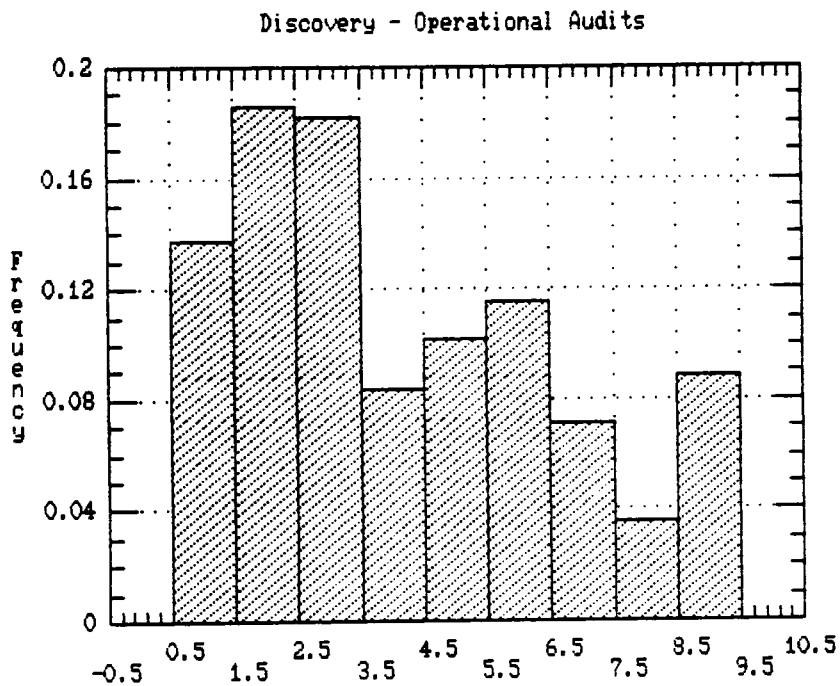
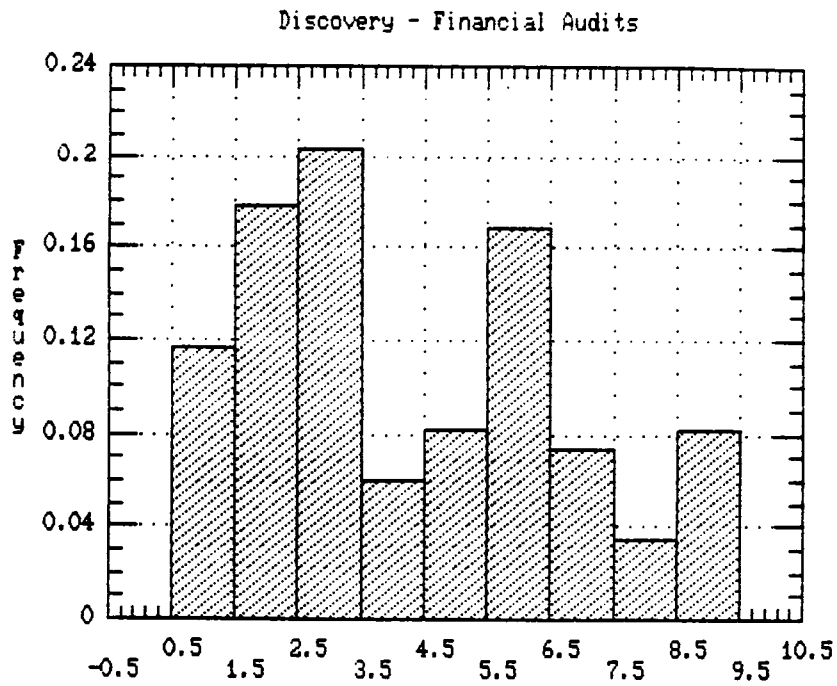


Figure 71. Frequency Histograms - Extent of Use of Discovery Sampling

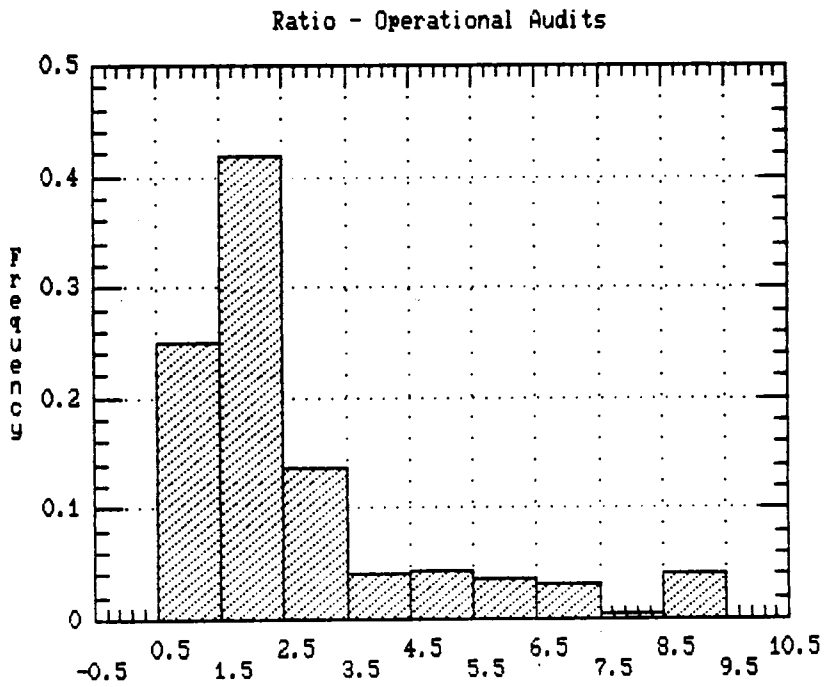
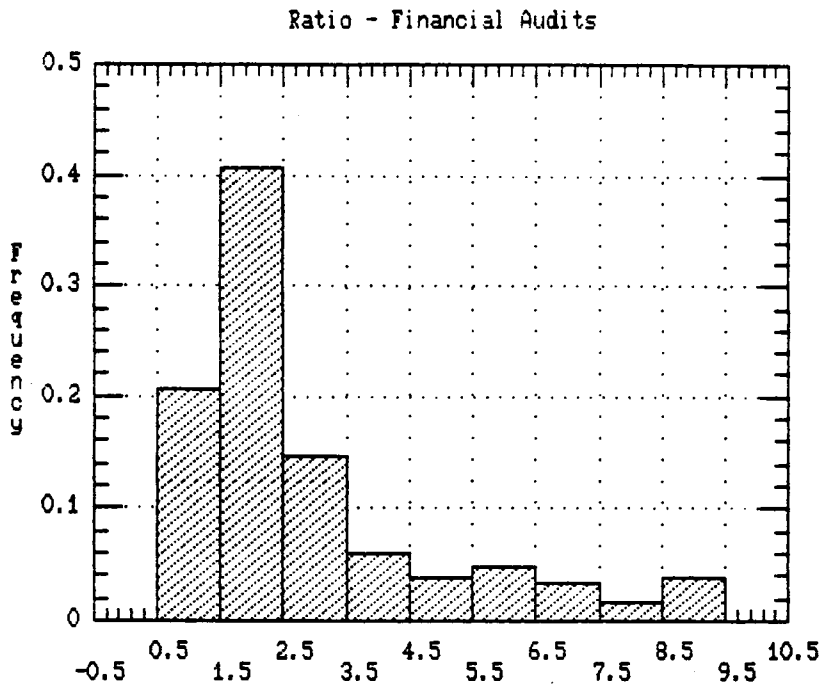


Figure 72. Frequency Histograms - Extent of Use of Ratio Estimation

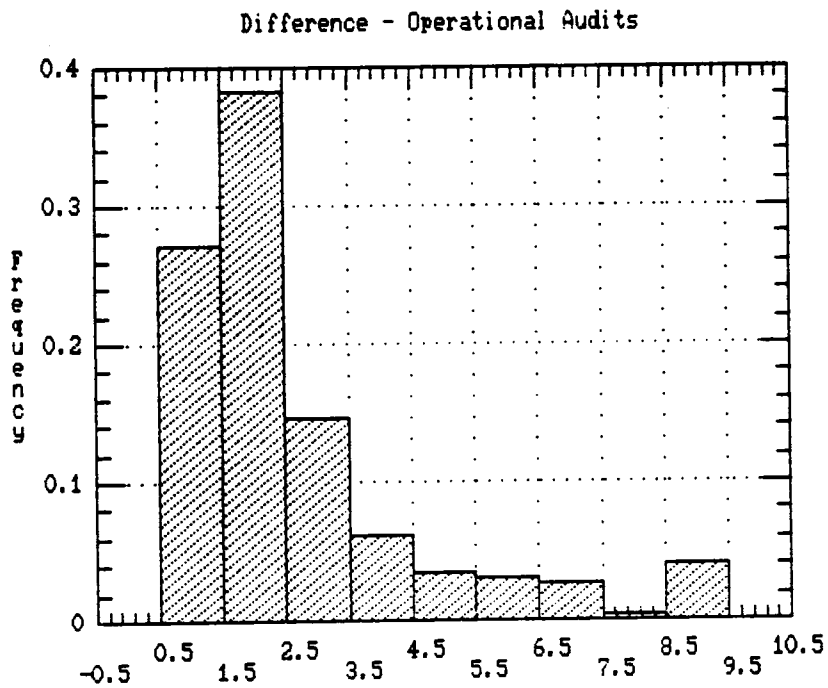
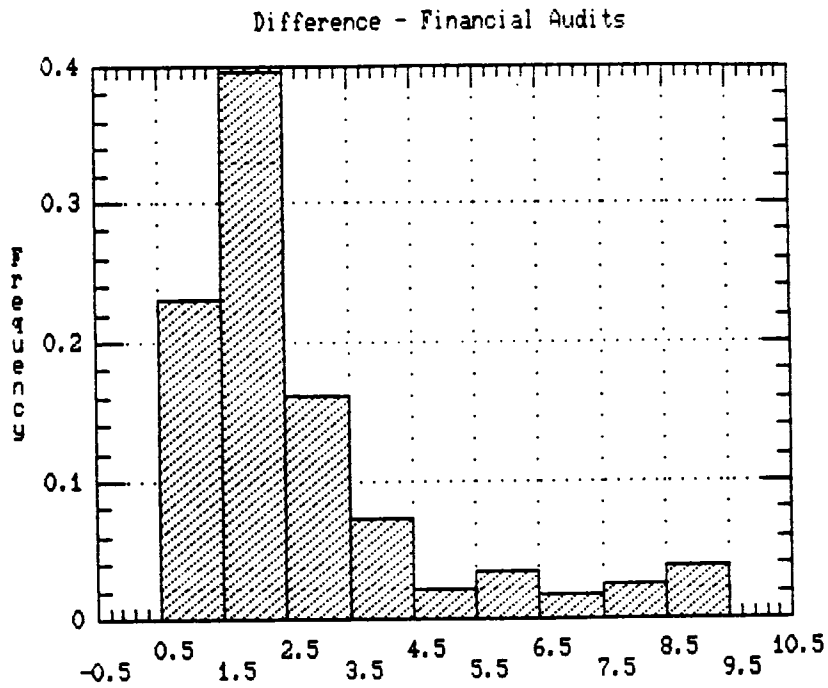


Figure 73. Frequency Histograms - Extent of Use of Difference Estimation

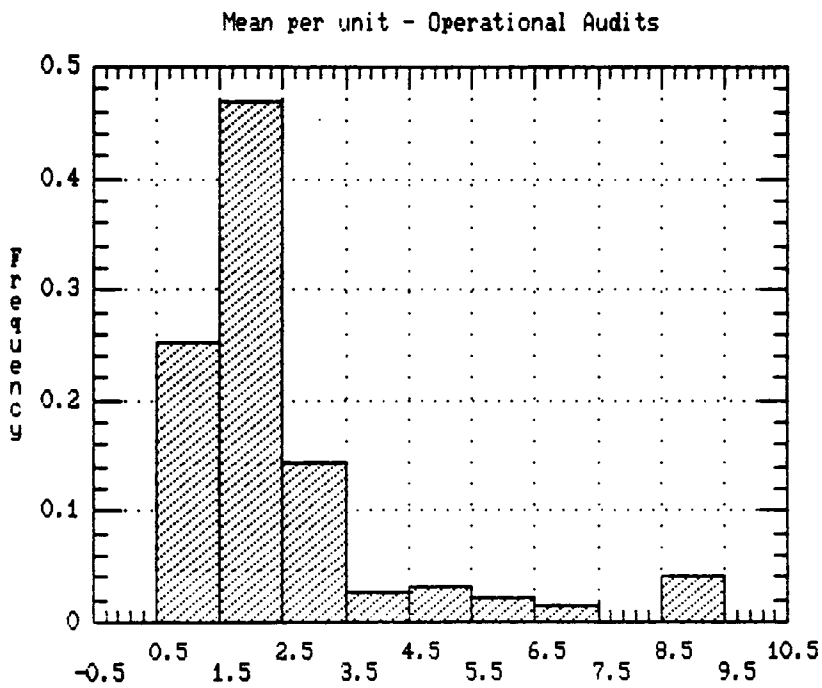
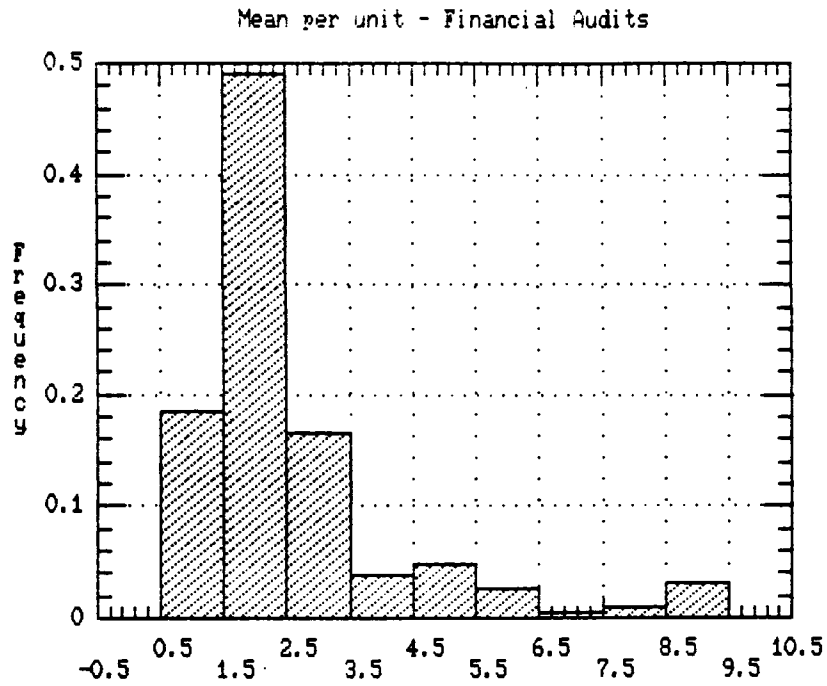


Figure 74. Frequency Histograms - Extent of Use of Mean per Unit Estimation

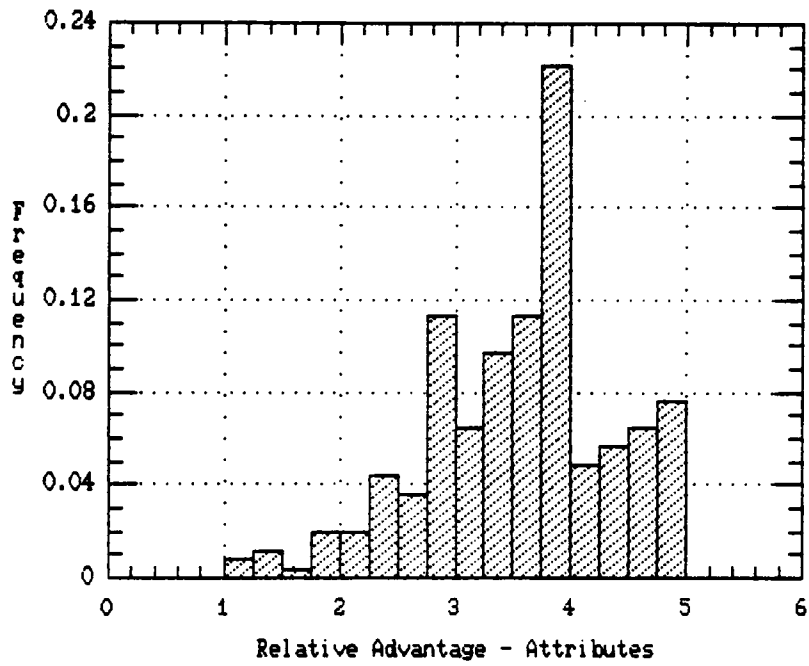
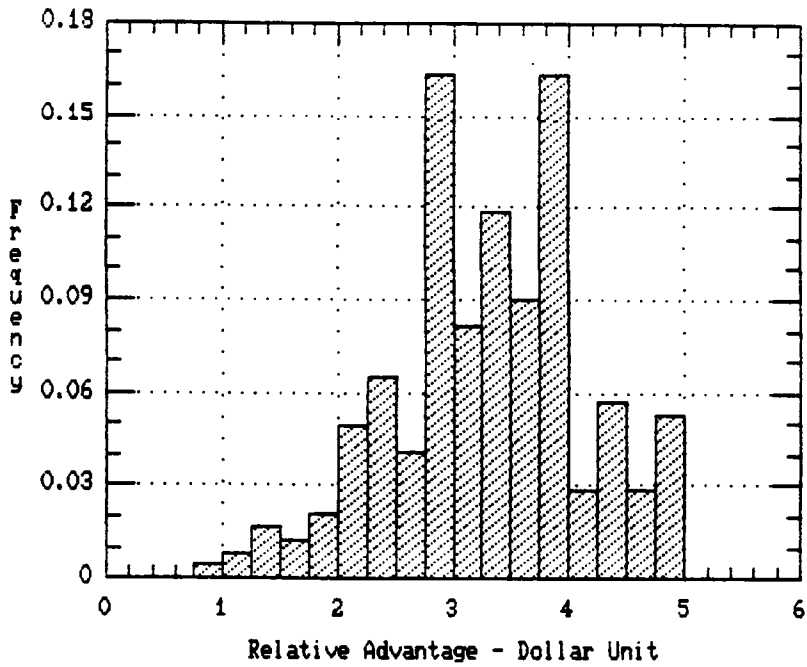


Figure 75. Frequency Histograms - Relative Advantage - Dollar Unit and Attributes

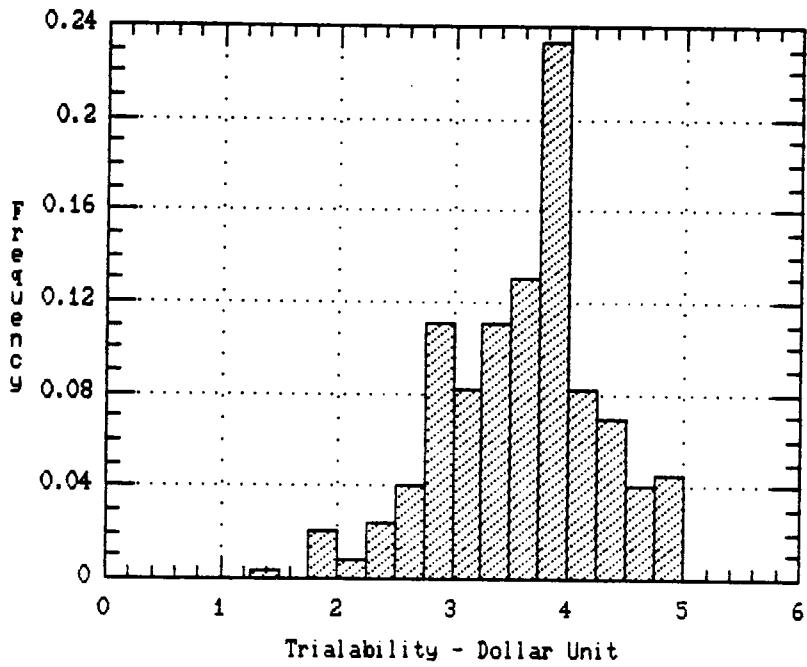
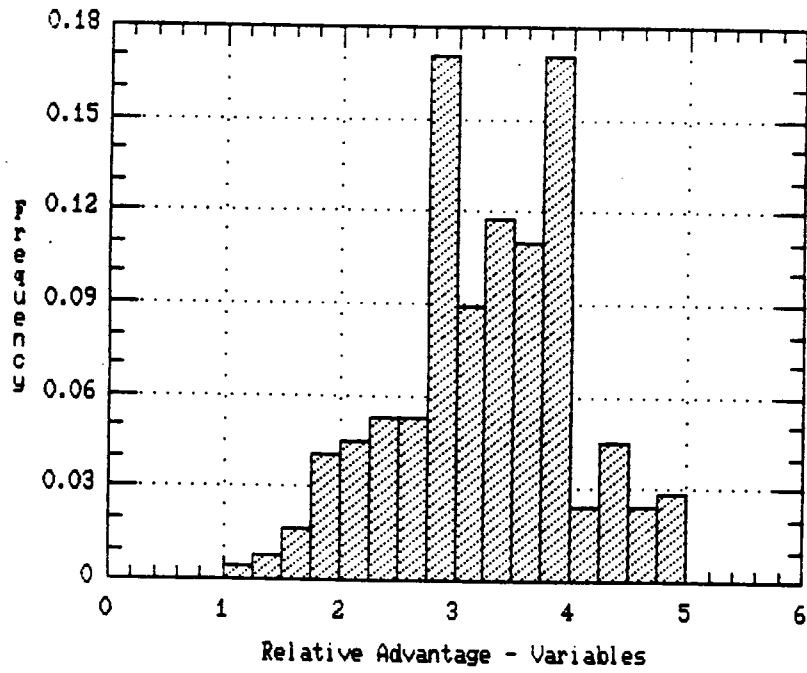


Figure 76. Frequency Histograms - Relative Advantage - Variables and Trialability - Dollar Unit

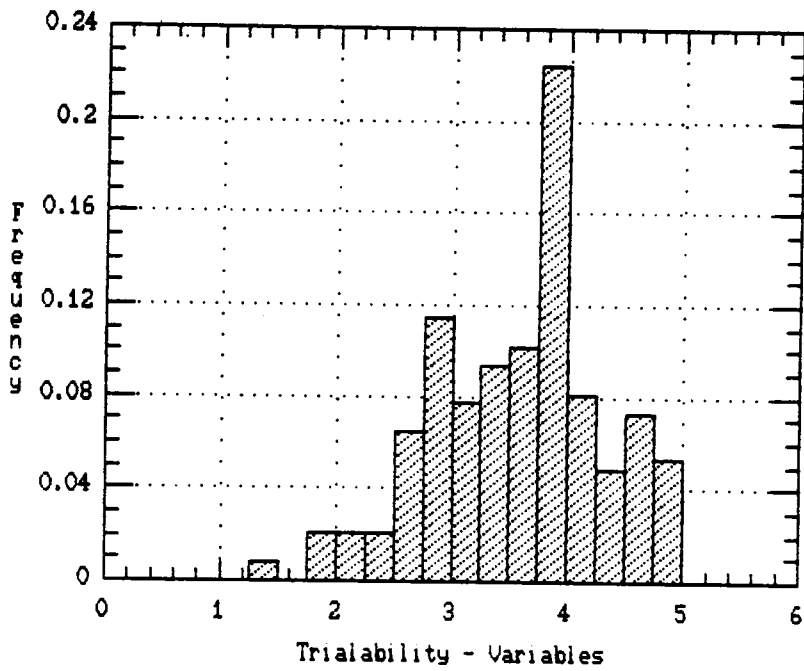
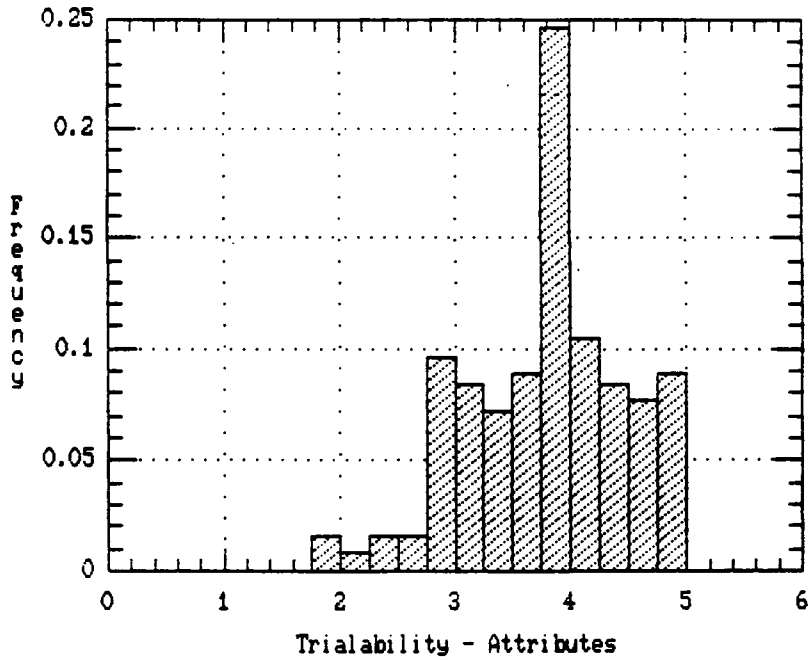


Figure 77. Frequency Histograms - Trialability - Attributes and Variables

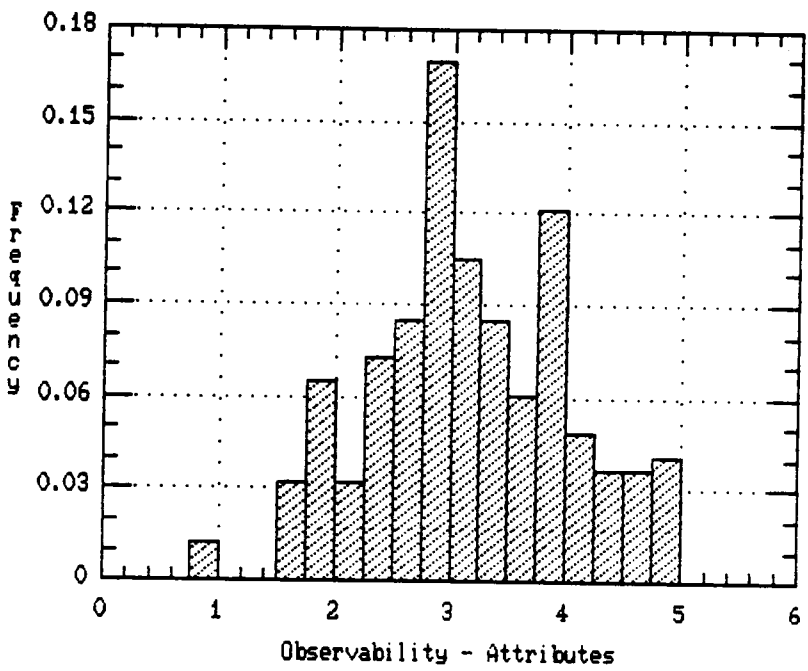
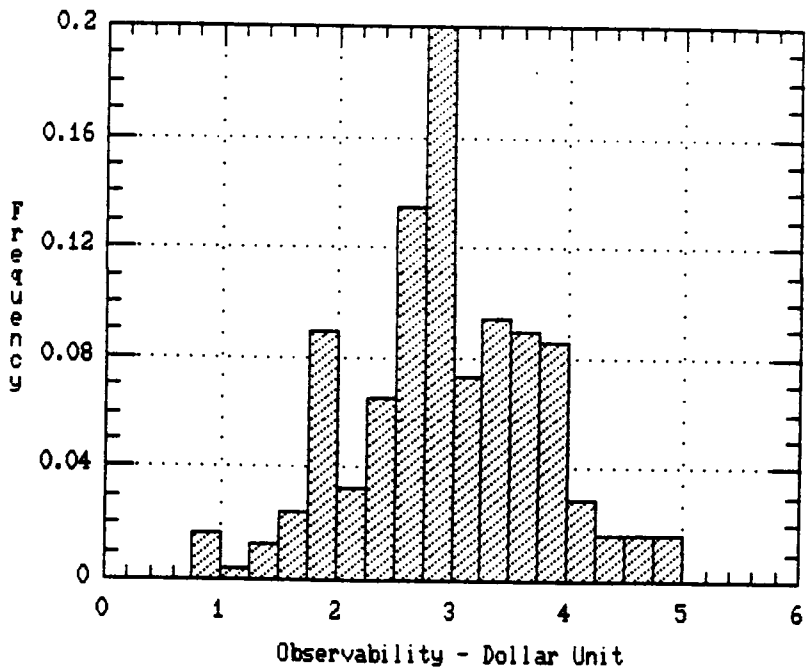


Figure 78. Frequency histograms - Observability - Dollar Unit and Attributes

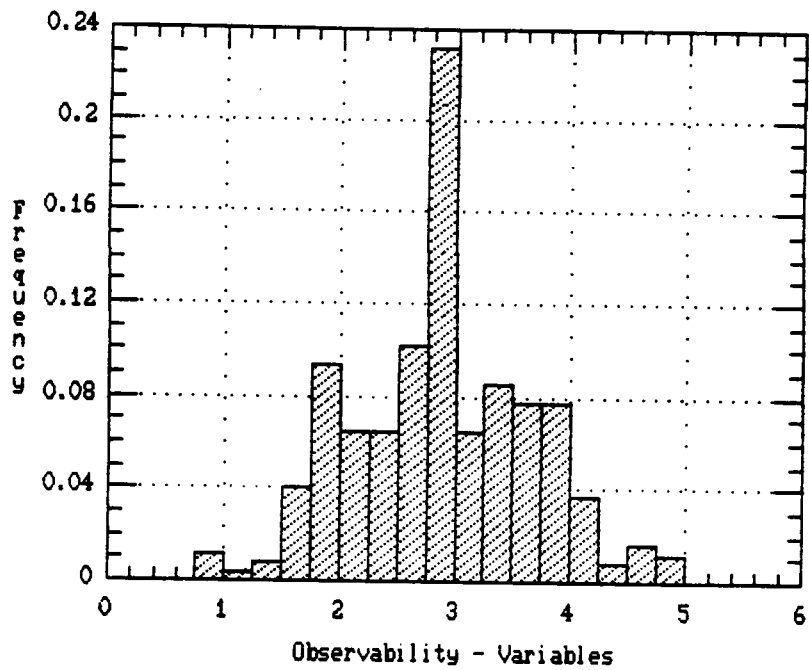


Figure 79. Frequency Histograms - Observability - Variables

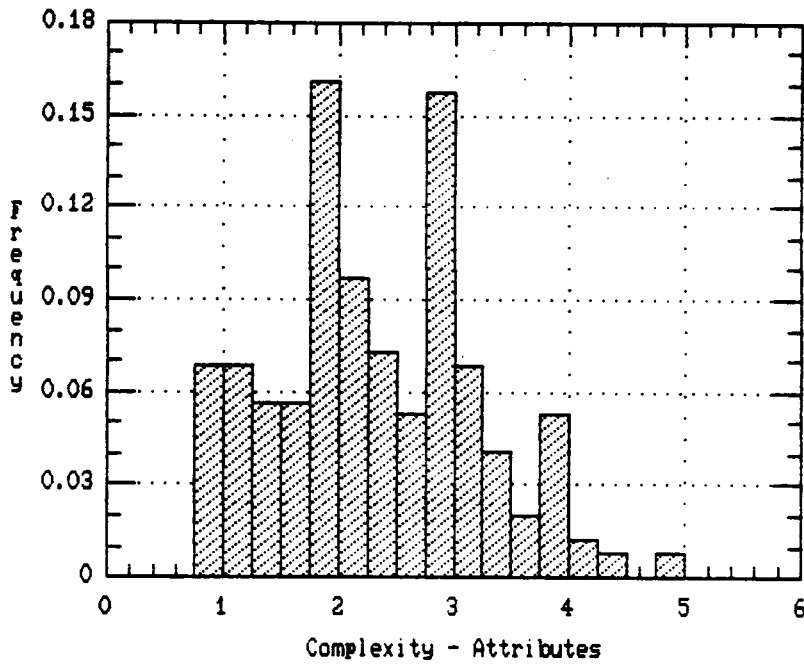
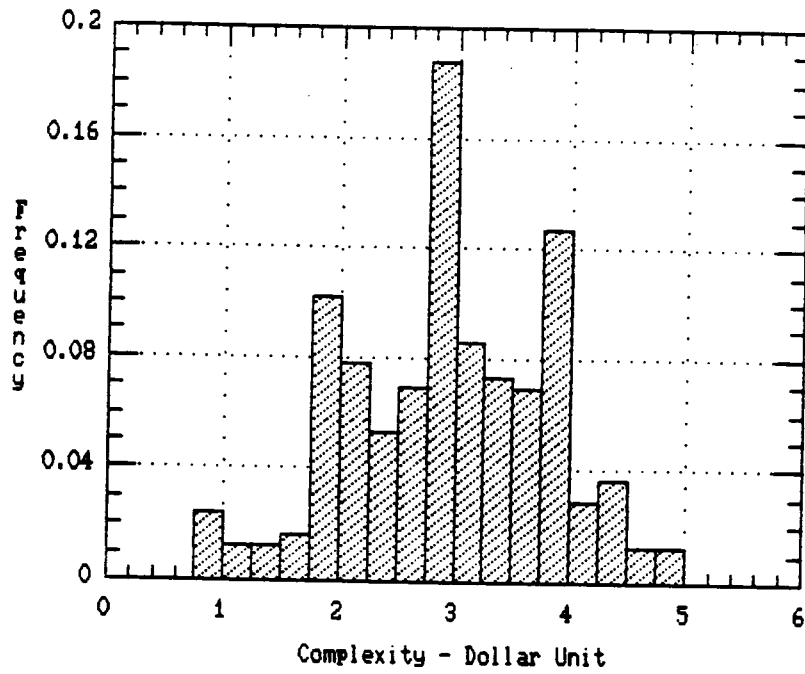


Figure 80. Frequency Histograms - Complexity - Dollar Unit and Attributes

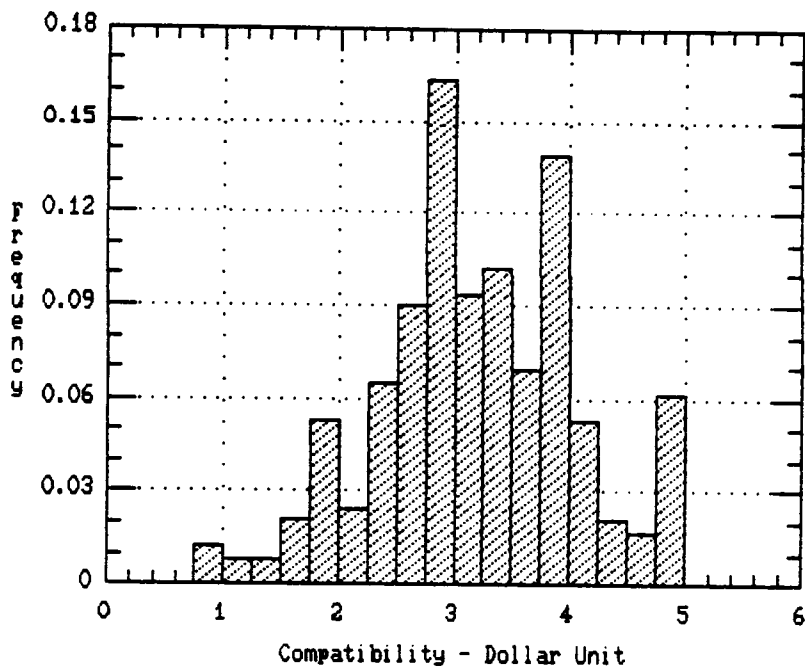
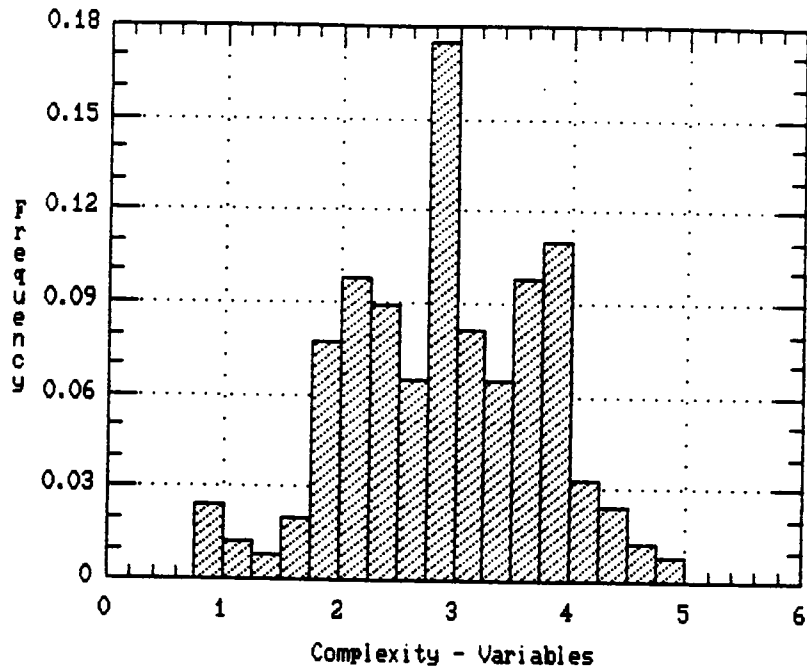


Figure 81. Frequency Histograms - Complexity - Variables and Compatibility - Dollar Unit

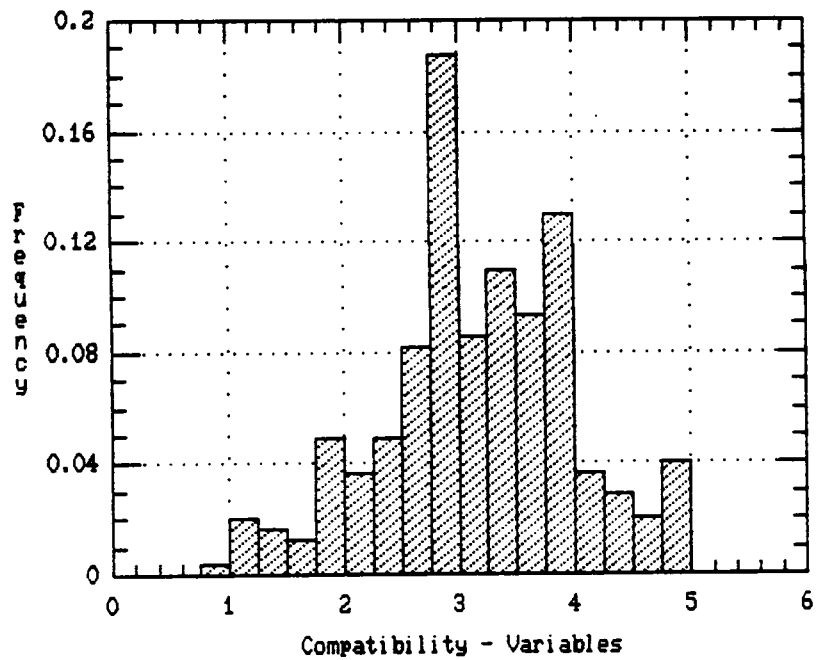
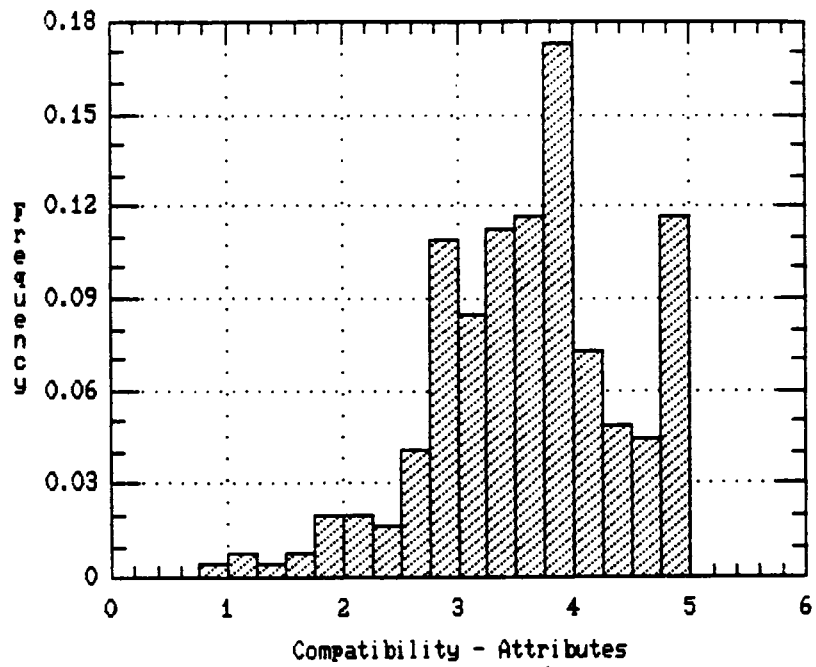


Figure 82. Frequency Histograms - Compatibility - Attributes and Variables

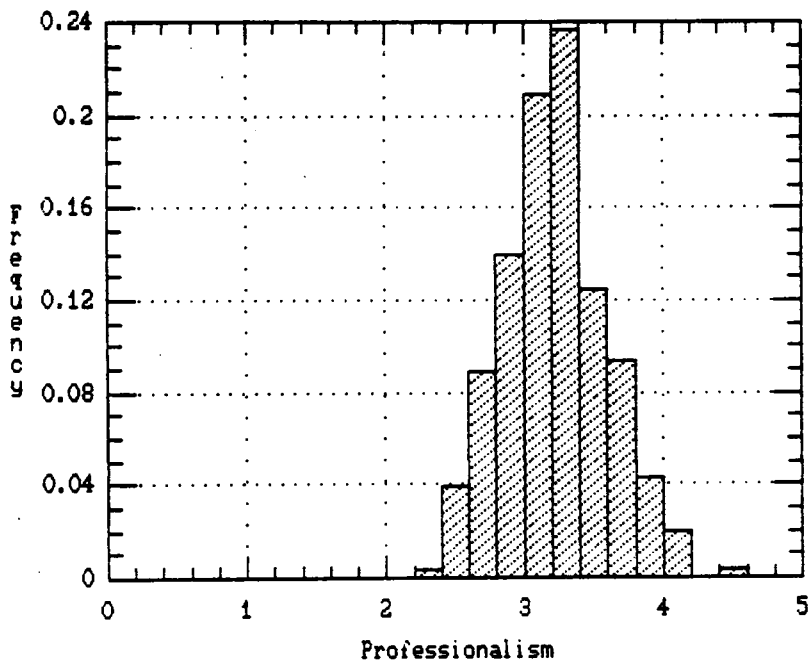
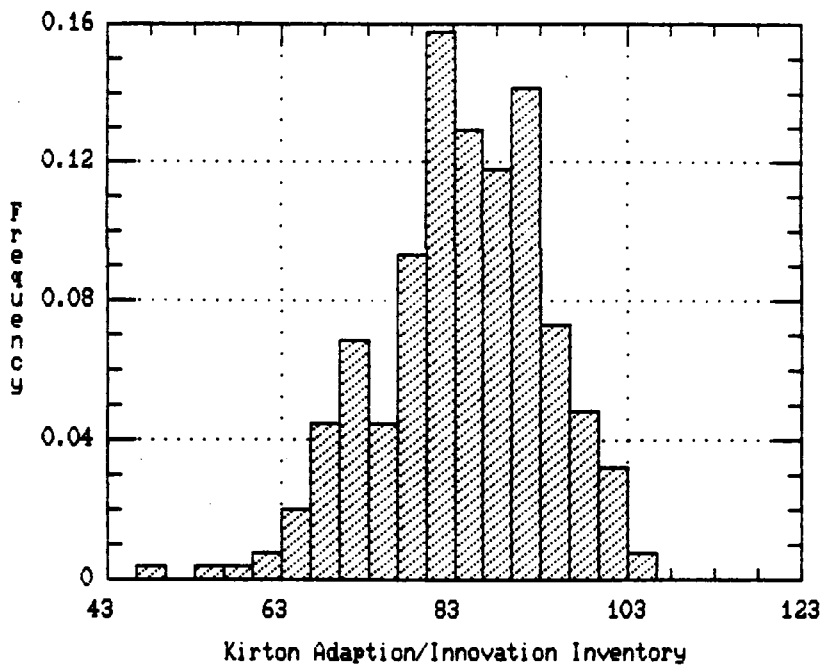


Figure 83. Frequency Histograms - KAI and Professionalism

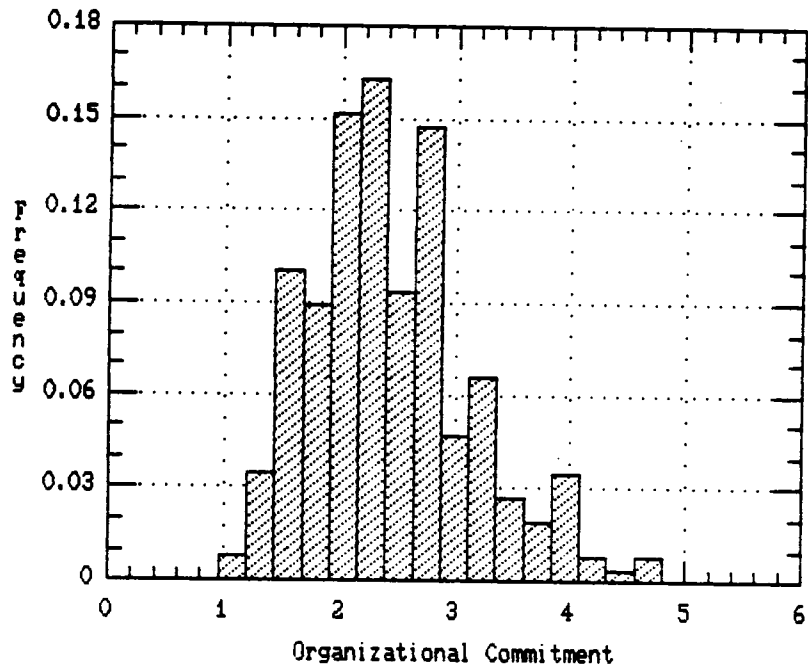
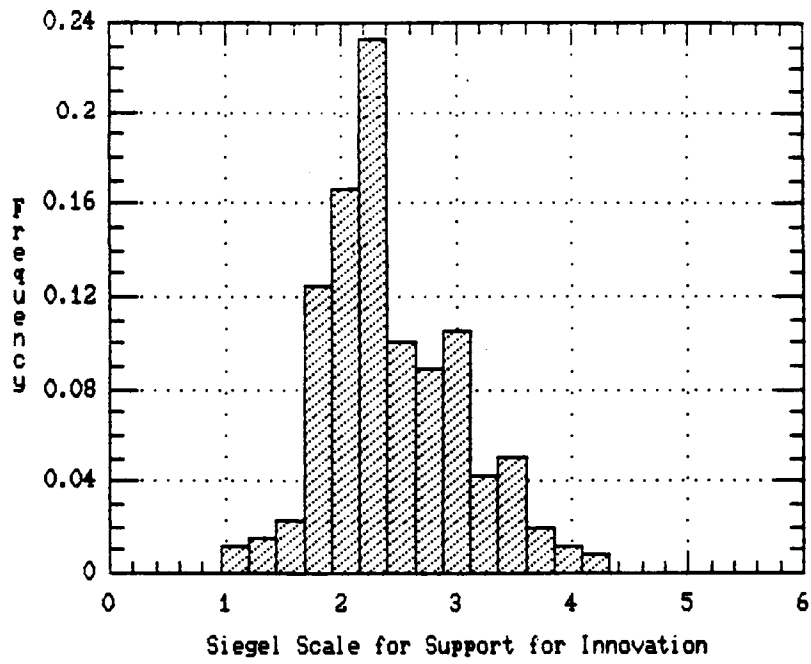


Figure 84. Frequency Histograms - SSSI and Organizational Commitment

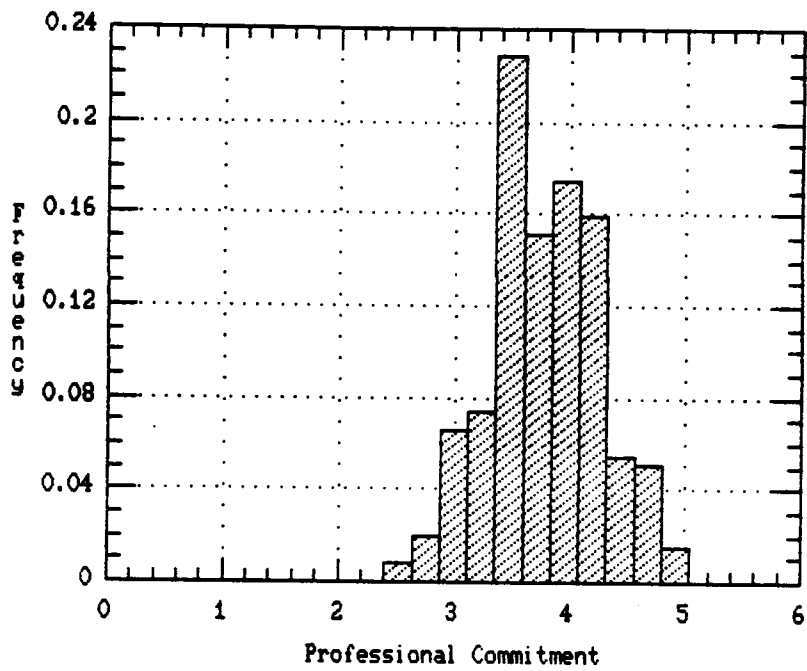


Figure 85. Frequency Histograms - Professional Commitment

Appendix C

Original Items - Innovation Attributes

Relative advantage items

- 1.* Using _____ takes more time than it is worth.
2. _____ is more objective and defensible than other sampling procedures.
3. The use of _____ results in more uniform interpretation of test results by audit staff.
4. _____ provides a measure of risk not available in judgmental sampling.
5. _____ is an efficient auditing procedure.
6. _____ is really not any more effective than non-statistical sampling.
- 7.* _____ saves time and money.
8. _____ enhances the credibility of our work.
9. _____ is an expensive procedure to apply.
10. Conclusions based upon the use of _____ are easily defended.
11. _____ is not an effective procedure for most audit situations.
- 12.* Using _____ reduces the risk of incorrect conclusions.
- 13.* After initial applications, _____ is relatively cheap to use.
- 14.* _____ does not offer any relative advantage over previous ideas.
15. Our department's performance will be improved by using _____.

Trialability items

- 1.* _____ can be instituted on a limited basis.
- 2.* It is not necessary to commit to full scale use of _____ without trial use.
- 3.* Use of _____ requires a commitment to implement it in all possible situations.
- 4.* _____ cannot be experimented with on a limited basis.

* items used on final scale

Figure 86. Original Items - Relative Advantage and Trialability

Observability items

1. It is easy to see the results of _____.
2. The advantages of _____ are easy to observe.
- 3.* Benefits of _____ are readily observable by report recipients.
- 4.* Benefits of the use of _____ have been clearly demonstrated by other auditors.
5. There have been many successful applications of _____.
- 6.* The results of _____ are difficult to observe and communicate to others.
- 7.* It is difficult to convince superiors of the merits of using _____.

Complexity

1. Applying _____ is easier said than done.
- 2.* _____ is difficult to understand.
3. It is hard to explain _____ to others.
- 4.* _____ is a complex auditing procedure.
- 5.* The principles underlying the application of _____ are easily understood.
- 6.* Any auditor should be able to learn how to apply _____ with ease.
- 7.* _____ is easy to understand and apply.

* items used on final scale

Figure 87. Original Items - Observability and Complexity

Compatibility items

1. Our staff has adequate technical training to apply _____.
- 2.* We do not have enough experienced staff to apply _____.
3. There are very few audit areas where we could use _____.
4. Sample sizes determined by using _____ are generally inappropriate.
- 5.* Our audit populations are not suitable for _____.
6. In order to use _____ we need more computer support.
7. Much of internal auditing is not suited for using _____.
8. Defining errors so that _____ may be used is difficult.
- 9.* To use _____ we do not have to radically change our work patterns.
- 10.* _____ is inconsistent with existing values, past experiences and present needs.
11. Conclusions obtained using _____ are similar to those made using other sampling procedures.
12. _____ is a radical departure from previous procedures.
13. Use of _____ is compatible with my ideas about auditing methodology.
14. Results obtained by using _____ are often unexpected.
15. _____ is similar to procedures used before.
16. Use of _____ requires significant changes in the technical expertise of the audit staff.
17. The manner in which we select audit items is not compatible with the use of _____.
- 18.* _____ can be easily adapted to fit our particular needs.

* items used on final scale

Figure 88. Original Items - Compatibility

Appendix D

Regression Models for Organization Groups

DUSO = Dollar Unit Sampling - Operational Audits
 DUSF = Dollar Unit Sampling - Financial Audits
 ATTF = Attributes Sampling - Financial Audits
 ATTO = Attributes Sampling - Operational Audits
 SOGF = Stop or Go Sampling - Financial Audits
 SOGO = Stop or Go Sampling - Operational Audits
 DISF = Discovery Sampling - Financial Audits
 DISO = Discovery Sampling - Operational Audits
 RATF = Ratio Estimation - Financial Audits
 RATO = Ratio Estimation - Operational Audits
 RATO = Ratio Estimation - Operational Audits
 MPUF = Mean per Unit Estimation - Financial Audits
 MPUO = Mean per Unit Estimation - Operational Audits
 DIFF = Difference Estimation - Financial Audits
 DIFO = Difference Estimation - Operational Audits
 RA = Relative Advantage
 TR = Trialability
 OB = Observability
 CX = Complexity
 CP = Compatibility
 PROF = Professionalism
 PCOM = Professional Commitment
 COSMO = Cosmopolitanism
 OCOM = Organizational Commitment
 KAI = Kirton Adaption/Innovation Inventory (Creativity
 Decision Style)
 SSSI = Siegel Scale for Support for Innovation
 SIZE = Size of Organization - Total Assets or Budget
 COMM = Indicator Variable - Commercial Enterprise
 BANK = Indicator Variable - Financial Enterprise
 GOV = Indicator Variable - Nonprofit Enterprise
 CAA = Computer Assisted Auditing
 MAA = Microcomputer Assisted Auditing

Figure 89. Legend for Abbreviations used in Appendix D

Model	R ²	R ² -adj.	F	n
DUSF = 5.20 - 1.03CX + 822CP	.330	.317	24.82	104
DUSO = 4.03 - .95CX + .75CP	.274	.259	17.78	97
ATTf = .64 + 1.52RA	.268	.262	38.20	106
ATTO = -1.61 + 1.22RA + .76CP	.350	.337	26.37	101
DISF = .54 + 1.30RA - .58CX	.170	.115	7.72	104
DISO = 2.06 + 1.41RA - .55OB	.199	.134	8.60	99
SOGF = .47 + 1.00RA	.124	.115	14.41	104
SOGO = .39 + .95RA	.123	.114	13.79	100
RATF = 5.76 - .94RA + .79 OB - .59CX	.092	.065	3.32	102
RATO = 5.42 - 1.01RA + .76OB - .51CX	.096	.068	3.34	98
DIFF = 5.52 - .88CX	.092	.083	10.00	101
DIFO = 4.59 - .94RA + 1.04OB - .63CX	.165	.113	5.07	97
MPUF = 1.00 + .45TR	.040	.030	4.09	100
MPUO = 1.10 - 1.00RA + .89OB + .62CP	.167	.139	5.93	93

LEGEND: See Figure 89.

Figure 90. Multiple Regression Models - Innovation Attributes - Commercial Group

Model	R ²	R ² -Adj.	F	n
DUSF = 2.11 + .81RA - .63CX + .66CP	.424	.389	12.03	53
DUSO = 1.70 + .92CP	.095	.076	5.03	50
ATTF = - .49 + 1.68CP	.290	.277	22.07	56
ATTO = .74 + 1.24CP	.151	.134	9.08	53
DISF = NO MODEL				
DISO = NO MODEL				
SOGF = 1.25 + .69CP	.069	.052	4.02	56
SOGO = .91 + .74RA	.071	.053	3.88	53
RATF = 2.64 - .78TR + .90CP	.125	.091	3.66	54
RATO = NO MODEL				
DIFF = 3.98 - .94TR - .70OB + 1.36CP	.217	.170	4.63	54
DIFO = 2.29 - .75OB + .76CP	.091	.053	2.41	51
MPUF = 3.98 - .92TR - .52OB + 1.14CP	.196	.145	3.89	52
MPUO = 6.63 - .90TR - .71OB - .50CX + .79CP	.219	.151	3.23	51

LEGEND: See Figure 89.

Figure 91. Multiple Regression Models - Innovation Attributes - Banks

Model	R ²	R ² -Adj.	F	n
DUSF = -3.14 + .90TR + 1.10CP	.285	.253	8.79	47
DUSO = -3.29 + .90TR + 1.06CP	.277	.247	9.02	50
ATTF = -1.01 + 1.82RA	.245	.228	14.61	47
ATTO = -2.75 + 1.29RA + 1.00CP	.300	.271	10.28	51
DISF = -1.65 + 1.55TR	.119	.100	6.09	47
DISO = -1.29 + 1.53TR	.100	.082	5.36	50
SOGF = -8.47 + 1.11TR + .87CX + 1.52CP	.254	.202	4.88	47
SOGO = -1.31 + 1.38RA	.146	.128	8.03	49
RATF = .48 + .61CP	.140	.121	7.35	47
RATO = .01 + .72RA	.116	.098	6.32	50
DIFF = -2.91 + .71CX + 1.04CP	.163	.136	4.30	47
DIFO = -1.97 + 1.29TR	.154	.136	8.74	50
MPUF = NO MODEL				
MPUO = .32 + .88RA	.091	.072	4.81	50

LEGEND: See Figure 89.

Figure 92. Multiple Regression Models - Innovation Attributes - Nonprofit

Model	R	c	D	chi-square	n
DUSF = 1.75 - 1.20CX + .54CP	.424	.783	.567	26.56	100
DUSO = .05 - .99CX + 1.30CP - .85RA	.401	.818	.635	21.86	100
ATTf = -3.65 + 1.29RA	.377	.768	.535	20.83	106
ATTO = -6.72 + 1.12RA + .97OB	.480	.826	.651	33.10	106
VARF = .64 - .67CX	.142	.645	.290	4.19	100
VARO = .05 - .62CX	.094	.625	.251	2.77	100

LEGEND: See Figure 89.

Figure 93. Logistic Regression Models - Innovation Attributes - Commercial Group

Model	R	c	D	chi-square	n
DUSF = -4.80 + 1.56CP	.438	.811	.622	14.47	50
DUSO = 1.45 + .68CX	.199	.678	.356	4.83	50
ATTF = -2.86 + .97CP	.252	.702	.404	6.58	54
ATTO = -1.72 + .54OB	.098	.613	.226	2.72	54
VARF = -3.11 + .96CP	.218	.707	.413	2.29	52
VARO = NO MODEL					

LEGEND: See Figure 89.

Figure 94. Logistic Regression Models - Innovation Attributes - Banks

Model	R	c	D	chi-square	n
DUSF = -6.45 + 1.55CP	.337	.763	.526	8.24	55
DUSO = -6.82 + 1.51CP	.304	.755	.511	6.15	55
ATTF = NO MODEL					
ATTO = -3.40 + 1.04CP	.247	.667	.335	6.21	55
VARF = NO MODEL					
VARO = -7.09 + 1.54TR	.240	.707	.414	4.20	55

LEGEND: See Figure 89.

Figure 95. Logistic Regression Models - Innovation Attributes - Nonprofit

Model	R ²	R ² -Adj.	F	n	CAA/MAA*
DUS = 5.21 - 1.03CX + .83CP	.33	.32	24.93	104	CAA
ATT = .64 + 1.52RA	.27	.26	38.20	106	MAA
DIS = -2.08 + 1.02RA - .37SIZE + .30COSMO	.20	.18	8.43	104	MAA
SOG = -4.73 + 1.04RA + .41COSMO	.24	.23	15.99	104	-
RAT = 5.76 - .94RA + .790B - .59CX	.09	.06	3.32	102	MAA
DIF = 5.25 - .88CX	.09	.08	10.00	101	-
MPU = 1.36 + .44TR - .98PCOM + .27COSMO	.12	.09	4.37	100	-

* Significantly increases R² when added to regression model

LEGEND: See Figure 89.

Figure 96. Multiple Regression Models - All Variables - Commercial - Financial Audits

Model	R ²	R ² -Adj.	F	n	CAA/MAA
DUS = - 2.21 - 1.01CX + .79CP + .770COM	.32	.30	14.61	97	CAA
ATT = -1.61 + 1.22RA + .76CP	.35	.34	26.37	101	CAA
DIS = -1.90 + 1.06RA - .45SIZE + .27COSMO	.23	.20	9.31	99	MAA
SOG = -4.14 + .97RA + .36COSMO	.23	.20	13.40	100	-
RAT = 3.30 - 1.36PCOM + .680COM + .25COSMO	.10	.07	3.54	103	-
DIF = 3.63 - .85RA + 1.32OB - 1.67PCOM + .34COSMO	.24	.20	7.14	97	CAA
MPU = 3.45 - .99RA + .95OB + .51CP - .59PCOM	.19	.15	5.19	93	CAA

* R² significantly increased when added to model

LEGEND: See Figure 89.

Figure 97. Multiple Regression Models - All Variables - Commercial: Operational audits

Model	R ²	R ² -Adj.	F	n
DUS = 8.50 - .81CX + 1.02CP - 1.54PROF	.43	.40	12.36	53
ATT = - .49 + 1.60CP	.29	.28	22.07	56
DIS = NO MODEL				
SOG = 1.25 + .69CP	.07	.05	4.02	56
RAT = 5.62 + .50CP -1.17PCOM	.13	.10	3.90	54
DIF = 11.25 - .70TR + .84CP - .75SIZE - 1.14PCOM - .900COM	.37	.31	5.76	54
MPU = 11.48 - .68TR + .70CP - .68SIZE - 1.21PCOM - .830COM	.38	.31	5.63	52

LEGEND: See Figure 89.

Figure 98. Multiple Regression Models - All Variables - Banks: Financial audits independent variables, financial auditing

Model	R ²	R ² -Adj.	F	n
DUS = 10.18 + .99CP - 2.58PROF	.31	.22	7.96	50
ATT = .74 + 1.24CP	.15	.13	9.08	53
DIS = NO MODEL				
SOG = -.61 + .64RA + .790COM	.15	.11	4.24	53
RAT = NO MODEL				
DIF = 2.32 + .46CP - .51SIZE	.12	.08	3.31	51
MPU = 5.25 - .92TR - .44CX + .50CP	.15	.10	2.80	51

LEGEND: See Figure 89.

Figure 99. Multiple Regression Models - All Variables - Banks: Operational Audits

Model	R ²	R ² -Adj.	F	n	CAA/MAA*
DUS = - 9.75 + 1.82CP + .05KAI + .25COSMO	.38	.32	6.17	45	-
ATT = - 2.06 + 1.83RA - .94SSSI + .27COSMO	.33	.28	6.99	47	MAA
DIS = .87 + 1.74TR - 1.31SSSI	.22	.18	6.05	47	-
SOG = -.20 + 1.82TR - .05KAI	.20	.16	5.12	45	-
RAT = 2.55 + .63CP - .17COSMO	.19	.16	5.26	47	-
DIF = 2.11 + .83CX + 1.09CP - .85SSSI - .28COSMO	.34	.28	5.39	47	-
MPU = 7.21 - 1.50PROF	.10	.08	5.27	47	CAA

* Significantly increases R² when added to regression model

LEGEND: See Figure 89.

Figure 100. Multiple Regression Models - All Variables - Nonprofit: Financial audits

Model	R ²	R ² -Adj.	F	CAA/MAA
DUS = - 9.35 + 1.62CP + .07KAI - .93SSSI + .34COSMO	.46	.41	9.31	CAA
ATT = 1.39 + 1.98RA - 1.200COM	.34	.31	12.27	MAA
DIS = 7.46 + 1.59TR - 1.66SSSI - 1.53PROF	.25	.20	5.01	-
SOG = - 1.31 + 1.39RA	.15	.13	8.03	-
RAT = 1.91 + .77RA - .86SSSI	.24	.20	7.29	-
DIF = 3.65 + 1.42TR - 1.34SSSI - .23COSMO	.37	.33	9.13	-
MPU = 1.57 + .93RA - .85SSSI	.15	.12	4.24	-

* Significantly increases R² when added to regression model

LEGEND: See Figure 89.

Figure 101. Multiple Regression Models - All Variables - Nonprofit: Operational audits

Model	R	c	D	chi-square	n	CAA/MAA*
DUSF = 1.75 - 1.20CX + .54CP	.424	.783	.567	26.56	100	CAA
DUSO = -2.47 - 1.54CX + .27COSMO + .900COM	.404	.801	.603	22.40	100	CAA
ATTF = -3.65 + 1.29RA	.377	.768	.535	20.83	103	MAA
ATTO = -10.08 + 1.21RA + 1.020B + .80PCOM	.494	.835	.679	35.35	104	MAA
VARF = -1.67 - .78CX + .20COSMO	.164	.669	.338	6.63	98	-
VARO = 2.13 - .90CX + .720COM + .55COSMO - 3.19PROF	.267	.783	.586	12.80	98	-

* significantly improves model when added

LEGEND: See Figure 89.

Figure 102. Logistic Regression Models - All Variables - Commercial

Model	R	c	D	chi-square	n
DUSF = 24.10 - 1.95CX - .09KAI - 3.25PROF	.520	.877	.754	19.94	44
DUSO = 19.74 - 1.45CX - 3.14PROF - .07KAI	.437	.837	.674	15.49	44
ATTF = 8.23 - .93CX - 1.62PROF	.266	.734	.467	8.63	54
ATTO = -3.47 + .84OB - 3.65PROF + .47COSMO	.293	.754	.508	11.33	54
VARF = 7.13 + .45CX - 2.17PCOM - .87SIZE	.320	.837	.673	10.52	52
VARO = NO MODEL					

LEGEND: See Figure 89.

Figure 103. Logistic Regression Models - All Variables - Banks

Model	R	c	D	chl-square	n
DUSF = -15.38 + 2.12CP + .08KAI	.432	.831	.663	12.85	51
DUSO = -14.75 + 2.26CP + .12KAI - 1.87SSSI + .72COSMO - 2.56PCOM	.381	.865	.731	14.45	51
ATTF = -5.19 + .82TR - .58SIZE + .29COSMO	.151	.713	.427	7.32	55
ATTO = -3.40 + 1.04CP	.247	.667	.335	6.21	55
VARF = 3.07 - 2.47SSSI	.344	.798	.596	5.09	55
VARO = 13.54 + 1.92TR - 3.49SSSI - 4.95PROF	.553	.948	.895	15.35	55

LEGEND: See Figure 89.

Figure 104. Logistic Regression Models - All Variables - Nonprofit

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