A Study of Internal Auditor Perceptions of Selected Audit Activities Performed During the Design Phase of Systems Development.

Margaret Virginia Cerullo

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A study of internal auditor perceptions of selected audit activities performed during the design phase of systems development

Cerullo, Margaret Virginia, Ph.D.
The Louisiana State University and Agricultural and Mechanical Col., 1990
A STUDY OF INTERNAL AUDITOR PERCEPTIONS
OF SELECTED AUDIT ACTIVITIES PERFORMED DURING
THE DESIGN PHASE OF SYSTEMS DEVELOPMENT

A Dissertation

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

in

The Department of Accounting

by

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ABSTRACT

Little evidence exists concerning the criteria which internal auditors consider when selecting activities to perform during systems design. Likewise, knowledge concerning the perceived role(s) of the internal auditor in systems design is limited.

This dissertation examined the perceptions of internal auditors who have assisted in the development of a system and have, therefore, participated in the choosing of activities to perform during systems development. Nine systems design audit activities were selected from the literature to represent the different levels of involvement recommended in the literature. Internal auditors' judgments of the similarity of the nine audit activities were collected in two questionnaires, representing two areas of internal auditor involvement:

1. The Controllability Questionnaire assumed that activities are chosen to provide assurance that adequate EDP application controls are designed into a system.

2. The Auditability Questionnaire assumed that activities are chosen to provide assurance that audit needs are designed into a system.

Respondents were approximately equal between the above groups. Internal auditors judged the similarity of each pair of the audit activities and then rated the activities on attributes chosen by the researcher, a priori, as factors influencing these similarity judgements.
The survey results were analyzed using multidimensional scaling (MDS) and canonical correlation techniques. Internal auditors' perceptions of systems design audit activities were modeled in two-dimensional MDS solutions for both groups of respondents. The attributes found to significantly affect the perceptions of systems design audit activities in the auditability MDS solution differed from those in the controllability MDS solution. Both models identified the activities which each respondent group perceived as the most and least appropriate.
CHAPTER I
INTRODUCTION AND OVERVIEW OF THE STUDY

Overview of Internal Auditor Involvement in Systems Design

Audits conducted after a computer system becomes operational are effective in identifying control weaknesses. However, the cost of implementing control modifications may far outweigh their benefits. In fact, retrofitting controls into an implemented computer system may cost up to 100 times more than building the same controls into a system as it is developed (Dunmore, 1988). Internal auditor participation in systems development is widely acknowledged as one means of providing assurance for adequate controls in new systems.

The development of computer systems is a complex process which is made easier by dividing the developmental tasks into phases. A structured approach called the systems development life cycle (SDLC) is used in most companies to ensure a more efficient development process [Porter and Perry (1987, 218-221)]. Although the names and specific tasks included in the phases may vary from organization to organization, the following stages are representative of the SDLC approach [Porter and Perry (1987, 219)]:

1. Requirements Definition Phase
2. Development Phase
   a. Analysis
   b. Design
   c. Programming & Testing
3. Installation/Integration/Conversion/Testing Phase
4. Operational Phase

To be most effective, internal auditor involvement is generally recommended for the development phase (2b in the above representation). The two main benefits of involvement at this juncture which are consistently stated in the literature are:

1. Assurance that adequate controls are built into the system in a cost-effective manner.

2. Future audit advantages, such as embedded audit techniques and reduction in subsequent audit time.

For this study, activities conducted during systems design which provide assurance that adequate controls are incorporated into an information system will be called controllability activities. Early involvement in the systems development process provides assurance for cost-effective controls. This cost-effective concept is based on research completed by Boehm (1976), a leading expert in software economics [Business Week (May 9, 1988, 154)]. Based on experiences at major corporations, Boehm presented the relative cost of correcting errors as a function of the SDLC phase in which they are corrected. The study found that it cost, on average, 75 times more to install a requirement at the post-implementation stage than at the design or analysis stage. The results imply that control recommendations made after a system has been installed may not be implemented because of the high costs of systems modifications.
Establishing the auditability of a developing system is a phrase which refers to the future audit advantages which may occur with internal auditor involvement in systems design. Although the two concepts, auditability and controllability, overlap, they differ in objectives and scope [Kuong (1988, 7-11)]. Controllability concerns the process of designing and incorporating controls into developing information systems to produce accurate and reliable information. Auditability deals with provisions for reviewing the system from an audit viewpoint, such as the ease of extracting and accessing information for audit purposes.

Participation during systems design allows the internal auditor to make provisions for a post-implementation audit. Thus, participation may result in the following audit advantages [Grabski et al. (1987, 152)]:

1. The ability to employ advanced, embedded audit techniques [Cash, Bailey, and Whinston (1977), Perry (1981), and Weiss (1983)].

2. The ability to include audit trails and become more acquainted with the system [Capote (1980) and Macchiaverna (1978)].

3. The need for less detailed testing in the future [Crawley et al. (1975) and Sardinas et al. (1981)].

In most of the literature reviewed, management, internal auditors, and external auditors agree that internal auditor involvement in systems design results in major benefits. For example, in a study by Rittenberg and Purdy (1978), the EDP audit objectives rated "very
important" or "important" by members of top management and heads of internal audit departments included design phase reviews of new EDP applications. Sharing management's concern for the installation of controls in the systems design phase, external auditors in the same study felt strongly that internal auditors should participate in the design phase of new EDP applications to assess the adequacy of controls.

Although supported by many, internal auditor involvement in systems design has also faced opposition. In the early literature, arguments to prohibit internal auditor involvement in systems design were common. The concept of "involvement" in the development of a system was felt by many to conflict with internal auditor independence when later auditing the system. As the benefits of internal auditor participation during systems design have become widely recognized, arguments against involvement have given way to recommendations for minimizing the potential loss of internal auditor independence [Grabski (1986)].

The literature mentions two methods for resolving the conflict between the need for internal auditor involvement in systems design and the potential loss of their independence when later auditing the implemented system. The method recommended in early articles was to assign different internal auditors to systems design and to audits
after the system had been implemented (post-implementation audits).

Rittenberg (1977) investigated the effect of assigning different auditors to design and post-implementation audits. He found that managers, data processing department managers, and internal auditors perceived a reduction in internal auditor independence when internal auditors performed most systems design audit activities. Assigning different auditors to the design and the post-implementation audits mitigated the perceived reduction in independence for many audit activities. However, for activities interpreted as taking an active role in designing the information system—high involvement activities—assigning different auditors to post-implementation audits did not reduce the perceived loss of independence.

Rittenberg (1977) concluded that the audit activities which were performed, rather than the internal auditor who performed them, is the predominant influencing factor in determining the perceived loss of internal auditor independence. Most of the ensuing articles focused on determining the appropriate activities for internal auditor performance during systems design. Thus, the predominant method for minimizing the potential loss of internal auditor independence in recent literature was to limit the activities which internal auditors perform during systems design.
In summary, for more than 20 years the accounting literature has consistently presented arguments both for and against internal auditor involvement in systems design. Arguments supporting internal auditor involvement focus on the advantages of assuring the controllability and auditability of a new system. The potential loss of independence/objectivity when auditing the system after it becomes operational is the negative aspect most often associated with internal auditor participation in systems design.

The increase in the number of internal auditors participating in systems design in recent years [Grabski (1986)] substantiates the benefits derived from this involvement. Consequently, arguments against involvement in systems design have given way to arguments for limiting internal auditor involvement in systems design. Limited involvement is the method suggested in recent literature to minimize the potential loss of internal auditor independence when later auditing the system.

Purpose of the Research

The Problem

In 1978 the Institute of Internal Auditors (IIA) established Standards for the Professional Practice of Internal Auditing (the Standards) as authoritative guidelines for internal auditors. The Standards authorize internal auditor involvement in systems development with one major restriction: internal auditors should not design
or draft procedures for a new system. Therefore, the Standards attest that "design" activities are detrimental to internal auditor independence. However, disagreement concerning the definition of "design" activities is evident in the post-Standards literature.

The terms "design activities" and "high involvement activities" are generally used in the literature to describe those activities considered detrimental to internal auditor independence. These terms are used interchangeably, implying that internal auditors who become "too involved" in the systems design process are performing "design" activities.

A review of the authoritative, empirical, and nonempirical literature related to internal auditor involvement during systems design (presented in Chapter II) reveals that many different and sometimes conflicting activities are recommended for internal auditor performance during systems design. These activities differ in the extent of internal auditor involvement in systems design required for their performance. For example, Grabski et al. (1987) recommend that internal auditors need not be "involved" in systems design, but should provide systems personnel with general control guidelines. Reasoning that most applications are highly structured, the authors state that providing lists of controls can adequately ensure that systems personnel include appropriate controls in new systems. In contrast, LeGrand (1986) cautions against
"laundry lists" of controls which can give the illusion of control when none exists. LeGrand emphasizes that lists of controls cannot substitute for conducting a control analysis for a specific system.

The disagreement in the literature concerning appropriate internal auditor involvement in systems design attests to the lack of clear guidelines for internal auditor participation in systems design. Until such time as authoritative guidelines are provided, internal auditors are faced with the dilemma of choosing among divergent systems design audit activities.

Little research evidence exists concerning the criteria which internal auditors consider when choosing among systems design audit activities. Most studies simply surveyed internal auditors to determine whether specific audit tasks were performed. After reviewing these surveys, one concludes that internal auditors are performing some tasks more than others. However, using these data in determining the criteria which internal auditors consider when choosing to perform an audit activity is somewhat illusive. For example, some researchers sought evidence from their surveys for the criterion "effect on internal auditor independence." If tasks believed, \textit{a priori}, to be "high involvement activities" were infrequently performed, these researchers inferred that internal auditors perceived those tasks as negatively affecting internal auditor independence. However, external variables, such as scarce
resources and lack of qualified personnel, may also be reasons for not performing particular audit activities.

Rittenberg (1977) specifically investigated internal auditors' perceptions of audit activities performed during systems design and their effect on internal auditor independence when later auditing the system. Although Rittenberg (1977, 30) found that most design-phase activities affected the perceived independence of the internal auditor, these findings were strongly influenced by whether the internal auditor had experience with design-phase audits. When responses of experienced and inexperienced auditors were compared, it was found that inexperienced auditors perceived a greater loss of independence because of design activities.

More than ten years have transpired since Rittenberg's study. During this time, the number of internal auditors involved in systems design has grown significantly. In fact, the three most comprehensive surveys (SRI (1977) and Macchiaverna (1978 and 1980)) revealed a steady increase in internal auditor involvement in systems design. From their experience in systems development activities, internal auditors may now recognize salient characteristics or attributes of audit activities which were previously unnoticed. Therefore, attributes other than "effect on internal auditor independence when later auditing the system" may influence decisions of whether to perform activities during systems design.
This Study

This dissertation is an exploratory study which attempts to determine the underlying structure of systems design audit activities. "Underlying structure" is operationally defined as the criteria or attributes which internal auditors with experience in systems development consider when differentiating among systems design audit activities. Because this structure was unknown at the time of the study, Multidimensional Scaling (MDS) was chosen as the appropriate methodology.

Multidimensional Scaling (MDS) is a technique developed in the behavioral and social sciences for studying the structure of objects [Davison (1983, 1)], and is most appropriate to use when the underlying dimensions are not known [Schiffman, Reynolds, and Young (1981, 3)]. MDS has been used in accounting "to help identify structure not obvious in the data that underlies attitudes and perceptions of accountants and users of accounting information" [Watkins (1984, 406)]. Libby (1979); Bailey, Bylinski, and Shields (1983); Pillsbury (1985); and Nair and Rittenberg (1987) all used MDS to study CPA and banker perceptions of different types of audit reports.

MDS is used to represent or model perception. One of the main advantages of this method is that the researcher is not required to specify, a priori, the significant attributes in the study. Consequently, MDS reduces researcher bias, a major problem when modeling perceptions.
Subjects are not restricted in their choice of criteria to use in making the similarity judgments. Therefore, the analysis could reveal relationships which had not been considered previously in the literature.

Internal auditors experienced in systems development were asked to judge the similarity of pairs of audit activities. These judgments provided the data for the MDS analysis. MDS techniques were used to reveal the characteristics or attributes of audit activities which internal auditors consider when judging the similarity of the activities.

MDS represents underlying attributes or combinations of attributes as dimensions in a graphical display of the activities. For example, in a two-dimension solution, the horizontal axis represents one dimension, and the vertical axis represents a different dimension. Activities which are associated with a high level of the attribute or combination of attributes which define a given dimension will be at one end of the corresponding axis. Activities which are associated with a low level of these attributes will be at the opposite end of the axis. As in most MDS studies, a broad definition of an attribute is appropriate. An attribute is defined as a psychological property, a physical property, or any other aspect which may be relevant to internal auditors' perceptions of systems design audit activities [Schiffman, Reynolds, and Young (1981)]. An example of a possible salient attribute is an
activity's "effect on an internal auditor's independence when later auditing the implemented system." An internal auditor may consider some activities as affecting internal auditor independence more than other activities. Thus, the "independence" attribute would differentiate among audit activities and would define a dimension of the MDS solution.

**Variables**

Nine systems design audit activities were selected from the literature review (Chapter II) to represent different levels of involvement in systems design. These nine audit activities were investigated for two areas of concern: controllability and auditability. The MDS analysis allowed an empirical determination of whether or not internal auditors differentiate among 1) the nine systems design audit activities, and 2) the two areas of concern.

**Auditability and Controllability**

This study investigates audit activities in two major areas of systems design involvement. These areas are defined as follows:

1. **Controllability**: Activities performed to provide assurance that adequate EDP application controls are designed into a system.

2. **Auditability**: Activities performed to provide assurance that audit needs are designed into a system.

The nonempirical literature implies that the internal auditor acts as both an appraiser and a consultant/expert.
in activities concerning EDP application controls. Participation in design activities is discouraged.

However, when considering tasks related to establishing a new system's auditability, internal auditors may be considered users of the system. "Users" of a computer system are those who will obtain information from the implemented system. In this role, auditors make provisions for obtaining information from the system which will allow them to assess the reliability of the system. Users generally share the responsibilities of design with systems personnel. Therefore, internal auditors may not perceive "high involvement" activities as inappropriate within this area of audit activity. Considering audit activities in terms of both controllability and auditability allowed the researcher to examine whether the area of involvement influences internal auditors' perceptions of activities.

Nine Audit Activities Selected

A review of the authoritative, empirical, and nonempirical literature (discussed in Chapter II) revealed a variety of internal audit tasks either performed or recommended for performance during systems design. Limiting the study to two areas of systems design—controllability and auditability—allowed the selection of nine specific audit activities for investigation (See Table 1-1 for complete descriptions of these activities):
1. Review/Evaluate Controls or Auditability of a System
2. Identify Control or Auditability Weaknesses
3. Provide a Checklist of Controls or Audit Needs
4. Provide Several Control or Auditability Solutions
5. Make Control or Auditability Recommendations
6. Serve As a Member of the Development Team
7. Act As a Control or Auditability Consultant
8. Sign-Off
9. Assist in Design of Needed Controls or Audit Requirements

These audit activities were chosen to represent the varying levels or degrees of internal auditor involvement in systems design. The activities are basically the same for the controllability and auditability groups. For example, "review/evaluate controls" is a controllability activity and "review/evaluate auditability" is an auditability activity.

Research Methodology

Figure 1-1 presents a flowchart of the major steps involved in this study.

Step One: Gathering the Data

Three types of data were collected: 1) demographic and attitudinal data, 2) similarity judgments between pairs of audit activities, and 3) ratings of each activity on selected attributes. Internal auditors' similarity judgments provided the primary data for analysis. Internal auditors' ratings of activities on selected attributes and certain demographic and attitudinal information were gathered to aid in interpreting the analysis of the similarity judgments.
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<th>SELECTED AUDIT ACTIVITIES</th>
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<td>REVIEW/EVALUATE CONTROLS OR AUDITABILITY OF SYSTEM: Provide systems personnel with the results of an internal audit review/evaluation.</td>
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<td>2.</td>
<td>IDENTIFY WEAKNESSES: Provide systems personnel with control or auditability weaknesses identified by the internal auditor in a review of the system.</td>
</tr>
<tr>
<td>3.</td>
<td>PROVIDE A CHECKLIST OF CONTROLS OR AUDIT NEEDS: Although the internal auditor does not review the system, he/she provides systems personnel with a general checklist of controls or audit needs applicable to any system.</td>
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<tr>
<td>4.</td>
<td>PROVIDE SEVERAL SOLUTIONS: Provide systems personnel with several solutions to correct weaknesses identified in the system.</td>
</tr>
<tr>
<td>5.</td>
<td>MAKE RECOMMENDATIONS: The internal auditor provides systems personnel with a list of recommended application controls or audit specifications for the system.</td>
</tr>
<tr>
<td>6.</td>
<td>SERVE AS A MEMBER OF THE SYSTEMS DEVELOPMENT TEAM: The internal auditor serves as a member of the team which is responsible for designing controls or audit needs for the system.</td>
</tr>
<tr>
<td>7.</td>
<td>ACT AS CONSULTANT: The internal auditor acts as a consultant to the systems development team.</td>
</tr>
<tr>
<td>8.</td>
<td>SIGN-OFF: The internal auditor approves the system's application controls or the system's auditability.</td>
</tr>
<tr>
<td>9.</td>
<td>ASSIST IN DESIGN: The internal auditor assists in the design of application controls or audit needs.</td>
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Mailed questionnaires were used to gather internal auditors' perceptions of the nine audit activities included in this study. Subjects were members of the Institute of Internal Auditors who worked for one of the Forbes 500 Companies and who had participated in some manner in the development of a system. Each subject received one of two
questionnaires developed for this study (See Appendix B). The questionnaires contained basically the same material. However, one instrument examined controllability activities and the other instrument examined auditability activities.

The questionnaires were divided into three parts:

Part One gathered demographic and certain attitudinal information and also determined whether respondents had experience in systems development. Internal auditors who had never participated in the development of a system were requested to return the questionnaires without completing the remaining two parts.

Part Two asked subjects to judge the similarity between each pair of the audit activities by marking a slash (/) on a five-inch undifferentiated line. The line was labeled "very dissimilar" at one end and "very similar" at the other end. These thirty-six judgments (proximity measures) by each subject provided the input for the MDS analysis. To reduce the effect of external variables on the similarity judgments, four assumptions were given to the subjects:

1. The internal auditor has the knowledge and training needed to complete every desirable task.
2. The resources (time, money, and personnel) are available to complete every desirable task.
3. The internal audit department has the support of management and systems personnel for every desirable task.
4. The EDP system being developed is significant.
Part Three of the questionnaires asked internal auditors to rate each audit activity on attributes believed, a priori, to distinguish among audit activities. These attributes are: (1) the assurance of controllability or auditability provided when the activity is performed, (2) the effect of performing the activity on the independence of the internal auditor, (3) the perceived level of involvement in systems design when performing an activity, and (4) four potential roles of the internal auditor when performing an activity: Independent Appraiser, Consultant, Participant in Design, and Future User of the System. (Refer to Table 1-2 for a more complete description of these attributes.)

Step 2: Analyzing the Data

Internal auditors' similarity judgments were analyzed to determine perceived differences among audit activities. These differences were scaled using MDS techniques to yield a multidimensional map for both the auditability and the controllability respondents. In these maps, each audit activity was represented by a point in such a way that activities which were judged very similar were represented as points close together and activities which were judged very dissimilar were far apart.

The Weighted Euclidian Model [Takane, Young, and DeLeeuw (1977)] was the MDS model used to analyze the similarity judgments. The model accounts for differences among individual judgments by computing subject weights for
each dimension. It was possible to examine each subject's weights to determine which dimension(s) had the largest influence on his/her judgments.

### TABLE 1-2

SELECTED ATTRIBUTES OF THE AUDIT ACTIVITIES

**CONTROLLABILITY AND AUDITABILITY ATTRIBUTES COMBINED**

1. **INDEPENDENCE**: The impact of performing each activity on the internal auditor's independence when auditing the system after it has been implemented.

2. **ASSURANCE PROVIDED**: The contribution of each activity in assuring the controllability/auditability of the system.

3. **LEVEL OF INVOLVEMENT**: The perceived level of internal auditor involvement in the systems design process when performing each activity.

4. **ROLE OF INDEPENDENT APPRAISER**: The perception of the internal auditor as an independent appraiser when performing each activity.

5. **ROLE OF CONSULTANT/ADVISOR**: The perception of the internal auditor as a consultant/advisor when performing each activity.

6. **ROLE OF FUTURE USER OF THE SYSTEM**: The perception of the internal auditor as a future user of the system when performing each activity. A "user" is a person who obtains data from the system to fulfill certain information requirements.

7. **ROLE OF PARTICIPANT IN DESIGN**: The perception of the internal auditor as a participant in design when performing each activity.
Relationships between the demographic and attitudinal information and the subjects' similarity judgments were examined using canonical correlation analysis [Milliron (1984, 72-75)]. Canonical correlation was also used to examine relationships between subjects' similarity judgments and the attribute rating data.

The ratings on the attributes for each audit activity were analyzed using a Weighted Multidimensional Unfolding Model [Young and Lewyckyj (1980)]. A successful analysis using this model would portray relationships between the attributes and the activities. This was considered a supplemental MDS analysis because the results were intended to assist in the interpretation of the MDS analysis of the similarity judgments.

**Step 3: Interpretation**

In step 3 the MDS map of the similarity judgments for each respondent group was interpreted to identify the underlying structure of systems design audit activities. The interpretation step involved four substeps. The first substep was to identify the groupings or patterns among the activities in the MDS solutions.

The second substep was to examine the relationships uncovered in step two. The canonical correlation analyses of the attribute rating data revealed whether the attributes selected *a priori* for the study were among the attributes which internal auditors considered in their similarity judgments.
The third substep was to examine any relationships between the demographic and attitudinal information and the coordinates on the dimensions of the similarity solutions which were uncovered in step 2. This substep identified the variables which influenced internal auditors' judgments.

The fourth substep was to compare the conclusions from the analysis of the controllability group to the conclusions from the analysis of the auditability group. This comparison determined whether internal auditors responding to the controllability questionnaire used different attributes to judge the similarity of audit activities than the attributes used by internal auditors responding to the auditability questionnaire.

Contributions of the Study

The numerous articles in the accounting literature concerning internal auditor involvement in systems design support the significance of this topic to the accounting profession. At the same time, this prolific output of publications also indicates the absence of guidelines for internal auditor involvement.

The objective of this study was to identify the attributes of systems design audit activities which internal auditors consider significant in differentiating among audit activities. This knowledge will contribute to the development of authoritative guidelines for internal auditor involvement.
The study's results may also assist in internal and external reviews of internal audit departments. In 1984, the Institute of Internal Auditors published *Quality Assurance: Review Manual for Internal Auditing*, which provides instructions for both internal and external reviews of internal audit departments. These reviews are required (Standard 560 (1978) and Statement on Internal Auditing Standards No. 4: Quality Assurance (1986)) to provide reasonable assurance that audit work conforms to the Standards. The manual specifically mentions that internal review teams ([IIA (1984, 31)]) and external review teams ([IIA (1984, 67)]) should assess the audit department's involvement in reviewing controls before system installation. However, no criteria are given to aid the reviewer's task. The results from this study provide practical guidance to these review teams.

The major benefits of internal auditor involvement in systems design relate to better controls over the system. Representative Ron Wyden, member of the Oversight and Investigations Subcommittee (Chaired by Representative John D. Dingell), referred to internal auditors as the first line of defense for detecting and deterring fraud ([Special Report (1987)])]. In a report submitted to the committee, The National Commission on Fraudulent Financial Reporting (NCFFFR) stated that internal auditors should be involved when a company develops computerized accounting applications. Although the level of involvement was not
discussed, the NCFFR recommends that the internal audit function must be objective. The results of this study will contribute toward developing boundaries for internal auditor involvement in the design phase of systems development, and, therefore, will contribute toward meeting the recommendations of the NCFFR.

This study is the first to investigate internal auditors' perceptions of the underlying structure of audit activities used during systems design. The literature focuses on two points: the benefits of internal auditor involvement (adequate controls cost-effectively included in systems and future audit advantages) and the potential loss of the internal auditor's independence when later auditing the system. This study provides evidence concerning the practical significance of these two points. In addition, the findings group specific activities according to the observed attributes. The attributes and activity groupings identified by this study may be used as the basis for future research studies concerning the internal auditor's involvement in systems design.
CHAPTER II
LITERATURE REVIEW

Introduction

This review focuses on the literature concerning the internal auditor's role in systems development. Much of the literature concerning computer controls in systems development does not address the internal auditor's role. Although there are many areas of overlap, a distinction should be made between the literature concerning computer controls and the literature addressing the auditing of these systems [SRI, Executive Summary, (1977, 3)].

Auditing computer applications centers on verifying the adequacy of controls and the accuracy and completeness of data processing results. Systems control articles refer to the methods used in the system environment to ensure the successful operation of the computer-based information system [SRI (1977)]. Although internal auditors are also concerned with the successful operation of the information system, this review is limited to the literature directly related to internal auditor involvement in systems design.

This review is divided into the following sections:

1. Authoritative literature or guidelines provided by professional associations.

2. Empirical literature

3. Nonempirical literature

24
4. Integration of the Authoritative, Empirical and Nonempirical Literature

5. Methodological literature: Accounting studies using multidimensional scaling

Authoritative Literature or Guidelines of Professional Associations

The IIA's "Statement of Responsibilities" and the Standards may be considered the only sources which actually mandate the internal auditor's performance in systems development. However, professional associations have produced guidelines which internal auditors may voluntarily follow to aid in planning audit tasks. The following will be discussed in this section:


Statement of the Responsibilities of the Internal Auditor (1971)

When internal auditors initially performed audit activities during the systems design phase of system development, questions arose concerning the effect of this involvement on the internal auditor's independence. The
appropriateness of reviewing both the development stages and the completed system was recognized by the IIA in 1971 when it revised the last paragraph of the IIA's "Statement of the Responsibilities of the Internal Auditor" to read:

Objectivity is essential to the audit function. Therefore, an internal auditor should not develop and install procedures, prepare records, or engage in any other activity which he would normally review and appraise and which could reasonably be construed to compromise his independence. His objectivity need not be adversely affected, however, by his determination and recommendation of the standards of control to be applied in the development of the systems and procedures under his review.

The Standards (1978)

Standards for the Professional Practice of Internal Auditing were established by the Institute of Internal Auditors in 1978. Internal audit department compliance with the Standards is emphasized as "essential" for meeting the responsibilities of internal auditors [the Standards (1978, 14)].

Independence, the first of five standards, is of particular interest to this study:

100 INDEPENDENCE -- INTERNAL AUDITORS SHOULD BE INDEPENDENT OF THE ACTIVITIES THEY AUDIT

Internal auditors are required to be independent in Organizational Status and in Objectivity.

The requirements for internal auditor objectivity as presented in the Standards include an independent mental attitude and an honest belief in their work product. Specific reference to the internal auditor's participation in systems development is made in section 120.03:
.03 The internal auditor's objectivity is not adversely affected when the auditor recommends standards of control for systems or reviews procedures before they are implemented. Designing, installing, and operating systems are not audit functions. Also the drafting of procedures for systems is not an audit function. Performing such activities is presumed to impair audit objectivity.

Therefore, according to the Standards, internal auditors may recommend standards of control or review procedures during the systems development process. However, the internal auditor may not design systems or draft procedures for systems.

Control Objectives (1983)

This publication provides comprehensive guidelines concerning the provision and verification of controls in a computer environment. Responsibility of the internal audit function in the area of systems design and development is described as reviewing new systems to determine whether (1983, 22):

1. Management policies have been carried out;
2. Control and audit trails are incorporated as needed for review by management, by operations, and by auditors;
3. Cost/benefit analysis have to be conducted to ensure that systems will be efficient and economical to operate;
4. Adequate documentation exists for review, maintenance, and auditing.

Integrating the Internal Auditor into EDP (1983)

This manuscript provides general guidelines concerning the expertise all internal auditors need to conduct audits in a computer environment. Although the publication does
not address the role of the internal auditor in systems design, several of the author's comments are relevant to this study. Paz states that decisions relating to the internal auditor's involvement in the systems development process should be made when the audit plan is developed. Then, in this publication issued five years after the Standards, the author adds that the decision should be made as to whether the internal auditor should be involved in the systems development process "as a participant, consultant, or reviewer" [Paz (1983, 13)].

**System Development Audit Review Guide (1986)**

The Internal Audit Steering Committee, formed by Coopers & Lybrand, produced this guide as the first publication in the IIA's *Technical Audit Guide Series*. It is based on the collective experiences of many leading internal auditors from industry and government.

Recognizing the importance of auditing systems development, the committee researched but found very little practical guidance on specific audit tasks to perform during systems development. To fill this gap, the committee produced this audit guide. The specific audit tasks given in the review guide, however, are not considered mandatory [IIA (1986, 3)]:

Exactly what is to be done, when it is to be done, and all of the other concerns that go into appropriate audit planning remain within the internal auditor's discretion.

The audit tasks included in the systems design phase include a review of:
1. The documentation;
2. Input forms and security;
3. Processing considerations;
4. Proposed output reports;
5. Telecommunications considerations;
6. Data-Base considerations;
7. Security and Controls; and
8. Acceptance of the system.


Although this report does not present guidelines for internal auditors, the report makes two recommendations which are relevant to internal auditors (NCFFR (1987, 37-38)):

1. Public companies should maintain an effective internal audit function staffed with an adequate number of qualified personnel appropriate to the size and the nature of the company, and
2. Public companies should ensure that their internal audit functions are objective.

It has been predicted (Phillips, Levis, and Agee (1987)) that these recommendations will result in a significant growth in internal audit departments. An increase in the number of internal audit staff members has been shown to be positively correlated with internal auditor involvement in systems design (Macchiavenna (1978)). Although the NCFFR does not officially recommend that internal auditors be involved in systems design, it does state (NCFFR (1987, 28)):

To ensure that controls are in place and to integrate fraud prevention and detection methods in the system itself, internal auditors should be involved when a company develops computerized accounting applications.
Summary of Authoritative Literature

In summary, the IIA "Statement of Responsibilities of the Internal Auditor" and the Standards provide the only guidance which is mandatory for internal auditors in nongovernmental organizations. The Standards allow the internal auditor to review controls and procedures of systems before their implementation. Designing, installing and operating systems are presumed to impair auditor objectivity.

Specific internal audit tasks to be performed during systems development are mentioned in the IIA publication, Systems Development Audit Review Guide (1986). These audit tasks are not considered mandatory, but are only presented as guidelines. Presently, internal auditor acceptance of these specific task recommendations are unknown. In the next section, the tasks which have been subjected to empirical study will be discussed.

Empirical Studies of the Internal Auditor's Involvement in Systems Design

The studies reviewed may be divided into three groups. First, the study by Rittenberg (1977) will be discussed. This study is the only major investigation into the perceptions of internal auditor independence when involved in systems design. The second group consists of national surveys conducted by the Stanford Research Institute (1977a and 1977b) and Macchiaverna (1978 and 1980).

The third group is composed of studies which are limited either geographically or in scope. Studies by

Table 2-1 summarizes information on groups two and three. For each study the year, author, percentage of sample participating in the study and information on the sample are displayed.

**Rittenberg (1977) Study**

Questionnaires, hypothetical cases and interviews were used to gather data on the perceptions of internal auditor independence when involved in systems design. Respondents include almost 200 internal auditors, CPA's, heads of data processing departments, and members of top management.

An application control case was presented to internal auditors and CPA's [Rittenberg (1977, 26)]. Rittenberg (1977, 26) concluded that respondents perceived a loss of independence when the same auditor performed both the design-phase and the post-installation audit. However, when compared to auditors experienced in EDP audit, inexperienced auditors perceived a greater loss of independence when the same auditor performed both the design-phase and post-installation audits. Rittenberg (1977, 30) concluded that perceptions of design-phase
### Table 2-1
Recent Empirical Research of Auditor Involvement
In Systems/Application Program Development

<table>
<thead>
<tr>
<th>Year Published</th>
<th>Author</th>
<th>Percentage Participation</th>
<th>Sample Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>1977</td>
<td>Stanford Research Institute</td>
<td>60%</td>
<td>A national survey in which 500 organizations out of a possible 3,337 were selected, with 283 (57%) responding. The percentage is based on actual responses weighted to reflect the probable response distribution of all organizations with internal auditors with in the sampling frame (subset). Study commissioned in 1975.</td>
</tr>
<tr>
<td>1977</td>
<td>Weiss, H.</td>
<td>73%</td>
<td>Questionnaire was distributed to registrants at the Sixth Conference on Computer Audit, Control and Security (April 1, 1976). 143 usable responses were obtained after eliminating duplicates from the same organization.</td>
</tr>
<tr>
<td>1977</td>
<td>Rittenberg &amp; Davis</td>
<td>79%</td>
<td>Questionnaires mailed to what the authors believed to be 48 more advanced internal audit departments. 39 questionnaires were returned. The studies are based on the same data, and the 1979 article is an adaption of the 1977 article.</td>
</tr>
<tr>
<td>1978</td>
<td>Rittenberg &amp; Purdy</td>
<td>79%</td>
<td>Questionnaires were mailed to members of the Institute of Internal Auditors in Iowa, Minnesota and Nebraska. Responses were received from 113 internal auditors representing about 100 companies. The article did not mention the response rate.</td>
</tr>
<tr>
<td>1977</td>
<td>Smith &amp; Uecker</td>
<td>73%</td>
<td>Survey conducted by The Conference Board. 284 companies responded to the questionnaire. 169 manufacturing firms were sampled: 67 had sales over $1 billion; 33 between $5 and $1 billion; 67 between $100 million and $500 million and 2 less than $100 million. 115 nonmanufacturing firms also responded. Excluding financial institutions, 30 had sales over $1 billion; 10 between $5 and $1 billion; 30 between $100 million and $500 million; and 3 less than $100 million. The survey was conducted in 1977.</td>
</tr>
<tr>
<td>1980</td>
<td>Macchiaverna</td>
<td>90%</td>
<td>Survey conducted by The Conference Board. 164 companies participated. 59 financial companies were sampled, of which 29 had 1977 assets of $1 billion or more. The non-financial firms included 33 with 1977 revenues over $2.5 billion; 26 between $1 and $2.5 billion; 21 between $5.5 and $1 billion; and 25 less than $500 million. The survey was conducted in 1979.</td>
</tr>
</tbody>
</table>

(Table 2 - 1 Continued on Next Page)
## Table 2 - 1 Continued

<table>
<thead>
<tr>
<th>Year Published</th>
<th>Author</th>
<th>Percentage Participation</th>
<th>Sample Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980</td>
<td>Mautz et al.</td>
<td>53%</td>
<td>Survey conducted under the auspices of the Financial Executives Research Foundation. The auditor participation data is based on interviews conducted in 49 companies. All Firms were in the Fortune 1,300.</td>
</tr>
<tr>
<td>1982</td>
<td>Helms &amp; Weiss, I.</td>
<td>91% (large staff) 54% (small staff)</td>
<td>Questionnaire was distributed at a meeting of the Houston chapter of the EDP Auditors Association. Total sample size was not reported. 54% of the small information system staffs (5 or fewer) reported participation, versus 91% for large staffs.</td>
</tr>
<tr>
<td>1983</td>
<td>Grabski</td>
<td>67% (EDP auditors) 28% (Non-EDP auditors) 47% (all auditors combined)</td>
<td>Questionnaire was administered to 18 non-EDP internal auditors, 18 EDP auditors and 18 systems analysts in a major southwest city who agreed to participate in a research project.</td>
</tr>
<tr>
<td>1983</td>
<td>Li</td>
<td>DP managers 11% CISA 36% non-CISA 22% EDP educators 4%</td>
<td>A project sponsored by the EDP Auditors Foundation to identify a common body of knowledge for EDP auditing. A total of 6,450 questionnaires were mailed to four groups of EDP professionals: 1. Data Processing managers, 2. Certified Information systems auditors (CISA) 3. Non-CISA, but member of EDP Auditor Assn. 4. Educators in EDP auditing. Questionnaires sent to heads of IS audit staffs in 10 national organizations located in Southeastern and Southwestern U.S.</td>
</tr>
<tr>
<td>1984</td>
<td>Helms</td>
<td>100%</td>
<td>An IIA 1983 survey of IAs to determine trends &amp; practices.</td>
</tr>
<tr>
<td>1984</td>
<td>White &amp; Xander</td>
<td>44%</td>
<td>Questionnaires were mailed to IA directors &amp; financial executives employed by 89 corp. in Southeastern U.S.. 60 internal auditors, and 49 financial executives responded.</td>
</tr>
</tbody>
</table>
involvement and independence may be strongly influenced by the internal auditor's experience with design-phase auditing.

In another phase of the research, representatives of top management, heads of EDP departments, internal auditors and CPA's were presented nine EDP design phase audit activities. Participants were asked whether performance of each activity would likely impair the auditor's independence in a post-installation audit and, if so, whether assigning different auditors to the post-installation audit would offset this loss of independence. Rittenberg classified the activities under four categories (1977, 32):

* Audit of the adequacy of application controls.
* Performance of compliance tests of general controls.
* Performance of expert-consultant activities relating to control aspects of new EDP developments.
* Participation as a member in various design activities.

The specific audit activities studied and the results obtained are shown in Figure 2-1. Rittenberg (1977, 33) noted that the perception of loss of independence for the activities labeled "application control activities" was higher (34%) than expected. Subsequent interviews indicated that (1977, 35):

... the approach taken is the predominant influencing factor. Some participants felt that 'specifying audit trail' or 'recommending controls' might cause the auditors to be viewed as designers.
FIGURE 2-1
EFFECT OF SPECIFIC DESIGN PHASE ACTIVITIES ON PERCEPTIONS OF INTERNAL AUDITOR INDEPENDENCE

% Perceiving Negative Impact on Independence

Application Controls

Expert-consultant activities

Designer participant activities

Key to activities:
1 = specific audit trail and control requirements;
2 = recommend control;
3 = compliance tests of general controls;
4 = assess and report potential risks of proposed EDP application;
5 = report on reasonableness of time and cost estimates;
6 = review and report on EDP feasibility study for reasonableness and compatibility with present facilities;
7 = sign off at end of major design phase, noting approval or specifying deficiencies;
8 = assist in design of needed processing control;
9 = act as liaison among users, programmers, and systems design personnel.

Later interviews revealed that many auditors preferred another approach: identifying control problems and providing alternatives to solving these control problems.

Management and EDP auditors were also asked to rate eight objectives of EDP auditing, both design-phase and post-installation. "Review new EDP applications during design phase to assess adequacy of controls" was rated first by EDP auditors and third by management.

National Surveys

Stanford Research Institute (1977)

This was a major research project administered by the Institute of Internal Auditors and conducted by the Stanford Research Institute (SRI). The study resulted in three reports: Executive, Data Processing Control Practices, and Data Processing Audit Practice. The two primary objectives of the project were:

(1) Identify and document specific audit and control techniques of proven value, and

(2) Identify practices and trends in internal audit concerning data processing for broad segments of business and government.

The study concluded that the scope of internal audit activities is not clear. Specific conclusions which are relevant to the proposed research are [SRI (1977, 8)]:

1. There is a need for improved controls because inadequate attention has been given to the importance of internal controls in the data processing environment.

2. Internal auditors must participate in the systems development process to ensure that appropriate audit and control features are designed into new computer-based information systems.
Two viewpoints of auditor involvement in systems development which have been prevalent in the literature were encountered when conducting interviews. Many felt that internal auditors lose their objectivity and independence when they become involved in systems development. However, the researchers felt that this viewpoint was losing ground to the viewpoint favoring internal auditor participation. Early participation by internal auditors was expressed as necessary to ensure adequate control. Those subscribing to this latter viewpoint saw no difference between evaluating controls being designed into a system and evaluating controls after the system was operational.

In the organizations interviewed by SRI, internal auditor participation took two contrasting forms [SRI (1977, 36)]:

1. Internal auditors were assigned to application development teams to present an internal audit point of view. Written recommendations were prepared, but the emphasis was on cooperating in developing well-controlled computer applications.

2. Internal auditors developed control guidelines for new computer applications systems.

Developing control guidelines may be interpreted as a "low level of involvement", while assignment to the development team may be viewed as a "high level of involvement" in systems development.

A mail survey was used to investigate internal audit involvement in the systems development process. Managers, internal auditors, and data processing representatives were
asked, "How involved are the internal auditors in your organization in the following phases of computer application systems?" Internal auditors believed themselves to be "more involved" in all phases than did data processing representatives. Approximately 40-43% of internal auditors, but only 37-42% of data processing managers, indicated involvement in the early phases of systems development [SRI (1977, 38)].

For the same question, top management was asked what they believed internal audit involvement should be. Fifty-four to six-one percent of the managers surveyed felt that internal auditors should be involved in the early phases of systems development [SRI (1977, 38)].

Macchiaverna (1978 and 1980)

Two research reports were published by The Conference Board, an independent, not-for-profit research institute. The first report (1978) is a comprehensive examination of corporate internal auditing, including the scope of internal auditing activities. The second report (1980) describes approaches used at that time to audit data processing activities.

Seventy percent of the responding companies performed audit activities during the design of new computer systems or programs. The percent of companies performing systems design activities was then compared to the size of the internal audit staff. Macchiaverna concluded that as the
size of an internal audit staff increases, the likelihood of participating in systems design increases.

Macchiaverna found that internal auditors generally limit their activities to reviewing and not actually designing controls. Typically, the auditors would make recommendations for control standards and criteria which should be built into new systems. Approving or signing off on the adequacy of the controls in a new system was the responsibility of only a few internal audit staffs.

In the 1980 study, the percent of surveyed companies in which internal auditors review or participate in systems development increased to 90% from the 70% found in 1978. However, respondents stated that only a mean of 17% of EDP audit time was devoted to systems development. The report noted a significant increase in the number (from only a few in 1978 to 37% in 1980) of the surveyed companies' EDP auditors who had sign-off or approval authority on new systems.

Limited Studies

This section discusses studies which are relevant but limited in scope or in their geographical coverage. Only the findings which are of interest to this study are discussed.

Smith and Uecker (1977) provide evidence of the internal auditor's role in systems design and development. The results of a questionnaire revealed that about two-thirds of responding internal auditors were consulted on
new EDP applications, and 73% recommended controls for new EDP applications.

Weiss (1977) distributed questionnaires to experienced computer auditors. The findings revealed that 73% of respondents performed some audits of systems under development with an average of 38% of the audit time spent in this endeavor. The study also found that 35% of participants sign-off on new systems.

The Rittenberg and Davis (1977 and 1979) and Rittenberg and Purdy (1978) articles were based on the same data and, therefore, will be discussed together. These studies found that 79% of the responding internal audit departments performed some design phase work. Although an average of only 23% of EDP audit time was spent on design phase audit activities, some departments reported as much as 70% of their EDP audit time was spent on these audits.

Top managers and EDP audit managers rated nine possible EDP audit objectives. EDP audit managers rated first the objective to "review new EDP applications during the design phase to assess adequacy of controls." Top managers also placed importance on this objective by rating it third. In fact, four of the top five objectives rated by management contain potential design-phase work.

EDP audit managers were presented 12 potential design phase audit activities and asked to indicate the frequency with which each activity was performed. The authors use the percent of cases in which an activity was performed to
gage the relative importance of the activity. The results were categorized into the following four areas:

1. **Audit of control adequacy:** Activities performed by an average of 80% of the internal audit departments.

2. **Audit of the design process:** Activities performed by an average of 70% of the internal audit departments.

3. **Auditor as User:** Activities performed by an average of 60% of the internal audit departments.

4. **Auditor as Participator:** Activities performed by an average of 35% of the internal audit departments.

The Mautz et al. (1980) research is a major study, but with only limited relevance to the internal auditor's role in systems design. The study found an increasing importance of the internal audit function and a trend of rapid growth in internal audit staffs.

Internal audit heads were asked the extent of internal audit involvement in the design, implementation, and operating of a data processing system. The following was given as a composite answer [Mautz et al. (1980, 119)]:

> Internal audit's job is primarily to design controls into the system, to sign-off on the system when controls are implemented, and to monitor and test the system periodically after the system is running.

Twenty-eight of the surveyed organizations had EDP auditors who participated in systems development. The phases of systems development in which EDP auditors participated were:
<table>
<thead>
<tr>
<th>Phase of Development</th>
<th>Number of Companies Involved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feasibility</td>
<td>7</td>
</tr>
<tr>
<td>Design</td>
<td>26</td>
</tr>
<tr>
<td>Implementation</td>
<td>8</td>
</tr>
<tr>
<td>Testing</td>
<td>9</td>
</tr>
<tr>
<td>Operation</td>
<td>10</td>
</tr>
</tbody>
</table>

As shown, 26 out of 28 companies with EDP auditors are "involved" in systems design. However, the level of involvement of the internal audit staff in EDP systems varied widely from organization to organization. After interviews with internal audit heads and EDP managers, the researchers concluded that the role of the EDP auditor included (Mautz et al. (1980, 146)) "participation in the specification, design, and implementation of an EDP system."

Rittenberg and Likecky (1980) surveyed 146 auditors, and management consultants employed by the nine largest CPA firms. These auditors and management consultants had responsibilities for evaluating EDP internal control. Respondents were asked to identify five major deficiencies in EDP systems which they had found in the last few years. Fifty percent of the respondents listed weaknesses in the systems development process. The two major weaknesses identified were a need for:

1. More formalized systems development methods, and

2. Control guidelines to assist users and data processing personnel in developing controls.

Some of the more frequent comments indicated weaknesses in the internal auditor's involvement in systems
development. The authors conclude [Rittenberg and Litecky (1980, 36)]:

The comments reflect a growing expectation that technically competent internal auditors should review the adequacy of controls proposed for new systems.

In a project sponsored by the EDP Auditors Foundation, (Li, 1983) participants ranked the importance of EDP audit tasks. Application development review was ranked as the fourth most important EDP audit task by all four groups.

Grabski (1983) found that in 47% of the 14 firms surveyed, auditors were involved during systems development.

Guy (1984) conducted a survey in 1981 which was limited to nine participating Atlanta companies. Chief EDP auditors or an EDP auditor in each company indicated the percent of audit effort spent on new systems as follows:

<table>
<thead>
<tr>
<th>Responses</th>
<th>Range</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Initial Planning</td>
<td>2-20%</td>
<td>12%</td>
</tr>
<tr>
<td>b. Design</td>
<td>5-60</td>
<td>27</td>
</tr>
<tr>
<td>c. Development &amp; Implementation</td>
<td>2-50</td>
<td>21</td>
</tr>
<tr>
<td>d. Approval</td>
<td>2-25</td>
<td>6</td>
</tr>
<tr>
<td>e. Performance Evaluation</td>
<td>10-80</td>
<td>34</td>
</tr>
</tbody>
</table>

The major reason given by these auditors for lack of involvement was "no experienced EDP personnel".

The purpose of the Helms (1984) study was to gather data on specific tasks performed by internal auditors during the various systems development stages. Heads of information systems audit staffs were given an instrument
developed from the literature containing 17 audit tasks performed in the early and middle stages of systems development. Participants were asked to complete the instrument for all systems which were considered material in both development hours and impact on the organization. The majority of the systems were traditional accounting transaction processing systems, but planning systems and budget control systems were also included. Table 2-2 presents the tasks in the order of the most systems which had auditors perform the task. Helms summarizes the roles of internal auditors as:

1. Control Expert: identified, recommended and designed controls for a high percentage of the systems.

2. Compliance Monitor: Concentrated in the design phase rather than throughout all stages of systems development.

Skudrna and Lackner (1984) surveyed 300 organizations with 107 responses to determine the thought and practices on the use of concurrent (continuous) audit techniques in industry. Respondents were asked the role of the internal auditor in the systems design and auditing phases of an advanced systems environment.

Responding organizations were divided into three groups: banks, service organizations, and manufacturing. Banks believed that the internal audit department should be
## TABLE 2-2

### SPECIFIC TASKS FROM THE HELMS STUDY

#### TASKS PERFORMED IN 70% OF THE SYSTEMS

1. Identification of audit trail and control requirements.
2. Review of documentation for compliance with company procedures.
3. Recommendations of controls during the systems design phase.

#### TASKS PERFORMED IN BETWEEN 56% AND 70% OF THE SYSTEMS

1. Assessment of the risks of the proposed application.
2. Review of design activities to assess adherence to company policies.
3. Assistance in the design of needed input, processing, or output controls.

#### TASKS PERFORMED IN 30% TO 50% OF THE SYSTEMS

1. Reviewed user and operations manuals for adequacy and consistency with the system description (50%).
2. Design or supervision of the development of embedded audit routines included in the system (47%).
3. Review of each design phase for completeness and adequacy (47%).
4. Review the system feasibility study for reasonableness and compatibility with existing facilities (46%).
5. Assist users in determining information requirements (performed traditionally by systems analysts) (36%).

#### TASKS PERFORMED IN 29% OF THE SYSTEMS

1. Monitor development for compliance with the system time and cost budget.

#### TASKS PERFORMED IN 25% OR LESS OF THE SYSTEMS

1. Review conversion tests for appropriateness and consistency (25%).
2. Participate as part of the team that performed conversion tests (7%).
3. Act as liaisons between users, programmers, and systems personnel (14%).
heavily involved. Service organizations believed the involvement to be slightly less than important. Manufacturing firms rated the involvement to be between moderately and very important.

All three industries felt that concurrent audit techniques should be incorporated into systems during systems design. Many respondents expressed concern for the independence of the internal auditor and the degree of internal auditor involvement during system design.

White and Xander (1984) conducted a survey in 1983 of internal auditing to determine trends and practices. The results were compared to previous IIA surveys. The researchers asked participants whether their internal auditors participated in the development of computer applications. The responses are:

<table>
<thead>
<tr>
<th></th>
<th>1983</th>
<th>1979</th>
<th>1975</th>
</tr>
</thead>
<tbody>
<tr>
<td>Usually</td>
<td>37.8%</td>
<td>40.4%</td>
<td>37.2%</td>
</tr>
<tr>
<td>Seldom</td>
<td>37.2%</td>
<td>37.2%</td>
<td>41.5%</td>
</tr>
<tr>
<td>Never</td>
<td>25.0%</td>
<td>22.4%</td>
<td>21.3%</td>
</tr>
<tr>
<td>Sample Size</td>
<td>1530</td>
<td>467</td>
<td>322</td>
</tr>
</tbody>
</table>

Brown and Davison (1987) asked internal auditors and financial executives what services internal audit should perform. Ninety-five percent of responding internal auditors and approximately eighty-nine percent of responding financial executives stated that internal auditors should participate in the development of management information systems. This service was ranked fifth by both groups of respondents. Seventy-five percent
of respondents stated that they participated in the development of computer applications.

Summary of Empirical Studies

Table 2-3 summarizes the level of internal auditor involvement in systems development that was found in the empirical studies. However, caution must be used in interpreting these findings. It is possible that the phrasing of the different questions may have prompted negative answers in some studies. For example, "participation in the development of systems" may have been interpreted differently than a phrase such as "conduct an audit of the development of computer systems." Internal auditors may have perceived the term "participation" as denoting a higher level of involvement than the term "audit." When considering the different tasks recommended in the literature for internal auditor performance during systems design, even the term "audit" may have been interpreted differently by different groups of respondents.

Table 2-4 displays the specific audit tasks which were cited in the empirical studies identifying audit tasks performed by participants. Five studies included the internal audit task, "sign-off on phases or when a system is complete". The next most cited task is "recommend controls/identify control requirements", which was included in four studies. Other tasks included in the studies which


TABLE 2-3

INTERNAL AUDITOR INVOLVEMENT IN SYSTEMS DEVELOPMENT

<table>
<thead>
<tr>
<th>STUDY</th>
<th>PERCENTAGE OF SAMPLE FIRMS AND/OR AUDITORS INVOLVED IN SYSTEMS DEVELOPMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stanford Research Institute (1977)</td>
<td>60%</td>
</tr>
<tr>
<td>Weiss (1977)</td>
<td>73%</td>
</tr>
<tr>
<td>Rittenberg Studies (1977)</td>
<td>79%</td>
</tr>
<tr>
<td>Smith and Uecker (1977)</td>
<td>73%</td>
</tr>
<tr>
<td>Macchiaverna (1978)</td>
<td>70%</td>
</tr>
<tr>
<td>Macchiaverna (1980)</td>
<td>90%</td>
</tr>
<tr>
<td>Mautz et al. (1980)</td>
<td>93%</td>
</tr>
<tr>
<td>Helms and Weiss (1982)</td>
<td>53%</td>
</tr>
<tr>
<td>Grabski (1983)</td>
<td>47%</td>
</tr>
<tr>
<td>White and Xander (1984)</td>
<td>75%</td>
</tr>
</tbody>
</table>

relate to the controllability (limited to application controls) and the auditability of the system are:

Controllability:
1. Recommend controls
2. Identify control requirements
3. Develop control guidelines
4. Review controls
5. Design controls
6. Assist in designing needed controls

Auditability:
1. Identify audit trail requirements
2. Prepare audit guidelines
3. Design embedded audit routines
4. Supervise the development of embedded audit routines

The Rittenberg and Helms studies investigated the most internal audit tasks. Eight similar tasks were used in both studies. Unexpectedly, it was found that ten different audit tasks were mentioned in only one empirical study. Therefore, it appears that there is not a consensus concerning the specific audit tasks which should be included in research studies.
**TABLE 2-4**

INTERNAL AUDIT TASKS MENTIONED IN THE EMPIRICAL STUDIES

1. Sign-off on phases or sign-off when system is complete:
   - Macchiaverna (1980)
   - Velas (1977)
   - Rittenberg and Davis (1977, 1979); Rittenberg and Purdy (1978) (Called the Rittenberg studies, 1977-1979)
   - Hautz et al. (1980)
   - Helms (1984)

2. Recommend controls/identify control requirements:
   - Macchiaverna (1978)
   - Smith and Uechter (1977)
   - Rittenberg studies (1977-1979)
   - Helms (1984)

3. The following audit tasks were mentioned in the studies by Rittenberg studies (1977-1979) and Helms (1984):
   1. Identify audit trail and control requirements
   2. Review design documentation for compliance with company policy
   3. Assess and report the risks of proposed application
   4. Review design activities for compliance with company policy
   5. Review conversion tests for appropriateness and consistency
   6. Review feasibility study for reasonableness and compatibility with existing facilities
   7. Participate as part of the team performing conversion tests
   8. Act as a liaison between programmers, users, and systems design personnel

4. One audit task was mentioned in both Hautz et al. (1980) and in Helms (1984):
   Design or assist in designing needed controls

5. The next group of audit tasks were mentioned in only one study:
   1. Assigned to application teams to jointly develop well-controlled computer applications (SRI, 1977)
   2. Develop control guidelines (SRI, 1977)
   3. Review controls (Macchiaverna, 1978)
   4. Act as consultant (Smith and Uechter, 1977)
   5. Prepare audit guidelines for future audits of the application (Rittenberg studies, 1977-1979)
   6. Design or supervise development of embedded audit routines to be included in application (Rittenberg studies, 1977-1979)
   7. Participate as member of feasibility study committee to assess appropriateness of proposed applications (Rittenberg studies, 1977-1979)
   8. Assist users in determining information requirements (Helms, 1984)
   9. Monitor development for compliance with the system time and cost budget (Helms, 1984)
   10. Review user and operations manuals for adequacy and consistency with the system description (Helms, 1984)
Nonempirical Literature

With only a few exceptions [DeMarco (1979), Fry et al. (1975), and Guy (1978)], the nonempirical articles reviewed support the internal auditor's involvement in systems design. Kuong (1977) summarizes many author's views by stating that the key to internal auditor involvement is "proper involvement."

However, the prescription for "proper involvement" varies from article to article. This section first discusses two areas of internal auditor involvement in systems development which were frequently cited in the nonempirical literature reviewed and which are chosen for study. These two areas are: the controllability of the systems (limited to EDP application controls), and the auditability of a system. Presented next is a more general discussion of the internal auditor's review/evaluation of developing systems as revealed in the articles. The following section presents the idea of contradictory roles of internal auditors. Finally, a summary is presented.

Controllability: Adequate EDP Application Controls

The most frequently mentioned benefit of internal auditor involvement in systems development is the assurance that adequate application controls are included in new systems. For example, Perry (1981) states that the primary role of the internal auditor involved in systems development is to provide management with an opinion on the adequacy of the system's controls. The main advantage of
finding control weaknesses during systems design is that these weaknesses can be corrected in a cost effective manner.

Many authors (Perry and Warner (1975), Warner (1975), Dowell and Hall (1981), Mair, Wood, and Davis (1982), Helms and Weiss (1983), and Thomson (1983)) claim that internal auditor involvement in systems development will ensure adequate controls in new systems. More realistically, Holley and Cash (1981) and Mendus (1986) state that internal auditor involvement should improve the quality of controls in systems. At the very least, internal auditors involved in systems design should detect control vacuums in new systems (Pauley (1969) and Juranas (1971)) which will allow prompt corrections to be made.

Table 2-5 lists the authors who specifically mention (while many other authors imply) that internal auditors involved in systems development should review/evaluate controls. Also listed in Table 2-5 are the authors who felt that internal auditors should make recommendations/suggestions for controls to be included in new systems. Although these two sets of opinions contain some overlap, "making recommendations" implies a greater level of involvement than "reviewing the systems."

Many authors emphasize that the responsibility for and the choice of specific application controls belong to the project team and the users of the system and that internal auditors must be careful not to become control designers.
For example, Dunmore (1988) states that audit involvement, even when assessing application controls, should only be advisory. Internal auditors may state control objectives and identify alternative control solutions, but they should not pick specific control techniques.

Instead of recommending specific controls for each application, several authors [Grabski, et al. (1987) and Kruger (1985)] recommend that internal auditors provide the systems development team with general control guidelines. The purpose of these guidelines is to make the systems development team aware of the fundamental principles of control. Because the guidelines can be made general, constant revision for individual applications would not be required. Grabski et al. (1987) reason that most applications in which auditors participate are highly structured. In such a stable environment, lists of controls can be used to prompt systems designers to include the appropriate controls and to be aware of common control weaknesses. Providing guidelines for controls is argued by Grabski et al. (1987) to be an effective method to include controls in applications without requiring the internal auditor to be directly involved.

Keys (1972), Methodios (1976), Weiss and Perry (1976), Bullard (1977), Culbertson (1977b) and Lathrop (1985) all agree that internal auditors should assist in establishing control standards or guidelines. However, these authors do not reject additional auditor assistance in developing
<table>
<thead>
<tr>
<th>AUTHORS</th>
<th>REVIEW/EVALUATE CONTROLS</th>
<th>MAKE RECOMMENDATIONS/SUGGESTIONS FOR CONTROLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brown (1975)</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Bullard (1977)</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Cleek (1986)</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Culbertson (1977b)</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Culbertson (1977a, 1978)</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Foh (1983)</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Gallegos, Richardson, and Borthick (1987)</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Hanne (1977)</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Helms and Weiss (1983)</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Holley and Cash (1981)</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Jeter (1986)</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Keys (1972)</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>LeGrand (1986)</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Lee (1981)</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Mason (1975)</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Mendus (1986)</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Perry and Warner (1978)</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Reilly and Lee (1981)</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Rothberg (1982)</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Schaffer (1975)</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Scoma (1975)</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Scott and Booker (1979)</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Scrinivanson &amp; Dascher (1980)</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Stanley (1979)</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Weiss and Perry (1976)</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Winters (1981)</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Ward and Harris (1987)</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Warner (1979)</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Watne and Turney (1984)</td>
<td>x</td>
<td>x</td>
</tr>
</tbody>
</table>
adequate controls. Bullard (1977) adds that the internal auditor should verify that these control standards are being followed.

In contrast, LeGrand (1986) cautions against "laundry lists" of controls. LeGrand feels that ineffectively applied controls can give the illusion of control when none exists. He states that the substitution of laundry list controls in place of logically applied controls analysis is a common flaw of system design.

In summary, most of the articles reviewed agree that internal auditors should review the controls for new systems during systems design. However, there is considerable disagreement among the articles concerning the internal auditor's contribution in establishing adequate controls in new systems.

The recommended level of internal auditor involvement in the development of application controls for new systems ranges from providing the system development team with a checklist of controls to recommending the controls to be used in a specific application. Table 2-5 lists the authors who state that internal auditors should make recommendations/suggestions for controls to be included in new systems. Again, these recommendations range from informal advice to the selection of the actual controls to be installed.
Auditability

In complex systems, auditability cannot be assumed, but must be planned during systems development (Borthick (1986)). Many authors [Brown (1975), Kuong (1977 and 1988), Lee (1981), Weber (1982), Hain, Wood, and Davis (1982), Watne and Turney (1984), and Gallegos, Richardson, and Borthick (1987)] state that it is the responsibility of the auditor, as a user of the system, to specify the needs for auditing the system. Other authors who also emphasize that the internal auditor is a user in regard to the auditability of the system include Perry (1975), Weiss and Perry (1976), and Wysong (1983). It is widely acknowledged that users should participate in systems design.

The systems design phase is recommended as the appropriate time for the internal auditor to evaluate the auditability of the system [Holley and Cash (1981) and Weber (1982)]. Kuong (1988) states that building auditability into the system parallels the systems development process, but that specifications of audit needs should take place during systems design. Reviewing for auditability implies specifying audit needs to be designed into the system. These needs may include [Kuong (1977, 2-3)] system accessibility and audit trail provisions, and built-in audit routines which enable the auditor to "automate" the audit process on an on-going basis.
Schaffer (1975), Brown (1977), Stanley (1979), and Warner (1979) all state that internal auditor participation in systems development ensures that audit trails or audit features are included in new systems. After the design phase the audit trail and other information provided by systems are essentially fixed because changes made at a later time can be prohibitively expensive. Therefore, the auditor may decide that certain audit capabilities or audit modules should be built into the system during system design to capture data or examine conditions of interest to the auditor. Next, the internal auditor must decide (Weber (1982)) who will be responsible for the detailed design of the modules. Holley and Cash (1981, 18) present two options available to auditors:

(1) Specification for audit information may be given to the project development team. These specifications may either be incorporated into the regular system processing or placed within separate audit programs, or

(2) The auditors may write a program to extract the needed information.

Weber (1982) suggests that allowing systems designers or programmers to assist with the development of audit modules may result in an unacceptable loss of objectivity and surprise audit capabilities. The auditor may decide to take full responsibility for the development and implementation of audit modules. It may even be necessary for the auditor to actually design accounting and audit trails through the system (Capote (1980), Thomson (1983), Mendus (1986), and Gallegos and Bieber (1987)). Kuong
(1988) states emphatically that it is the internal auditor's responsibility to design audit specifications during systems design.

In summary, many authors (Table 2-6) present the viewpoint that the internal auditor should be considered a user in regard to the auditability of a new system. Therefore, as a user, the auditor has the responsibility to participate in designing the audit needs for the new system.

<table>
<thead>
<tr>
<th>AUTHOR</th>
<th>YEAR OF PUBLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brown</td>
<td>1975</td>
</tr>
<tr>
<td>Perry</td>
<td>1975</td>
</tr>
<tr>
<td>Kuong</td>
<td>1977, 1988</td>
</tr>
<tr>
<td>Weiss and Perry</td>
<td>1976</td>
</tr>
<tr>
<td>Lee</td>
<td>1981</td>
</tr>
<tr>
<td>Mair, Wood, and Davis</td>
<td>1982</td>
</tr>
<tr>
<td>Wysong</td>
<td>1983</td>
</tr>
<tr>
<td>Watne and Turney</td>
<td>1984</td>
</tr>
<tr>
<td>Gallegos, Richardson, and Borthick</td>
<td>1987</td>
</tr>
</tbody>
</table>

Another option for ensuring the auditability of new systems is for the auditor to provide the project development team with the specifications for audit information in the new system. The responsibility would then rest on this team to design the audit needs into the system. Of course, one final option is that the internal auditor can just assume that the project development team
will be aware of auditor needs without the auditor's participation.

**Extent of Involvement in Developing Systems**

After determining that the internal auditor should be involved in assessing the controllability and the auditability of the system, the extent of this involvement must be determined. The role of approving the system after the design phase is mentioned by Keys (1972), Dale (1977), Watne and Turney (1984) and Cleek (1986). Similarly, Wu and Safran (1987) state that the internal auditor should approve the system before it becomes operational. Although the idea of the internal auditor "signing-off" at the end of each system development phase appears in the above articles, Perry (1981) expresses an opposing viewpoint. Perry believes that this sign-off responsibility is not consistent with other audit responsibilities. He believes that auditors should only make recommendations and others should "sign-off".

Marliss (1981) recommends that an internal auditor participate in the "team" that reviews and inspects design stages. Similarly, Kuong (1977) recommends that a representative from the audit department be a member of a Systems Acceptance/ Certification Committee. This committee's involvement includes initiating, monitoring and accepting the finished product from the design team. The responsibilities of the internal auditor on this committee would be to endorse or render an opinion on the system.
project, subject to any remaining reservations on control  
[Kuong (1977, 1-7)].

Pauley (1969) expresses the view that the internal  
auditor's contribution is mostly in the form of informal  
suggestions and discussion. Other authors disagree. For  
example, Reilly and Lee (1981) believe that the internal  
auditor should not only evaluate the system, but should  
assist in the design of systems.

Culbertson (1977) states that the internal auditor  
should participate as an ex officio member of the design  
team. Several other authors (Perry (1975), Capote (1980),  
and Mendus (1986)) recommend that the internal auditor  
should be a member of the systems design team. Ward and  
Harris (1987, 8) agree that internal auditors should be an  
"integral part" of the system development team to provide  
assurance that control issues are considered when designing  
the system.

Foundations and Practice* (1982), recognizes only two ways  
that the internal auditor may evaluate the system  
development process (Weber (1982, 99)):

1. As a member of the system development team, or
2. In an ex post review capacity when the system  
is evaluated.

Weber explains that when the auditor participates in the  
systems development process, the objectives are to ensure  
for a specific application system that controls are built  
into the systems. However, when the auditor carries out an
ex post audit, the objectives are reduced to the extent of substantive testing needed. This interpretation encourages internal auditor participation as a member of the development team.

Many authors express opposition to Weber's interpretation of "proper" internal auditor involvement in systems development. For example, Perry (1981) expresses the view that if the auditor participates as a member of the development team and is involved in the development of control solutions, the auditor's independence is jeopardized. The extent of involvement must be limited. Another viewpoint of auditor involvement follows.

Contradictory Roles

Reilly and Lee (1981) express the opinion that internal audit departments have two somewhat contradictory responsibilities: independent appraisal function and consultant. First, internal auditors perform an independent appraisal function when they review and evaluate the work of employees throughout the organization, including those involved in systems development. This activity is referred to as the "management watchdog" aspect of internal auditing. This aspect relates to one of Perry's (1981, 42) general objectives for internal auditor participation in the design phase: Determining whether an application complies with policies, procedures, standards, and regulations.
Davis (1982, 111) adds that as a participant in the systems design phase, the internal auditor should be involved from several different viewpoints:

----From a system effectiveness viewpoint,
----From an efficiency viewpoint, and
----From an asset safeguard and integrity viewpoint.

This multipurpose outlook can be described as an operational audit. Internal auditors act as independent appraisers in evaluating systems as they relate to organization's objectives [Culbertson (1977b) and Hall (1980)] and company policies (Keys, 1972).

The second responsibility of internal auditors listed by Reilly and Lee (1981) is to perform a service function to all levels of operating and staff management. This activity is termed the "internal consultant" aspect of internal auditing. The internal auditor was seen as a consultant in systems development by the following authors:

\[\text{Foh (1983) Scott and Booker (1979)}
\]
\]
\[\text{Wysong (1983) Mendus (1986)}
\]
\[\text{Gallegos, Richardson, and Borthick (1987)}
\]

As a control consultant, the internal auditor may provide advice and consultation to the project team in the areas of internal controls and audit/management trails [Wysong (1983)]. Wysong emphasizes that internal auditors should not give formal approval of any part of a developing system. However, Wysong (1983, 30) states that "the advisory role does not relieve auditors of the ultimate
responsibility to evaluate the systems and to render opinions as to their adequacy."

Perry (1981) emphasizes that internal auditors acting as control consultants must segregate this role from their role of auditor. As an auditor reviewing the system under development, the internal auditor must give an opinion as to the adequacy of controls. If the project team asks for help in making controls adequate, Perry suggests several options which are available to the auditor in providing assistance in control design [Perry (1981, 6)]:

--- Personally assist in the control design and implementation (risk the loss of independence).

--- Engage consultants to assist project team (impractical).

--- Advice on or arrange for control design instruction (long-term solution).

--- Counsel and advise on the control design process (the most practical short-term solution).

Perry (1981, 6) recommends that auditors assume a counselor role if the following guidelines are observed:

(1) Should explain their role to project team.
(2) Are not part of project team and thus have no authority or responsibility.
(3) Should present a series of control alternatives, not just a single control solution.
(4) Should not comment on the adequacy of a solution for the application under development.

Many authors (see the Auditability Section) view the internal auditor as a user of the system when determining the auditability of the system. The auditor is considered a user because he/she must rely on the system to provide
for future audit needs. Users normally take an active role in designing systems.

Three different roles that the internal auditor may assume during systems design have been presented in this section: independent appraiser, consultant, and user of the system.

Summary

The prevailing thought of the articles reviewed is that the responsibility for actually designing a system's controls and for specifying a system's objectives rests with the users of the system and systems personnel. The role of the auditor is to "review" and "assist" in the development of EDP application controls. Internal auditor assistance may range from making suggestions and recommendations to being a member of the systems development team.

However, the auditor is considered by many authors as a user regarding the auditability of the system. The internal auditor, as a user of the system, may assume an active part in designing the auditability of the system.

Integration of Findings

The purpose of this section is to integrate the findings in the reviews of the authoritative, empirical and nonempirical literature. This integration provides the basis for selecting the audit activities included in this study. The review found that a variety of audit tasks were either discussed, studied or recommended for performance
during systems design. Many of these tasks represent different and even conflicting levels of involvement by the internal auditor in systems design.

In the review of the authoritative literature, the Standards were recognized as dictating internal auditor behavior. The Standards allow the internal auditor to review controls and procedures of developing systems. Actual designing of systems is not permitted. This emphasis on "reviewing" but not "designing" systems is also found throughout the empirical and nonempirical literature.

A lack of consensus concerning the specific audit tasks to be performed during systems design is emphasized in the empirical studies concerning the internal auditor's involvement in systems design. Table 2-4 lists the variety of internal audit tasks used in these studies.

When reviewing the nonempirical literature, major areas of internal audit tasks performed during systems design came into focus. Two major areas frequently mentioned and which were chosen for study are: the controllability of the system, and the auditability of the system. The topic of controllability is limited in this study to the aspect of assessing the adequacy of EDP application controls. Restricting the study to these two areas of systems design significantly narrows the range of activities under consideration for study. The tasks from the empirical studies (Table 2-4) are reduced to the following:
Controllability:
1. Recommend controls
2. Identify control requirements
3. Develop control guidelines
4. Review controls
5. Design controls
6. Assist in designing needed controls

Auditability:
1. Identify audit trail requirements
2. Prepare audit guidelines
3. Design embedded audit routines
4. Supervise the development of embedded audit routines

The nonempirical literature review focused on articles discussing controllability, auditability, the extent of the internal auditor's involvement in systems design, and the potentially contradictory responsibilities of internal auditors during systems design. Table 2-5 lists the authors recommending that internal auditors review/evaluate controls and/or make recommendations/suggestions for controls to be included in new systems. The methods for making recommendations for control varied. Some authors interpreted the extent of internal auditor involvement in developing systems to include the responsibility to monitor the entire development process, and, therefore, encouraged the internal auditor to serve as a member of the development team or to obtain the authority to approve or "sign-off" on each phase of development. This study is limited to the systems design audit activities related to assessing the controllability and auditability of a developing system. Therefore, when internal auditors sign-off or serve on the development team, these
responsibilities are limited to the controllability and auditability aspects of the system. The review revealed both support and opposition for this viewpoint.

The nonempirical review found that, to avoid the appearance of designing controls, other authors recommended that internal auditors simply provide systems personnel with control guidelines applicable to most applications. Recognizing that internal auditors may need to give more guidance on the controls for a specific system, other authors recommended providing systems personnel with several alternative control solutions. Recommending specific controls for a system was interpreted by some as a design activity.

In contrast, there appears to be a general consensus in the nonempirical literature that the internal auditor may provide systems personnel with specific audit requirements for a new system. This viewpoint implies that internal auditors may be more involved in the design of audit needs than in the design of controls without affecting internal auditor independence when later auditing the system. In fact, several authors recommend that the internal auditor either assist in designing audit needs or actually design these needs.

Finally, the nonempirical findings list somewhat contradictory aspects of internal auditing in systems design. First, the independent appraisal function of reviewing and evaluating is related to internal auditor
involvement in systems design. Under this aspect, systems are evaluated in relation to an organization's objectives and policies, including the policy concerning adequate controls. Second, the internal auditor is viewed as a control consultant to systems personnel. In this role the internal auditor provides advice, consultation, and "assistance" to aid in the design of controls for the new system. Designing controls for new systems is generally considered inappropriate. However, as previously stated, many authors view the auditor as a user of the system when determining the auditability of the system. Therefore, the auditor, as a user of the system, may specify or even assist in the design of specific audit needs. No articles were found which opposed the viewpoint of the internal auditor as a user of the system when determining auditability.

In summary, reviews of the authoritative, empirical and nonempirical literature provide support for the study of two areas of systems design audit activities: controllability activities and auditability activities. Internal auditors' perceptions of these categorized activities should provide more information concerning the structure of systems design audit activities than the study of systems design audit activities as one group. Categorization allows comparisons between the two areas of auditor participation.
The acceptable level of internal auditor involvement in systems design for activities appears to be different for the two areas of activities. To investigate this concept, nine audit activities are chosen to represent varying levels of internal auditor involvement in systems design. These activities are (See Table 1-1 for complete descriptions of these activities):

1. Review/Evaluate Controls or Auditability of a System
2. Identify Control or Auditability Weaknesses
3. Provide a Checklist of Controls or Audit Needs
4. Provide Several Control or Auditability Solutions
5. Make Control or Auditability Recommendations
6. Serve As a Member of the Development Team
7. Act As a Control or Auditability Consultant
8. Sign-Off
9. Assist in Design of Needed Controls or Audit Requirements

The next section of the literature review is the methodological review. This section summarizes three accounting studies which have used MDS.

Methodological Review

Multidimensional Scaling (MDS) is well established in the behavioral and social sciences and has become increasingly popular in econometrics, finance and marketing studies [Carroll and Arabie (1980)]. However, this methodology is not as widely known in accounting.

MDS has been used in accounting studies to identify perceptions of accountants and users of accounting information. For example, Libby (1979); Bailey, Bylinski and Shields (1984); Pillsbury (1985); Nair and Rittenberg
all used MDS to examine perceptions of the messages of audit reports.

Whether MDS has been used alone or in multimethod studies, it has been shown to be a useful method for providing insight into accounting issues. To further acquaint the reader with accounting MDS studies, three studies are discussed.

SHOCKLEY AND HOLT (1983)

In this study bankers compare and rate the Big Eight CPA firms to provide answers to two issues:

1. Can purchasers of audit services systematically differentiate between the Big Eight suppliers of audit services, and

2. If so, what are the qualitative attributes along which audit firms may be differentiated?

Subjects completed two tasks. In task one subjects ranked the Big Eight firms according to their similarity. These similarity judgments provided input for MDS analysis.

Both a two- and three-dimensional MDS solution were chosen as the most acceptable. The two dimensional solution clearly revealed three distinct clusters of firms showing that bankers did discriminate among the firms.

In task two, data on subjects' rankings and ratings of ten attributes were used to interpret the MDS solutions. These independently collected ratings on the attributes were correlated with the stimulus coordinates on a given dimension to aid in interpreting stimulus space dimensions. Also, in an open-ended question, subjects identified an additional variable of industry expertise or
specialization. This variable was found to coordinate highly with dimension one. Dimension two was not interpretable. Dimension three was associated with perceptions of conservatism.

Using the independently gathered ratings on the attributes did allow the researchers to interpret two of the three dimensions. MDS was used successfully to demonstrate that executives can differentiate among the major audit firms.

PILLSBURY (1985)

Bankers and auditors rated the similarity of the assurance intended for eight different types of reports. Models of the subjects' perceptions of the assurance intended by the eight different reports were generated using MDS. MDS was considered the appropriate methodology because the organizing concepts and underlying dimensions of limited assurance engagements were still in the developmental stages.

Bankers' and auditors' similarity ratings of the audit reports were used as input for MDS analysis. The analysis determined if there was consistency within the auditors and within the bankers regarding their perceptions of the assurance intended by the different reports. Consistency was found in both groups.

Two dimensions were found for both groups. The horizontal dimension was interpreted as reflecting the level of assurance implied by the various reports. The
interpretation of the vertical dimension was not as clear as the horizontal for two reasons. First, the dimension was not the same for both bankers and auditors. Second, considerable disagreement existed between the subjects regarding the importance of the vertical dimension. The vertical dimension for the auditors was labeled "clarity of responsibility they were assuming." A definitive interpretation of the bankers' vertical dimension was not found.

MDS was used successfully to provide evidence of a difference in the auditors' and bankers' perceptions of the assurance intended by the reports. This conclusion was possible even though one dimension of the banker's solution was not interpretable.

MILLIRON (1984, 1985)

The study involved two phases. The first phase used MDS to obtain an operational definition of tax complexity. The second phase used this definition of tax complexity to test for potential effects of complexity on the reporting position selections in four different tax situations. This summary is limited to phase one.

In phase one three distinct types of data were gathered. Tax complexity judgments of each subject provided the data for a MDS analysis. To help interpret the MDS dimensions, data was gathered on adjective descriptors. Demographic and attitudinal information was also gathered to determine whether generalizations could be
drawn between the subject's tax complexity judgments and their backgrounds.

Four distinct complexity dimensions were identified. The first dimension appeared to reflect a personal versus financial topic orientation. Dimension two was labeled the quantitativeness dimension because subjects differentiated the cases based on the number of calculations involved. The third dimension correlated highly with three adjective descriptors which led to its labeling as the misuse dimension. The fourth dimension was labeled the readability dimension, both because of correlated adjective descriptors and because of their pattern of distribution.

The next step was to determine whether subjects' weighing of the complexity dimensions was correlated with demographic and attitudinal factors. The weights on the dimensions provided a measure of the importance of each dimension to each subject. The complexity ratings did not appear to depend on demographic or attitudinal factors.

The three distinct types of data gathered in the Milliron study were also gathered in the current study. Milliron found the independently collected adjective descriptors to be useful in defining the dimensions.

**Summary of MDS Studies**

MDS has been used in accounting studies to identify perceptions of accountants and users of accounting information. Whether MDS has been used alone or in
multimethod studies, it has been shown to be a useful method.

The results of accounting MDS studies demonstrate:

(1) the usefulness of MDS in identifying previously unknown structure in a data set,

(2) the value of a spatial representation in helping to interpret the data,

(3) the fact that some aspects of the solution may remain indeterminate without affecting the overall interpretation of the data,

(4) the usefulness of collecting adjective descriptors in addition to similarity judgments.

One of the benefits of MDS is the ability to generate a solution which is not pre-specified or even anticipated by the researcher. This benefit is especially appropriate for this study because little empirical evidence exists concerning internal auditors' perceptions.
CHAPTER III
RESEARCH QUESTIONS AND METHODOLOGY

Overview

This study investigated internal auditors' perceptions of nine systems design audit activities (Table 1-1) selected from the literature. The researcher hypothesized that internal auditors with experience in systems development perceive a mental map of relationships among audit activities used during systems design. Multidimensional Scaling (MDS) techniques were used to develop a graphical representation of the perceived relationships among systems design audit activities.

In a technical sense, MDS measures people's perceptions of the concept under study by identifying the inherent structure in a data set and depicting this structure in an r-dimensional geometric representation, where r equals the number of dimensions. The dimensions underlying this spatial representation are interpreted as attributes or combinations of attributes that distinguish the stimuli (audit activities in this study).

Internal auditors were asked to make judgments concerning the similarities between pairs of audit activities. This proximity data was used as input for the MDS analysis. Activities which internal auditors judged to be similar to one another were presented by MDS as points close to each other in a spatial configuration. Activities
judged dissimilar appeared as points distant from one another. This configuration was analyzed to identify the attributes used by internal auditors to distinguish among audit activities.

The researcher further hypothesized that internal auditors' perceptions of the similarities among the nine audit activities were influenced by the purpose of the activity: either to assure the controllability or to insure the auditability of a system. Controllability refers to activities performed when assessing the adequacy of EDP application controls and auditability refers to activities which prepare the system for audit after implementation. Separate questionnaires were used to collect the proximity data for the two areas of internal auditor participation, which allowed for a separate analysis of each one.

Research Questions

The overall objective of this research was to empirically identify internal auditors' perceptions of the underlying structure of systems design audit activities in two widely recognized areas of participation:

1) Controllability: Assessing EDP application controls

2) Auditability: Determining the auditability of the system.

"Underlying structure" has been defined for this study as the attributes (adjective descriptors or properties) of audit activities which influence internal auditors' perceptions of these activities.
MDS techniques were used to examine internal auditors' perceptions of the nine systems design audit activities included in this study (refer to Table 1-1). An interpretable MDS solution required participating internal auditors to consistently discriminate among the nine audit activities. If all activities were judged as very similar, internal auditors would not have discriminated among them. MDS procedures also required internal auditors to consistently agree that certain activities were similar and that others were dissimilar. Thus, the following questions were addressed:

**Research Questions:**

Is there a consistent discrimination process in internal auditors' perceptions of the selected audit activities in the controllability group?

Is there a consistent discrimination process in internal auditors' perceptions of the selected audit activities in the auditability group?

Developing an MDS solution is a complex process which involves choosing the number of dimensions which underlie the structure of the audit activities. The accounting literature concerning internal auditor involvement in systems design focuses on two topics. The first topic emphasizes the benefits of internal auditor involvement in systems design. Major contributions of involvement include assuring (1) that adequate controls are built into the system and (2) the auditability of the new system.

The second topic emphasized in the literature is the negative aspect of internal auditor involvement. The
potential loss of internal auditor independence when later auditing the system is a factor which many authors feel should limit internal auditor involvement in systems design.

The two topics emphasized in the literature provide the hypothesized dimensions for each solution. Because MDS solutions are most commonly found in two or three dimensions, this is a reasonable hypothesis, leading to these research questions:

Research Questions:

Does a two-dimensional solution describe the structure of systems design audit activities related to controllability of a system?

Does a two-dimensional solution describe the structure of systems design audit activities related to the auditability of a system?

Assuming that a two-dimensional solution is acceptable, attributes underlying the dimensions must be identified. The two aspects of systems design which are predominant in the literature are hypothesized as the underlying attributes:

Research Questions:

Do the two dimensions of both respondent groups represent:

1. The benefits derived from involvement in systems design:
   a. Assurance that adequate controls are built into the system for the controllability group, and
   b. Assurance of the auditability of the system for the auditability group?

2. The activity's effect on internal auditor independence?
A common method used to aid the dimension identification process is to collect data from subjects on attributes believed, a priori, to influence their similarity judgments. Subjects' ranking of seven attributes on each audit activity facilitated a canonical correlation analysis of the relationships among the attribute ratings on each activity and the coordinates of the activities on the dimensions of the MDS solutions. Uncovered relationships were used in naming the dimensions.

Seven attributes (Table 1-2) were believed, a priori, to influence internal auditors' perceptions of systems design audit activities:

1. Independence
2. Assurance Provided
3. Level of Involvement
4. Role as Independent Appraiser
5. Role as Consultant/Advisor
6. Role as User of the System
7. Role as Participant in Design.

For each of these, the following research questions were addressed:

**Research Questions:**

Does the attribute aid in defining a dimension of the controllability solution?

Does the attribute aid in defining a dimension of the auditability solution?

Subjects' ranking of the attributes also provided the input for another MDS analysis. The ranking are "derived similarity judgments," as opposed to the "direct similarity judgments" which served as input in the primary MDS analysis. An MDS unfolding model [Schiffman, Reynolds, and
Young (1981, 73) was used to analyze the relationships among the attributes and the activities. The activities and attributes were represented as points in the same Euclidean space, a joint-space analysis. In a successful analysis, attributes which are revealed as points close to activity points are judged important for those activities:

**Research Question:**

Is there a strong relationship between any attribute and any of the nine activities?

The use of weighted MDS models in all of the analyses provided information on differences among individuals in the similarity judgments of internal auditors. The MDS solutions were based upon averages of the subjects' similarity judgments. Weighted MDS also computed the importance of each dimension in the group solution in each subject's similarity judgments and presented this importance as subject weights. Differences in internal auditors' similarity judgments were determined by analyzing subject weights to answer the following research question:

**Research Questions:**

Do internal auditors agree in their similarity judgments?

When the subject weights were found to vary, demographic and attitudinal information was examined in an effort to discover any relationships to the activity coordinates in the MDS solution. The possibility that a participant's background influenced his/her similarity judgments was investigated:
Research Question:

Are there significant relationships among stimulus coordinates and participants' background and attitudinal information?

The accounting literature, in general, links the roles of independent appraiser and control expert to the internal auditor who performs activities related to application controls. Internal auditor participation in the design of application controls is considered unacceptable in most of the literature. However, when addressing the audltability of the system, many authors state that the internal auditor is a user of the system. If this opinion is correct, audit activities which are perceived as unacceptable for auditing application controls may be acceptable or even desirable when determining the auditability of a system.

Therefore, considering audit activities separately in terms of controllability of the system and auditability of the system may reveal previously unknown aspects in the perceptions of internal auditors. Comparisons between the results of the controllability analysis and the results of the auditability analysis were conducted to reveal any differences in the perceptions of audit activities:

Research Question:

Are there significant differences between the perceptions of internal auditors responding to the controllability instrument and the perceptions of internal auditors responding to the auditability instrument?
Methodology

Overview of Data Gathering Methods

Included in this study are nine audit activities (Table 1-1) and seven attributes (Table 1-2) of these activities which were selected from the literature concerning internal auditor involvement during systems design. These attributes are: (1) the assurance of controllability or auditability provided when the activity is performed, (2) the effect of performing the activity on the independence of the internal auditor, (3) the perceived level of involvement in systems design when performing an activity, and four potential roles of the internal auditor when performing an activity: (4) independent appraiser, (5) consultant/advisor, (6) future user of the system, and (7) participant in design. The attributes chosen were believed, a priori, to influence internal auditors' perceptions of similarities among audit activities.

Because the nine audit activities were investigated in two different areas of involvement (controllability and auditability), two separate instruments were used to capture internal auditors' perceptions. Each internal auditor was requested to complete an instrument related to only one area of participation in systems design.
Subjects

The population of interest was limited to internal auditors having experience in systems development. This group of internal auditors was chosen because judgments concerning the nine audit activities were required of participants, and subjects can give informed judgments only if they are acquainted with the stimuli under study [Davison (1983, 41)].

A list of internal auditors with experience in systems development was not available. Consequently, several steps were required in identifying the desired subjects. First, internal auditors who were both members of the Institute of Internal Auditors (IIA) and employed by one of the Forbes 500 Companies were selected.

Employment in large organizations was chosen as the first qualifying factor because internal auditors employed in these companies should normally have more exposure to systems development than internal auditors working for smaller companies. The Forbes 500 was selected over several other available corporate listings because both industrial and service companies are included. Both types of companies are active in designing systems. Companies listed on any one of the Forbes 500 rosters (largest companies by sales, profits, assets, and market values) were included, which resulted in a total of 796 potential companies.
The second step was to identify an internal auditor working for each of the 796 Forbes companies who was a member of the IIA. The membership list of the IIA provided the names and places of employment of its members. Of the 796 companies, only 575 had internal auditors who were included in the latest (1988) IIA membership list. Therefore, questionnaires were sent to an internal auditor in each of the 575.

In the 575 companies chosen to be included in the study, the number of employees who were IIA members varied from 1 to 61. If more than one internal auditor was employed, a random number table was used to select the particular auditor who was mailed a questionnaire. Either the controllability questionnaire or the auditability questionnaire was mailed to the selected internal auditor. Two hundred eighty-eight auditability questionnaires and two hundred eighty-seven controllability questionnaires were included in the initial mailing to these internal auditors.

The third step in identifying subjects required the examination of the answers to questions on the instrument that were designed to identify internal auditors with experience in systems development. If the recipient did not qualify as a participant for this study, he/she was requested to return the questionnaire without completing it. Therefore, respondents were classified as "experienced" or "inexperienced."
Replacements were attempted for the subjects whose questionnaires were returned because the subject no longer worked for the firm and for the questionnaires returned by "inexperienced" respondents. Replacement subjects were selected based upon one or both of the following criteria:

1. The 1988 IIA membership listing included another internal auditor from the same company, and/or
2. The inexperienced respondent indicated that his/her company participated in systems development.

When there were two or more internal auditors from whom to choose the replacement, the subject was again randomly selected. Although the replacement procedure resulted in mailing multiple questionnaires to some firms, only the data from one experienced respondent from each company was included in the analysis.

The above procedures resulted in a total of 181 useable responses, for a response rate of 37.7%. An advantage of MDS is that, generally speaking, few subjects are required to yield a stable solution [Schiffman, Reynolds, and Young (1981, 4)]. Davison (1983, 41) gives a rule of thumb concerning the number of subjects needed for MDS when averaging the judgments of several people. The required number of subjects is approximately equal to 40 times the anticipated number of dimensions (2) divided by the number of stimuli minus one (9-1=8). Therefore, for this study ten responses [80/8] in each of the two groups would be adequate to perform MDS. In the present study, 92 useable responses were received for the controllability
group and 89 useable responses were received for the auditability group.

**Stimuli**

Nine stimuli (audit activities) were included in the study. The nine were chosen as representing the activities suggested in the literature for systems design. The number of stimuli was purposely kept low to reduce the number of similarity judgments required of each subject.

Most MDS studies in accounting include a relatively low number of stimuli. Libby (1979) and Bailey, Bylinski, and Shields (1983) used ten stimuli to reveal two-dimensional solutions. Belkoumi (1980) used 12 stimuli which resulted in a three-dimensional solution. Shockley and Holt (1983) included only eight stimuli for a three-dimensional solution. Nair and Rittenberg (1987) used nine stimuli to determine a two-dimensional solution. Finally, Milliron (1985) used 13 stimuli to determine a four-dimensional solution.

It is also desirable to include as many stimuli as is practically possible in an MDS experiment. Kruskal and Wish (1978, 52) recommend including nine stimuli for a two-dimensional solution, thirteen for a three-dimensional solution and seventeen for a four-dimensional solution. Schiffman, Reynolds, and Young (1981, 24) point out that these recommendations apply when a single matrix of data is being analyzed. They state that it is reasonable to assume that these recommendations could be weakened for a weighted
MDS analysis when more than ten matrices are used. In fact, several of the examples in their book violate these recommendations. In the current study, each subject's responses provided a matrix of data. Consequently, either a two-dimensional or a three-dimensional solution seemed appropriate for the nine audit activities.

To ensure the stability of the solutions, the data were randomly split into subsamples. Parallel analyses were performed on each subsample and compared to determine their similarity. This subsampling technique provided a check on the reliability of the analyses [Schiffman, Reynolds, and Young (1981, 25)]. The results of the parallel analyses are described in Chapter IV.

**Design of The Instruments**

As mentioned, two instruments were developed to separately gather internal auditors' perceptions of systems design audit activities in two areas—Controllability and Auditability. This section describes the tasks which were completed by the subjects in each questionnaire.

**Subjects' Tasks**

Schiffman, Reynolds, and Young (1981) state that the ideal MDS experiment involves gathering four types of data: (a) similarity judgments among all pairs of stimuli, (b) ratings of stimuli on descriptors such as adjectives, (c) objective measures (such as physicochemical parameters in a study of sensory perceptions), and (d) information about the subjects. Objective measures of audit activities were
unavailable. The other three recommended types of data were gathered in this study. As part of the attitudinal data, subjects were asked to indicate the role(s) of the internal auditor when performing systems design audit activities.

Respondents were asked to:

1. Judge the similarity of all possible pairs of audit activities;
2. Rate every activity on seven attributes;
3. Rate the role(s) of the internal auditor when performing activities related to application controls and the auditability of the system;
4. Provide demographic and attitudinal information, including an indication of the role(s) of the internal auditor when performing audit activities related to the controllability and the auditability of the system.

**Judgment Tasks**

The similarity judgments were the primary source of information for determining the underlying structure of the systems design audit activities. The use of direct similarity judgments allowed the researcher to find a solution without specifying the variables used in making the judgments. Therefore, experimenter bias was reduced.

Internal auditors' similarity judgments were gathered by using the graphic rating scale method [Davison (1982, 43)]. Subjects were presented with pairs of activities and asked to judge the similarity of the activities by marking a slash (/) on a five-inch line. The anchors were "very similar" and "very dissimilar." Schiffman, Reynolds, and
Young (1981, 22) recommend the five-inch undifferentiated line scale rather than a series of numbers. A four-inch line was found to compress subjects' judgments and the right-hand end of a six-inch line was not used very often. The five-inch line was used by Milliron (1985) in a recent MDS study in accounting.

The nine audit activities were presented in pairs using a complete design in which each subject judges each pair. It was assumed in the current study, as in almost all similarity experiments, that the similarity of stimulus one to stimulus two is equal to the similarity of stimulus two to stimulus one (Schiffman, Reynolds, and Young (1981, 24)). Therefore, subjects were required to make 36 judgements \[ I(I-1)/2 \text{ where } I= \text{Number of Stimuli}=9 \]. To illustrate, the experimental task required for the pair of audit activities--Review/Evaluate Controls and Identify Control Weaknesses--is shown below (Not to scale):

\[
\begin{array}{c}
\text{Compare: Activity 1: Review/Evaluate Controls, and} \\
\text{Activity 2: Identify Control Weaknesses} \\
\end{array}
\]

\[
\begin{array}{c}
\text{Very} \\
\text{Dissimilar} \\
\hline
\text{Similar} \\
\end{array}
\]

The order in which the pairs of audit activities are presented can influence subjects' similarity judgments [Tversky (1977) and Zinnes and Wolff (1977)]. This influence is called space effect. Space effects are
balanced for an audit activity if the activity is the first member in one half of the pairs in which it appears.

**Time effects** are associated with the ordering of the stimulus pairs. Time effects are balanced for an audit activity if the pairs in which the activity appears are equally spaced throughout the similarity judgment section.

Ross ordering [Ross (1934)] was the method used to derive an ordering and arrangement of the pairs of audit activities in this study. By using this method both time and space effects were balanced.

Subjects' judgments can also be affected by what they expect to be included in the stimulus set [Davison (1983, 47)]. Instructions can help to standardize the subjects' expectations. After the task was explained, but before judgments were made, subjects were asked to read through a list of the nine audit activities. In this manner, the subjects were aware of all of the audit activities included in the study before making a judgment concerning a particular pair of activities.

The researcher did not specify the criteria which participants should use in making their similarity judgments. Therefore, the subjects were free to use their own perceptual framework in judging the similarity of a pair of stimuli. However, four assumptions were given to add consistency to the answers and to encourage subjects to disregard cues irrelevant to this study [Davison (1983, 47-48)]. These assumptions were:
1. The internal auditor has the knowledge and training needed to complete every task.

2. The resources (time, money, and personnel) are available to complete every task.

3. The internal audit department has the support of management and systems personnel for every task.

4. The EDP system which is being designed is significant.

**Rating the Attributes**

After the subjects completed their similarity judgments, they rated each activity on seven attributes (Table 1-2) that were thought, a priori, to influence the similarity of audit activities. Attributes were chosen from the literature on the basis of their perceived ability to discriminate among the audit tasks.

The subjects' ratings on these attributes were gathered to aid in interpreting the MDS configuration. A five-inch scale was used for rating the attributes. Subjects were asked to "RATE EACH AUDIT ACTIVITY BY MARKING A SLASH (/) ALONG THE GIVEN SCALE". For example (not to scale):

```
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
REVIEW/EVALUATE THE SYSTEM'S APPLICATION CONTROLS

Rate the Effect of This Activity on the Internal Auditor's Independence When Later Auditing the Implemented System:

<table>
<thead>
<tr>
<th>Complete</th>
<th>Maintains</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loss of</td>
<td>Total</td>
</tr>
<tr>
<td>Independence</td>
<td>Independence</td>
</tr>
</tbody>
</table>

* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
Although adjective data have been found to be extremely noisy in perception studies [Schiffman, Reynolds, and Young (1981, 20)], the descriptors can be helpful in interpreting the multidimensional space derived from the similarity judgments. In addition, the attribute ratings, as derived similarity judgments, provided the input for a joint-space MDS analysis of attributes and activities. The computational problems associated with this analysis are discussed in a later section.

**Demographic Information**

In addition to the two types of data described above, background and attitudinal information were gathered on each subject. This information facilitated an examination of the relationships among subjects' background and attitudinal variables and their similarity judgments.

As part of the attitudinal data, subjects were asked to indicate the role(s) of the internal auditor when performing audit activities (1) related to EDP application controls and (2) related to the auditability of the system. For example (not to scale):

```
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
When performing activities related to EDP APPLICATION CONTROLS, the internal auditor is sometimes required to fulfill the role(s) of: (you may pick more than one)

___INDEPENDENT APPRAISER    ___PARTICIPANT IN DESIGN
___CONSULTANT/ADVISOR       ___FUTURE USER OF THE SYSTEM
___OTHER ROLE; PLEASE DESCRIBE________________________________________

* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
```
Because these questions could have biased the subjects' similarity judgments, this was the last information gathered. Subjects were told not to return to a section once it was completed.

**Pretest**

Pretesting the questionnaire involved two stages. The first stage was the developmental stage. In the fall of 1988, the list of activities and related attributes was mailed to twenty academicians specializing in the systems and internal auditing areas. Comments were received from approximately half of these experts. During the same period, on-site interviews were conducted with two internal auditors in large corporations. The material collected from both sources was used in developing the questionnaire.

A local chapter of the Institute of Internal Auditors agreed to help in pretesting the questionnaire. In November of 1988, questionnaires were distributed to the members and two-thirds of these questionnaires were returned in the mail with comments.

After modifications were made to the questionnaires, a second pretest was conducted at the January 1989 meeting of the same local IIA chapter. Selected members were again given the questionnaires to complete and return in the mail. Most respondents indicated that the time to complete the questionnaire was between 30 and 35 minutes.

As a precautionary measure, 100 of the 575 questionnaires in the complete sample were mailed in June.
of 1989. If the response rate from this mailing had been low, an alternative approach for gathering the data would have been considered. However, a 50% response rate (which included "inexperienced" respondents) was obtained. An MDS analysis based on the data from these respondents was found to provide interpretable MDS solutions for both the controllability and the auditability respondent groups. Therefore, the remaining questionnaires were mailed in July of 1989.

Reducing Non-Response Bias

The decision to obtain data through a mail questionnaire required serious consideration of the problems of non-response. A low response rate introduces a pernicious error source into experimental data. It means that the researcher has failed to measure many of the units which were chosen, and that there may be reason to believe that units in the non-responding group differ from those which were measured [Cochran (1977, 359)].

Therefore, as described in the previous section, the experimental materials were designed to enhance the response rate, and a follow-up program was carried out in an effort to maximize the total response. Several measures, as identified by Lockhardt (1984), were taken to ensure a favorable response rate:

(1) A personalized and individually signed cover letter on university stationary (Appendix A-1) accompanied the survey instruments. The letter explained the nature and purpose of the survey and assured confidentiality of the responses.
(2) As an incentive, the subjects were offered a summary of the results. The number of respondents indicating a desire to receive the summary confirmed that the summary was an incentive (indication of desire involved writing in their names and addresses).

(3) A self-addressed, postage-paid envelope was included to encourage response.

(4) A reminder and thank-you post-card was mailed ten days after each mailing of the questionnaires.

(5) A second letter (Appendix A-2) and another survey instrument were mailed two weeks after the postcard if a response was not received.

In addition, "replacement" questionnaires were mailed to randomly selected internal auditors from the companies of "inexperienced" respondents (as discussed in the previous section). The resulting response rate is discussed in Chapter IV.

**Analysis of Data**

The ALSCAL program developed by Takane, Young, and DeLeeuw (1977) was chosen for use in this study. The procedures used in ALSCAL have been evaluated using both Monte Carlo methods and empirical data and have been "found to be robust in the face of measurement error, capable of recovering the true underlying configuration in the Monte Carlo situation" [Takane, Young, and DeLeeuw (1977, 7)]. ALSCAL has been used in the following accounting studies: Brown (1981); Rockness and Nikolai (1977); Bailey, Bylinski, and Shields (1983); Shockley and Holt (1983); and Schneider (1985).

ALSCAL includes an individual differences model, also called a weighted Euclidian model, which can be used with
ordinal (nonmetric) data. For a detailed discussion of the weighted MDS model, the reader is referred to Schiffman, Reynolds, and Young (1981) and Takane, Young, and Deleeuw (1977).

The similarity judgments and the attribute ratings were assumed to be measured at the ordinal level. Therefore, nonmetric MDS models were used to analyze the data. Nonmetric MDS procedures yield solutions in which the distances in the derived space are merely in the same rank order as the proximity judgments. Nonmetric scaling has been shown [Schiffman, Reynolds, and Young (1981, 6)] to provide a better fit than metric scaling in cases of low dimensionality. However, the choice of metric or nonmetric MDS rarely makes a crucial difference in the outcome of the analysis [Schiffman, Reynolds, and Young (1981, 74)].

Weighted MDS models were used to provide a measure of the perceptual differences among individuals. These perceptual differences are represented by subject weights on a common set of dimensions. The weight represents the significance of a dimension to the individual. A subject who weighs a dimension more heavily will perceive the distances between the stimuli on that dimension to be greater than a subject who places less weight on that dimension.

The appropriate number of dimensions for the MDS solutions must be determined. For both the controllability and auditability solutions, the data matrices from all
subjects responding to the corresponding questionnaire were combined to produce one solution. For a weighted MDS model, which requires estimates of both distances and subject weights, no solution of less than two dimensions is appropriate [Schiffman, Reynolds, and Young (1981, 180)]. Also, the relatively small number of stimuli included in the study makes three dimensions the upper limit. Therefore, only solutions in two or three dimensions were considered. The objective was to choose the dimensionality which simultaneously maximized goodness-of-fit in a least squares sense and achieved the highest level of interpretability.

In particular, STRESS, a measure of goodness-of-fit developed by Kruskal (1964), was used in the present study. STRESS approaches zero as the configuration approaches a perfect least-squares fit. R-square was also used as a measure of goodness-of-fit in the study. R-square measures the proportion of variance in the similarity judgments accounted for by the MDS model. Generally, STRESS decreases and r-square increases with an increasing number of dimensions. Since r-square has a simple interpretation, it was considered the best indicator of how well the data fit the model [Schiffman, Reynolds, and Young (1981, 175)].

In addition to STRESS and r-square, an image diagram or scattergram was examined (Davison (1983, 96-98)). The scattergram presents the distances between activities along one axis and the estimated MDS placement of the activities.
along the other axis. There is one point for each pair of activities. If the data satisfied the model perfectly, these points would fall along a straight line extending from the origin at a 45-degree angle to the horizontal axis. The more points that deviate from the line, the worse the fit of the model to the data.

Naming the dimensions derived from the subjects' similarity judgments in each respondent group requires some subjective interpretation. However, data collected independently of the similarity judgments can provide objective measures to aid in interpreting the dimensions. Such data were collected by asking subjects to rate the audit activities on attributes believed, a priori, to influence the desirability of performing an audit activity during systems design. A similar method was used successfully by Shockley and Holt (1983) and Milliron (1985).

The use of a weighted MDS model facilitated the comparison of each subject's judgments to the group judgment. Subject weights for each dimension were determined. These weights are a measure of the importance of each dimension in a respondent's similarity judgments. Subject weights were examined for each audit area to determine whether internal auditors agreed in their similarity judgments.

The relationship between subjects' demographic and attitudinal information and subjects' similarity judgments
was also examined. Canonical correlation analysis [Thompson (1984)] was used to provide information about the strength of the relationships between (1) the coordinates of the activities on the MDS dimensions and the subjects' background and attitudinal information, and (2) the coordinates of the activities on the MDS dimensions and the attribute data. Canonical correlation seeks two linear combinations, one for the predictor set (the attributes or demographic variables) and one for the criterion set (the activity coordinates on the MDS solutions), such that their ordinary product-moment correlation is as large as possible. The strongest possible relationship is identified by the first correlation coefficient and the corresponding linear combinations of the variables are called the first canonical variates. A second linear combination of the two sets of variables is then sought which maximizes the correlation and which is uncorrelated with the first linear combination. A redundancy coefficient, which is analogous to r-square, was also examined to determine the amount of variance in the criterion set that is "redundant" in the variance in the predictor set [Dillon and Goldstein (1984)]. Redundancy relates to the share of the variance of one set that can be accounted for by a canonical variate from the other set. In other words, redundancy is the amount of variance in the dimensions that can be explained by either the attributes or the demographic variables.
A second MDS model, Weighted Multidimensional Unfolding (WMDU) was used in a supplemental analysis of the data. The reader is referred to Takane, Young and Deleeuw (1977) for a detailed discussion of this model. In this study, the seven attribute ratings on each of the nine audit activities served as the input for the WMDU. The resulting "joint-space" configuration can provide a model of the relationships among the attributes and the activities. The points in the configuration are arranged so that the distances between them reflect the information in the data and thus reveal the relationships among the activities and the attributes.

Caution is necessary whenever the WMDU model is used. This "joint-space" analysis frequently encounters problems of local minima and degenerate solutions. These problems will be discussed in more detail in the next section.

Potential Problems: Local Minima, Degenerate Solutions, and Lack of Convergence

Three major problems must be avoided when using MDS. The first is the local minima problem. Local minima are a potential problem because several different sets of stimulus coordinate estimates and subject weight estimates may satisfy the solution equations. The set of values that yields the best fit to the data represents the global minimum. All others are called local minima.

The local minima problem arises when the algorithm for fitting the MDS model chooses parameter estimates which represent local minima instead of the global minimum. An
Indication that the solution is a local minimum occurs when the measures of fit do not improve when going to the next higher dimension [Kruskal and Wish (1978)]. Davison (1983, 133) suggests that the best way to avoid a local minimum is to start the iterative process from a rationally derived configuration. ALSCAL meets this requirement by using a modified Schonemann solution [Schonemann (1972)] in the initialization phase.

Another potential problem is a degenerate solution. A degenerate solution occurs when the points in the derived space are clumped together into clusters so that most of the points are on or close to a very small number of locations in the space. Values for STRESS close to zero (.01 or less) may be a signal of a fully or partially degenerate solution [Shepard (1974)]. Degenerate solution problems are frequently encountered when performing a joint-space analysis. Therefore, the value of STRESS for the Unfolding MDS analyses were inspected for near zero values.

The last potential problem is that of convergence, which arises because programs generally call for the researcher to specify the maximum number of iterations allowed. The algorithm may not reach the desired solution in the allowed number of iterations. This problem usually does not exist with ALSCAL which automatically performs up to fifty iterations. If convergence does not occur after these iterations, ALSCAL acknowledges this fact and the


researcher can increase the number of iterations. Additional iterations were necessary for convergence of the Unfolding MDS models used with the attribute rating data.

**Summary**

The methodology outlined in this chapter was designed to provide information concerning the underlying structure of systems design audit activities. WMDS was used to model the perceptions of internal auditors with experience in systems development.

The analysis was conducted to determine whether internal auditors perceive differences among the nine audit activities included in the study. These activities were chosen from the literature to represent different levels of internal auditor involvement in systems design.

Differences in the perceptions of internal auditors in the controllability and auditability groups were also investigated. Finally, the attributes which internal auditors considered salient in judging the similarity between pairs of audit activities were examined. These attributes helped to define the underlying structure of systems design audit activities.
CHAPTER IV
ANALYSIS OF THE DATA

Response Rate, Test for Non-Response Bias, And Demographics of Respondents

Response Rate

In calculating the response rate, the following ratio was used [Bailey (1981)]:

\[
\text{Completed Responses Received} = \frac{\text{Completed Responses Received}}{\text{[Total sample - Inappropriate Subjects + Replacements]}}
\]

Inappropriate subjects were defined as (1) subjects who indicated a lack of experience in systems development or (2) subjects no longer employed by the firm to whom the survey was addressed, as determined by undeliverable mail.

Exclusion of the second category of subjects was justified because specific firm affiliation was a criteria for subject selection [Bailey (1981)]. The calculation is further complicated by the replacement procedure whereby an inexperienced respondent or a subject who could not be located was, under specified conditions, replaced by another internal auditor from the same company.

Initially, questionnaires were mailed to 575 internal auditors. Several measures, as identified by Lockhart (1984), were taken to ensure a favorable response rate. These measures included sending a reminder post-card ten days after each mailing and a second letter and another survey instrument two weeks after the post-card.

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The post office returned 85 questionnaires as undeliverable, and 68 respondents indicated "no experience in systems development." Replacement subjects were selected according to one or both of the following criteria:

1. The 1988 IIA Membership Listing included another internal auditor from the same company, and/or

2. The inexperienced respondent indicated that his/her company participated in systems development.

The above guidelines resulted in 58 replacement questionnaires.

Two responses with incomplete data and four subjects who did not complete the questionnaires but with whom telephone interviews were conducted were not included in the total responses received. The information from these interviews was used in interpreting the data. Only responses from experienced respondents who completed at least 30 out of the 36 similarity judgments were counted as "useable" responses. This group encompassed 181 participants. Therefore, the response rate was:

\[
\text{Response Rate} = \frac{181}{575 - 68 - 85 + 58} = 37.7\%
\]

The aggregate responses were divided between the two audit areas as follows:

- Auditability: 89 responses
- Controllability: 92 responses

As explained in Chapter III, an advantage of MDS is that, generally speaking, few subjects are required to
yield a stable solution. The number of responses received was considered more than sufficient for the data analysis. In fact, more participants are included in the current study than were included in most prior MDS studies in the accounting literature. For example, investigators have compared the perceptions of 30 CPA's and 28 bankers [Libby (1979)], 25 CPA's and 25 loan officers [Pillsbury (1985)], and 40 bankers with 40 CPA's [Nair and Rittenberg (1987)].

Test for Non-Response Bias

Non-response bias occurs when a study's outcome would have differed substantially if all mail survey recipients had responded. Oppenheim (1966) recommends checking for non-response bias by comparing early and late responses. Late responses, Oppenheim states (1966, 34), resemble non-respondents. Other accounting studies have followed Oppenheim's advice [Bailey (1981) and Mayer-Sommer (1979)].

Simple linear regression analysis was used to test both the controllability respondents and the auditability respondents for non-response bias. The purpose of the regression was to observe whether the "time of response" influenced a subject's similarity judgments. Subject weights, which measure the importance of each dimension of the solution to each subject, were used to represent the subjects' responses. Applying MDS procedures, these subject weights were presented as points. [See Schiffman, Reynolds, and Young (1981, 309-313) for details concerning this procedure.] These "flattened subject weights" were
used as the dependent variables in the simple linear regression conducted for each respondent group. Response time, the independent or predictor variable, was defined to be the number of days between the date of the initial questionnaire mailing and the date that the researcher received the response. At a .05 significance level, neither the auditability nor the controllability responses were found to be influenced by response time. The results (presented in Appendix C) suggest a lack of non-response bias in this study.

Demographics of Respondents

One hundred eighty-one internal audit departments which participate in systems development in large U.S. corporations were represented in the sample. The demographics of the responding internal auditors are presented in Appendix D. The most important characteristics are summarized below.

--- Respondents were almost equally divided between EDP auditors and general internal auditors. This distribution supports the generalization of the study results. The fact that both EDP and general internal auditors are equally represented gives credence to the supplemental analysis which includes comparisons between the two groups.

--- Approximately 45% (82 out of 181) of the responding internal auditors had more than ten years of work experience. An additional 48 respondents (27%) had from seven to ten years of work experience. Therefore, 72% of
the responding internal auditors had at least seven years of work experience. The years of internal auditing experience of those respondents classified as inexperienced, and, therefore, not included in this study were also computed. Approximately 49% of the "inexperienced" respondents had over ten years of experience and another 16% had from seven to ten years of experience. This makes a total of 65% of the "inexperienced" respondents who had from seven to ten years of experience.

--- Over 57% of the respondents had formal training in audit concerns for developing information systems. Formal training was defined in the questionnaire as college coursework and/or professional development courses. Over 82% of the participating internal auditors had "on-the-job" training.

--- Subject responses were measured on undifferentiated five-inch lines. However, the answers to the opinion questions were divided into five categories, based upon the centimeters(cm) measured from the "strongly agree" end: Strongly agree (0-25 cm), agree (26-50 cm), no opinion (51-75 cm), disagree (76-100 cm), and strongly disagree (101-128 cm). Over 75% of the respondents strongly agreed with the statement that "internal auditors should be involved in systems development." Another 16% agreed with the above statement, making a total of 91% of the respondents who
support internal auditor involvement in systems development.

The opinions of the "inexperienced" internal auditors who responded to the survey concerning involvement in systems development was also computed. Using the same categories as the participants, 60% strongly agreed and 23% agreed. Therefore, 83% of "inexperienced" internal auditors surveyed also support internal auditor involvement in systems development.

--- Approximately 65% of the respondents strongly agreed and 20% agreed (making a total of 85%) that participation in systems development should include involvement during systems design. This statistic is very important because the survey addressed systems design audit activities. Only six internal auditors or approximately 3% of the respondents disagreed with the concept of internal auditor involvement during systems design.

--- Internal audit departments in 82 out of the 181 companies represented in the study (45.6%) frequently participate in systems development. The remaining departments occasionally participate.

--- Eighty-four or 46.7% of the responding internal auditors had no opinion on the adequacy of IIA guidelines concerning internal auditor involvement in systems development. Fifty-five or 30% of the respondents felt the guidelines were inadequate.
Primary Analysis of the Data

Overview

The objective of the primary analysis was to:

IDENTIFY INTERNAL AUDITORS' PERCEPTIONS OF THE UNDERLYING STRUCTURE OF SYSTEMS DESIGN AUDIT ACTIVITIES.

This objective was accomplished by first modeling internal auditor perceptions of systems design audit activities using MDS.

Two- and three-dimensional MDS solutions were obtained for both the controllability and the auditability respondents. The measures of goodness of fit, STRESS and r-square, and the interpretability of the solutions were compared for the two- and three-dimensional solutions. In addition, subject weights were examined to determine the effect of outliers on the solutions. These procedures led to the acceptance of the two-dimensional solution for both the controllability and auditability groups. [Details of these comparisons are given below.]

The interpretation of the two-dimensional solutions was aided by the subjects' rating of each activity on seven attributes. These attributes were chosen, a priori, as criteria which internal auditors consider in differentiating among systems design activities. The canonical correlations between the attribute variables and the coordinates of the activities on the MDS dimensions were analyzed for both respondent groups. Redundancy analyses on the resulting variates determined the amount of
variance in the activity coordinates which was explained by the attribute variates. These analyses confirmed that the seven attributes included in the study were perceived as important criteria when judging the similarity of the systems design audit activities.

The attributes which were highly correlated with the dimensions of the controllability and auditability solutions aided the interpretation of those dimensions. These attributes also aided in the interpretation of the activity clusters on the dimensions of both solutions.

Finally, the attributes and the activity clusters of the two respondent groups were compared to determine any differences between the models.

**Consistent Discrimination Process**

The first step in analyzing the data was to answer the following research question for both the controllability and auditability groups:

*Is there a consistent discrimination process in internal auditors' perceptions of the selected audit activities?*

This question presumes that internal auditors discerned dissimilarities between the nine audit activities included in the study. A consistent discrimination process meant that the internal auditors included in the study tended to agree in their similarity judgments concerning the relationships among the audit activities. Although a consistent discrimination process did not require identical similarity judgments, consistency did require the internal
auditors to agree, in general, that certain activities were similar and that other activities were dissimilar. Multidimensional scaling (MDS) procedures were used to model the discrimination process. The MDS measures of goodness of fit were examined to determine whether the internal auditors' judgments were consistent and, therefore, could be modeled by MDS.

Respondents made 36 similarity judgments concerning nine audit activities performed during systems design, which then provided the input for the MDS analyses. The number of possible dimensions in the analysis was limited to two or three for reasons explained in Chapter III. The resulting goodness of fit measures for the controllability and auditability groups in two and three dimensions were:

<table>
<thead>
<tr>
<th>Controllability Group</th>
<th>STRESS</th>
<th>R-Square</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two-dimensional Solution</td>
<td>.310</td>
<td>.440</td>
</tr>
<tr>
<td>Three-dimensional Solution</td>
<td>.215</td>
<td>.446</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Auditability Group</th>
<th>STRESS</th>
<th>R-Square</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two-dimensional Solution</td>
<td>.321</td>
<td>.333</td>
</tr>
<tr>
<td>Three-dimensional Solution</td>
<td>.223</td>
<td>.358</td>
</tr>
</tbody>
</table>

STRESS measures how far the data depart from the model and r-square reveals the portion of the variance in the similarity judgments which was accounted for by the model. STRESS decreased and r-square increased with the higher dimension. If the measures had shown a different pattern, a local minima problem would have been indicated. (For a discussion of this potential problem, refer back to Chapter III.)
An examination of the distances between stimulus points (Figures 4-1 and 4-2) for the two-dimensional solution suggested that internal auditors did consistently differentiate among systems design audit activities because groupings or clusters of activities were uncovered on each dimension. These activity clusters indicate that the internal auditors' perceptions of the activities are similar to one another on the criterion represented by the corresponding dimension.

**Selection of a Two-Dimensional Solution**

After establishing the appropriateness of the MDS analysis, the two- and three-dimensional solutions for each respondent group were compared to answer the following research question:

*Does a two-dimensional solution describe the structure of systems design audit activities?*

For both respondent groups, STRESS in the three-dimensional solution was approximately 10% lower than the two-dimensional STRESS. However, this lower STRESS value does not necessarily mean a more interpretable solution (i.e., a better model). Schiffman, Reynolds, and Young present several examples to illustrate that r-square is a "much better indicator of the appropriate dimensionality than STRESS" [Schiffman, Reynolds, and Young (1981, 175)]. R-square was considered the primary measure of goodness of fit for this study.
Figure 4-1
Total Controllability Solution

Dimension 1 (Horizontal): Primary Cluster - Dimension 2 (Vertical): Primary Cluster -...
Figure 4-2
Total Auditability Solution

Dimension 1 (Horizontal): Primary Cluster
Dimension 2 (Vertical): Primary Cluster
For both groups, the r-square of the three-dimensional solution was only slightly higher than the r-square of the two-dimensional solution. The slight increase in r-square was not felt to offset the large increase in interpretation difficulties associated with a three-dimensional solution. Therefore, because of the comparable ease in interpretation and because the r-square of the two-dimensional solution was only slightly lower than the three-dimensional solution, the two-dimensional solution was chosen as the more parsimonious one.

The validity of the two-dimensional solution for each respondent group was examined (Schiffman, Reynolds, and Young (1981, 12)) by randomly dividing both the controllability and auditability subjects into three subgroups containing approximately 30 subjects each. Two-dimensional MDS solutions were found for each subgroup and compared with the solutions for the combined groups. No major differences were revealed. The points in common among the subgroups and the combined group solutions are summarized in Appendix E. The two-dimensional outcomes were further examined by scrutinizing the scatterplots of distances vs. disparities and the subject weights.

Examination of Scatterplots of Distances vs. Disparities and Subject Weights

Examination of Scatterplots

The goodness of fit for each solution is illustrated (Figures 4-3 and 4-4) in a scatterplot of distances vs. disparities. Each point on the scatterplot represents a
FIGURE 4-3
CONTROLLABILITY SCATTERPLOT OF DISTANCES VS. DISPARITIES

SCATTERPLOT PLOT OF LINEAR FITS: DISTANCES VS. DISPARITIES (DIFFERENTIAL)
FIGURE 4.6
AUDITABILITY SCATTERPLOT OF DISTANCES VS. DISPARITIES
pair of activities. If the data satisfied the model perfectly, the points would fall along a straight line extending from the origin at a 45-degree angle to the horizontal axis [Davison (1983)]. The more points that deviate from the line, the worse the fit of the model to the data. Figures 4-3 and 4-4 show some deviation, but the general pattern appears to follow a line from the origin at a 45-degree angle to the horizontal axis.

No distinct clustering of points was observed. In other words, if all the points were located at only two or three tightly clustered locations and these clusters were separated from one another, this would signify a degenerate solution. [See Chapter III for a discussion of this potential problem.] To summarize, the scatterplots exhibited no abnormalities in the two-dimensional solutions in either the controllability or auditability groups.

**Subject Weights**

An examination of subject weights for both the controllability and the auditability solutions revealed one apparent "outlier" for each group. An "outlier" was identified by "subject weirdness" scores [See Young and Lewyckyj (1980)]. Weirdness scores (Table G-1 and G-2) of more than .70 were considered outliers. The subjects found to be outliers among the controllability and auditability respondents had weirdness scores of .7636 (subject #86) and .8648 (subject #16), respectively. Outliers generally occur because of either an error in recording or entering
the data or because a subject is simply different from the
rest [Stevens (1986, 9-10)]. After the outliers were
checked to make sure that the data was correct, the
influence which the outliers had on the MDS solutions was
checked. Removing the "outlier" from the two-dimensional
controllability analysis had no effect on the solution's
STRESS or r-square. Removing the "outlier" from the two-
dimensional auditability analysis resulted in a slightly
higher STRESS and a slightly lower r-square. Since the
removal of the apparent outliers did not improve the
solutions, these subjects were retained in subsequent
analyses.

Summary
Examination of the scatterplots of distances vs.
disparities and the subject weights uncovered no apparent
abnormalities. Hence, the analyses of scatterplots and
subject weights reinforce the acceptance of two-dimensional
solutions for both the controllability and auditability
groups.

Interpretation of the Two-Dimensional Solutions
In order to conclude that the two-dimensional
solutions adequately model the respondents' similarity
judgments, the attributes which separate or distinguish the
activities on each dimension must be identified. The
dimensions of each MDS solution represent the attributes
which separate or distinguish activity clusters.
Identifying these attributes was the major objective of the analysis.

Dimension names were chosen to represent the underlying attributes. A study of prior research and the nonempirical literature (refer to Chapter II) provided two potential underlying attributes for each respondent group. The identification process answered the following research question:

Do the two dimensions represent:

1. The benefits derived from involvement in systems design:
   a. Assurance that adequate controls are built into the system for the controllability group, and
   b. Assurance of the auditability of the system for the auditability group?

2. The activity's effect on internal auditor independence?

The first step in interpreting the dimensions was to observe clusters of activities. The spacing of the stimuli (the nine systems design audit activities) on the two dimensions was examined and activity clusters were found. Figures 4-1 and 4-2 illustrate the clusters on the two dimensions for the respondent groups.

Naming the underlying attribute(s) which determined the observed activity clusters on each dimension required an element of subjective judgment on the part of the researcher. However, the attribute data, which were collected after the subjects made their similarity judgments, provided objective evidence for interpreting the activity clusters. The nine activities—related to either
controllability or auditability, depending upon the respondent's questionnaire—were rated (on a five-inch undifferentiated line) on the following seven adjective descriptors or attributes:

1. Independence of the Internal Auditor when Performing the Activity
2. Auditability or Controllability Assurance Provided by the Activity
3. Level of Involvement Necessary When Performing the Activity
4. Role of Independent Appraiser
5. Role of Consultant
6. Role of Future User of the System
7. Role of Participant in Design

The following question was addressed for each of the above seven attributes:

Does the attribute aid in defining a dimension of the controllability or the auditability solution?

To answer the above question, canonical correlations between the mean ratings of the attributes on each activity and the coordinates of the activities in the two-dimensional solutions were calculated for the controllability and auditability data. The researcher, however, did not consider the relationships uncovered in the canonical correlation analyses as infallible. The potential meanings of the activity clusters were carefully considered before naming the MDS dimensions. In addition, although coordinate placement was an important consideration, subjective judgment was required in determining the activity clusters on each dimension. Activities with coordinates of less than (absolute) 20 on a dimension were omitted from the activity clusters on that
dimension. The coordinates for the activities in the
controllability and auditability solutions are listed in
Tables 4-2 and 4-4, respectively. Because results differ
between the two audit groups, the interpretation of the
controllability and auditability solutions are discussed
separately.

Interpretation of the Controllability Solution

A canonical correlation analysis of the attribute
ratings of the controllability respondents and the
coordinates of the activities in the two-dimensional
solution was performed to discover any relationships among
the attribute data and the placement of the activities in
Figure 4-1. In other words, the average ratings on the
attributes for activities one through nine were correlated
with the dimension coordinates for activities one through
nine, respectively. As explained in Chapter III, the
purpose of canonical correlation is to account for the
maximum relationship between two sets of variables (i.e.,
the dimension coordinates and the mean adjective ratings).
The largest possible relationship is identified by the
first correlation coefficient, and the corresponding linear
combination of the variables is called the first canonical
variate. A second combination (the second variate) of the
two sets of variables maximizes correlations between linear
combinations which were uncorrelated with the first linear
combinations.
Redundancy Analysis was used to explain the proportion of variance in the similarity judgments that was accounted for by the canonical variate for the attribute ratings. (Refer to Dillon and Goldstein (1984, 347-352) for details concerning this procedure.) The seven attributes were found to explain 98.9% of the dimension variance. The correlations between the ratings and the dimensions were inspected to judge whether all seven attributes were essential for a parsimonious analysis. Schiffman, Reynolds, and Young (1981, 285) suggest that to ensure robust estimation of the weights in a canonical analysis of MDS output, the total number of variables in both data sets should be less than the number of stimuli. Therefore, limiting the number of attribute variables to six would meet this recommendation, since six plus the two dimensions would be less than the nine audit activities included in the study.

All seven attributes were included in the first analysis and then the attributes with the lowest correlations with both dimensions were dropped, one at a time. Analyses of six attributes and the two dimensions, five attributes and the two dimensions, and finally, four attributes and the two dimensions were conducted.

The five-attribute analysis explained approximately the same percentage (98.2%) of the dimension variance as the six-attribute analysis and resulted in variates which were highly correlated with only one dimension. The
interpretation of the six-attribute analysis was not clear because the attribute variates had high (> .5) weights on both dimensions. Reducing the number of attributes to four lowered the percentage of dimension variance explained to 88.5% and the variates were not as clear in their interpretation as the variates in the five variable analysis. Therefore, the minimum number of attributes for the canonical correlation was selected to be five. The variables selected and their weights on each variate are shown in Table 4-1.

**TABLE 4-1**

CANONICAL CORRELATION WITH THE FIVE ATTRIBUTES AND THE DIMENSION COORDINATES OF THE CONTROLLABILITY SOLUTION

<table>
<thead>
<tr>
<th>Attributes</th>
<th>First Variate</th>
<th>Second Variate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Independence</td>
<td>.8039</td>
<td>.3423</td>
</tr>
<tr>
<td>Assurance Provided</td>
<td>.0167</td>
<td>-.7303</td>
</tr>
<tr>
<td>Level of Involvement</td>
<td>-.4713</td>
<td>-.4660</td>
</tr>
<tr>
<td>Role of Independent Appraiser</td>
<td>.7333</td>
<td>-.5864</td>
</tr>
<tr>
<td>Role of Participant in Design</td>
<td>-.7783</td>
<td>-.1922</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Attribute Variates</th>
<th>First</th>
<th>Second</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimension One</td>
<td>.9938</td>
<td>-.0772</td>
</tr>
<tr>
<td>Dimension Two</td>
<td>.1106</td>
<td>.9792</td>
</tr>
</tbody>
</table>

The use of canonical correlation analysis for descriptive purposes requires no distributional assumptions [Dillon and Goldstein (1984, 339)]. However, significance tests for the relationships between canonical variates do require multivariate normality and homogeneity of variance.
Therefore, these significance tests were used very conservatively (Schiffman, Reynolds, and Young (1981, 284)). Significance had to be substantial to reach the conclusion from these tests that there was a relationship. The hypothesis that the correlation coefficient was zero was rejected for the first and second variates with p-values of .03 and .05, respectively. Therefore, these tests give support for the canonical relationships found in the analysis.

To test the validity of the above weights, the controllability respondents were categorized by four demographic variables and canonical correlations were calculated for each subgroup. The most highly weighted attributes on most of the canonical variates were found to be consistent with the findings of the analysis for the combined group. Appendix F presents the canonical weights from the analyses for four of the demographic variables.

Canonical weights are comparable to regression weights. The magnitude of the weight indicates the importance of the variable in obtaining a maximum correlation between the two sets (Dillon and Goldstein (1984, 338-339)). The ideal output for the interpretation of the relationship between an attribute and a dimension would be a high (> .5) weight on one variate and a low weight on the other variate. In addition, one variate should have a high weight on one dimension and a low weight on the other and vice versa for the other variate.
In the canonical analysis of the five attributes and the dimension coordinates of the controllability solution, the first and second attribute variates displayed a strong and unique relationship to dimensions one and two, respectively. Therefore, the attributes with high weights on the variates were used in interpreting the dimensions of the controllability solution.

**Controllability Dimension One**

Dimension one (refer to Figure 4-1) is characterized by the spacing of the nine stimulus points along the horizontal axis. Distance between the activities on dimension one is measured along the X axis. The vertical distance between the stimuli, which is measured along the Y axis, was ignored for this analysis.

The information contained in the first canonical variate was used to "explain" the horizontal "distance" between activities. Without consideration of their signs, three attributes had weights greater than .5 on the first variate and a fourth attribute had a weight of over .47:

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The activity's impact on internal auditor independence</td>
<td>.8039</td>
</tr>
<tr>
<td>2. The role of independent appraiser</td>
<td>.7333</td>
</tr>
<tr>
<td>3. The role of participant in design</td>
<td>-.7783</td>
</tr>
<tr>
<td>4. The level of involvement</td>
<td>-.4713</td>
</tr>
</tbody>
</table>

The above weights indicate that internal auditors in the controllability group considered these four attributes when making their similarity judgments. An inverse relationship between the two attributes, "independence" and "role of the independent appraiser," and the two
attributes, "role of participant in design" and "level of involvement," is indicated by the opposite signs of their weights. This inverse relationship was considered when interpreting the placement of activities on dimension one (refer to Figure 4-1).

Based upon the information provided by the attribute ratings and the researcher's understanding of the literature on systems design audit activities, the horizontal stimulus space was interpreted as dividing activities into two major clusters: (1) independent appraiser activities and (2) participant-in-design activities. Activities which had no effect on internal auditor independence were clustered together as independent appraiser activities. Participant-in-design activities were represented on the opposite end of the horizontal axis. Performing an activity which required the internal auditor to assume the role of participant in design was perceived as having a negative effect upon internal auditor independence. Thus, dimension one was interpreted as representing "the activity's effect on internal auditor independence." This finding confirms the research expectations concerning the controllability group.

In consideration of the insight provided by the attribute ratings and the observed activity groupings, dimension one was named The Activity's Effect On Internal Auditor Independence. The conflicting relationship between performing high involvement activities and maintaining
internal auditor independence is supported in the literature review.

Table 2-5 lists authors who advocate that internal auditors review or evaluate system controls during systems development. Many of these same authors state that internal auditors should make recommendations for controls to be included in the system under development. Activities which appear to represent this appraisal function were observed to the left of the origin on the X axis. The activities in this cluster are:

<table>
<thead>
<tr>
<th>Primary Independent Appraiser Activity Cluster</th>
<th>Rank</th>
<th>Activity</th>
<th>Description</th>
<th>Coordinate</th>
</tr>
</thead>
<tbody>
<tr>
<td>First</td>
<td>Two</td>
<td>Identify Control Weaknesses</td>
<td>-1.1371</td>
<td></td>
</tr>
<tr>
<td>Second</td>
<td>One</td>
<td>Review/Evaluate Controls</td>
<td>-1.1249</td>
<td></td>
</tr>
<tr>
<td>Third</td>
<td>Five</td>
<td>Recommend Controls</td>
<td>-1.0087</td>
<td></td>
</tr>
<tr>
<td>Fourth</td>
<td>Four</td>
<td>Provide Several Control Solutions</td>
<td>-0.8914</td>
<td></td>
</tr>
</tbody>
</table>

According to the attribute weights, internal auditors judged the above activities as having little negative impact on internal auditor independence. Consequently, these activities were labeled as the independent appraiser activity cluster.

The activities on the opposite end of this dimension (the activities to the right of the origin) are divided into two clusters (refer to Figure 4-1):

<table>
<thead>
<tr>
<th>Primary Participant-in-Design Activity Cluster</th>
<th>Rank</th>
<th>Activity</th>
<th>Description</th>
<th>Coordinate</th>
</tr>
</thead>
<tbody>
<tr>
<td>First</td>
<td>Six</td>
<td>Serve As Member of Development Team</td>
<td>1.3555</td>
<td></td>
</tr>
<tr>
<td>Second</td>
<td>Nine</td>
<td>Assist in Design</td>
<td>1.2903</td>
<td></td>
</tr>
<tr>
<td>Third</td>
<td>Seven</td>
<td>Act as Control Consultant</td>
<td>.9931</td>
<td></td>
</tr>
</tbody>
</table>

Secondary Participant-in-Design Activity Cluster

<table>
<thead>
<tr>
<th>Rank</th>
<th>Activity</th>
<th>Description</th>
<th>Coordinate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fourth</td>
<td>Eight</td>
<td>Sign-Off</td>
<td>.3068</td>
</tr>
<tr>
<td>Fifth</td>
<td>Three</td>
<td>Provide A Checklist of Controls</td>
<td>.2165</td>
</tr>
</tbody>
</table>
Activities six, nine, and seven were considered primary activities because they are located in positions roughly opposite from the activities in the independent activity group. The first two of the above activities, "serve as member of development team" and "assist in design," are "high involvement" activities which several authors claim negatively affects internal auditor independence [Lathrop (1985) and Perry (1981)]. Therefore, this activity grouping was named the primary participant-in-design activity cluster.

Activities eight ("sign-off") and three ("provide a checklist of controls") were labeled as secondary activities because of their placement relatively close to the origin on the X axis. Respondents did not appear to judge these two activities as affecting the internal auditor's independence in the same manner as the three activities included in the primary participant in design cluster. Dimension two was the primary determinant of the placement of activities eight and three.

Controllability Dimension Two

Dimension two (see Figure 4-1) is characterized by the spacing of the nine stimulus points along the vertical axis. Distance between stimuli is measured along the Y axis. Horizontal distance between the stimuli was considered to be irrelevant for this dimension.

The second canonical attribute variate was examined to provide insight into the stimuli spacing on dimension two.
Two attributes had weights greater than .5 on the second variate and a third attribute had a weight approaching .5 on the second variate:

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Weights</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The assurance of adequate controls provided by each activity</td>
<td>-.7303</td>
</tr>
<tr>
<td>2. The role of independent appraiser</td>
<td>-.5864</td>
</tr>
<tr>
<td>3. The level of involvement</td>
<td>-.4660</td>
</tr>
</tbody>
</table>

All of the above attributes are negative, which indicates an inverse relationship with another attribute [Dillon and Goldstein (1984, 339)]. The only positive attribute on the second variate is "independence" (.3423). Therefore, maintaining internal auditor independence was perceived as contradictory to assuring the controllability of a system. However, the "role of independent appraiser" attribute, with a weight of -.5864, was perceived as consistent with this objective. Respondents perceived that internal auditors should act in an appraiser role when assuring the controllability of a system. However, internal auditors appear to de-emphasize the importance of independence when assuming this role. This interpretation is supported by the observed activity clusters.

The "assurance provided" attribute had the strongest relationship to the spacings represented by the second dimension. This relationship indicates that the stimulus spacings represent a measure of the assurance of adequate EDP application controls which was provided by each activity. This finding confirms the research expectations for the controllability group.
Activities which internal auditors interpreted as fulfilling the role of appraiser were also perceived as providing assurance of the controllability of the system. Consequently, dimension two is named Assurance Provided by Appraisal Activities. The activity clusters on dimension two are labeled least- and most-assurance activity clusters to reflect the above relationships.

Two activities were at extreme poles on this dimension. At one pole is activity three, in which the auditor provides a checklist of controls to systems personnel. This activity does not require internal auditor involvement in the development process and was perceived as providing the least assurance that adequate controls are built into the system. Separated by a large distance from activity three, activities four and five were considered to be another primary cluster of activities:

<table>
<thead>
<tr>
<th>Rank</th>
<th>Activity</th>
<th>Description</th>
<th>Coordinate</th>
</tr>
</thead>
<tbody>
<tr>
<td>First</td>
<td>Three</td>
<td>Provide a Checklist of Controls</td>
<td>-1.9484</td>
</tr>
<tr>
<td>Second</td>
<td>Four</td>
<td>Provide Several Control Solutions</td>
<td>-0.8143</td>
</tr>
<tr>
<td>Third</td>
<td>Five</td>
<td>Recommend Controls</td>
<td>-0.3740</td>
</tr>
</tbody>
</table>

Activity seven, "act as a control consultant," is placed almost on the origin of the Y axis (refer to Figure 4-1), which signifies that dimension two had very little influence on internal auditors' similarity judgments concerning this activity. Therefore, activity seven is omitted from the activity clusters on dimension two.

Activity eight, in which the auditor "signs-off" or approves the controls as designed, is at the pole opposite
activity three. This appraisal activity is interpreted as providing the most assurance that adequate controls are built into the system. After a large distance gap, activity one ("review/evaluate controls") and activity two ("identify control weaknesses") follow. Activities one and two are closely spaced on dimension two, which means that they were considered to be very similar on this dimension. The primary most-assurance activity clusters are:

<table>
<thead>
<tr>
<th>Rank</th>
<th>Activity</th>
<th>Description</th>
<th>Coordinate</th>
</tr>
</thead>
<tbody>
<tr>
<td>First</td>
<td>Eight</td>
<td>Sign off</td>
<td>1.9490</td>
</tr>
<tr>
<td>Second</td>
<td>One</td>
<td>Review/Evaluate Controls</td>
<td>.5447</td>
</tr>
<tr>
<td>Third</td>
<td>Two</td>
<td>Identify Control Weaknesses</td>
<td>.5086</td>
</tr>
</tbody>
</table>

Activities nine ("assist in design"), six ("member of development team"), and seven ("act as control consultant") are gathered around the origin of the Y axis (refer to Figure 4-1) and, therefore, are not included in an activity cluster on dimension two. The major criterion used by subjects in making similarity judgments about these activities was "internal auditor independence."

**Summary of the Controllability Analysis**

The controllability analysis answered the following research questions:

1. Does a two-dimensional solution adequately describe the structure of systems design audit activities?
(2) Do the two dimensions represent:

1. The benefit derived from involvement in systems design: assurance that adequate controls are built into the system; and
2. The activity's effect on internal auditor independence?

(3) Do the attributes chosen by the researcher aid in defining the dimensions of the controllability group?

Respondents to the controllability questionnaire made 36 similarity judgments concerning nine audit activities performed during systems design. Participants were told to assume that the major purpose of internal auditor involvement was to provide assurance that adequate EDP controls were designed into the system.

The similarity judgments were analyzed using MDS in both two and three dimensions. The two-dimensional solution was determined to be parsimonious. The clusterings of the nine activities on the two dimensions were then interpreted.

Respondent ratings of each activity on attributes selected from the literature provided objective evidence to aid in this interpretation. The attributes underlying dimension one and dimension two were identified as:

(1) the activity's effect on internal auditor independence, and
(2) the assurance of adequate controls provided by each appraisal activity.

The activity clusters on each dimension are summarized in Table 4-2. The above findings provide empirical support
for the conflicting relationship between internal auditor

### TABLE 4-2

**TOTAL CONTROLLABILITY GROUP ACTIVITY COORDINATES AND DIMENSION ACTIVITY CLUSTERS**

<table>
<thead>
<tr>
<th>ACTIVITY</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>REVIEW/EVALUATE CONTROLS</td>
</tr>
<tr>
<td>2</td>
<td>IDENTIFY CONTROL WEAKNESSES</td>
</tr>
<tr>
<td>3</td>
<td>PROVIDE CHECKLIST OF CONTROLS</td>
</tr>
<tr>
<td>4</td>
<td>PROVIDE SEVERAL CONTROL SOLUTIONS</td>
</tr>
<tr>
<td>5</td>
<td>RECOMMEND CONTROLS</td>
</tr>
<tr>
<td>6</td>
<td>SERVE AS MEMBER OF DEVELOPMENT TEAM</td>
</tr>
<tr>
<td>7</td>
<td>ACT AS CONTROL CONSULTANT</td>
</tr>
<tr>
<td>8</td>
<td>SIGN-OFF</td>
</tr>
<tr>
<td>9</td>
<td>ASSIST IN DESIGN</td>
</tr>
</tbody>
</table>

**ACTIVITY CLUSTERS AND COORDINATES***

<table>
<thead>
<tr>
<th>ACTION CLUSTERS</th>
<th>DIMENSION ONE</th>
<th>DIMENSION TWO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>GROUP COORDINATE</td>
<td>GROUP COORDINATE</td>
</tr>
<tr>
<td>1</td>
<td>INDEPENDENT APRAISER</td>
<td>MOST ASSURANCE</td>
</tr>
<tr>
<td>2</td>
<td>INDEPENDENT APRAISER</td>
<td>MOST ASSURANCE</td>
</tr>
<tr>
<td>3</td>
<td>PARTICIPANT IN DESIGN</td>
<td>LEAST ASSURANCE</td>
</tr>
<tr>
<td>4</td>
<td>INDEPENDENT APRAISER</td>
<td>LEAST ASSURANCE</td>
</tr>
<tr>
<td>5</td>
<td>INDEPENDENT APRAISER</td>
<td>LEAST ASSURANCE</td>
</tr>
<tr>
<td>6</td>
<td>PARTICIPANT IN DESIGN</td>
<td>MOST ASSURANCE</td>
</tr>
<tr>
<td>7</td>
<td>PARTICIPANT IN DESIGN</td>
<td>MOST ASSURANCE</td>
</tr>
<tr>
<td>8</td>
<td>PARTICIPANT IN DESIGN</td>
<td>MOST ASSURANCE</td>
</tr>
<tr>
<td>9</td>
<td>PARTICIPANT IN DESIGN</td>
<td>MOST ASSURANCE</td>
</tr>
</tbody>
</table>

*Activities with coordinates of less than absolute 20 were omitted from the activity clusters on that dimension.

participation in systems design and internal auditor independence which is discussed in the literature.

**Interpretation of the Auditability Solution**

In a manner similar to the controllability analysis, the canonical correlation between the seven attribute ratings and the coordinates of the activities on the two dimensions was calculated. Redundancy analysis found that the seven attributes explained 96% of the dimension variance. This high percentage supports the use of the
attributes to explain the placement of the activities on each dimension.

As discussed in the controllability analysis, the significance tests for the relationships between canonical variates were used very conservatively. Significance had to be substantial to conclude from these tests that there was a relationship. The hypothesis that the correlation coefficient was zero was rejected for the first variate (p-value of .00), but not for the second (p-value of .50).

In an attempt to ensure robust estimates of the canonical weights (Schiffman, Reynolds, and Young, 1981), the analysis was conducted using six attributes instead of all seven. The "level of involvement" attribute, which was highly correlated with the two attributes, "role of future user" (.94) and "role of participant in design" (.96), was removed. This six-attribute analysis resulted in weights very similar to those in the seven-attribute solution. However, the redundancy coefficient was reduced to 95.5%, and the hypothesis that the canonical correlation was zero could not be rejected for either variate (p-values of .17 and .19). Another analysis was conducted by eliminating the attribute "independence," which was selected because it had low correlations with dimensions one and two, -0.2989 and 0.3641, respectively. As in the previous six-variable test, the hypothesis of zero correlation could not be rejected for either variate, but the resulting weights and
their interpretations were similar to the other analyses (Appendix F).

The seven-attribute analysis was chosen for use in interpreting the dimensions. Reliance on the attribute weights from this analysis was supported by the fact that the weights in the seven-attribute solution were consistent with those in the two six-attribute analyses. The high predictive ability of the attributes, as indicated by the high percentage of dimension variance explained (96%), gives credence to the relationships identified in the weighting of the seven attributes displayed in Table 4-3.

<table>
<thead>
<tr>
<th>Attributes</th>
<th>Weighting</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>First Variate</td>
<td>Second Variate</td>
<td></td>
</tr>
<tr>
<td>Independence</td>
<td>.1452</td>
<td>.4659</td>
<td></td>
</tr>
<tr>
<td>Assurance Provided</td>
<td>-.0425</td>
<td>-.8619</td>
<td></td>
</tr>
<tr>
<td>Level of Involvement</td>
<td>.3615</td>
<td>-.7954</td>
<td></td>
</tr>
<tr>
<td>Independent Appraiser</td>
<td>-.8471</td>
<td>.3505</td>
<td></td>
</tr>
<tr>
<td>Role of Consultant</td>
<td>.7242</td>
<td>.1326</td>
<td></td>
</tr>
<tr>
<td>Role of Future User</td>
<td>.2219</td>
<td>-.8392</td>
<td></td>
</tr>
<tr>
<td>Role of Participant in Design</td>
<td>.5785</td>
<td>-.7019</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Attribute Variates</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>First</td>
<td>Second</td>
</tr>
<tr>
<td>Dimension One</td>
<td>.9369</td>
<td>-.3348</td>
</tr>
<tr>
<td>Dimension Two</td>
<td>.4135</td>
<td>.8723</td>
</tr>
</tbody>
</table>

Caution must be used when interpreting the second variate because the hypothesis that the canonical correlation is zero could not be rejected. However, additional support for these findings was obtained by categorizing the
auditability subjects according to five demographic variables, in a manner similar to the analysis for the controllability subjects. Canonical correlations were calculated for each subgroup. The highest weighted attributes on most of the canonical variates were found to be consistent with the findings of the canonical correlation analysis of the attribute data for the total auditability group. Appendix G presents the canonical weights which resulted from the analyses of the five demographic variable groups.

The variates which resulted from the canonical correlation between the seven attribute variables and the dimension coordinates of the nine stimuli (Table 4-3) were clearly interpretable. Variates one and two displayed a strong relationship to dimensions one and two, respectively. Therefore, the attributes with high weights on the first variate were used to explain dimension one and the attributes with high weights on the second variate were used to explain dimension two. In addition, activity clusters were also carefully studied by the researcher before dimensions were named.

**Auditability Dimension One**

Dimension one (refer to Figure 4-2) is characterized by the spacing of the nine audit activity points along the horizontal axis. Distance between activities on dimension one is measured along the X axis. The vertical distance
between activities which is measured along the Y axis was ignored for this analysis.

The information contained in the first canonical variate was used to "explain" the horizontal spread among activities. Three attributes had high weights on the first variate:

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Weighting</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The role of independent appraiser</td>
<td>-.8471</td>
</tr>
<tr>
<td>2. The role of consultant</td>
<td>.7242</td>
</tr>
<tr>
<td>3. The role of participant in design</td>
<td>.5785</td>
</tr>
</tbody>
</table>

The above weights indicate that the auditability respondents perceived the roles of consultant and participant in design as conflicting to the role of independent appraiser. The attribute "independence" had a low weight (.1452) on the first variate and, therefore, was not considered a factor in the activity groupings on dimension one. Therefore, dimension one for the auditability respondents represented neither "an activity's effect on internal auditor independence," nor "the assurance provided for the auditability of the system."

The canonical correlation analysis reveals an inverse relationship between the traditional audit role of appraiser and the roles of consultant and participant in design. When judging the similarity of audit activities on this dimension respondents considered the role that the internal auditor should assume when assuring the auditability of a system. Therefore, dimension one is labeled The Internal Auditor's Role in Assuring Auditability.
On dimension one, the activities to the right of the origin on the X axis may be considered potential activities for assuring auditability. This potential auditability activity cluster includes:

<table>
<thead>
<tr>
<th>Rank</th>
<th>Activity</th>
<th>Description</th>
<th>Coordinate</th>
</tr>
</thead>
<tbody>
<tr>
<td>First</td>
<td>Three</td>
<td>Provide General Audit Requirements</td>
<td>1.2297</td>
</tr>
<tr>
<td>Second</td>
<td>Seven</td>
<td>Consultant for Audit Requirements</td>
<td>1.0027</td>
</tr>
<tr>
<td>Third</td>
<td>Four</td>
<td>Provide Several Audit Requirement Solutions</td>
<td>0.9590</td>
</tr>
<tr>
<td>Fourth</td>
<td>Five</td>
<td>Submit Audit Specifications</td>
<td>0.6676</td>
</tr>
</tbody>
</table>

The activities to the left of the origin on the X axis consist of activities performed when the internal auditor assumes the role of appraiser. Consequently, these activities are called appraisal activities, and are grouped in the following clusters:

<table>
<thead>
<tr>
<th>Rank</th>
<th>Activity</th>
<th>Description</th>
<th>Coordinate</th>
</tr>
</thead>
<tbody>
<tr>
<td>First</td>
<td>Eight</td>
<td>Sign-Off</td>
<td>-1.8396</td>
</tr>
<tr>
<td>Second</td>
<td>One</td>
<td>Review/Evaluate Auditability</td>
<td>-0.9886</td>
</tr>
<tr>
<td>Third</td>
<td>Two</td>
<td>Identify Audit Weaknesses</td>
<td>-0.8595</td>
</tr>
</tbody>
</table>

Activity eight (sign-off) is the extreme pole in the appraisal activity cluster. "Identify audit weaknesses" was located very close (Figure 4-2) to the "review/evaluate" activity, which indicates that the respondents viewed these two activities as very similar. However, a large gap separates these activities from the activity "sign-off." Approximately the same spacing was observed among the activities in the second dimension of the controllability solution (Figure 4-1), which also represented appraisal activities. "Sign-off" had the
highest rank of any appraisal activity in both respondent groups.

Activities six ("member of development team") and nine ("assist in design") are located very close to the origin on the X axis (refer to Figure 4-2). This location indicates that dimension two, the vertical spread, was the most important consideration in the internal auditors' assessment of these activities.

**Auditability Dimension Two**

Dimension two (see Figure 4-2) is characterized by the spacing of the nine stimulus points along the vertical axis. Distance between activities on dimension two is measured along the Y axis, which is divided by the X axis. Horizontal distance between the stimuli are irrelevant for this dimension.

The second canonical attribute variate was examined to provide insight into the stimuli spacing on auditability dimension two. Although the likelihood test did not support this canonical correlation, the attribute weights did aid the researcher in determining the interpretation of this dimension. The attributes with the highest weights on the second variate are:

<table>
<thead>
<tr>
<th>Rank</th>
<th>Attribute</th>
<th>Weighting</th>
</tr>
</thead>
<tbody>
<tr>
<td>First</td>
<td>Assurance Provided</td>
<td>-.8619</td>
</tr>
<tr>
<td>Second</td>
<td>The Role of Future User</td>
<td>-.8392</td>
</tr>
<tr>
<td>Third</td>
<td>The Level of Involvement</td>
<td>-.7954</td>
</tr>
<tr>
<td>Fourth</td>
<td>The Role of Participant in Design</td>
<td>-.7019</td>
</tr>
<tr>
<td>Fifth</td>
<td>Independence</td>
<td>.4659</td>
</tr>
</tbody>
</table>

"Assurance provided" has the highest weight, followed in order by the "role of future user," the "level of
involvement," and the "role of participant in design" attributes. These attributes represent the criteria considered most important by the internal auditors when judging the similarity of the activities on this dimension. Although the "independence" attribute has a weight of less than .5, it must be considered in the understanding of dimension two. "Independence" is positively weighted while all of the other attribute weights are negative. Therefore, maintaining internal auditor independence was considered to be adverse to assuring the auditability of the system.

Auditability dimension two represented the assurance of auditability provided by the activity, and was named Assurance Provided By Each Activity. The activities which were performed in the roles of both future user of the system and participant in design and which were high-involvement activities provided the most assurance that audit needs were met. The activities on dimension two were labeled either least-assurance or most-assurance activities.

The highest ranking of the most-assurance activities is shared by activities six ("member of development team") and nine ("assist in design"). This means that the auditability respondents, as a group, viewed these activities as identical on this dimension. The most-assurance activity clusters are:
In addition to "assurance provided," "level of involvement" and the "role of participant in design" were also associated with this activity grouping. Another attribute with a high weight on this dimension was the "role of future user." Therefore, the activities included in the above primary cluster are empirically identified as "high involvement," "participant in design," and "future user" activities. Although several recent publications (e.g., Kuong, 1988) associate future user activities with assuring the auditability of a system, to the researcher's knowledge, this is the first empirical identification of specific future user activities.

The least-assurance activities on dimension two were perceived as providing little assurance of the auditability of the system and consist of the following:

<table>
<thead>
<tr>
<th>Rank</th>
<th>Activity</th>
<th>Description</th>
<th>Coordinate</th>
</tr>
</thead>
<tbody>
<tr>
<td>First</td>
<td>Two</td>
<td>Identify Audit Weaknesses</td>
<td>-1.2686</td>
</tr>
<tr>
<td>Second</td>
<td>One</td>
<td>Review/Evaluate Auditability</td>
<td>-1.0951</td>
</tr>
<tr>
<td>Third</td>
<td>Four</td>
<td>Provide Several Audit Requirement Solutions</td>
<td>-0.8766</td>
</tr>
<tr>
<td>Fourth</td>
<td>Three</td>
<td>Provide General Audit Requirements</td>
<td>-0.8664</td>
</tr>
</tbody>
</table>

The above activities are recognized in the literature as appraisal activities. (See Table 2-5 for a list of authors...
Internal auditors perceived that independent appraiser activities provide little assurance that the system will be auditable when implemented.

**Summary of the Auditability Analysis**

The auditability analysis addressed the following research questions:

1. Does a two-dimensional solution describe the structure of systems design audit activities?

2. Do the two dimensions represent:
   a. The benefit derived from involvement in systems design: assurance of the auditability of the system; or
   b. The activity's effect on internal auditor independence?

3. Do the attributes chosen by the researcher aid in defining the dimensions of the auditability group?

Respondents to the auditability questionnaire made 36 similarity judgments concerning nine audit activities performed during systems design. Participants were told to assume that the major purpose of internal auditor involvement was to assure the auditability of the system.

The similarity judgments were analyzed by MDS in both two and three dimensions. The two-dimensional solution was determined to be parsimonious. The spacing of the nine activities on the two dimensions was then interpreted.

Respondent ratings of each activity on seven selected attributes provided objective evidence to aid in this interpretation. The attributes underlying dimension one and dimension two, respectively, were identified as:
(1) The internal auditor's role in auditability, and
(2) The assurance of auditability provided by each activity.

The activity groupings on each dimension are shown in Table 4-4. Dimension two provides empirical evidence that internal auditors do perceive a role of future user when attempting to assure the auditability of the system. Dimension one reflects the viewpoint that the role of

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**TABLE 4-4**

TOTAL AUDIT GROUP ACTIVITY COORDINATES

<table>
<thead>
<tr>
<th>ACTIVITY</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>REVIEW/EVALUATE AUDITABILITY</td>
</tr>
<tr>
<td>2</td>
<td>IDENTIFY AUDIT WEAKNESSES</td>
</tr>
<tr>
<td>3</td>
<td>PROVIDE GENERAL AUDIT REQUIREMENTS</td>
</tr>
<tr>
<td>4</td>
<td>PROVIDE SEVERAL AUDIT REQUIREMENT SOLUTIONS</td>
</tr>
<tr>
<td>5</td>
<td>SUBMIT AUDIT SPECIFICATIONS</td>
</tr>
<tr>
<td>6</td>
<td>MEMBER OF DEVELOPMENT TEAM</td>
</tr>
<tr>
<td>7</td>
<td>CONSULTANT FOR AUDIT REQUIREMENTS</td>
</tr>
<tr>
<td>8</td>
<td>SIGN-OFF</td>
</tr>
<tr>
<td>9</td>
<td>ASSIST IN DESIGN</td>
</tr>
</tbody>
</table>

**ACTIVITY CLUSTERS AND COORDINATES***

<table>
<thead>
<tr>
<th>ACTIVITY</th>
<th>DIMENSION ONE GROUP</th>
<th>DIMENSION ONE COORDINATE</th>
<th>DIMENSION TWO GROUP</th>
<th>DIMENSION TWO COORDINATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>APPRAISAL</td>
<td>-0.9886</td>
<td>LEAST ASSURANCE</td>
<td>-1.0951</td>
</tr>
<tr>
<td>2</td>
<td>APPRAISAL</td>
<td>-0.8595</td>
<td>LEAST ASSURANCE</td>
<td>-1.2686</td>
</tr>
<tr>
<td>3</td>
<td>CONSULTANT</td>
<td>1.2297</td>
<td>LEAST ASSURANCE</td>
<td>-0.8664</td>
</tr>
<tr>
<td>4</td>
<td>CONSULTANT</td>
<td>0.9590</td>
<td>LEAST ASSURANCE</td>
<td>-0.8766</td>
</tr>
<tr>
<td>5</td>
<td>CONSULTANT</td>
<td>0.6676</td>
<td>MOST ASSURANCE</td>
<td>1.0618</td>
</tr>
<tr>
<td>6</td>
<td>APPRAISAL</td>
<td>-0.1198</td>
<td>MOST ASSURANCE</td>
<td>1.3149</td>
</tr>
<tr>
<td>7</td>
<td>CONSULTANT</td>
<td>1.0027</td>
<td>MOST ASSURANCE</td>
<td>0.2239</td>
</tr>
<tr>
<td>8</td>
<td>APPRAISAL</td>
<td>-1.8396</td>
<td>*</td>
<td>0.1913</td>
</tr>
<tr>
<td>9</td>
<td>*</td>
<td>-0.0514</td>
<td>MOST ASSURANCE</td>
<td>1.3149</td>
</tr>
</tbody>
</table>

*Activities with coordinates of less than absolute 20 were omitted from the activity clusters on that dimension.
consultant rather than appraiser is appropriate when assuring the auditability of a system.

Comparison of the Controllability and Auditability Solutions

Separate instruments were used to capture the internal auditors' perceptions of nine selected systems design audit activities under two different assumptions:

1) The Controllability Questionnaire presented the assumption that the major purpose of the nine audit activities was to provide assurance that adequate EDP application controls were designed into the system.

2) The Auditability Questionnaire presented the assumption that the major purpose of the nine audit activities was to provide assurance that the system would be auditable when implemented.

The similarity judgments of internal auditors in both respondent groups were presented in two-dimensional MDS solutions. The particular attributes related to the dimensions and the resulting interpretations were compared between the controllability and auditability groups to answer the following research question:

Are there differences between the perceptions of internal auditors responding to the controllability instrument and the perceptions of internal auditors responding to the auditability instrument?

Differences were observed between the perceptions of the two respondent groups. The attributes underlying dimension one and two for each group are presented below:
1. **Controllability Respondent Attributes:**

- **Dimension One:** The activity's effect on internal auditor independence, and
- **Dimension Two:** The assurance of adequate controls provided by each appraisal activity.

2. **Auditability Respondent Attributes:**

- **Dimension One:** The internal auditor's role in assuring auditability, and
- **Dimension Two:** The assurance of auditability provided by each activity.

Dimension one represents the dimension of greatest importance to the respondents. For the controllability group, dimension one reflected the conflict between internal auditor independence and high-involvement or participation in design which is frequently addressed in the literature (Grabski (1986)). In contrast, "internal auditor independence" was not a significant criterion on dimension one for the auditability group. Dimension one of the auditability group revealed a distinction between the auditor's traditional role of appraiser and the roles which may be assumed when assuring the auditability of the system. This distinction implies that internal auditors should assume the roles of consultant or participant in design rather than the role of independent appraiser when assuring the auditability of the system.

Dimension two was named Assurance Provided in both the controllability and auditability solutions because "assurance provided" was the primary attribute which differentiated activity spacing on this dimension. Activities for both groups were divided into those
providing the least assurance and those providing the most assurance. There was, however, a major difference in the interpretation of this dimension between the two groups.

The controllability group appeared to consider the level of assurance provided by appraisal activities only. The auditability group did not restrict the focus of dimension two to appraisal activities. In fact, the auditability respondents identified tasks which provide the least assurance as independent appraisal activities. The tasks which provide the most assurance concerning the auditability of the system were identified as activities performed by the auditor in the role of future user and in the role of participant in design.

Supplemental Data Analyses

Two supplemental data analyses were conducted: (1) An Unfolding MDS Analysis, and (2) An Analysis of Subject Differences. These analyses were performed to provide additional insight into internal auditor perceptions of the relationships among systems design audit activities. The detailed analyses are presented in Appendices G-J.

Unfolding MDS Analysis

An unfolding MDS analysis was conducted for each respondent group to answer the following research question:

Is there a strong relationship between the seven attributes and the nine systems design audit activities?

A successful analysis would portray relationships between the attributes and the activities in a joint-space
analysis. In other words, attributes and activities would be represented as points on the same MDS graph.

Unfortunately, joint-space analysis is plagued with a high probability of a degenerate solution [Schiffman, Reynolds, and Young (1981, 64)].

Two-dimensional unfolding MDS solutions were obtained for the controllability and auditability groups. (Three-dimensional solutions are not possible with the unfolding model.) These solutions were determined to be degenerate from their low STRESS and high r-square values, from the compact clusterings of the activities and attributes on their spatial configurations, and from their scatterplots of distances versus disparities. Therefore, no conclusions were made from this analysis. [See Appendix H.]

Investigation of Subject Differences

The primary data analysis presented interpretations of the two-dimensional MDS solutions for the controllability and auditability respondents. The major advantage of a weighted MDS model is the ability to examine individual differences as well as the group structure.

Subject weights were calculated as measures of the importance of each dimension in a respondent's similarity judgments. [Appendix I presents the subject weight scores.] Examination of individual subject weights for each solution positively answered the next research question:

Do internal auditors tend to agree in their similarity judgments?
In addition to examining the subject weight scores on each dimension, MDS procedures were used to compute another measure of the importance of the dimensions to each subject within the responding groups. [See Schiffman, Reynolds, and Young (1981, 309-313) for details concerning this procedure.] With this measure, each respondent was represented as a point, known as a "flattened" subject weight. [The flattened subject weights are presented in Appendix I.] The large number of subjects made the interpretation of the flattened subject weights difficult. Therefore, these weights were categorized to aid in their interpretation. A similar procedure was used by Milliron (1985). When making their similarity judgments, subjects who considered:

(1) Dimensions one and two to be of equal importance are represented by points located around zero (measurements from -.25 to +.25);

(2) Dimension two to be more important than dimension one are represented by points to the left of -.25; and

(3) Dimension one to be more important than dimension two are represented by points to the right of +.25.

The above categories were used to aid in explaining subject differences. A basis for categorizing subjects was needed before further analysis of these subject weights could be conducted. This need led to the next research question:

Are there significant relationships among subject weighting and participants' background and attitudinal information?
The analyses of the two respondent groups are discussed separately and then summarized.

**Controllability Subject Differences**

A canonical correlation analysis of the controllability respondents' demographic data and the activity coordinates of the controllability solution (Appendix J) revealed that a subject's "job classification" influenced his similarity judgments. Controllability respondents were almost equally divided between:

1. EDP specialists (the EDP group), and
2. General internal auditors (the non-EDP group).

An analysis of the flattened subject weights for each subgroup is presented in Table 4-5.

---

**TABLE 4-5**

**CONTROLLABILITY RESPONDENTS: THE IMPORTANCE OF EACH DIMENSION**

<table>
<thead>
<tr>
<th>Most Important Dimension(s)</th>
<th>Percent of Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Both Dimensions</td>
<td>EDP 25.0%  Non-EDP 12.6%</td>
</tr>
<tr>
<td>Dimension One</td>
<td>EDP 45.4%  Non-EDP 62.5%</td>
</tr>
<tr>
<td>Dimension Two</td>
<td>EDP 29.5%  Non-EDP 24.9%</td>
</tr>
</tbody>
</table>

**DIMENSION ATTRIBUTES:**

Dimension One: The activity's effect on internal auditor independence, and

Dimension Two: The assurance of adequate controls provided by each activity.

---

More general internal auditors than EDP specialists perceived the independence of the internal auditor to be the primary criterion that distinguishes systems design audit activities. The assurance provided by these
activities was considered of secondary importance to a majority of the general internal auditors.

The above categorization of subject weights only revealed the dimension which respondents considered more important than the other dimension. To gain insight into the influence of the weights for each dimension on the controllability MDS solution, separate two-dimensional MDS analyses were conducted for the EDP and non-EDP groups [Nair and Rittenberg (1987)]. In addition, canonical correlation analyses between each subgroup's attribute ratings and its dimension coordinates were performed. The canonical correlation results are shown in Appendix G. Appendix K discusses the differences between the EDP and non-EDP groups as revealed in the MDS solutions.

**Auditability Subject Differences**

A canonical correlation analysis (Appendix J) of the auditability respondents' demographic data and the activity coordinates of the auditability MDS solution found that two variables, "Years" and "Opinions Concerning the Internal Auditor's Role as Participant in Design," influenced the internal auditors' similarity judgments. To aid in investigating the subject spaces, auditability respondents were divided into subgroups based upon these two variables.

Auditability respondents were first divided into four groups based on their years of experience as internal auditors:
Year Group One (0 to 3 years) contained four subjects. Year Group Two (4 to 6 years) contained fifteen subjects. Year Group Three (7 to 10 years) contained thirty-nine subjects. Year Group Four (over 10 years) contained thirty-nine subjects.

The four subjects from group one were combined with the fifteen subjects from group two to form one combined year group two. Flattened subject weights were examined for the year groups two, three, and four.

Table 4-6a reveals that subject reliance upon the two dimensions did indeed differ among the three "year" groups. Over 36% of group two and over 43% of group four placed more importance on dimension two (determining the assurance of auditability provided by an activity) than dimension one (The Internal Auditor's Role in Assuring Auditability). Approximately 31% of the respondents in these two groups relied on both dimensions. In contrast, only 22.6% of year group three subjects relied on both dimensions when making their similarity judgments. The remaining subjects in this group were equally divided between those relying most on dimension one and those relying most on dimension two.

The second variable which influenced subjects' judgments in the auditability group was "opinion concerning the internal auditor's role as a participant in design."

Respondents agreeing that the role of the internal auditor in assuring the auditability of the system sometimes requires participation in design were labeled the
TABLE 4-6
AUDITABILITY RESPONDENTS:
THE IMPORTANCE OF EACH DIMENSION

A. YEARS OF EXPERIENCE

<table>
<thead>
<tr>
<th>Most Important Dimension(s)</th>
<th>Percent of Respondents in Years of Experience Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Both Dimensions</td>
<td>Two</td>
</tr>
<tr>
<td></td>
<td>31.6%</td>
</tr>
<tr>
<td>Dimension One</td>
<td>31.6%</td>
</tr>
<tr>
<td>Dimension Two</td>
<td>36.8%</td>
</tr>
</tbody>
</table>

B. OPINION CONCERNING THE INTERNAL AUDITOR'S ROLE AS A PARTICIPANT IN DESIGN

<table>
<thead>
<tr>
<th>Most Important Dimension(s)</th>
<th>Percent of Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PID</td>
</tr>
<tr>
<td>Both Dimensions</td>
<td>24.4%</td>
</tr>
<tr>
<td>Dimension One</td>
<td>34.1%</td>
</tr>
<tr>
<td>Dimension Two</td>
<td>41.5%</td>
</tr>
</tbody>
</table>

DIMENSION ATTRIBUTES:
Dimension One: The internal auditor’s role in assuring auditability, and
Dimension Two: The assurance of auditability provided by each activity.

PID (participant-in-design) group and the other respondents were labeled the NPID (nonparticipant-in-design) group.

The comparisons of subject differences between the two subgroups are shown in Table 4-6b. A higher percentage of respondents in both groups considered dimension two to be more relevant than dimension one for distinguishing among the activities. Almost 49% of the respondents who rejected internal auditor participation in systems design placed primary emphasis on the assurance provided by the activity. Only 26.7% of the NPID respondents distinguished among the activities primarily by distinguishing among the potential
roles of the internal auditor when assuring auditability. Although the largest percent of PID respondents also found dimension two to be more important than dimension one, the percentage difference (41.5% vs. 34.1%) between these subjects is not as large as in the NPID group (48.9% vs. 26.7%). Both subgroups had the same percentage (24.4%) of respondents who relied equally upon the two dimensions.

The above conclusions of subject differences were based upon the percent of respondents in categories of flattened subject weights. Separate two-dimensional MDS solutions for each auditability demographic variable group [Nair and Rittenberg (1987)] were conducted to aid in understanding the weighted differences in perceptions among these subgroups. These differences are discussed in Appendix K.

**Summary of Subject Differences**

One demographic variable was found to influence the similarity judgments of controllability subjects: job classification. Controllability respondents were almost equally divided between (1) EDP specialists and (2) non-EDP specialists, most of whom in the latter group were general internal auditors.

Two demographic variables were found to influence the similarity judgments of auditability subjects: years of experience and opinion of participation in systems design. Internal auditors were divided into three groups according to their years of experience. Auditability respondents
were also classified according to whether or not they agreed that the internal auditor should participate in systems design in order to assure the auditability of the system.

Further analysis of (1) the flattened subject weights from the MDS solution for the controllability and auditability respondents and (2) MDS solutions for significant demographic subgroups confirmed differences among the perceptions of these subgroups of respondents.

Summary Of The Data Analysis

A response rate of 37.7% was obtained, with no discernable non-response bias. Respondents were found to be highly experienced and almost equally divided among general internal auditors and EDP auditors. In addition, most of the respondents agreed that the internal auditor should be involved in systems development.

The following results were reported in the analysis of the data:

Primary Analysis

(1) Internal auditors were found to consistently discriminate among the nine audit activities included in this study.

(2) Two-dimensional MDS solutions adequately described the structure of audit activities for both the controllability and auditability respondent groups.

(3) The two dimensions of the controllability solution represent (in order of importance to the respondents):

(a) The activity's effect on internal auditor independence, and
(b) The assurance of adequate controls provided by each activity.
(4) The two dimensions of the auditability solution represent (in order of importance to the respondents):

(a) The internal auditor's role in assuring auditability, and
(b) The assurance of the system's auditability provided by each activity.

(5) Differences were observed between the perceptions of internal auditors responding to the controllability instrument and the perceptions of internal auditors responding to the auditability instrument.

Supplemental Analysis

(6) The Unfolding MDS Model was unable to represent the relationships among the seven attributes and the nine audit activities included in the study.

(7) Differences in similarity judgments among subjects were observed.

(8) Significant relationships among subjects' weighting of dimensions and the participants' background and attitudinal information were found.

(9) The influence of demographic variables upon similarity judgments was illustrated by comparing the MDS solutions for demographic subgroups.

Items one through five answered the main research questions, and items six through nine answered the ancillary questions.
CHAPTER V

CONCLUSIONS, IMPLICATIONS, AND RECOMMENDATIONS
FOR FURTHER RESEARCH

From the 1960's when computer systems were first being established in major corporations, up to the present when computer systems are commonplace, controversy has surrounded the internal auditor's involvement in EDP systems design. Early articles either questioned or defended internal auditor involvement in the systems development process. In recent articles, the controversy centers around the particular activities internal auditors should perform during systems design. This study investigated internal auditor perceptions of systems design activities.

This chapter discusses the implications of auditor involvement in systems design, and presents recommendations for further research. First, however, the problem, approach, and findings are summarized to provide an overview of the study.

Research Questions and Approach

Internal auditors are generally involved in designing and maintaining internal controls of an organization. As management's representative, internal auditors are challenged to assure that cost-effective controls are designed into systems, and to assure that adequate controls are maintained after the system has been implemented. Because modification of systems is often cost prohibitive,
Internal auditor involvement in systems development is generally recommended during the design phase.

There is general agreement that internal auditors should participate in systems design; however, clear guidelines for participation are lacking. Although the literature suggests a variety of internal audit activities, many articles caution internal auditors against performing activities which require high involvement in systems design. The researcher surmized (1) that the higher the level of involvement required by an activity, the higher the probability that the auditor's independence is affected, and (2) that the benefits of involvement vary according to the activities performed by the internal auditors.

An examination of the empirical literature revealed little evidence concerning the criteria which internal auditors perceive as important when determining activities to perform during systems design. The objective of most previous studies was to identify the specific tasks which internal auditors executed throughout the entire systems development process. Most of these studies concluded that the activities performed by internal auditors "appear" to demonstrate their concern for maintaining "internal auditor independence." These studies assumed that internal auditors perceived activities as "independent" or "design" activities in a manner similar to the particular researcher's interpretation. The current study provides
empirical evidence concerning the activities which internal auditors perceive as independent and those which internal auditors consider to negatively effect internal auditor independence.

In reviewing the activities listed in both the empirical and nonempirical literature, two major areas of internal auditor participation came into focus. These areas relate to the purpose of internal auditor involvement:

1. Activities performed to provide assurance that adequate controls are designed into a system (controllability).
2. Activities performed to provide assurance that audit needs are designed into a system (auditability).

The internal auditor's role in assuring the controllability of a system under development is well established in the literature. The recent literature has suggested an additional role of the internal auditor during systems design. The internal auditor is presented as a future user of the system who has a responsibility to ensure that the system will be auditable after implementation. The recommended requirements for auditability vary from assuring that audit manuals are prepared and that systems specifications are reviewed to assuring that embedded audit modules are incorporated into the system. Auditability usually implies the assurance that the audit trail is maintained on future audit engagements. Although considering the internal auditor as a future user of a developing system may be a recent topic,
tasks associated with auditability have been included in most of the previous studies concerning system development activities. However, previous studies did not isolate activities according to the purpose of internal auditor involvement, but assumed that the same criteria were used to distinguish among all systems development audit activities.

The current study examined internal auditor perceptions of the similarity of nine systems design audit activities (Table 1-1) which were selected from the literature to represent varying levels of internal auditor involvement. These activities were examined in two areas based upon the primary purpose of internal auditor involvement:

(1) **Controllability:** The purpose of internal auditor involvement was to ensure the controllability of the system, or

(2) **Auditability:** The purpose of internal auditor involvement was to ensure the auditability of the system.

Internal auditors used in this study worked for a Forbes 500 company, had experience in systems development, and were members of the Institute of Internal Auditors. Each subject completed one of two questionnaires in which they made similarity judgments concerning pairs of audit activities. Separate instruments were designed to capture internal auditors' perceptions of the activities when the purpose was: (1) to assure that adequate EDP application
controls were designed into the system and (2) to assure the auditability of the system.

The first step in interpreting the data was to apply Multidimensional Scaling (MDS) techniques in order to develop a graphical display of the perceived relationships among systems design audit activities. The primary research objective was to identify the criteria or attributes which internal auditors considered when distinguishing among systems design audit activities. The attributes were represented by the dimensions of the solution. The two topics of systems design which are predominant in the literature were hypothesized as the underlying attributes or dimensions:

1. The benefits derived from involvement in systems design:
   a. Assurance that adequate controls are built into the system for the controllability group, and
   b. Assurance of the auditability of the system for the auditability group.

2. The activity's effect on internal auditor independence.

Seven attributes (Table 1-2) were chosen, a priori, as possible influencing attributes. Internal auditors rated each activity on these seven attributes. These ratings were used to aid the identification of the attributes underlying each MDS model's dimensions.

Comparisons between the results of the analysis of the controllability data and the analysis of the auditability data were made to determine whether the purpose of the activities influenced the underlying attributes. Finally,
the data were examined to determine whether demographic factors influenced internal auditors' similarity judgments.

**Summary of Findings**

The similarity judgments of internal auditors for both the controllability respondents and the auditability respondents were successfully modeled in two-dimensional solutions. Canonical correlation analyses of the attribute ratings and the stimulus coordinates of the solution dimensions for each respondent group were helpful in identifying the attributes considered by each group. The attributes uncovered are shown in Table 5-1.

### TABLE 5-1

**THE UNDERLYING ATTRIBUTES OF BOTH RESPONDENT GROUP SOLUTIONS**

1. **Controllability Respondent Attributes:**
   - Dimension One: The activity's effect on internal auditor independence, and
   - Dimension Two: The assurance of adequate controls provided by each appraisal activity.

2. **Auditability Respondent Attributes:**
   - Dimension One: The internal auditor's role in assuring auditability, and
   - Dimension Two: The assurance of auditability provided by each activity.

**Controllability Respondent Findings**

"The activity's effect on internal auditor independence" was the most influential (i.e., labeled dimension one) attribute in internal auditors' similarity judgments for this respondent group. Dimension one
revealed a conflicting relationship between the perceived level of internal auditor independence and activities which were performed by the internal auditor when assuming the role of participant in design. Using the "independence" criterion, respondents divided the nine activities into two opposing activity clusters:

(1) independent appraiser activities which were perceived to have little or no effect on internal auditor independence, and

(2) participation-in-design activities which were perceived to have a negative impact on internal auditor independence.

Despite several exceptions, these activity clusters confirm the discussions of the activities found in the literature [Grabski (1986)]. A few authors [for example, Dunmore (1988)] declared that several control solutions must be provided to systems personnel for the internal auditor to maintain the appearance of independence. Selecting or recommending specific controls was claimed to negatively affect internal auditor independence. The controllability respondents did not perceive this relationship. Both "recommending controls" and "providing several control solutions" were included in the independent activity cluster. More importantly, on dimension two, the participants indicated that these activities provide little assurance of controllability.

As anticipated, the activities, "serve as a member of the development team" and "assist in design", were both judged as participant-in-design activities. The close
proximity of these two activities also conveys the fact that "to serve on the development team" was regarded as very similar to "assisting in design". To a lesser degree the activity, "acting as a consultant", was also judged as a participant-in-design activity. The classification of the latter activity refutes several authors' [Foh (1983), Wysong (1983) and Mendus (1986)] suggestions that the role of consultant is within the boundaries of independent activities.

The second controllability criterion was The Assurance Provided By Appraisal Activities. The activity "sign-off" was perceived as providing the most assurance that adequate controls were built into the system. Internal auditors perceived that "reviewing/evaluating controls" and "identifying control weaknesses" provide assurance of adequate controls while maintaining the independence of the internal auditor. However, having the authority to "sign-off" or to approve the system was perceived as providing the most assurance, even though performing this activity affected internal auditor independence. The respondents appeared to recognize that a degree of independence must be sacrificed for a high level of assurance that adequate controls are designed into the system. This finding was confirmed in conversations with internal auditors and by the comments which several respondents included in their questionnaires. These auditors indicated that fulfilling their obligation to assure adequate controls did, at times,
require a level of involvement that could be perceived as a compromise of their independence. However, these auditors felt that the benefits of involvement far outweighed any perception of the loss of independence.

Providing systems personnel with a checklist of controls that applies to any system was judged to be, by a large degree, the activity which provided the least assurance of controllability. In Part I of the questionnaire, 91% of the respondents indicated that internal auditors should participate in systems development. The low assurance perceived from this low-involvement activity confirms that demographic finding.

**Auditability Respondent Findings**

Dimension one of the auditability group solution contrasts the role of independent appraiser with the roles of consultant and participant in design. The appraisal activities which controllability respondents found to provide the most assurance of controllability were the same activities classified as appraisal activities by the auditability respondents. However, the implication of the auditability grouping of these activities is quite different from that of the controllability grouping. The auditability grouping suggests that appraisal activities are not appropriate when assuring the auditability of a system. This conclusion is supported by dimension two's classification of independent appraisal activities as providing the least assurance of auditability.
Although consultant activities may have been considered appropriate for determining the auditability of a system, they were not the activities which provided the most assurance of auditability. Assurance Provided By Each Activity was the name chosen for the auditability second dimension. However, three additional attributes had high loadings on this dimension:

1. the role of future user,
2. the level of involvement, and
3. the role of participant in design.

The role of consultant was not significant for this dimension. Internal auditors, as a group, perceived that assurance of auditability required the internal auditor to assume the roles of future user and participant in design.

Dimension two divided activities into two primary clusters. The most-assurance cluster included the activities:

1. serve as a member of development team,
2. assist in design, and
3. submit audit specifications.

All three of these activities are represented as "high-involvement" and "participant-in-design" activities by the auditability respondents. The attribute "role of future user" was also significant in grouping these activities. Therefore, the respondents identified future user activities as high-involvement and participant-in-design activities.
The activities perceived as providing the least assurance of the auditability of the system are those which allow the internal auditor to maintain his or her independence. This conclusion was supported by the canonical correlation analysis which revealed that the attribute "independence" had an inverse relationship with the attribute "assurance provided."

**Differences Between the Two Respondent Groups**

Table 5-1 shows that differences were observed between the perceptions of the two respondent groups. The controllability group perceived "the activity's effect on internal auditor independence" as the most important attribute when distinguishing among systems design activities. Dimension one for these respondents reflects the conflict between maintaining internal auditor independence and performing participation in design activities.

In contrast, "internal auditor independence" was not a significant criterion on dimension one for the auditability group. This group of respondents perceived that the most important attribute in distinguishing among audit activities was the role of the internal auditor when assuring auditability. Internal auditors indicated that the roles of consultant and participation in design were more appropriate than the role of independent appraiser when assuring the auditability of the system.
Dimension two was named Assurance Provided in both the controllability and auditability solutions. Activities for both respondent group solutions were divided into those providing the least assurance and those providing the most assurance. There was, however, a major difference in the interpretation of this dimension between the two respondent groups.

The controllability group appeared to emphasize the level of assurance provided by different appraisal activities. Respondents perceived that providing assurance of controllability required the auditor to restrict his role to one of appraiser. In contrast, the auditability group identified independent appraisal activities as providing the least assurance. The tasks which provided the most assurance were identified as activities performed by the auditor in the role of a future user and in the role of a participant in design.

In summary, the data analysis revealed differences between the controllability and auditability respondents in their perceptions of the underlying structure of systems design activities. Isolating systems design activities according to the purpose of the activity was successful in identifying these differences. This finding suggests that future development of guidelines for internal auditor involvement in systems development should consider the purpose of the auditor involvement.
The Influence of Demographic Variables

A canonical correlation analysis of the demographic variables and the activity coordinates in the controllability solution found that "job classification" influenced the respondents' similarity judgments. Respondents were almost equally divided between EDP specialists and general internal auditors. An examination of subject weights revealed that more general internal auditors than EDP specialists perceived "the independence of the internal auditor" to be the primary criterion that distinguishes systems design audit activities. However, MDS solutions, which average the subject weights, discovered no differences in the underlying attributes between the two subgroups.

Differences in activity clusters (refer to Appendix K) were found when comparing the individual MDS solutions for the two subgroups. EDP auditors and general internal auditors used the same criteria, but perceived certain activities differently. The placement of activity seven, "act as control consultant", is the major distinction between the two groups on dimension one activity clusters. "Acting as a control consultant" was viewed as an independent appraisal activity by the general internal auditors, but was perceived as a participation-in-design activity by the EDP auditors.

On dimension two, both groups agreed on the activities providing the most assurance of controllability, but
disagreed on the activities providing the least assurance. "Provide a checklist of controls" and "serve as a member of the development team" were included in the cluster for both groups. In addition, general internal auditors included "act as a control consultant", and EDP auditors added "provide several control solutions" and "assist in design" in the least-assurance activity cluster.

A canonical correlation analysis of the demographic variables and the activity coordinates in the auditability solution found that two demographic variables influenced subjects' similarity judgments: (1) years of experience and (2) opinions concerning the internal auditor's role as participant in design. Three subgroups based on the years of experience variable were investigated:

(1) Years Group Two contained 19 subjects with up to seven years of experience as an internal auditor,

(2) Years Group Three contained 31 subjects with from seven to ten years of internal auditing experience, and

(3) Years Group Four contained 39 subjects with over ten years of experience as internal auditors.

An examination of subject weights from the total auditability solution confirmed that subject reliance upon the two dimensions did differ among the three year groups. Over 43% of internal auditors with more than ten years of experience and 36.8% of internal auditors with less than seven years of experience considered "the assurance provided by each activity" as the primary criteria in distinguishing systems design audit activities. Respondents with seven to ten years of experience were
equally divided between those relying most on dimension one (38.7%) and those relying most on dimension two (38.7%).

The MDS solutions for year groups two, three, and four (refer to Figures K-3, K-4, and K-5) revealed differences in the activity clusters. An examination of the differences in the activity clusters presented in Table K-2 suggests that internal auditors with at least seven years of experience possessed a greater ability to discriminate among the activities than the less experienced internal auditors.

All three year groups had similar classifications of appraisal activities and least assurance activities (refer to Table K-2). The major differences among the three groups occurred in the potential auditability activity cluster and the most-assurance activity cluster. Although all groups included the activities "serve on development team" and "assist in design" as most-assurance activities on dimension two, groups three and four did not include these activities as potential auditability activities on dimension one. In fact, none of the activities included in the potential auditability activity cluster were included by groups three and four as primary most assurance activities. The canonical correlations on dimension two did not provide a reliable understanding of the differences among the three groups.

The second demographic variable was "opinions concerning the internal auditor's role as participant in"
design". Auditability respondents were almost equally divided between the two subgroups:

(1) PID: respondents who held the opinion that when assuring the auditability of a system, internal auditors may sometimes assume the role of a participant in design.

(2) NPID: respondents expressing the opinion that when assuring the auditability of the system, internal auditors are never required to participate in design.

When comparing the two groups, it was found that a higher percentage of both groups relied most on dimension two (Assurance Provided). However, when MDS solutions, which average subject weights, were performed, the PID group considered "the internal auditor's role in assuring auditability" as the most important criterion. The canonical correlation for these respondents (Table G-3) revealed a contrast on dimension one between the role of appraiser and the three roles: participant in design, consultant, and future user. "Assurance provided" was the second criteria considered in the PID group's similarity judgments. The role of future user was the only role associated with the attribute "assurance provided".

Dimension one for the NPID group resulted in activity clusters very similar (see Appendix K) to those of the PID group dimension two, Assurance Provided. The canonical correlation for this group (Table G-3) revealed the "role of future user" as the highest weighted attribute (-.7999) and "assurance provided" as the second highest weighted attribute (-.7285). Both the PID and NPID groups placed
importance on the fact that internal auditors needed to assure auditability because they were future users of the system.

On dimension two for the NPID group, activities were classified as either appraisal or potential auditability activities. Although this classification is similar to the PID group's classification, the canonical correlation revealed that only the role of participant in design was considered when determining potential auditability activities. The NPID respondents agreed with the PID respondents and all three years group respondents that to serve as a "member of the development team" or to "assist in design" provided the most assurance of auditability.

The above differences in the classification of activities perceived as "appropriate" when providing assurance of the auditability of the system point out the need for further study. The current investigation has provided the necessary groundwork for such research.

Recommendations for Future Research

The recommendations for future research are discussed in terms of the findings of the study:

(1) The attributes identified as criteria which internal auditors consider when differentiating among systems design audit activities.

(2) The activity groupings on each attribute.

(3) Two design techniques:
   a. Isolating activities according to the purpose of the activity, and
   b. Dividing systems development audit activities into activities performed during a particular phase of development.
The Attributes and Activity Groupings

To provide the most assurance that adequate EDP controls are designed into the system, respondents indicated that the internal auditor must assume the role of appraiser. However, the activity judged as providing the most assurance was not perceived as an independent activity. This finding was interpreted in an earlier section as implying that a degree of independence must be sacrificed for a high level of assurance of adequate controls. This conclusion should be the subject of future research. The empirically derived "list" of independent activities and participant-in-design activities from this study can aid in this research.

Future research could investigate the activities which internal auditors consider as "appropriate" to perform when assuring adequate control in a system developed either by the traditional systems development process or by end-user prototyping. This study has not differentiated between these two developmental efforts since end-user prototyping is a new technology and few internal auditors are presently involved in such efforts. However, traditional systems development involves a much longer time frame than end-user development, which embodies designing and refining a number of prototypes (working models) of the ultimate information system. End-user prototype information systems can be transformed into working systems in a fraction of the time
needed for the standard system development life cycle. Future research should consider the internal auditor's involvement in the traditional systems development life cycle versus his or her involvement in the prototyping systems development cycle. Given significant software advances in easy-to-use fourth generation languages such as LOTUS 1-2-3 and dBASE, changes are forthcoming in the traditional ways of controlling information systems development.

Further study is required to confirm the criteria used by the auditability respondents. The conclusion can be made that appraisal activities are inappropriate in assuring auditability because these activities provide little assurance that the system will be auditable. However, the activities which should be performed by internal auditors are not as clear. On dimension one, respondents appeared to identify activities considered appropriate for determining the auditability of the system. However, dimension two included only one-half (two out of four) of these activities as providing the most assurance of auditability. These most-assurance activities were interpreted as future user, high-involvement, and participant-in-design activities.

Research is also needed to confirm the credibility of the role of the internal auditor as a future user of the system. This research could attempt to determine the scope of the internal auditor's responsibility for assuring the
auditability of a system. For example, activities which other "users" perform during systems design could be compared to the audit activities identified in this study as "future user" activities for the auditor. In addition, the most "appropriate" activities for the auditor's role of future user of the system could be subjected to further study.

In both the controllability and auditability areas, future studies could compare external and internal auditors' perceptions of activity groupings. For example, external auditors could be asked to rate the nine activities included in this study on (1) their effect on internal auditor independence and (2) the assurance provided by the activities.

**Design Techniques**

This study isolated activities according to the purpose of the activity. To the author's knowledge, this is a seminal research study concerning whether internal auditors' perceptions of systems design activities are affected by the purpose of the involvement. The findings confirm that internal auditors have a different perspective when assuring auditability than when assuring controllability of a developing system. Therefore, dividing activities according to the purpose of the activity is recommended for future investigations.

Most previous studies concerned all systems development activities. This study encourages the separate
investigation of activities performed during each phase of systems development.

Implications of the Study

This study provides evidence concerning internal auditor perceptions of systems design audit activities. Little evidence was previously available.

The study analyzed data gathered from internal auditors with experience in systems development. However, demographic data was collected from respondents who did not have experience in systems development. Therefore, it was possible to determine that most responding "inexperienced" and "experienced" internal auditors felt that internal auditors should be involved in systems development.

Controllability

The literature on controllability suggests that the internal auditor may assume two different roles during systems design: the role of independent appraiser and the role of control consultant. This study confirms the role of independent appraiser, but refutes the role of control consultant. The activity "act as a control consultant" was not considered to be an activity which maintained auditor independence and, even more significantly, was not included among the activities which were perceived as providing the most assurance that adequate controls were designed into the system.
The results provide a list of activities which provide the most assurance that adequate controls are designed into a new system:

1. Sign-off or approve the system
2. Review/Evaluate Controls
3. Identify Control Weaknesses

The last two activities were perceived as very similar. Therefore, identifying control weaknesses may be considered a part of reviewing/evaluating controls.

One of the most important insights provided by this study is that having the authority to sign-off or approve the system's controls provided much more assurance of adequate controls than did the process of reviewing/evaluating the controls. This perception is supported by empirical surveys which reveal an increase in the number of auditors having the authority to "sign-off."

Auditability

The MDS analysis produced a better model (i.e., explained more of the respondents' variance) of the similarity judgments from respondents completing the controllability questionnaire than respondents completing the auditability questionnaire. This was not surprising. Determining the auditability of a developing system is a recent topic in the literature and internal auditors have probably had very limited exposure to this concept. However, the practical implications were understood, and there was enough agreement among respondents to produce an
adequate model of the relationships among systems design activities performed to assure the auditability of a developing system.

The results support the role of the internal auditor as a future user of the system when determining auditability. Respondents revealed that internal auditor independence was not a criterion for activity selection and that acting as an independent appraiser provided little assurance of auditability. In fact, the activities which were chosen as providing the most assurance were high-involvement activities in which the internal auditor may be considered a participant in design.

Implications To The Accounting Profession

The literature review concluded that adequate guidelines concerning the activities which internal auditors should perform during systems design were lacking. Assuming that the results of this study are representative of the perceptions of internal auditors with experience in systems development, this study provides a number of practical guidelines (refer to Table 5-2) for internal auditors involved in systems design. These guidelines are tentative in nature and should be subjected to examination by the profession.

The guidelines first recognize a distinction between internal auditor participation (1) when providing assurance that adequate controls are designed for a system and (2) when providing confidence that a system may be adequately
TABLE 5-2
GUIDELINES FOR INTERNAL AUDITOR PARTICIPATION IN SYSTEMS DESIGN

A. WHEN THE PURPOSE OF INVOLVEMENT IS TO PROVIDE ASSURANCE THAT ADEQUATE CONTROLS ARE DESIGNED INTO A CRITICAL SYSTEM

1. The internal auditor should assume the role of an appraiser and should maintain a high degree of independence.

2. The internal auditor should not assume the following roles:
   (a) The role of control consultant
   (b) The role of a future user of the system
   (c) The role of a participant in design

3. Internal auditors should perform a review/evaluation of the controls as designed by the development team or by systems personnel. The objective of this review should be to identify control weaknesses.

B. THE PURPOSE OF INVOLVEMENT IS TO PROVIDE ASSURANCE THAT A CRITICAL SYSTEM MAY BE ADEQUATELY AUDITED AFTER IT BECOMES OPERATIONAL

1. The internal auditor should not assume the traditional role of independent appraiser.

2. The internal auditor should assume the role of a future user of the system when assessing a system's auditability.

3. The internal auditor should submit audit specifications (i.e., specify the audit needs) for the system to the development team.

When the purpose of involvement concerns controllability, activities which require a high level of...
involvement (i.e., participation-in-design activities) fall outside the boundary of appropriate internal auditor involvement. If the internal auditor is to provide assurance of controllability, a certain degree of independence must be maintained. This study identified three activities which should not be performed by internal auditors when assessing controllability. Internal auditors should not:

1. serve as a member of the development team,
2. assist in the design of the system, or
3. act as a control consultant.

The guidelines state that internal auditors should assume the role of appraiser when assessing the controls of a developing system. Activities which provide assurance of adequate controls and which allow the internal auditor to maintain his or her independence are:

1. review/evaluate controls and
2. identify control weaknesses.

The above activities are stated separately, but "identifying control weaknesses" may be considered a means of completing a review/evaluation of controls.

The activity identified as providing the most assurance of adequate controls is "sign-off". This activity was not recommended in the guidelines presented in Table 5-2 because the process of approving a system requires a level of involvement which may compromise internal auditor independence. However, the perceived negative effect of performing this activity appeared to be small. In fact, the assurance gained by performing this
activity was much greater than the perceived negative effect on independence. In summary, the guidelines neither recommend nor discourage the performance of the "sign-off" activity, but simply caution auditors of the activity's potential negative effect on their independence.

Part B of Table 5-2 presents guidelines for providing assurance of the auditability of a system. First, it is recognized that the internal auditor should not act in a traditional audit role. It is not necessary or even desirable for the internal auditor to maintain independence when assessing the auditability of a system. The activities identified as appraisal activities ("sign-off", "review/evaluate auditability", and "identify audit weaknesses") provided the least assurance of auditability.

The guidelines state that internal auditors should act as future users of the system by specifying audit needs to the development team. Although three activities ("serve as a member of the development team", "assist in design", and "submit audit specifications") were found to provide the most assurance of auditability, only the activity "submit audit specifications" was included in the guidelines. Both serving as a member of the development team and assisting systems personnel in the design of a system were perceived by respondents as compromising internal auditor independence. Limiting auditor involvement to the area of auditability would be difficult when executing either of these tasks. These activities may, therefore, inhibit the
adequate completion of other internal auditor responsibilities, such as assuring the controllability of the system.

General Conclusions

In this study, 91% of respondents supported internal auditor involvement in systems development and almost as many (85%) indicated that participation in systems development included involvement during systems design. Thirty percent of these respondents believed that the Institute of Internal Auditors does not provide adequate guidelines concerning internal auditor involvement in systems development. After conducting a comprehensive literature review, the researcher also concluded that adequate guidelines for internal auditor involvement in systems design are lacking. In fact, the literature suggests activities which are contradictory in nature.

The internal auditor with little or no experience in systems development must choose among the contradictory activities which are suggested in the literature. A natural reaction is for these auditors to seek the guidance of others more experienced in systems development. This study presents the opinions of internal auditors, working for large U.S. companies, who are experienced in systems development. The results include lists of activities which are perceived as providing the most assurance (1) that adequate EDP application controls are designed into the
system, and (2) that the system will be auditable once it is implemented.

Although only nine activities were included in this study, they are representative of the varying levels of involvement in systems design suggested in the literature. The results do not, therefore, provide a list of activities to perform in a cookbook fashion, but provide guidance in determining the activities which will fulfill the intended purpose. For example, if an internal auditor agrees that to "sign-off" or approve the controls of the system is the most appropriate method to assure controllability, he/she must still determine the specific activities which would be necessary to provide the evidence needed to approve these controls.

The results of this study should not only provide guidance to internal auditors inexperienced in systems design, but should also aid those whose responsibilities include an evaluation of the internal auditor's role in systems development. Both external auditors and peer review committees may consider the attributes and activity groupings presented in this study as practical guidelines which can aid their evaluation process.

Finally, the results of this study provide evidence of internal auditor perceptions which can aid in the development of future guidelines by the Institute of Internal Auditors and other authoritative bodies. It is hoped that the high percentage (30%) of internal auditors
indicating that the IIA does not provide adequate guidelines will encourage the profession to study and act upon this need.
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APPENDIX A

COVER LETTERS AND POST-CARD FOR QUESTIONNAIRES
Dear :

You are among a select group of internal auditors chosen to participate in an investigation valuable to the internal auditing profession. The study, which is my doctoral dissertation at Louisiana State University, concerns nine audit tasks performed by internal auditors during the design phase of systems development.

The attached questionnaire is divided into different parts. The first page collects demographic information and asks, in general terms, your opinion of internal auditor involvement in the systems development process. If you have never participated in the development of a system, complete Part One only and return the questionnaire.

Part Two asks your opinion concerning the similarity between pairs of audit activities. Part Three seeks your opinion of particular characteristics of audit activities. Overall, the questionnaire will identify the characteristics of audit activities which internal auditors consider important. Such a list of attributes may provide a "frame of reference" or "informal guidelines" for choosing among potential audit activities. A clear statement from internal auditors may also influence the development of authoritative guidelines.

Your help is VITAL to the successful completion of this important study. Your answers will not be identified in any way. In appreciation of your assistance, I will mail you the results of the study if you provide your name and address on the last page of the questionnaire.

I would appreciate your returning the questionnaire within two weeks to allow prompt processing of the results. However, if you must delay, your response will still be welcomed. Please return the questionnaire, even if you decide not to respond, in the enclosed self-addressed stamped envelope.

Sincerely,

Virginia Cerullo
Assistant Professor of Accounting
Last week a questionnaire regarding audit activities performed during systems design was sent to you as a representative of the internal auditing profession.

If you have already completed and returned it, please accept my sincere thanks. If not, please do so today. It is extremely important that your input be included in the study if the results are to represent the thinking of your profession.

Virginia Cerullo
Department of Accounting
Southwest Missouri State University
901 S. National Avenue
Springfield, MO 65804
Dear:

On July 14, I wrote to you seeking your help in a study regarding audit activities performed during systems design. At this time, I have not received a reply. Therefore, let me tell you more about the project.

This is, to my knowledge, the first study to investigate internal auditors' perceptions of the similarities among audit activities performed during systems design. Your judgments will be combined with the judgments of your colleagues to determine the characteristics of audit activities which internal auditors consider most important in making these decisions. The findings should aid internal auditors in setting practical guidelines for involvement in systems design.

If this letter and your completed questionnaire have crossed in the mail, please accept my thanks. If, however, you never received or have misplaced the original questionnaire, I have enclosed another, along with a self-addressed, stamped envelope. Please complete and return the questionnaire as soon as possible. I believe, with your cooperation, this research will contribute toward increased understanding of the internal auditor's role in systems design.

Sincerely,

Virginia Cerullo
Assistant Professor of Accounting
APPENDIX B

THE CONTROLLABILITY AND AUDITABILITY QUESTIONNAIRES

NOTE: The length of the actual questionnaires was seven pages, back and front.
B-1. THE CONTROLLABILITY QUESTIONNAIRE

INTRODUCTION

This questionnaire concerns the internal auditor's involvement in the development of EDP application controls during the design phase of systems development. Your opinions are sought concerning the similarities of nine audit activities performed during systems design.

When completing this instrument, please assume the following:
1. The system considered is VITAL to company operations.
2. The internal auditors performing the activities possess the necessary knowledge and training and have the resources, such as time and manpower, available to perform any or all of the nine audit activities.
3. The internal auditors have the backing/support of management and systems personnel to perform any of the nine activities.
4. The major purpose of the activities is to provide assurance that adequate EDP controls are designed into the system. Adequate controls provide assurance that the information provided by the system or application is accurate and reliable (high-integrity information).

Please complete the instrument in the order presented: Part One should be completed first; then, Part Two; and finally, Part Three. DO NOT RETURN to a part once completed. Parts Two and Three begin the experimental material. Part One collects background information.

PART ONE

1. What is your position in the company?

2. Would you describe yourself as:
   ___A General Internal Auditor ___An EDP Specialist ___Other Specialist

3. Approximately how many years have you been an internal auditor?
   ___0-3 years ___4-6 years ___7-10 years ___over 10 years

4. Are you a member of The EDP Auditors Association? ___Yes ___No

5. Are you a Certified Information Systems Auditor? Yes___ No___

6. Please indicate your training in audit concerns for developing systems:
   ___None ___On the Job ___Formal (PD Courses or College Courses)
Please indicate your opinion to the following questions by marking a slash (/) on the line provided:

7. The internal audit department should be involved in some manner during the systems development process:

   Strongly Disagree
   \_____________________________________________________________/

   Strongly Agree

8. If the internal audit department is involved, this involvement should encompass the systems design stage:

   Strongly Disagree
   \_____________________________________________________________/

   Strongly Agree

9. The Institute of Internal Auditors provides adequate guidelines for internal auditor involvement during the systems development process:

   Strongly Disagree
   \_____________________________________________________________/

   Strongly Agree

10. Does your internal audit department participate in the systems development process? ___Frequently ___Occasionally ___Never

    If Yes, does the involvement include the systems design phase? ___Frequently ___Occasionally ___Never

11. Have you ever:

    1. audited a system under development? ___Yes ___No
    2. acted as a consultant to persons developing a system? ___Yes ___No
    3. participated in any manner in the development of a system? ___Yes ___No

   IF YOU ANSWERED "NO" TO ALL 3 SITUATIONS, YOU NEED NOT ANSWER THE REMAINING QUESTIONNAIRE. PLEASE RETURN THE ENTIRE QUESTIONNAIRE IN THE ENCLOSED ENVELOPE. THANK YOU.

   IF YOU ANSWERED "YES" TO ANY OF THE THREE SITUATIONS, please turn the paper over and continue to Part Two.
PART TWO

EDP APPLICATION CONTROLS

(Input, Processing & Output Controls for a Specific System)

ASSUMPTIONS REPEATED:
1. The system considered is VITAL to company operations.
2. The internal auditors performing the activities possess the necessary knowledge and training and have the resources, such as time and manpower, to perform any/all of the nine audit activities.
3. Internal auditors have the backing/support of management and systems personnel to perform any of the nine audit activities.
4. The major purpose of the activities is to provide assurance that adequate EDP application controls are designed into the system. Adequate controls provide assurance that the information provided by the system or application is accurate and reliable (high-integrity information).

Nine internal audit activities to assist the development of adequate EDP APPLICATION CONTROLS in significant new systems are presented below. These activities have been mentioned in the accounting literature for internal auditor PERFORMANCE DURING THE SYSTEMS DESIGN PHASE of developing systems. Paired comparisons of the activities are presented next. Given the assumptions above, consider each pair and rate the degree of similarity between the two audit activities. Please record your judgment by marking a slash (/) on the 5-inch line provided. The basis of your similarity judgments are left to your discretion.

**ACTIVITY** | **DESCRIPTION**
--- | ---
1 | REVIEW/EVALUATE CONTROLS: Provide systems personnel the results of an internal audit Review/Evaluation of application controls as designed.
2 | IDENTIFY CONTROL WEAKNESSES: Provide systems personnel with control weaknesses identified by the internal auditor in a review of the system.
3 | PROVIDE CHECKLIST OF CONTROLS: Although the internal auditor does not review this specific system, he/she provides systems personnel with a general checklist of controls applicable to any system.
4 | PROVIDE SEVERAL CONTROL SOLUTIONS: Provide systems personnel with several solutions to control problems encountered by the internal auditor in a review of the system.
5 | RECOMMEND CONTROLS: After reviewing the system, the internal auditor provides systems personnel with a list of recommended application controls for the system.
6 | SERVE AS MEMBER OF DEVELOPMENT TEAM: Serve as a member of the systems development team which designs the application controls.
7 | ACT AS CONTROL CONSULTANT: Act as a control consultant to the systems development team.
8 | SIGN-OFF: Approve the application controls as designed.
9 | ASSIST IN DESIGN: The internal auditor assists systems personnel in the design of application controls.
SIMILARITY JUDGMENTS FOR THE NINE AUDIT ACTIVITIES

Indicate your opinion of the similarity of pairs of audit activities by marking a slash (/) at the point of judged similarity on the line below each pair of activities.

---------------------------------------------

Compare: REVIEW/EVALUATE CONTROLS:
Provide systems personnel the results of an internal audit Review/Evaluation of application controls as designed.

AND

IDENTIFY CONTROL WEAKNESSES:
Provide systems personnel with control weaknesses identified by the internal auditor in a review of the system.

Very Similar
Dissimilar

---------------------------------------------

Compare: ASSIST IN DESIGN:
The internal auditor assists systems personnel in the design of application controls.

AND

PROVIDE CHECKLIST OF CONTROLS:
Although the internal auditor does not review this specific system, he/she provides systems personnel with a general checklist of controls applicable to any system.

Very Similar
Dissimilar

---------------------------------------------

Compare: SIGN-OFF:
Approve the application controls as designed.

AND

PROVIDE SEVERAL CONTROL SOLUTIONS:
Provide systems personnel with several solutions to control problems encountered by the internal auditor in a review of the system.

Very Similar
Dissimilar

---------------------------------------------

Compare: ACTS AS CONTROL CONSULTANT:
Act as a control consultant to the systems development team.

AND

RECOMMEND CONTROLS:
After reviewing the system, the internal auditor provides systems personnel with a list of recommended application controls for the system.

Very Similar
Dissimilar
Compare: SERVE AS A MEMBER OF DEVELOPMENT TEAM:
Serve as a member of the systems development team which designs the application controls.

AND

REVIEW/EVALUATE CONTROLS:
Provide systems personnel the results of an internal audit Review/Evaluation of application controls as designed.

Very Dissimilar Very Similar

COMPARE: PROVIDE CHECKLIST OF CONTROLS:
Although the internal auditor does not review this specific system, he/she provides systems personnel with a general checklist of controls applicable to any system.

AND

IDENTIFY CONTROL WEAKNESSES:
Provide systems personnel with control weaknesses identified by the internal auditor in a review of the system.

Very Dissimilar Very Similar

COMPARE: PROVIDE SEVERAL CONTROL SOLUTIONS:
Provide systems personnel with several solutions to control problems encountered by the internal auditor in a review of the system.

AND

ASSIST IN DESIGN:
The internal auditor assists systems personnel in the design of application controls.

Very Dissimilar Very Similar

COMPARE: RECOMMEND CONTROLS:
After reviewing the system, the internal auditor provides systems personnel with a list of recommended application controls for the system.

AND

SIGN-OFF:
Approve the application controls as designed.

Very Dissimilar Very Similar
Compare: **SERVE AS A MEMBER OF DEVELOPMENT TEAM:**
Serve as a member of the systems development team which designs the application controls.

**AND**

**ACT AS A CONTROL CONSULTANT:**
Act as a control consultant to the systems development team.

Very Dissimilar

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**REVIEW/EVALUATE CONTROLS:**
Provide systems personnel the results of an internal audit Review/Evaluation of application controls as designed.

**AND**

**PROVIDE CHECKLIST OF CONTROLS:**
Although the internal auditor does not review this specific system, he/she provides systems personnel with a general checklist of controls applicable to any system.

Very Dissimilar

------------

**IDENTIFY CONTROL WEAKNESSES:**
Provide systems personnel with control weaknesses identified by the internal auditor in a review of the system.

**AND**

**PROVIDE SEVERAL CONTROL SOLUTIONS:**
Provide systems personnel with several solutions to control problems encountered by the internal auditor in a review of the system.

Very Dissimilar

------------

**ASSIST IN DESIGN:**
The internal auditor assists systems personnel in the design of application controls.

**AND**

**RECOMMEND CONTROLS:**
After reviewing the system, the internal auditor provides systems personnel with a list of recommended application controls for the system.

Very Dissimilar
Compare: SIGN-OFF:
Approve the application controls as designed.

AND

SERVE AS MEMBER OF DEVELOPMENT TEAM:
Serve as a member of the systems development team
which designs the application controls.

Very
Dissimilar
Similar

Compare: ACTS AS CONTROL CONSULTANT:
Act as a control consultant to the systems development

AND

REVIEW/EVALUATE CONTROLS:
Provide systems personnel the results of an internal
audit Review/Evaluation of application controls as
designed.

Very
Dissimilar
Similar

Compare: PROVIDE SEVERAL CONTROL SOLUTIONS:
Provide systems personnel with several solutions to
control problems encountered by the internal auditor
in a review of the system.

AND

PROVIDE CHECKLIST OF CONTROLS:
Although the internal auditor does not review this
specific system, he/she provides systems personnel
with a general checklist of controls applicable to
any system.

Very
Dissimilar
Similar

Compare: RECOMMEND CONTROLS:
After reviewing the system, the internal auditor provides
systems personnel with a list of recommended application
controls for the system.

AND

IDENTIFY CONTROL WEAKNESSES:
Provide systems personnel with control weaknesses
identified by the internal auditor in a review of
the system.

Very
Dissimilar
Similar
COMPARISON:

SERVE AS A MEMBER OF DEVELOPMENT TEAM:
Serve as a member of the systems development team which designs the application controls.

AND

ASSIST IN DESIGN:
The internal auditor assists systems personnel in the design of application controls.

Very Similar
Dissimilar

ACTS AS CONTROL CONSULTANT:
Act as a control consultant to the systems development team.

AND

SIGN-OFF:
Approve the application controls as designed.

Very Similar
Dissimilar

REVIEW/EVALUATE CONTROLS:
Provide systems personnel the results of an internal audit Review/Evaluation of application controls as designed.

AND

PROVIDE SEVERAL CONTROL SOLUTIONS:
Provide systems personnel with several solutions to control problems encountered by the internal auditor in a review of the system.

Very Similar
Dissimilar

PROVIDE CHECKLIST OF CONTROLS:
Although the internal auditor does not review this specific system, he/she provides systems personnel with a general checklist of controls applicable to any system.

AND

RECOMMEND CONTROLS:
After reviewing the system, the internal auditor provides systems personnel with a list of recommended application controls for the system.

Very Similar
Dissimilar
**IDENTIFY CONTROL WEAKNESSES:**

Provide systems personnel with control weaknesses identified by the internal auditor in a review of the system.

AND

**SERVE AS MEMBER OF DEVELOPMENT TEAM:**

Serve as a member of the systems development team which designs the application controls.

**ASIST IN DESIGN:**

The internal auditor assists systems personnel in the design of application controls.

AND

**ACT AS CONTROL CONSULTANT:**

Act as a control consultant to the systems development team.

**SIGN-OFF:**

Approve the application controls as designed.

AND

**REVIEW/EVALUATE CONTROLS:**

Provide systems personnel the results of an internal audit Review/Evaluation of application controls as designed.

**RECOMMEND CONTROLS:**

After reviewing the system, the internal auditor provides systems personnel with a list of recommended application controls for the system.

AND

**PROVIDE SEVERAL CONTROL SOLUTIONS:**

Provide systems personnel with several solutions to control problems encountered by the internal auditor in a review of the system.
Compare: SERVE AS A MEMBER OF DEVELOPMENT TEAM:
Serve as a member of the systems development team which designs the application controls.

AND

PROVIDE CHECKLIST OF CONTROLS:
Although the internal auditor does not review this specific system, he/she provides systems personnel with a general checklist of controls applicable to any system.

Compare: ACTS AS CONTROL CONSULTANT:
Act as a control consultant to the systems development team.

AND

IDENTIFY CONTROL WEAKNESSES:
Provide systems personnel with control weaknesses identified by the internal auditor in a review of the system.

Compare: SIGN-OFF:
Approve the application controls as designed.

AND

ASSIST IN DESIGN:
The internal auditor assists systems personnel in the design of application controls.

Compare: REVIEW/EVALUATE CONTROLS:
Provide systems personnel the results of an internal audit Review/Evaluation of application controls as designed.

AND

RECOMMEND CONTROLS:
After reviewing the system, the internal auditor provides systems personnel with a list of recommended application controls for the system.
Compare: PROVIDE SEVERAL CONTROL SOLUTIONS:
Provide systems personnel with several solutions to control problems encountered by the internal auditor in a review of the system.

AND

SERVE AS MEMBER OF DEVELOPMENT TEAM:
Serve as a member of the systems development team which designs the application controls.

Very
Dissimilar

Similar

******************************************************************************

Compare: PROVIDE CHECKLIST OF CONTROLS:
Although the internal auditor does not review this specific system, he/she provides systems personnel with a general checklist of controls applicable to any system.

AND

ACT AS A CONTROL CONSULTANT:
Act as a control consultant to the systems development team.

Very
Dissimilar

Similar

******************************************************************************

Compare: IDENTIFY CONTROL WEAKNESSES:
Provide systems personnel with control weaknesses identified by the internal auditor in a review of the system.

AND

SIGN-OFF:
Approve the application controls as designed.

Very
Dissimilar

Similar

******************************************************************************

Compare: ASSIST IN DESIGN:
The internal auditor assists systems personnel in the design of application controls.

AND

REVIEW/EVALUATE CONTROLS:
Provide systems personnel the results of an internal audit Review/Evaluation of application controls as designed.

Very
Dissimilar

Similar
Compare: **RECOMMEND CONTROLS:**
After reviewing the system, the internal auditor provides systems personnel with a list of recommended application controls for the system.

**AND**

**SERVE AS MEMBER OF DEVELOPMENT TEAM:**
Serve as a member of the systems development team which designs the application controls.

Very Dissimilar
Similar

*******************************************************************************

Compare: **PROVIDE SEVERAL CONTROL SOLUTIONS:**
Provide systems personnel with several solutions to control problems encountered by the internal auditor in a review of the system.

**AND**

**ACT AS A CONTROL CONSULTANT:**
Act as a control consultant to the systems development team.

Very Dissimilar
Similar

*******************************************************************************

Compare: **PROVIDE CHECKLIST OF CONTROLS:**
Although the internal auditor does not review this specific system, he/she provides systems personnel with a general checklist of controls applicable to any system.

**AND**

**SIGN-OFF:**
Approve the application controls as designed.

Very Dissimilar
Similar

*******************************************************************************

Compare: **IDENTIFY CONTROL WEAKNESSES:**
Provide systems personnel with control weaknesses identified by the internal auditor in a review of the system.

**AND**

**ASSIST IN DESIGN:**
The internal auditor assists systems personnel in the design of application controls.

Very Dissimilar
Similar
PART THREE

ASSUMPTIONS REPEATED:
1. The system considered is VITAL to company operations.
2. The internal auditors performing the activities possess the necessary knowledge and training and have the resources, such as time and manpower, to perform any/all of the nine audit activities.
3. Internal auditors have the backing/support of management and systems personnel to perform any of the nine audit activities.
4. The major purpose of the activities is to provide assurance that adequate EDP application controls are designed into the system. Adequate controls provide assurance that the information provided by the system or application is accurate and reliable (high-integrity information).

A. In this part, I ask your opinion concerning the relationship between the nine audit activities included in Part Two and the following factors:

1. INDEPENDENCE: The impact of each activity on the internal auditor's independence when auditing the system after it has been implemented.
2. ASSURANCE PROVIDED: The contribution of each activity in assuring that adequate controls are built into the system.
3. LEVEL OF INVOLVEMENT: The perceived level of internal auditor involvement in the systems development process when performing each activity.
4. ROLE OF INDEPENDENT APPRAISER: The perception of the internal auditor as an independent appraiser when performing each activity.
5. ROLE OF CONSULTANT/ADVISOR: The perception of the internal auditor as a consultant/advisor when performing each activity.
6. ROLE OF FUTURE USER OF THE SYSTEM: The perception of the internal auditor as a future user of the system when performing each activity.
7. ROLE OF PARTICIPANT IN DESIGN: The perception of the internal auditor as a participant in design when performing each activity.

RATE THE ABOVE SEVEN FACTORS ON EACH OF THE AUDIT ACTIVITIES FROM PART TWO. INDICATE YOUR OPINION BY MARKING A SLASH (/) ON THE LINE PROVIDED UNDER EACH FACTOR.
FOR THE ACTIVITY—REVIEW/EVALUATE CONTROLS: Provide systems personnel the results of an internal audit review/evaluation of the system's application controls.

1. Rate the activity's IMPACT on the INTERNAL AUDITOR'S INDEPENDENCE when auditing the implemented system:

<table>
<thead>
<tr>
<th>COMPLETE</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOSS OF</td>
</tr>
<tr>
<td>INDEPENDENCE</td>
</tr>
<tr>
<td>MAINTAINS</td>
</tr>
<tr>
<td>TOTAL</td>
</tr>
<tr>
<td>INDEPENDENCE</td>
</tr>
</tbody>
</table>

2. Rate the ASSURANCE OF ADEQUATE CONTROLS PROVIDED by this activity:

| NO |
| ASSURANCE |
| PROVIDED |

3. Rate the LEVEL OF INTERNAL AUDITOR INVOLVEMENT in systems design for this activity:

| LOW LEVEL |
| INVOLVEMENT |
| HIGH LEVEL |
| INVOLVEMENT |

4. When performing this activity, the internal auditor assumes the role of INDEPENDENT APPRAISER:

| STRONGLY |
| DISAGREE |

5. When performing this activity, the internal auditor assumes the role of CONSULTANT/ADVISOR:

| STRONGLY |
| DISAGREE |

6. When performing this activity, the internal auditor assumes the role of FUTURE USER OF THE SYSTEM:

| STRONGLY |
| DISAGREE |

7. When performing this activity, the internal auditor assumes the role of PARTICIPANT IN DESIGN:

| STRONGLY |
| DISAGREE |
FOR THE APPROACH—IDENTIFY CONTROL WEAKNESSES: Provide systems personnel with control weaknesses identified by the internal auditor in a review of the system.

1. Rate the activity's IMPACT on the INTERNAL AUDITOR'S INDEPENDENCE when auditing the implemented system:

<table>
<thead>
<tr>
<th>COMPLETE</th>
<th>MAINTAINS</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOSS OF</td>
<td>TOTAL</td>
</tr>
<tr>
<td>INDEPENDENCE</td>
<td>INDEPENDENCE</td>
</tr>
</tbody>
</table>

2. Rate the ASSURANCE OF ADEQUATE CONTROLS PROVIDED by this activity:

<table>
<thead>
<tr>
<th>NO ASSURANCE</th>
<th>ASSURES ADEQUATE CONTROLS</th>
</tr>
</thead>
</table>

3. Rate the LEVEL OF INTERNAL AUDITOR INVOLVEMENT in systems design for this activity:

<table>
<thead>
<tr>
<th>LOW LEVEL INVOLVEMENT</th>
<th>HIGH LEVEL INVOLVEMENT</th>
</tr>
</thead>
</table>

4. When performing this activity, the internal auditor assumes the role of INDEPENDENT APPRAISER:

<table>
<thead>
<tr>
<th>STRONGLY DISAGREE</th>
<th>STRONGLY AGREE</th>
</tr>
</thead>
</table>

5. When performing this activity, the internal auditor assumes the role of CONSULTANT/ADVISOR:

<table>
<thead>
<tr>
<th>STRONGLY DISAGREE</th>
<th>STRONGLY AGREE</th>
</tr>
</thead>
</table>

6. When performing this activity, the internal auditor assumes the role of FUTURE USER OF THE SYSTEM:

<table>
<thead>
<tr>
<th>STRONGLY DISAGREE</th>
<th>STRONGLY AGREE</th>
</tr>
</thead>
</table>

7. When performing this activity, the internal auditor assumes the role of PARTICIPANT IN DESIGN:

<table>
<thead>
<tr>
<th>STRONGLY DISAGREE</th>
<th>STRONGLY AGREE</th>
</tr>
</thead>
</table>
FOR THE ACTIVITY—PROVIDE CHECKLIST OF CONTROLS: Although the internal auditor does not review this specific system, he/she provides systems personnel with a general checklist of controls applicable to any system.

1. Rate the activity's IMPACT on the INTERNAL AUDITOR'S INDEPENDENCE when auditing the implemented system:

<table>
<thead>
<tr>
<th>COMPLETE</th>
<th>MAINTAINS</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOSS OF</td>
<td>TOTAL INDEPENDENCE</td>
</tr>
</tbody>
</table>

2. Rate the ASSURANCE OF ADEQUATE CONTROLS PROVIDED by this activity:

<table>
<thead>
<tr>
<th>NO ASSURANCE</th>
<th>ADEQUATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>PROVIDED</td>
<td>CONTROLS</td>
</tr>
</tbody>
</table>

3. Rate the LEVEL OF INTERNAL AUDITOR INVOLVEMENT in systems design for this activity:

| LOW LEVEL INVOLVEMENT | HIGH LEVEL INVOLVEMENT |

4. When performing this activity, the internal auditor assumes the role of INDEPENDENT APPRAISER:

| STRONGLY DISAGREE | STRONGLY AGREE |

5. When performing this activity, the internal auditor assumes the role of CONSULTANT/ADVISOR:

| STRONGLY DISAGREE | STRONGLY AGREE |

6. When performing this activity, the internal auditor assumes the role of FUTURE USER OF THE SYSTEM:

| STRONGLY DISAGREE | STRONGLY AGREE |

7. When performing this activity, the internal auditor assumes the role of PARTICIPANT IN DESIGN:

| STRONGLY DISAGREE | STRONGLY AGREE |
FOR THE ACTIVITY--PROVIDE SEVERAL CONTROL SOLUTIONS: Provide systems personnel with several solutions to control problems encountered by the internal auditor in a review of the system.

1. Rate the activity's IMPACT on the INTERNAL AUDITOR'S INDEPENDENCE when auditing the implemented system:

   COMPLETE                          MAINTAINS
   LOSS OF                           TOTAL
   INDEPENDENCE                      INDEPENDENCE

2. Rate the ASSURANCE OF ADEQUATE CONTROLS PROVIDED by this activity:

   NO                              ASSURES
   ASSURANCE                       ADEQUATE
   PROVIDED                        CONTROLS

3. Rate the LEVEL OF INTERNAL AUDITOR INVOLVEMENT in systems design for this activity:

   LOW LEVEL                       HIGH LEVEL
   INVOLVEMENT                     INVOLVEMENT

4. When performing this activity, the internal auditor assumes the role of INDEPENDENT APPRAISER:

   STRONGLY                        STRONGLY
   DISAGREE                        AGREE

5. When performing this activity, the internal auditor assumes the role of CONSULTANT/ADVISOR:

   STRONGLY                        STRONGLY
   DISAGREE                        AGREE

6. When performing this activity, the internal auditor assumes the role of FUTURE USER OF THE SYSTEM:

   STRONGLY                        STRONGLY
   DISAGREE                        AGREE

7. When performing this activity, the internal auditor assumes the role of PARTICIPANT IN DESIGN:

   STRONGLY                        STRONGLY
   DISAGREE                        AGREE
FOR THE ACTIVITY—RECOMMEND CONTROLS: After reviewing the system, the internal auditor provides systems personnel with a list of recommended application controls for the system.

1. Rate the activity's IMPACT on the INTERNAL AUDITOR'S INDEPENDENCE when auditing the implemented system:

<table>
<thead>
<tr>
<th>COMPLETE</th>
<th>MAINTAINS</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOSS OF INDEPENDENCE</td>
<td></td>
<td>INDEPENDENCE</td>
</tr>
</tbody>
</table>

2. Rate the ASSURANCE OF ADEQUATE CONTROLS PROVIDED by this activity:

<table>
<thead>
<tr>
<th>NO ASSURANCE</th>
<th>ASSURES</th>
</tr>
</thead>
<tbody>
<tr>
<td>PROVIDED</td>
<td>ADEQUATE CONTROLS</td>
</tr>
</tbody>
</table>

3. Rate the LEVEL OF INTERNAL AUDITOR INVOLVEMENT in systems design for this activity:

<table>
<thead>
<tr>
<th>LOW LEVEL INVOLVEMENT</th>
<th>HIGH LEVEL INVOLVEMENT</th>
</tr>
</thead>
</table>

4. When performing this activity, the internal auditor assumes the role of INDEPENDENT APPRAISER:

| STRONGLY DISAGREE | STRONGLY AGREE |

5. When performing this activity, the internal auditor assumes the role of CONSULTANT/ADVISOR:

| STRONGLY DISAGREE | STRONGLY AGREE |

6. When performing this activity, the internal auditor assumes the role of FUTURE USER OF THE SYSTEM:

| STRONGLY DISAGREE | STRONGLY AGREE |

7. When performing this activity, the internal auditor assumes the role of PARTICIPANT IN DESIGN:

| STRONGLY DISAGREE | STRONGLY AGREE |
FOR THE ACTIVITY--SERVE AS MEMBER OF THE SYSTEMS DEVELOPMENT TEAM.

1. Rate the activity's IMPACT on the INTERNAL AUDITOR'S INDEPENDENCE when auditing the implemented system:

   COMPLETE MAINTAINS
   LOSS OF TOTAL INDEPENDENCE

2. Rate the ASSURANCE OF ADEQUATE CONTROLS PROVIDED by this activity:

   NO ASSURES
   ASSURANCE ADEQUATE
   PROVIDED CONTROLS

3. Rate the LEVEL OF INTERNAL AUDITOR INVOLVEMENT in systems design for this activity:

   LOW LEVEL
   INVOLVEMENT

4. When performing this activity, the internal auditor assumes the role of INDEPENDENT APPRAISER:

   STRONGLY
   DISAGREE

5. When performing this activity, the internal auditor assumes the role of CONSULTANT/ADVISOR:

   STRONGLY
   DISAGREE

6. When performing this activity, the internal auditor assumes the role of FUTURE USER OF THE SYSTEM:

   STRONGLY
   DISAGREE

7. When performing this activity, the internal auditor assumes the role of PARTICIPANT IN DESIGN:

   STRONGLY
   DISAGREE
FOR THE ACTIVITY—ACT AS CONTROL CONSULTANT: Act as a control consultant to the systems development team.

1. Rate the activity's IMPACT on the INTERNAL AUDITOR'S INDEPENDENCE when auditing the implemented system:

<table>
<thead>
<tr>
<th>COMPLETE</th>
<th>MAINTAINS</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOSS OF</td>
<td>TOTAL INDEPENDENCE</td>
</tr>
<tr>
<td>INDEPENDENCE</td>
<td></td>
</tr>
</tbody>
</table>

2. Rate the ASSURANCE OF ADEQUATE CONTROLS PROVIDED by this activity:

<table>
<thead>
<tr>
<th>NO</th>
<th>ASSURES ADEQUATE CONTROLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASSURANCE PROVIDED</td>
<td></td>
</tr>
</tbody>
</table>

3. Rate the LEVEL OF INTERNAL AUDITOR INVOLVEMENT in systems design for this activity:

<table>
<thead>
<tr>
<th>LOW LEVEL</th>
<th>HIGH LEVEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>INVOLVEMENT</td>
<td>INVOLVEMENT</td>
</tr>
</tbody>
</table>

4. When performing this activity, the internal auditor assumes the role of INDEPENDENT APPRAISER:

<table>
<thead>
<tr>
<th>STRONGLY</th>
<th>DISAGREE</th>
<th>STRONGLY</th>
<th>AGREE</th>
</tr>
</thead>
</table>

5. When performing this activity, the internal auditor assumes the role of CONSULTANT/ADVISOR:

<table>
<thead>
<tr>
<th>STRONGLY</th>
<th>DISAGREE</th>
<th>STRONGLY</th>
<th>AGREE</th>
</tr>
</thead>
</table>

6. When performing this activity, the internal auditor assumes the role of FUTURE USER OF THE SYSTEM:

<table>
<thead>
<tr>
<th>STRONGLY</th>
<th>DISAGREE</th>
<th>STRONGLY</th>
<th>AGREE</th>
</tr>
</thead>
</table>

7. When performing this activity, the internal auditor assumes the role of PARTICIPANT IN DESIGN:

<table>
<thead>
<tr>
<th>STRONGLY</th>
<th>DISAGREE</th>
<th>STRONGLY</th>
<th>AGREE</th>
</tr>
</thead>
</table>
FOR THE ACTIVITY—SIGN-OFF: An internal auditor approves the application controls as designed.

1. Rate the activity's IMPACT on the INTERNAL AUDITOR'S INDEPENDENCE when auditing the implemented system:

<table>
<thead>
<tr>
<th>COMPLETE</th>
<th>MAINTAINS</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOSS OF</td>
<td>TOTAL</td>
</tr>
<tr>
<td>INDEPENDENCE</td>
<td>INDEPENDENCE</td>
</tr>
</tbody>
</table>

2. Rate the ASSURANCE OF ADEQUATE CONTROLS PROVIDED by this activity:

| NO ASSURANCE | ASSURES ADEQUATE CONTROLS |

3. Rate the LEVEL OF INTERNAL AUDITOR INVOLVEMENT in systems design for this activity:

| LOW LEVEL INVOLVEMENT | HIGH LEVEL INVOLVEMENT |

4. When performing this activity, the internal auditor assumes the role of INDEPENDENT APPRAISER:

| STRONGLY DISAGREE | STRONGLY AGREE |

5. When performing this activity, the internal auditor assumes the role of CONSULTANT/ADVISOR:

| STRONGLY DISAGREE | STRONGLY AGREE |

6. When performing this activity, the internal auditor assumes the role of FUTURE USER OF THE SYSTEM:

| STRONGLY DISAGREE | STRONGLY AGREE |

7. When performing this activity, the internal auditor assumes the role of PARTICIPANT IN DESIGN:

| STRONGLY DISAGREE | STRONGLY AGREE |
FOR THE ACTIVITY--ASSIST IN DESIGN: The internal auditor assists systems personnel in the design of application controls.

1. Rate the activity's IMPACT on the INTERNAL AUDITOR'S INDEPENDENCE when auditing the implemented system:

<table>
<thead>
<tr>
<th>COMPLETE MAINTAINS</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOSS OF</td>
</tr>
<tr>
<td>INDEPENDENCE</td>
</tr>
<tr>
<td>MAINTAINS TOTAL</td>
</tr>
<tr>
<td>INDEPENDENCE</td>
</tr>
</tbody>
</table>

2. Rate the ASSURANCE OF ADEQUATE CONTROLS PROVIDED by this activity:

| NO ASSURANCE |
| PROV |
|__________|

3. Rate the LEVEL OF INTERNAL AUDITOR INVOLVEMENT in systems design for this activity:

| LOW LEVEL INVOLVEMENT |
| HIGH LEVEL INVOLVEMENT |
|________________________|

4. When performing this activity, the internal auditor assumes the role of INDEPENDENT APPRAISER:

| STRONGLY AGREE |
| DISAGREE |
|__________|

5. When performing this activity, the internal auditor assumes the role of CONSULTANT/ADVISOR:

| STRONGLY AGREE |
| DISAGREE |
|__________|

6. When performing this activity, the internal auditor assumes the role of FUTURE USER OF THE SYSTEM:

| STRONGLY AGREE |
| DISAGREE |
|__________|

7. When performing this activity, the internal auditor assumes the role of PARTICIPANT IN DESIGN:

| STRONGLY AGREE |
| DISAGREE |
|__________|
B. PLEASE LIST ANY OTHER ATTRIBUTES, GIVEN THE ASSUMPTIONS, WHICH YOU
FEEL ARE IMPORTANT IN CHOOSING AMONG AUDIT ACTIVITIES DURING SYSTEMS
DESIGN.

________________________________________________________________________

________________________________________________________________________

C. THE ROLE OF THE INTERNAL AUDITOR WHEN PERFORMING TWO TYPES OF
AUDIT ACTIVITIES:

1. When performing activities related to EDP APPLICATION CONTROLS, the
internal auditor is sometimes required to fulfill the role(s) of: (you
may pick more than one)

__INDEPENDENT APPRAISER  __PARTICIPANT IN DESIGN
__CONSULTANT/ADVISOR  __USER OF THE SYSTEM
__OTHER ROLE; PLEASE
DESCRIBE

________________________________________________________________________

2. Internal auditors may perform activities during systems design which
provide assurance that adequate audit requirements are built into the
system. When performing activities related to assuring the AUDITABILITY
OF THE SYSTEM, the internal auditor is sometimes required to fulfill the
role(s) of: (You may pick more than one)

__INDEPENDENT APPRAISER  __PARTICIPANT IN DESIGN
__CONSULTANT/ADVISOR  __USER OF THE SYSTEM
__OTHER ROLE; PLEASE
DESCRIBE

________________________________________________________________________
B-2. THE AUDITABILITY QUESTIONNAIRE

INTRODUCTION

This questionnaire concerns the internal auditor's involvement in assuring the auditability of a system which is being developed. Your opinions are sought concerning the similarities of nine activities performed during the design stage of systems development.

When completing this instrument, please assume the following:
1. The system considered is VITAL to company operations.
2. The internal auditors performing the activities possess the necessary knowledge and training and have the resources, such as time and manpower, available to perform any or all of the nine audit activities.
3. The internal auditors have the backing/support of management and systems personnel to perform any of the nine activities.
4. The major purpose of the activities is to provide assurance that the system may be appropriately audited after implementation, or that future audit needs are provided. These future audit needs may include audit trails which may be clearly identified, the inclusion of embedded audit routines, and/or the ability to access data which may be needed by the internal auditor in an audit of the system after it is in operation.

Please complete the instrument in order--Part One should be completed first, then Part Two and finally Part Three. DO NOT RETURN to a part once completed. Parts Two and Three contain the experimental material. Part One collects background information.

PART ONE

1. What is your position in the company?

2. Would you classify yourself as:
   ___A General Internal Auditor, ___An EDP Specialist, ___Other Specialist

3. Approximately how many years have you been an internal auditor?
   ___0-3 years ___4-6 years ___7-10 years ___Over 10 years

4. Are you a member of the EDP Auditors Association?___Yes ___No

5. Are you a Certified Information Systems Auditor?___Yes ___No

6. Please indicate your training in audit concerns for developing systems:
   ___None ___On the Job ___Formal (PD Courses or College Courses)
PLEASE INDICATE YOUR OPINION TO THE FOLLOWING QUESTIONS BY MARKING A SLASH (/) ON THE LINE PROVIDED.

7. The internal audit department should be involved in some manner during the systems development process:

   Strongly Agree
   Disagree

8. If the internal audit department is involved, this involvement should encompass the systems design stage:

   Strongly Agree
   Disagree

9. The Institute of Internal Auditors provides adequate guidelines for internal auditor involvement during systems development process:

   Strongly Agree
   Disagree

10. Does your internal audit department participated in the systems development process? __Frequently __Occasionally __Never

    If your answer is YES, does the involvement include the systems design phase? __Frequently __Occasionally __Never

11. Have you ever:

    1. Audited a system under development? __Yes __No

       2. Acted as a consultant to persons developing a system? __Yes __No

       3. Participated in any manner in the development of a system? __Yes __No

       IF YOU ANSWERED "NO" TO ALL 3 SITUATIONS, YOU NEED NOT ANSWER THE REMAINING QUESTIONNAIRE. PLEASE RETURN THE ENTIRE QUESTIONNAIRE IN THE ENCLOSED ENVELOPE. THANK YOU.

       IF YOU ANSWERED "YES" TO ANY OF THE THREE SITUATIONS, PLEASE TURN THE PAGE OVER AND CONTINUE TO PART TWO.
PART TWO

AUDITABILITY OF AN EDI SYSTEM

(THE ABILITY TO APPROPRIATELY AUDIT A SPECIFIC EDI SYSTEM)

ASSUMPTIONS REPEATED:
1. The system considered is VITAL to company operations.
2. The internal auditors performing the activities possess the necessary knowledge and training and have the resources, such as time and manpower, available to perform any/all of the nine audit activities.
3. The internal auditors have the backing/support of management and systems personnel to perform any of the nine activities.
4. The major purpose of the activities is to provide assurance that the system may be appropriately audited after implementation, or that future audit needs are provided. These future audit needs may include audit trails which may be clearly identified, the inclusion of embedded

Nine internal audit activities related to the audit requirements of the system or the AUDITABILITY of the system are presented below. These activities have been mentioned in the accounting literature for internal auditor PERFORMANCE DURING THE SYSTEMS DESIGN PHASE of developing systems. Paired comparisons of the approaches are presented next. Given the assumptions above, consider each pair and rate the degree of similarity between the two audit activities. Please record your judgment by marking a slash (/) on the 5-inch line provided. The basis of your similarity judgments are left to your discretion.

<table>
<thead>
<tr>
<th>ACTIVITY</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>REVIEW/EVALUATE AUDITABILITY: Provide systems personnel the results of an internal audit Review/Evaluation of application controls as designed.</td>
</tr>
<tr>
<td>2</td>
<td>IDENTIFY AUDIT WEAKNESSES: Provide systems personnel with audit weaknesses identified for the system.</td>
</tr>
<tr>
<td>3</td>
<td>PROVIDE GENERAL AUDIT REQUIREMENTS: Provide systems personnel with a general statement of audit requirements for any system.</td>
</tr>
<tr>
<td>4</td>
<td>PROVIDE SEVERAL AUDIT REQUIREMENT SOLUTIONS: Provide systems personnel several solutions for fulfilling audit requirements for the system.</td>
</tr>
<tr>
<td>5</td>
<td>SUBMIT AUDIT SPECIFICATIONS: Provide Audit Specifications to be designed by systems personnel.</td>
</tr>
<tr>
<td>6</td>
<td>MEMBER OF DEVELOPMENT TEAM: Serve as a member of the systems development team which designs the audit requirements for the system.</td>
</tr>
<tr>
<td>7</td>
<td>CONSULTANT FOR AUDIT REQUIREMENTS: Act as a consultant to development team on audit requirements for the system.</td>
</tr>
<tr>
<td>8</td>
<td>SIGN-OFF: Approve the auditability of the system.</td>
</tr>
<tr>
<td>9</td>
<td>ASSIST IN DESIGN: The internal auditor assists systems personnel in the design of audit requirements.</td>
</tr>
</tbody>
</table>
SIMILARITY JUDGMENTS FOR THE NINE AUDIT ACTIVITIES

Indicate your opinion of the similarity of pairs of audit activities by marking a slash (/) at the point of judged similarity on the line below each pair of activities.

******************************************************************************

Compare: REVIEW/EVALUATE AUDITABILITY:
Provide systems personnel the results of an internal audit Review/Evaluation of the auditability of the system as designed

AND

IDENTIFY AUDIT WEAKNESSES:
Provide systems personnel with audit weaknesses identified for the system.

Very
Dissimilar


******************************************************************************

Compare: ASSIST IN DESIGN OF AUDIT NEEDS:
The internal auditor assists systems personnel in the design of audit requirements.

AND

PROVIDE GENERAL AUDIT REQUIREMENTS:
Provide systems personnel with a general statement of audit requirements for any system.

Very
Dissimilar


******************************************************************************

Compare: SIGN-OFF:
Approve the auditability of the system.

AND

PROVIDE SEVERAL AUDIT REQUIREMENTS:
Provide systems personnel several solutions for fulfilling audit requirements for the system.

Very
Dissimilar


******************************************************************************

Compare: CONSULTANT FOR AUDIT REQUIREMENTS:
Act as a consultant to development team on audit requirements for the system.

AND

SUBMIT AUDIT SPECIFICATIONS:
Provide audit specifications to be designed by systems personnel.

Very
Dissimilar


******************************************************************************
**Compare: MEMBER OF DEVELOPMENT TEAM:**
Serve as a member of the systems development team which designs the audit requirements for the system.

**AND**

**REVIEW/EVALUATE AUDITABILITY:**
Provide systems personnel the results of an internal audit Review/Evaluation of the auditability of the system as designed.

**Very**
**Dissimilar**

**Very**
**Similar**

**AND**

**COMPARE:**

**Compare: PROVIDE GENERAL AUDIT REQUIREMENTS:**
Provide systems personnel with a general statement of audit requirements for any system.

**AND**

**IDENTIFY AUDIT WEAKNESSES:**
Provide systems personnel with audit weaknesses identified for the system.

**Very**
**Dissimilar**

**Very**
**Similar**

**AND**

**COMPARE:**

**Compare: PROVIDE SEVERAL AUDIT REQUIREMENT SOLUTIONS:**
Provide systems personnel several solutions for fulfilling audit requirements for the system.

**AND**

**ASSIST IN DESIGN OF AUDIT NEEDS:**
The internal auditor assists systems personnel in the design of audit requirements.

**Very**
**Dissimilar**

**Very**
**Similar**

**AND**

**COMPARE:**

**SUBMIT AUDIT SPECIFICATIONS:**
Provide Audit Specifications to be designed by systems personnel.

**AND**

**SIGN-OFF:**
Approve the auditability of the system.

**Very**
**Dissimilar**

**Very**
**Similar**
Compare: MEMB:E:R OF DEVELOPMENT TEAM:
Serve as a member of the systems development team which
designs the audit requirements for the system.

AND

CONSULTANT FOR Audit REQUIREMENTS:
Act as a consultant to development team on audit
requirements for the system.

Very
Dissimilar

Similar

Compare: REVIEW/EVALUATE AUDITABILITY:
Provide systems personnel the results of an internal audit Review/Evaluation of the auditability of the
system as designed.

AND

PROVIDE GENERAL Audit REQUIREMENTS:
Provide systems personnel with a general statement of audit requirements for any system.

Very
Dissimilar

Similar

Compare: IDENTIFY Audit WEAKNESEA:
Provide systems personnel with audit weaknesses identified for the system.

AND

PROVIDE SEVERAL Audit REQUIREMENT SOLUTIONS:
Provide systems personnel several solutions for fulfilling audit requirements for the system.

Very
Dissimilar

Similar

Compare: ASSIST IN DESIGN OF Audit NEEDS:
The internal auditor assists systems personnel in the design of audit requirements.

AND

SUBMIT Audit SPECIFICATIONS:
Provide Audit Specifications to be designed by systems personnel.

Very
Dissimilar

Similar
**SIGN-OFF:**
Approve the auditability of the system.

**SERVE AS MEMBER OF DEVELOPMENT TEAM:**
Serve as a member of the systems development team which designs the audit requirements for the system.

**ACT AS A CONSULTANT FOR AUDIT NEEDS:**
Act as a consultant to development team on audit requirements for the system.

**REVIEW/EVALUATE AUDITABILITY:**
Provide systems personnel the results of an internal audit Review/Evaluation of the auditability of the system as designed.

**PROVIDE SEVERAL AUDIT REQUIREMENT SOLUTIONS:**
Provide systems personnel several solutions for fulfilling audit requirements for the system.

**PROVIDE GENERAL AUDIT REQUIREMENTS:**
Provide systems personnel with a general statement of audit requirements for any system.

**SUBMIT AUDIT SPECIFICATIONS:**
Provide Audit Specifications to be designed by systems personnel.

**IDENTIFY AUDIT WEAKNESSES:**
Provide systems personnel with audit weaknesses identified for the system.
Serve as a member of the systems development team which designs the audit requirements for the system.

AND

Assist in design of audit needs:
The internal auditor assists systems personnel in the design of audit requirements.

Very
dissimilar

Very
similar

Act as a consultant to development team on audit requirements for the system.

AND

Sign-off:
Approve the auditability of the system.

Very
dissimilar

Very
similar

Provide systems personnel the results of an internal audit Review/Evaluation of the auditability of the system as designed.

AND

Provide several audit requirement solutions:
Provide systems personnel several solutions for fulfilling audit requirements for the system.

Very
dissimilar

Very
similar

Provide systems personnel with a general statement of audit requirements for any system.

AND

Submit audit specifications:
Provide Audit Specifications to be designed by systems personnel.

Very
dissimilar

Very
similar

Provide systems personnel with a general statement of audit requirements for any system.
**COMPARISON: IDENTIFY AUDIT WEAKNESSES:**
- Provide systems personnel with audit weaknesses identified for the system.

**AND**
**SERVE AS MEMBER OF DEVELOPMENT TEAM:**
- Serve as a member of the systems development team which designs the audit requirements for the system.


**COMPARISON: ASSIST IN DESIGN OF AUDIT NEEDS:**
- The internal auditor assists systems personnel in the design of audit requirements.

**AND**
**ACT AS A CONSULTANT FOR AUDIT NEEDS:**
- Act as a consultant to development team on audit requirements for the system.


**COMPARISON: SIGN-OFF:**
- Approve the auditability of the system.

**AND**
**REVIEW/EVALUATE AUDITABILITY:**
- Provide systems personnel the results of an internal audit Review/Evaluation of the auditability of the system as designed.


**COMPARISON: SUBMIT AUDIT SPECIFICATIONS:**
- Provide Audit Specifications to be designed by systems personnel.

**AND**
**PROVIDE SEVERAL AUDIT REQUIREMENT SOLUTIONS:**
- Provide systems personnel several solutions for fulfilling audit requirements for the system.
SERVE AS MEMBER OF DEVELOPMENT TEAM:
Serve as a member of the systems development team which designs the audit requirements for the system.

PROVIDE GENERAL AUDIT REQUIREMENTS:
Provide systems personnel with a general statement of audit requirements for any system.

ACT AS A CONSULTANT FOR AUDIT NEEDS:
Act as a consultant to development team on audit requirements for the system.

IDENTIFY AUDIT WEAKNESSES:
Provide systems personnel with audit weaknesses identified for the system.

SIGN-OFF:
Approve the auditability of the system.

ASSIST IN DESIGN OF AUDIT NEEDS:
The internal auditor assists systems personnel in the design of audit requirements.

REVIEW/Evaluate AUDITABILITY:
Provide systems personnel the results of an internal audit Review/Evaluation of the auditability of the system as designed.

Submit AUDIT SPECIFICATIONS:
Provide Audit Specifications to be designed by systems personnel.
**Coapare: PROVIDE SEVERAL AUDIT REQUIREMENT SOLUTIONS:**
Provide systems personnel several solutions for fulfilling audit requirements for the system.

**AND**

**SERVE AS MEMBER OF DEVELOPMENT TEAM:**
Serve as a member of the systems development team which designs the audit requirements for the system.

Present: Very
Dissimilar: Very

**Compare: PROVIDE GENERAL AUDIT REQUIREMENTS:**
Provide systems personnel with a general statement of audit requirements for any system.

**AND**

**ACT AS A CONSULTANT FOR AUDIT NEEDS:**
Act as a consultant to development team on audit requirements for the system.

Present: Very
Dissimilar: Similar

**Compare: IDENTIFY AUDIT WEAKNESSES:**
Provide systems personnel with audit weaknesses identified for the system.

**AND**

**SIGN-OFF:**
Approve the auditability of the system.

Present: Very
Dissimilar: Similar

**Compare: ASSIST IN DESIGN OF AUDIT NEEDS:**
The internal auditor assists systems personnel in the design of audit requirements.

**AND**

**REVIEW/EVALUATE AUDITABILITY:**
Provide systems personnel the results of an internal audit Review/Evaluation of the auditability of the system as designed.

Present: Very
Dissimilar: Similar
Compare: SUBMIT AUDIT SPECIFICATIONS:
Provide Audit Specifications to be designed by systems personnel.

AND
SERVE AS MEMBER OF DEVELOPMENT TEAM:
Serve as a member of the systems development team which designs the audit requirements for the system.

Very Dissimilar Similar

COMPARE:

PROVIDE SEVERAL AUDIT REQUIREMENT SOLUTIONS:
Provide systems personnel several solutions for fulfilling audit requirements for the system.

AND
ACT AS A CONSULTANT FOR AUDIT NEEDS:
Act as a consultant to development team on audit requirements for the system.

Very Dissimilar Similar

COMPARE:

PROVIDE GENERAL AUDIT REQUIREMENTS:
Provide systems personnel with a general statement of audit requirements for any system.

AND
SIGN-OFF:
Approve the auditability of the system.

Very Dissimilar Similar

COMPARE:

IDENTIFY AUDIT WEAKNESSES:
Provide systems personnel with audit weaknesses identified for the system.

AND
ASSIST IN DESIGN OF AUDIT NEEDS:
The internal auditor assists systems personnel in the design of audit requirements.

Very Dissimilar Similar

COMPARE:
PART THREE

ASSUMPTIONS REPEATED:
1. The system considered is VITAL to company operations.
2. The internal auditors performing the activities possess the necessary
knowledge and training and have the resources, such as time and
manpower, available to perform any/all of the nine audit activities.
3. The internal auditors have the backing/support of management and
systems personnel to perform any of the nine activities.
4. The major purpose of the activities is to provide assurance that the
system may be appropriately audited after implementation, or that
future audit needs are provided. These future audit needs may
include audit trails which may be clearly identified, the inclusion
of embedded audit routines, and/or the ability to access data which
may be needed by the internal auditor in an audit of the system
after it is in operation.

A. In this part, I ask your opinion concerning the relationship
between the nine audit activities included in Part Two and
the following factors:

1. INDEPENDENCE: The impact of performing each activity on the
   internal auditor's independence when auditing the system after
   it has been implemented.
2. ASSURANCE PROVIDED: The contribution of each activity in assuring
   the auditability of the system.
3. LEVEL OF INVOLVEMENT: The perceived level of internal auditor
   involvement in the systems design process when performing each
   activity.
4. ROLE OF INDEPENDENT APPRAISER: The perception of the internal auditor
   as an independent appraiser when performing each activity.
5. ROLE OF CONSULTANT/ADVISOR: The perception of the internal auditor
   as a consultant/advisor when performing each activity.
6. ROLE OF FUTURE USER OF THE SYSTEM: The perception of the internal
   auditor as a future user of the system when performing each activity.
   "User" is a person who obtains data from the system to fulfill
   certain information requirements.
7. ROLE OF PARTICIPANT IN DESIGN: The perception of the internal auditor
   as a participant in design when performing each activity.

******************************************************************************

RATE THE ABOVE SEVEN FACTORS ON EACH OF THE AUDIT ACTIVITIES FROM
PART TWO. INDICATE YOUR OPINION BY MARKING A SLASH (/) ON THE LINE
PROVIDED UNDER EACH FACTOR.

******************************************************************************
FOR THE ACTIVITY—REVIEW/EVALUATE AUDITABILITY: Provide systems personnel the results of an internal audit review/evaluation of application controls as designed.

1. Rate the activity's IMPACT on the INTERNAL AUDITOR'S INDEPENDENCE when auditing the system after its implementation:

<table>
<thead>
<tr>
<th>COMPLETE</th>
<th>MAINTAINS</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOSS OF</td>
<td>TOTAL</td>
</tr>
<tr>
<td>INDEPENDENCE</td>
<td>INDEPENDENCE</td>
</tr>
</tbody>
</table>

2. Rate the ASSURANCE OF AUDITABILITY PROVIDED by this activity:

<table>
<thead>
<tr>
<th>NO</th>
<th>ASSURES</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASSURANCE</td>
<td>SYSTEMS' AUDITABILITY</td>
</tr>
</tbody>
</table>

3. Rate the LEVEL OF INTERNAL AUDITOR INVOLVEMENT in the system's design process when using this activity:

<table>
<thead>
<tr>
<th>LOW LEVEL</th>
<th>HIGH LEVEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>INVOLVEMENT</td>
<td>INVOLVEMENT</td>
</tr>
</tbody>
</table>

4. When performing this activity, the internal auditor assumes the role of INDEPENDENT APPRAISER:

<table>
<thead>
<tr>
<th>STRONGLY</th>
<th>DISAGREE</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGREE</td>
<td></td>
</tr>
</tbody>
</table>

5. When performing this activity, the internal auditor assumes the role of CONSULTANT/ADVISOR:

<table>
<thead>
<tr>
<th>STRONGLY</th>
<th>DISAGREE</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGREE</td>
<td></td>
</tr>
</tbody>
</table>

6. When performing this activity, the internal auditor assumes the role of FUTURE USER OF THE SYSTEM:

<table>
<thead>
<tr>
<th>STRONGLY</th>
<th>DISAGREE</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGREE</td>
<td></td>
</tr>
</tbody>
</table>

7. When performing this activity, the internal auditor assumes the role of PARTICIPANT IN DESIGN:

<table>
<thead>
<tr>
<th>STRONGLY</th>
<th>DISAGREE</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGREE</td>
<td></td>
</tr>
</tbody>
</table>
FOR THE ACTIVITY—IDENTIFY AUDIT WEAKNESSES: Provide systems personnel with audit weaknesses identified by the internal auditor in a review of the system.

1. Rate the activity's IMPACT on the INTERNAL AUDITOR'S INDEPENDENCE when auditing the system after its implementation:

<table>
<thead>
<tr>
<th>MAINTAINS TOTAL INDEPENDENCE</th>
<th>COMPLETE LOSS OF INDEPENDENCE</th>
</tr>
</thead>
</table>

2. Rate the ASSURANCE OF AUDITABILITY PROVIDED by this activity:

<table>
<thead>
<tr>
<th>NO ASSURANCE PROVIDED</th>
<th>ASSURES SYSTEM'S AUDITABILITY</th>
</tr>
</thead>
</table>

3. Rate the LEVEL OF INTERNAL AUDITOR INVOLVEMENT in systems design for this activity:

<table>
<thead>
<tr>
<th>LOW LEVEL INVOLVEMENT</th>
<th>HIGH LEVEL INVOLVEMENT</th>
</tr>
</thead>
</table>

4. When performing this activity, the internal auditor assumes the role of INDEPENDENT APPRAISER:

<table>
<thead>
<tr>
<th>STRONGLY DISAGREE</th>
<th>STRONGLY AGREE</th>
</tr>
</thead>
</table>

5. When performing this activity, the internal auditor assumes the role of CONSULTANT/ADVISOR:

<table>
<thead>
<tr>
<th>STRONGLY DISAGREE</th>
<th>STRONGLY AGREE</th>
</tr>
</thead>
</table>

6. When performing this activity, the internal auditor assumes the role of FUTURE USER OF THE SYSTEM:

<table>
<thead>
<tr>
<th>STRONGLY DISAGREE</th>
<th>STRONGLY AGREE</th>
</tr>
</thead>
</table>

7. When performing this activity, the internal auditor assumes the role of PARTICIPANT IN DESIGN:

<table>
<thead>
<tr>
<th>STRONGLY DISAGREE</th>
<th>STRONGLY AGREE</th>
</tr>
</thead>
</table>
**FOR THE ACTIVITY---PROVIDE GENERAL AUDIT REQUIREMENTS:** Provide systems personnel with a general statement of audit requirements for any system.

1. Rate the **IMPACT of this activity on the INTERNAL AUDITOR'S INDEPENDENCE** When auditing the implemented system:

<table>
<thead>
<tr>
<th>COMPLETE</th>
<th>MAINTAINS</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOSS OF</td>
<td>TOTAL</td>
</tr>
<tr>
<td>INDEPENDENCE</td>
<td>INDEPENDENCE</td>
</tr>
</tbody>
</table>

2. Rate the **ASSURANCE OF AUDITABILITY PROVIDED by this activity**:

<table>
<thead>
<tr>
<th>NO ASSURANCE</th>
<th>ASSURES</th>
</tr>
</thead>
<tbody>
<tr>
<td>PROVIDED</td>
<td>SYSTEM'S AUDITABILITY</td>
</tr>
</tbody>
</table>

3. Rate the **LEVEL INTERNAL AUDITOR INVOLVEMENT** in systems design for this activity:

| LOW LEVEL INVOLVEMENT | HIGH LEVEL INVOLVEMENT |

4. When performing this activity, the internal auditor assumes the role of **INDEPENDENT APPRAISER**:

| STRONGLY DISAGREE | STRONGLY AGREE |

5. When performing this activity, the internal auditor assumes the role of **CONSULTANT/ADVISOR**:

| STRONGLY DISAGREE | STRONGLY AGREE |

6. When performing this activity, the internal auditor assumes the role of **FUTURE USER OF THE SYSTEM**:

| STRONGLY DISAGREE | STRONGLY AGREE |

7. When performing this activity, the internal auditor assumes the role of **PARTICIPANT IN DESIGN**:

| STRONGLY DISAGREE | STRONGLY AGREE |
FOR THE ACTIVITY—PROVIDE SEVERAL AUDIT REQUIREMENT SOLUTIONS: Provide systems personnel several solutions for fulfilling audit requirements for the system.

1. Rate the IMPACT of this activity on the INTERNAL AUDITOR'S INDEPENDENCE when auditing the implemented system:

   COMPLETE MAINTAINS LOSS OF TOTAL INDEPENDENCE INDEPENDENCE

2. Rate the ASSURANCE OF AUDITABILITY PROVIDED by this activity:

   NO ASSURES ASSURANCE SYSTEM'S PROVIDED AUDITABILITY

3. Rate the LEVEL OF INTERNAL AUDITOR INVOLVEMENT in systems design for this activity:

   LOW LEVEL INVOLVEMENT HIGH LEVEL INVOLVEMENT

4. When performing this activity, the internal auditor assumes the role of INDEPENDENT APPRAISER:

   STRONGLY AGREE DISAGREE

5. When performing this activity, the internal auditor assumes the role of CONSULTANT ADVISOR:

   STRONGLY AGREE DISAGREE

6. When performing this activity, the internal auditor assumes the role of FUTURE USER OF THE SYSTEM:

   STRONGLY AGREE DISAGREE

7. When performing this activity, the internal auditor assumes the role of PARTICIPANT IN DESIGN:

   STRONGLY AGREE DISAGREE
FOR THE ACTIVITY—SUBMIT AUDIT SPECIFICATIONS: Provide audit specifications to be designed by systems personnel.

1. Rate the IMPACT of this activity on the INTERNAL AUDITOR’S INDEPENDENCE when auditing the implemented system:

<table>
<thead>
<tr>
<th>COMPLETE</th>
<th>MAINTAINS</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOSS OF</td>
<td>TOTAL</td>
</tr>
<tr>
<td>INDEPENDENCE</td>
<td>INDEPENDENCE</td>
</tr>
</tbody>
</table>

2. Rate the ASSURANCE OF AUDITABILITY PROVIDED by this activity:

<table>
<thead>
<tr>
<th>NO ASSURANCE</th>
<th>ASSURES</th>
</tr>
</thead>
<tbody>
<tr>
<td>PROVIDED</td>
<td>SYSTEM’S AUDITABILITY</td>
</tr>
</tbody>
</table>

3. Rate the LEVEL OF INTERNAL AUDITOR INVOLVEMENT in systems design for this activity:

| LOW LEVEL INVOLVEMENT | HIGH LEVEL INVOLVEMENT |

4. When performing this activity, the internal auditor assumes the role of INDEPENDENT APPRAISER:

| STRONGLY | STRONGLY |
| DISAGREE | AGREE |

5. When performing this activity, the internal auditor assumes the role of CONSULTANT/ADVISOR:

| STRONGLY | STRONGLY |
| DISAGREE | AGREE |

6. When performing this activity, the internal auditor assumes the role of FUTURE USER OF THE SYSTEM:

| STRONGLY | STRONGLY |
| DISAGREE | AGREE |

7. When performing this activity, the internal auditor assumes the role of PARTICIPANT IN DESIGN:

| STRONGLY | STRONGLY |
| DISAGREE | AGREE |
FOR THE ACTIVITY—MEMBER OF DEVELOPMENT TEAM: Serve as a member of the systems development team which designs the audit requirements for the system.

1. Rate the IMPACT of this activity on the INTERNAL AUDITOR'S INDEPENDENCE when auditing the implemented system:

<table>
<thead>
<tr>
<th>COMPLETE</th>
<th>MAINTAINS</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOSS OF</td>
<td>TOTAL</td>
</tr>
<tr>
<td>INDEPENDENCE</td>
<td>INDEPENDENCE</td>
</tr>
</tbody>
</table>

2. Rate the ASSURANCE OF AUDITABILITY PROVIDED by this activity:

<table>
<thead>
<tr>
<th>NO</th>
<th>ASSURES</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASSURANCE</td>
<td>SYSTEM'S</td>
</tr>
<tr>
<td>PROVIDED</td>
<td>AUDITABILITY</td>
</tr>
</tbody>
</table>

3. Rate the LEVEL OF INTERNAL AUDITOR INVOLVEMENT in systems design for this activity:

<table>
<thead>
<tr>
<th>LOW LEVEL</th>
<th>HIGH LEVEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>INVOLVEMENT</td>
<td>INVOLVEMENT</td>
</tr>
</tbody>
</table>

4. When performing this activity, the internal auditor assumes the role of INDEPENDENT APPRAISER:

| STRONGLY | STRONGLY |
| DISAGREE | AGREE    |

5. When performing this activity, the internal auditor assumes the role of CONSULTANT/ADVISOR:

| STRONGLY | STRONGLY |
| DISAGREE | AGREE    |

6. When performing this activity, the internal auditor assumes the role of FUTURE USER OF THE SYSTEM:

| STRONGLY | STRONGLY |
| DISAGREE | AGREE    |

7. When performing this activity, the internal auditor assumes the role of PARTICIPANT IN DESIGN:

| STRONGLY | STRONGLY |
| DISAGREE | AGREE    |
FOR THE ACTIVITY—CONSULTANT FOR AUDIT REQUIREMENTS: Act as a consultant to the development team concerning audit requirements for the system.

1. Rate the IMPACT of this activity on the INTERNAL AUDITOR'S INDEPENDENCE when auditing the implemented system:

   COMPLETE LOSS OF MAINTAINS TOTAL INDEPENDENCE
   
2. Rate the ASSURANCE OF AUDITABILITY PROVIDED by this Activity:

   NO ASSURANCE ASSURES SYSTEM'S
   ASSURANCE PROVIDED AUDITABILITY
   
3. Rate the LEVEL OF INTERNAL AUDITOR INVOLVEMENT for this activity:

   LOW LEVEL INVOLVEMENT HIGH LEVEL INVOLVEMENT
   
4. When performing this activity, the internal auditor assumes the role of INDEPENDENT APPRAISER:

   STRONGLY DISAGREE STRONGLY AGREE
   
5. When performing this activity, the internal auditor assumes the role of CONSULTANT/ADVISOR:

   STRONGLY DISAGREE STRONGLY AGREE
   
6. When performing this activity, the internal auditor assumes the role of FUTURE USER OF THE SYSTEM:

   STRONGLY DISAGREE STRONGLY AGREE
   
7. When performing this activity, the internal auditor assumes the role of PARTICIPANT IN DESIGN:

   STRONGLY DISAGREE STRONGLY AGREE
FOR THE ACTIVITY—SIGN-OFF: An internal auditor approves the auditability of the system.

1. Rate the IMPACT of this activity on the INTERNAL AUDITOR'S INDEPENDENCE when auditing the implemented system:

<table>
<thead>
<tr>
<th>COMPLETE</th>
<th>MAINTAINS</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOSS OF</td>
<td>TOTAL INDEPENDENCE</td>
</tr>
<tr>
<td>INDEPENDENCE</td>
<td></td>
</tr>
</tbody>
</table>

2. Rate the ASSURANCE OF AUDITABILITY PROVIDED by this activity:

<table>
<thead>
<tr>
<th>NO ASSURANCE</th>
<th>ASSURES SYSTEM'S AUDITABILITY</th>
</tr>
</thead>
</table>

3. Rate the LEVEL OF INTERNAL AUDITOR INVOLVEMENT for this activity:

<table>
<thead>
<tr>
<th>LOW LEVEL INVOLVEMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGH LEVEL INVOLVEMENT</td>
</tr>
</tbody>
</table>

4. When performing this activity, the internal auditor assumes the role of INDEPENDENT APPRAISER:

| STRONGLY AGREE |
| STRONGLY DISAGREE |

5. When performing this activity, the internal auditor assumes the role of CONSULTANT/ADVISOR:

| STRONGLY AGREE |
| STRONGLY DISAGREE |

6. When performing this activity, the internal auditor assumes the role of FUTURE USER OF THE SYSTEM:

| STRONGLY AGREE |
| STRONGLY DISAGREE |

7. When performing this activity, the internal auditor assumes the role of PARTICIPANT IN DESIGN:

| STRONGLY AGREE |
| STRONGLY DISAGREE |
FOR THE ACTIVITY—ASSIST IN DESIGN: The internal auditor assists systems personnel in the design of audit requirements.

1. Rate the IMPACT of this activity on the INTERNAL AUDITOR'S INDEPENDENCE when auditing the implemented system:

<table>
<thead>
<tr>
<th>COMPLETE</th>
<th>MAINTAINS</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOSS OF</td>
<td>TOTAL</td>
<td>INDEPENDENCE</td>
</tr>
</tbody>
</table>

2. Rate the ASSURANCE OF ADEQUATE CONTROLS PROVIDED by this activity:

<table>
<thead>
<tr>
<th>NO ASSURANCE</th>
<th>ASSURES SYSTEM'S AUDITABILITY</th>
</tr>
</thead>
</table>

3. Rate the LEVEL OF INTERNAL AUDITOR INVOLVEMENT in systems design for this activity:

<table>
<thead>
<tr>
<th>LOW LEVEL INVOLVEMENT</th>
<th>HIGH LEVEL INVOLVEMENT</th>
</tr>
</thead>
</table>

4. When performing this activity, the internal auditor assumes the role of INDEPENDENT APPRAISER:

<table>
<thead>
<tr>
<th>STRONGLY DISAGREE</th>
<th>STRONGLY AGREE</th>
</tr>
</thead>
</table>

5. When performing this activity, the internal auditor assumes the role of CONSULTANT/ADVISOR:

<table>
<thead>
<tr>
<th>STRONGLY DISAGREE</th>
<th>STRONGLY AGREE</th>
</tr>
</thead>
</table>

6. When performing this activity, the internal auditor assumes the role of FUTURE USER OF THE SYSTEM:

<table>
<thead>
<tr>
<th>STRONGLY DISAGREE</th>
<th>STRONGLY AGREE</th>
</tr>
</thead>
</table>

7. When performing this activity, the internal auditor assumes the role of PARTICIPANT IN DESIGN:

<table>
<thead>
<tr>
<th>STRONGLY DISAGREE</th>
<th>STRONGLY AGREE</th>
</tr>
</thead>
</table>
B. PLEASE LIST ANY OTHER ATTRIBUTES, GIVEN THE ASSUMPTIONS, WHICH YOU FEEL ARE IMPORTANT IN CHOOSING AMONG AUDIT ACTIVITIES TO PERFORM DURING SYSTEMS DESIGN.

C. THE ROLE OF THE INTERNAL AUDITOR WHEN PERFORMING TWO TYPES OF AUDIT ACTIVITIES:

1. Internal auditors may perform activities during systems design which provide assurance that adequate EDP application controls (input, processing, and output controls for a specific system) are built into the system. When performing activities related to EDP APPLICATION CONTROLS, the internal auditor is sometimes required to fulfill the role(s) of: (You may check more than one role)

   ___ Independent Appraiser   ___ Participant in Design
   ___ Consultant/Advisor   ___ Future User of the System
   ___ Other Role; Please Describe _______________________

2. When performing activities related to assuring the AUDITABILITY OF THE SYSTEM, the internal auditor is sometimes required to fulfill the role(s) of: (You may check more than one role)

   ___ Independent Appraiser   ___ Participant in Design
   ___ Consultant/Advisor   ___ User of the System
   ___ Other Role; Please Describe _______________________
APPENDIX C
RESULTS OF SIMPLE REGRESSIONS USING RESPONSE TIME
### Table C-1

**TIME USED TO PREDICT CONTROLLABILITY**

**FLATTENED SUBJECT WEIGHTS**

<table>
<thead>
<tr>
<th>SOURCE</th>
<th>DF</th>
<th>SUM OF SQUARES</th>
<th>MEAN SQUARE</th>
<th>F VALUE</th>
<th>PROB&gt;F</th>
</tr>
</thead>
<tbody>
<tr>
<td>MODEL</td>
<td>1</td>
<td>1.19937</td>
<td>1.19937</td>
<td>1.007</td>
<td>0.3211</td>
</tr>
<tr>
<td>ERROR</td>
<td>44</td>
<td>52.39773</td>
<td>1.19085</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**PARAMETER ESTIMATES**

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>DF</th>
<th>PARAMETER ESTIMATE</th>
<th>STANDARD ERROR</th>
<th>T FOR HO: PARAMETER=0</th>
<th>PROB&gt;T</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTERCEPT</td>
<td>1</td>
<td>0.37046342</td>
<td>0.33759177</td>
<td>1.097</td>
<td>0.2784</td>
</tr>
<tr>
<td>TIME</td>
<td>1</td>
<td>-0.01168007</td>
<td>0.01163854</td>
<td>-1.004</td>
<td>0.3211</td>
</tr>
</tbody>
</table>

### Table C-2

**TIME USED TO PREDICT AUDITABILITY**

**FLATTENED SUBJECT WEIGHTS**

<table>
<thead>
<tr>
<th>SOURCE</th>
<th>DF</th>
<th>SUM OF SQUARES</th>
<th>MEAN SQUARE</th>
<th>F VALUE</th>
<th>PROB&gt;F</th>
</tr>
</thead>
<tbody>
<tr>
<td>MODEL</td>
<td>1</td>
<td>0.55550176</td>
<td>0.55550176</td>
<td>0.706</td>
<td>0.4057</td>
</tr>
<tr>
<td>ERROR</td>
<td>42</td>
<td>33.06771139</td>
<td>0.78732646</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**PARAMETER ESTIMATES**

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>DF</th>
<th>PARAMETER ESTIMATE</th>
<th>STANDARD ERROR</th>
<th>T FOR HO: PARAMETER=0</th>
<th>PROB&gt;T</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTERCEPT</td>
<td>1</td>
<td>0.18279369</td>
<td>0.26827254</td>
<td>0.681</td>
<td>0.4994</td>
</tr>
<tr>
<td>TIME</td>
<td>1</td>
<td>-0.00775678</td>
<td>0.00923457</td>
<td>-0.840</td>
<td>0.4057</td>
</tr>
<tr>
<td>JOB DESCRIPTION</td>
<td>Controllability</td>
<td>Auditability</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------------------</td>
<td>-----------------</td>
<td>--------------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General Internal Auditor</td>
<td>42  45.7</td>
<td>50  56.2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EDP Audit Specialist</td>
<td>44  47.8</td>
<td>35  39.3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other Specialist</td>
<td>6   6.5</td>
<td>1   1.1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>YEARS EXPERIENCE AS INTERNAL AUDITOR</th>
<th>Controllability</th>
<th>Auditability</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-3 Years</td>
<td>8  8.7</td>
<td>3  3.4</td>
</tr>
<tr>
<td>4-6 Years</td>
<td>20 21.7</td>
<td>15 16.9</td>
</tr>
<tr>
<td>7-10 Years</td>
<td>19 20.7</td>
<td>29 32.6</td>
</tr>
<tr>
<td>Over 10 Years</td>
<td>43 46.7</td>
<td>39 43.8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TRAINING</th>
<th>Controllability</th>
<th>Auditability</th>
</tr>
</thead>
<tbody>
<tr>
<td>On the Job</td>
<td>74  80.4</td>
<td>72  80.9</td>
</tr>
<tr>
<td>Formal Training</td>
<td>52  56.5</td>
<td>49  55.1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>COMPANY PARTICIPATES IN SYSTEMS DEVELOPMENT</th>
<th>Controllability</th>
<th>Auditability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequently</td>
<td>40  43.5</td>
<td>42  47.2</td>
</tr>
<tr>
<td>Occasionally</td>
<td>49  53.3</td>
<td>40  44.9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MEMBER OF EDP AUDITORS' ASSOCIATION</th>
<th>Controllability</th>
<th>Auditability</th>
</tr>
</thead>
<tbody>
<tr>
<td>45  48.9</td>
<td>31  34.8</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CERTIFIED INFORMATION SYSTEMS AUDITOR</th>
<th>Controllability</th>
<th>Auditability</th>
</tr>
</thead>
<tbody>
<tr>
<td>34  37.0</td>
<td>32  36.0</td>
<td></td>
</tr>
</tbody>
</table>
**TABLE D-2**  
**ATTITUINAL INFORMATION FROM RESPONDENTS**

**"THE INTERNAL AUDIT DEPARTMENT SHOULD BE INVOLVED IN SOME MANNER IN THE SYSTEMS DEVELOPMENT PROCESS"**

<table>
<thead>
<tr>
<th></th>
<th>CONTROLLABILITY</th>
<th>AUDITABILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Percent</td>
</tr>
<tr>
<td>Strongly Agree</td>
<td>72</td>
<td>78.3</td>
</tr>
<tr>
<td>Agree</td>
<td>16</td>
<td>17.4</td>
</tr>
<tr>
<td>No Opinion*</td>
<td>3</td>
<td>3.3</td>
</tr>
<tr>
<td>Disagree</td>
<td>1</td>
<td>1.1</td>
</tr>
<tr>
<td>Strongly Disagree</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

**"IF THE INTERNAL AUDIT DEPARTMENT IS INVOLVED, THIS INVOLVEMENT SHOULD ENCOMPASS THE SYSTEMS DESIGN STAGE"**

<table>
<thead>
<tr>
<th></th>
<th>CONTROLLABILITY</th>
<th>AUDITABILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Percent</td>
</tr>
<tr>
<td>Strongly Agree</td>
<td>59</td>
<td>64.1</td>
</tr>
<tr>
<td>Agree</td>
<td>22</td>
<td>23.9</td>
</tr>
<tr>
<td>No Opinion*</td>
<td>10</td>
<td>10.9</td>
</tr>
<tr>
<td>Disagree</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Strongly Disagree</td>
<td>1</td>
<td>1.1</td>
</tr>
</tbody>
</table>

**"THE INSTITUTE OF INTERNAL AUDITORS PROVIDES ADEQUATE GUIDELINES FOR INTERNAL AUDITOR INVOLVEMENT IN THE SYSTEMS DEVELOPMENT PROCESS"**

<table>
<thead>
<tr>
<th></th>
<th>CONTROLLABILITY</th>
<th>AUDITABILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Percent</td>
</tr>
<tr>
<td>Strongly Agree</td>
<td>10</td>
<td>10.9</td>
</tr>
<tr>
<td>Agree</td>
<td>12</td>
<td>13.0</td>
</tr>
<tr>
<td>No Opinion*</td>
<td>44</td>
<td>47.8</td>
</tr>
<tr>
<td>Disagree</td>
<td>18</td>
<td>19.6</td>
</tr>
<tr>
<td>Strongly Disagree</td>
<td>8</td>
<td>8.7</td>
</tr>
</tbody>
</table>

*Includes "No Answer" subjects
TABLE D-3

RESPONDENT OPINIONS ON THE ROLES OF THE INTERNAL AUDITOR

"When performing activities related to EDI APPLICATION CONTROLS, the internal auditor is sometimes required to fulfill the role(s) of: (you may pick more than one)"

<table>
<thead>
<tr>
<th>Percent</th>
<th>Controllability Number</th>
<th>Controllability Percent</th>
<th>Auditability Number</th>
<th>Auditability Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Independent Appraiser</td>
<td>84</td>
<td>91.3</td>
<td>72</td>
<td>80.9</td>
</tr>
<tr>
<td>Consultant/Advisor</td>
<td>81</td>
<td>88.0</td>
<td>77</td>
<td>83.7</td>
</tr>
<tr>
<td>Other Role</td>
<td>7</td>
<td>7.6</td>
<td>3</td>
<td>3.4</td>
</tr>
<tr>
<td>Participant in Design</td>
<td>45</td>
<td>48.9</td>
<td>45</td>
<td>50.6</td>
</tr>
<tr>
<td>Future User</td>
<td>30</td>
<td>32.6</td>
<td>25</td>
<td>28.1</td>
</tr>
</tbody>
</table>

"When performing activities related to assuring the AUDITABILITY OF THE SYSTEM, the internal auditor is sometimes required to fulfill the role(s) of: (you may pick more than one)"

<table>
<thead>
<tr>
<th>Percent</th>
<th>Controllability Number</th>
<th>Controllability Percent</th>
<th>Auditability Number</th>
<th>Auditability Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Independent Appraiser</td>
<td>58</td>
<td>63.0</td>
<td>70</td>
<td>78.7</td>
</tr>
<tr>
<td>Consultant/Advisor</td>
<td>64</td>
<td>69.6</td>
<td>64</td>
<td>71.9</td>
</tr>
<tr>
<td>Other Role</td>
<td>3</td>
<td>3.3</td>
<td>6</td>
<td>6.7</td>
</tr>
<tr>
<td>Participant in Design</td>
<td>56</td>
<td>60.9</td>
<td>40</td>
<td>44.9</td>
</tr>
<tr>
<td>Future User of the System</td>
<td>47</td>
<td>51.1</td>
<td>27</td>
<td>30.3</td>
</tr>
</tbody>
</table>
APPENDIX E

COMPARISONS OF SUBSAMPLES TO THE TOTAL GROUP SOLUTIONS
TABLE E-1

COMPARISONS OF THREE SUBSAMPLES TO THE TOTAL SOLUTIONS FOR THE CONTROLLABILITY RESPONDENTS

MEASUREMENTS OF DATA FIT:

<table>
<thead>
<tr>
<th></th>
<th>STRESS</th>
<th>R-SQUARE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Controllability Group</td>
<td>.310</td>
<td>.440</td>
</tr>
<tr>
<td>Subsample One</td>
<td>.296</td>
<td>.497</td>
</tr>
<tr>
<td>Subsample Two</td>
<td>.301</td>
<td>.491</td>
</tr>
<tr>
<td>Subsample Three</td>
<td>.302</td>
<td>.419</td>
</tr>
</tbody>
</table>

IN COMMON FOR ALL CONTROLLABILITY SOLUTIONS:
1. Activity three ("provides a checklist") and activity eight ("sign-off") are on opposite ends of one dimension, but not widely separated on the other dimension.

2. Activities one ("review/evaluate controls") and two (identify control weaknesses") are closely linked and apart from the other activities.

3. Activities nine ("assist in design") and six ("serve as member of development team") are closely linked in the total and two of the subsamples. Activities nine, six, and seven ("control consultant") are grouped together in all solutions.

4. Activities four ("provide several solutions") and five ("recommend controls") are grouped together in all solutions.

IN SUMMARY, NO MAJOR DIFFERENCES WERE OBSERVED.
TABLE E-2
COMPARISONS OF THREE SUBSAMPLES TO THE TOTAL SOLUTION FOR THE AUDITABILITY RESPONDENTS

MEASUREMENTS OF DATA FIT:

<table>
<thead>
<tr>
<th></th>
<th>STRESS</th>
<th>R-SQUARE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total auditability group</td>
<td>.321</td>
<td>.440</td>
</tr>
<tr>
<td>Subsample one</td>
<td>.316</td>
<td>.408</td>
</tr>
<tr>
<td>Subsample two</td>
<td>.366</td>
<td>.307</td>
</tr>
<tr>
<td>Subsample three</td>
<td>.310</td>
<td>.401</td>
</tr>
</tbody>
</table>

IN COMMON FOR ALL AUDITABILITY SOLUTIONS:
1. Activities one ("review/evaluate auditability") and two ("identify audit weaknesses") were closely linked in all solutions.

2. Activities nine ("assist in design") and six ("member of development team") were closely linked in all solutions.

3. Activities three ("provide general audit requirements") and four ("provide several audit requirement solutions") were located close together and apart from the other activities in all solutions.

4. Activities eight ("sign-off") was in an extreme position and apart from the other activities in all solutions.

5. Activities seven ("consultant for audit requirements") and five ("submit audit specifications") were apart in all solutions.

6. Activities three ("provide general audit requirements") and eight ("sign-off") were on opposite ends of a dimension in all solutions.

IN SUMMARY NO MAJOR DIFFERENCES WERE OBSERVED.
APPENDIX F

COMPARISON OF THE ATTRIBUTE WEIGHTS
FOR THE TWO SIX- AND THE SEVEN-ATTRIBUTE CANONICAL
CORRELATIONS FOR THE AUDITABILITY GROUP
<table>
<thead>
<tr>
<th></th>
<th>DIMENSION ONE WEIGHTS</th>
<th>DIMENSION TWO WEIGHTS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SEVEN VARIABLES</td>
<td>SIX* VARIABLES</td>
</tr>
</tbody>
</table>
| 1. INDEPENDENCE | 0.1452 | -0.1454 | **
| 2. ASSURANCE | -0.0425 | 0.0429 | 0.2037 |
| 3. INVOLVEMENT | 0.3615 | **** | -0.2056 |
| 4. ROLE OF INDEPENDENT APPRAISER | -0.8471 | 0.8469 | 0.7661 |
| 5. ROLE OF CONSULTANT/ ADVISOR | 0.7242 | -0.7242 | -0.7362 |
| 6. ROLE OF FUTURE USER | 0.2219 | -0.2215 | -0.0602 |
| 7. ROLE OF PARTICIPANT IN DESIGN | 0.5785 | -0.5782 | -0.4363 |
|       | SEVEN VARIABLES | SIX* VARIABLES | SIX** VARIABLES |
| 1. INDEPENDENCE | 0.4659 | 0.4658 | **** |
| 2. ASSURANCE | -0.8619 | -0.8618 | -0.8385 |
| 3. INVOLVEMENT | -0.7954 | **** | -0.8492 |
| 4. ROLE OF INDEPENDENT APPRAISER | -0.3505 | 0.3509 | 0.5034 |
| 5. ROLE OF CONSULTANT/ ADVISOR | 0.1326 | 0.1322 | -0.0059 |
| 6. ROLE OF FUTURE USER | -0.8392 | -0.8393 | -0.8659 |
| 7. ROLE OF PARTICIPANT IN DESIGN | -0.7019 | -0.7021 | -0.7981 |

*Level of Involvement was removed
**Independence was removed
APPENDIX G

CANNONICAL CORRELATIONS BY DEMOGRAPHIC GROUPS
CONDUCTED TO SUPPORT THE CANNONICAL WEIGHTS
OF THE CONTROLLABILITY AND AUDITABILITY
GROUP ANALYSES
### TABLE G-1
**Canonical Correlation Weights for Controllability**
**Respondents in Two Demographic Groups**

1. **Respondents Classified by Years of Experience**

<table>
<thead>
<tr>
<th>ATTRIBUTES</th>
<th>FIRST</th>
<th>SECOND</th>
<th>FIRST</th>
<th>SECOND</th>
<th>FIRST</th>
<th>SECOND</th>
</tr>
</thead>
<tbody>
<tr>
<td>INDEPENDENCE</td>
<td>.0708</td>
<td>.8736*</td>
<td>.5817*</td>
<td>.6269*</td>
<td>-.1359</td>
<td>.9234</td>
</tr>
<tr>
<td>ASSURANCE</td>
<td>.7405*</td>
<td>-.3218</td>
<td>.2860</td>
<td>-.7786*</td>
<td>.6487*</td>
<td>-.1252</td>
</tr>
<tr>
<td>INVOLVEMENT</td>
<td>.0846</td>
<td>-.7104*</td>
<td>-.1492</td>
<td>-.7597*</td>
<td>.3480</td>
<td>-.4714</td>
</tr>
<tr>
<td>APPRAISER</td>
<td>.8149*</td>
<td>.3387</td>
<td>.6461*</td>
<td>-.3861</td>
<td>.6846*</td>
<td>.6112*</td>
</tr>
<tr>
<td>PART/DESIGN</td>
<td>-.2097</td>
<td>-.7406*</td>
<td>-.5948*</td>
<td>.4456</td>
<td>.1246</td>
<td>-.7317*</td>
</tr>
</tbody>
</table>

**Likelihood Tests for Ho: Canonical Correlations Are Zero**

| PR>F         | .1117 | .2076 | .1458 | .1842 | .0024 | .0206 |

2. **Respondents Classified According to Whether Their Company Participates Frequently (Frequent Group) or Occasionally (Occasional Group) in Systems Development**

<table>
<thead>
<tr>
<th>ATTRIBUTES</th>
<th>FIRST</th>
<th>SECOND</th>
<th>FIRST</th>
<th>SECOND</th>
<th>FIRST</th>
<th>SECOND</th>
</tr>
</thead>
<tbody>
<tr>
<td>INDEPENDENCE</td>
<td>.4113</td>
<td>.8055*</td>
<td>.8500*</td>
<td>-.1554</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ASSURANCE</td>
<td>-.7554*</td>
<td>.0411</td>
<td>-.0844</td>
<td>.7973*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>INVOLVEMENT</td>
<td>-.5837*</td>
<td>-.4496</td>
<td>-.5316*</td>
<td>.5485*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>APPRAISER</td>
<td>-.6013*</td>
<td>.6973*</td>
<td>.6662*</td>
<td>.4838</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PART/DESIGN</td>
<td>-.2960</td>
<td>-.7577*</td>
<td>-.7914*</td>
<td>.2926</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Likelihood Tests for Ho: Canonical Correlations Are Zero**

| PR>F         | .0188 | .0221 | .0517 | .3349 |

*Primary Activities*
### TABLE G-2

**CANONICAL CORRELATION WEIGHTS FOR CONTROLLABILITY RESPONDENTS USING TWO ADDITIONAL DEMOGRAPHIC VARIABLES**

1. **RESPONDENTS CLASSIFIED BY THEIR OPINION CONCERNING INTERNAL AUDITORS PARTICIPATION IN SYSTEMS DEVELOPMENT**

<table>
<thead>
<tr>
<th>ATTRIBUTES</th>
<th>FIRST</th>
<th>SECOND</th>
<th>FIRST</th>
<th>SECOND</th>
</tr>
</thead>
<tbody>
<tr>
<td>INDEPENDENCE</td>
<td>-.3117</td>
<td>-.3425*</td>
<td>-.2194</td>
<td>-.8630*</td>
</tr>
<tr>
<td>ASSURANCE</td>
<td>.7395*</td>
<td>-.0749</td>
<td>.6730*</td>
<td>-.0987</td>
</tr>
<tr>
<td>INVOLVEMENT</td>
<td>.5085*</td>
<td>.0659</td>
<td>.1980</td>
<td>.7449*</td>
</tr>
<tr>
<td>APPRAISER</td>
<td>.6563*</td>
<td>-.3963*</td>
<td>.5453*</td>
<td>-.6993*</td>
</tr>
<tr>
<td>PART/DESIGN</td>
<td>.1631</td>
<td>.3596</td>
<td>.1162</td>
<td>.8253</td>
</tr>
</tbody>
</table>

DIMENSION ONE   | .0898  | .8874  | -.6044 | .7742  |
DIMENSION TWO   | .9890  | -.0137 | .7617  | .6273  |

LIKELIHOOD TESTS FOR HO: CANONICAL CORRELATIONS ARE ZERO

<table>
<thead>
<tr>
<th></th>
<th>PR&gt;F</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>.0558</td>
<td>.2048</td>
<td>.0063</td>
<td>.0278</td>
</tr>
</tbody>
</table>

2. **RESPONDENTS CLASSIFIED AS EDP SPECIALIST OR GENERAL AUDITOR**

<table>
<thead>
<tr>
<th>AUDITOR</th>
<th>EDP GROUP</th>
<th>GENERAL INTERNAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATTRIBUTES</td>
<td>FIRST</td>
<td>SECOND</td>
</tr>
<tr>
<td>INDEPENDENCE</td>
<td>.6416*</td>
<td>.5409*</td>
</tr>
<tr>
<td>ASSURANCE</td>
<td>.3095</td>
<td>-.7178*</td>
</tr>
<tr>
<td>INVOLVEMENT</td>
<td>-.2533</td>
<td>-.5712*</td>
</tr>
<tr>
<td>APPRAISER</td>
<td>.8701*</td>
<td>-.3774</td>
</tr>
<tr>
<td>PART/DESIGN</td>
<td>-.6872*</td>
<td>.8298</td>
</tr>
</tbody>
</table>

DIMENSION ONE   | .8403    | .5242  | .9887    | -.1432 |
DIMENSION TWO   | -.5279   | .8298  | .1952    | .9741  |

LIKELIHOOD TESTS FOR HO: CANONICAL CORRELATIONS ARE ZERO

<table>
<thead>
<tr>
<th></th>
<th>PR&gt;F</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>.0060</td>
<td>.0208</td>
<td>.0003</td>
<td>.0039</td>
</tr>
</tbody>
</table>

* Indicates Primary Activities
### TABLE G-3

**CANONICAL CORRELATION WEIGHTS FOR AUDITABILITY RESPONDENTS IN TWO DEMOGRAPHIC GROUPS**

1. **RESPONDENTS CLASSIFIED BY YEARS OF EXPERIENCE**

<table>
<thead>
<tr>
<th>Attributes</th>
<th>First Variates</th>
<th>Second Variates</th>
<th>First Variates</th>
<th>Second Variates</th>
<th>First Variates</th>
<th>Second Variates</th>
</tr>
</thead>
<tbody>
<tr>
<td>INDEPENDENCE</td>
<td>-.6371*</td>
<td>-.1066</td>
<td>-.0449</td>
<td>.5349*</td>
<td>-.0072</td>
<td>.3017</td>
</tr>
<tr>
<td>ASSURANCE</td>
<td>.8046*</td>
<td>-.2736</td>
<td>.2163</td>
<td>-.7469*</td>
<td>.5499*</td>
<td>.5569*</td>
</tr>
<tr>
<td>INVOLVEMENT</td>
<td>.8569*</td>
<td>.2436</td>
<td>.7125*</td>
<td>-.4705</td>
<td>.7387*</td>
<td>-.3410</td>
</tr>
<tr>
<td>APPRAISER</td>
<td>-.5451*</td>
<td>-.6589*</td>
<td>-.9139*</td>
<td>-.0210</td>
<td>-.8271*</td>
<td>-.3821</td>
</tr>
<tr>
<td>CONSULTANT</td>
<td>.6691*</td>
<td>-.0555</td>
<td>.6595*</td>
<td>.5625*</td>
<td>.4326</td>
<td>.2359</td>
</tr>
<tr>
<td>FUTURE USER</td>
<td>-.6401*</td>
<td>.1421</td>
<td>.5756*</td>
<td>-.6449*</td>
<td>.5946*</td>
<td>-.3710</td>
</tr>
<tr>
<td>PART/DESIGN</td>
<td>.7880*</td>
<td>.4728*</td>
<td>.8976*</td>
<td>-.2494</td>
<td>.8551*</td>
<td>-.2291</td>
</tr>
</tbody>
</table>

**DIMENSION ONE**

<table>
<thead>
<tr>
<th></th>
<th>0-6 YEARS</th>
<th>7-10 YEARS</th>
<th>OVER 10 YEARS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>.4321</td>
<td>.8274</td>
<td>.6177</td>
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</tbody>
</table>

**DIMENSION TWO**

<table>
<thead>
<tr>
<th></th>
<th>0-6 YEARS</th>
<th>7-10 YEARS</th>
<th>OVER 10 YEARS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>.9272</td>
<td>-.3437</td>
<td>.8242</td>
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</tbody>
</table>

**LIKELIHOOD TESTS THAT CANONICAL CORRELATIONS ARE ZERO:**

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<thead>
<tr>
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<th>PR&gt;F</th>
<th>PR&gt;F</th>
<th>PR&gt;F</th>
<th>PR&gt;F</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>.0000</td>
<td>.6709</td>
<td>.0000</td>
<td>.2835</td>
</tr>
</tbody>
</table>

2. **RESPONDENTS CLASSIFIED BY WHETHER THEY AGREE [PID Group] OR DISAGREE [NPID Group] THAT PARTICIPANT IN DESIGN IS NECESSARY WHEN ASSESSING THE AUDITABILITY OF THE SYSTEM**

<table>
<thead>
<tr>
<th>Attribute</th>
<th>PID Variates</th>
<th>NPID Variates</th>
</tr>
</thead>
<tbody>
<tr>
<td>INDEPENDENT</td>
<td>.0466</td>
<td>-.0760</td>
</tr>
<tr>
<td>ASSURANCE</td>
<td>.4873</td>
<td>-.2180</td>
</tr>
<tr>
<td>INVOLVEMENT</td>
<td>.7127*</td>
<td>.5659</td>
</tr>
<tr>
<td>APPRAISER</td>
<td>-.8757*</td>
<td>-.8955</td>
</tr>
<tr>
<td>CONSULTANT</td>
<td>.7729*</td>
<td>.3896</td>
</tr>
<tr>
<td>FUTURE USER</td>
<td>.6902*</td>
<td>.2868</td>
</tr>
<tr>
<td>PART/DESIGN</td>
<td>.8788*</td>
<td>.7283</td>
</tr>
</tbody>
</table>

**DIMENSION ONE**

<table>
<thead>
<tr>
<th></th>
<th>PID Variates</th>
<th>NPID Variates</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>.9949</td>
<td>.4442</td>
</tr>
</tbody>
</table>

**DIMENSION TWO**

<table>
<thead>
<tr>
<th></th>
<th>PID Variates</th>
<th>NPID Variates</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>.0444</td>
<td>.9093</td>
</tr>
</tbody>
</table>

**LIKELIHOOD TESTS FOR HO: CANONICAL CORRELATIONS ARE ZERO**

<table>
<thead>
<tr>
<th></th>
<th>PR&gt;F</th>
<th>PR&gt;F</th>
<th>PR&gt;F</th>
<th>PR&gt;F</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>.0000</td>
<td>.3617</td>
<td>.0000</td>
<td>.4261</td>
</tr>
</tbody>
</table>

* Indicates Primary Activities.
### Table G-4

**Canonical Correlation Weights for Auditability Respondents Using Two Additional Demographic Variables**

1. **Respondents Classified According to Whether Their Company Participates Frequently (Frequent Group) or Occasionally (Occasional Group) in Systems Development**

<table>
<thead>
<tr>
<th>Attributes</th>
<th>Frequent Group Variates</th>
<th>Occasional Group Variates</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FIRST</td>
<td>SECOND</td>
</tr>
<tr>
<td>Independence</td>
<td>-.3360</td>
<td>.3098</td>
</tr>
<tr>
<td>Assurance</td>
<td>.2839</td>
<td>-.7921*</td>
</tr>
<tr>
<td>Involvement</td>
<td>.0677</td>
<td>-.8384*</td>
</tr>
<tr>
<td>Appraiser</td>
<td>.6043*</td>
<td>.6620*</td>
</tr>
<tr>
<td>Consultant</td>
<td>-.6913*</td>
<td>-.2338</td>
</tr>
<tr>
<td>Future User</td>
<td>.2333</td>
<td>-.8115*</td>
</tr>
<tr>
<td>Part/Design</td>
<td>-.1656</td>
<td>-.8300*</td>
</tr>
<tr>
<td>Dimension One</td>
<td>.3787</td>
<td>.9074</td>
</tr>
<tr>
<td>Dimension Two</td>
<td>.9286</td>
<td>-.3638</td>
</tr>
</tbody>
</table>

**Likelihood Tests for Ho: Canonical Correlations Are Zero:**

- Pr>F: .0000 .3600 .0000 .5467

2. **Respondents Classified by Their Opinion Concerning Internal Auditor Participation in Systems Development**

<table>
<thead>
<tr>
<th>Attributes</th>
<th>Strongly Agree Variates</th>
<th>Agree Variates</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FIRST</td>
<td>SECOND</td>
</tr>
<tr>
<td>Independence</td>
<td>-.4404</td>
<td>.0195</td>
</tr>
<tr>
<td>Assurance</td>
<td>-.1907</td>
<td>-.0485</td>
</tr>
<tr>
<td>Involvement</td>
<td>.4175</td>
<td>.1745</td>
</tr>
<tr>
<td>Appraiser</td>
<td>-.4345</td>
<td>-.6663*</td>
</tr>
<tr>
<td>Consultant</td>
<td>.8485*</td>
<td>-.1312</td>
</tr>
<tr>
<td>Future/User</td>
<td>.0827</td>
<td>.1856</td>
</tr>
<tr>
<td>Part/Design</td>
<td>.6751*</td>
<td>.2823</td>
</tr>
<tr>
<td>Dimension One</td>
<td>.8931</td>
<td>.4432</td>
</tr>
<tr>
<td>Dimension Two</td>
<td>-.3250</td>
<td>.9316</td>
</tr>
</tbody>
</table>

**Likelihood Tests for Ho: Canonical Correlations Are Zero**

- Pr>F: .0000 .3167 .0000 .3167
### Table G-5

**Canonical Correlation Weights for Auditability Respondents Using the Variable Concerning the Internal Auditor's Role as a Future User of the System**

Respondents classified by their opinion concerning the internal auditor's role as a future user of the system

<table>
<thead>
<tr>
<th>Attributes</th>
<th>First Variates</th>
<th>Second Variates</th>
<th>Not a Future User Variates</th>
<th>Second Variates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Independence</td>
<td>.1853</td>
<td>.4658*</td>
<td>-.0202</td>
<td>.4901*</td>
</tr>
<tr>
<td>Assurance</td>
<td>-.6345*</td>
<td>-.5149*</td>
<td>-.0226</td>
<td>-.8192*</td>
</tr>
<tr>
<td>Involvement</td>
<td>-.8477*</td>
<td>-.2146</td>
<td>-.4515</td>
<td>-.7088*</td>
</tr>
<tr>
<td>Appraiser</td>
<td>.8724*</td>
<td>-.1806</td>
<td>.9235*</td>
<td>.1716</td>
</tr>
<tr>
<td>Consultant</td>
<td>-.4876*</td>
<td>.7346*</td>
<td>-.5613*</td>
<td>.1995</td>
</tr>
<tr>
<td>Future User</td>
<td>-.8302*</td>
<td>-.3166</td>
<td>-.3060</td>
<td>-.7687*</td>
</tr>
<tr>
<td>Part/Design</td>
<td>-.9406*</td>
<td>-.1215</td>
<td>-.6879*</td>
<td>-.5157*</td>
</tr>
<tr>
<td>Dimension One</td>
<td>.4938</td>
<td>-.8609</td>
<td>.9949</td>
<td>-.0960</td>
</tr>
<tr>
<td>Dimension Two</td>
<td>.8860</td>
<td>.4591</td>
<td>.1495</td>
<td>.9450</td>
</tr>
</tbody>
</table>

Likelihood tests for HO: Canonical Correlations are zero:

| PR>F             | .0000          | .2609           | .0000                      | .5206           |

* Indicates Primary Activities
APPENDIX H
DETAILS OF SUPPLEMENTAL DATA ANALYSIS
UNFOLDING MDS ANALYSIS
UNFOLDING MDS ANALYSIS

The unfolding MDS solution for the controllability group required 65 iterations to converge. The goodness of fit measures for the solution were: STRESS, .011 and R-square, 1.0. The extremely low STRESS value together with the r-square of one was recognized as an indication of a degenerate solution (Kruskal and Wish, 1978).

The suspicion of degeneracy was supported by observing the placement of the activities and attributes in the spatial configuration. These coordinates are shown in Table H-1. All of the activities are at one location, and most of the attributes are in a second group. Only two of the attributes ("role of independent appraiser" and "independence") are represented by distinct points. A solution with a few compact clusters of points is another sign of a degenerate solution (Kruskal and Wish, 1978).

An examination of the scatterplot of distances versus disparities found that most points are on or close to a very small number of clumps or compact clusters, and these clumps are widely separated. Therefore, a degenerate solution is confirmed (Kruskal and Wish, 1978, 29-30). No conclusions can be drawn from this solution.

The auditability analysis results (TABLE H-2) are very similar to the controllability results. Forty-one iterations were needed to find a solution for the auditability group. The goodness of fit measures for this solution were: STRESS, .111 and R-square, .989. The low
STRESS and high r-square again suggest a degenerate solution. Table H-2 shows the coordinates for the attributes and activities in the auditability unfolding solution. Most of the points in the solution are represented in two clusters as in the solution for the controllability group. The "independence" and "role of independent appraiser" attributes, and the "identify auditability weaknesses" activity were distinct points.

The scatterplot of distances versus disparities revealed three distinct clusters which were widely

<table>
<thead>
<tr>
<th>ATTRIBUTES</th>
<th>DESCRIPTION</th>
<th>COORDINATES</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>INDEPENDENCE</td>
<td>-1.7916</td>
</tr>
<tr>
<td>2</td>
<td>ASSURANCE PROVIDED</td>
<td>1.3672</td>
</tr>
<tr>
<td>3</td>
<td>LEVEL OF INVOLVEMENT</td>
<td>1.3001</td>
</tr>
<tr>
<td>4</td>
<td>ROLE OF INDEPENDENT APPRAISER</td>
<td>1.3995</td>
</tr>
<tr>
<td>5</td>
<td>ROLE OF CONSULTANT</td>
<td>1.2276</td>
</tr>
<tr>
<td>6</td>
<td>ROLE OF FUTURE USER</td>
<td>1.0472</td>
</tr>
<tr>
<td>7</td>
<td>ROLE OF PARTICIPANT IN DESIGN</td>
<td>1.0739</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ACTIVITIES</th>
<th>DESCRIPTION</th>
<th>COORDINATES</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>REVIEW/EVALUATE CONTROLS</td>
<td>-0.6171</td>
</tr>
<tr>
<td>2</td>
<td>IDENTIFY CONTROL WEAKNESSES</td>
<td>-0.6170</td>
</tr>
<tr>
<td>3</td>
<td>PROVIDE CHECKLIST OF CONTROLS</td>
<td>-0.6573</td>
</tr>
<tr>
<td>4</td>
<td>PROVIDE SEVERAL CONTROL SOLUTIONS</td>
<td>-0.6205</td>
</tr>
<tr>
<td>5</td>
<td>RECOMMEND CONTROLS</td>
<td>-0.6197</td>
</tr>
<tr>
<td>6</td>
<td>SERVE ON DEVELOPMENT TEAM</td>
<td>-0.6258</td>
</tr>
<tr>
<td>7</td>
<td>ACT AS CONTROL CONSULTANT</td>
<td>-0.6202</td>
</tr>
<tr>
<td>8</td>
<td>SIGN-OFF</td>
<td>-0.6210</td>
</tr>
<tr>
<td>9</td>
<td>ASSIST IN DESIGN</td>
<td>-0.6251</td>
</tr>
</tbody>
</table>
In summary, two-dimensional unfolding MDS solutions were obtained for the controllability and auditability groups. (Three-dimensional solutions are not possible with the unfolding model.) These solutions were determined to be degenerate from the low STRESS and high r-square values, the graph of the activities and attributes, and the scatterplots of distances versus disparities. Therefore, no conclusions can be made from this analysis.
APPENDIX I
SUBJECT WEIGHTS

As revealed in Table I-1 and in Table I-2, subject weights were found to vary for the controllability and auditability respondents. Subject "weirdness" scores (Young and Lewyckyj, 1980) are also shown in the two tables. A subject with weights proportional to the average weights would have a weirdness of zero, and a subject who relied entirely on one dimension when making similarity judgments would have a weirdness score of one. Subject weirdness scores ranged from .0030 to .7636 for the controllability respondents and from .0044 to .8648 for the auditability subjects. Therefore, subject differences were observed by examining the weirdness scores.

In addition, "flattened" subject weights were computed to reveal the importance of the dimensions to each subject. The flattened subject weights are presented for the controllability and the auditability groups in Tables I-3 and I-4, respectively.
### TABLE I-1

**CONTROLLABILITY SUBJECT WEIGHTS**

<table>
<thead>
<tr>
<th>SUBJECT NUMBER</th>
<th>WEIRDNESS</th>
<th>DIMENSION</th>
<th>SUBJECT NUMBER</th>
<th>WEIRDNESS</th>
<th>DIMENSION</th>
</tr>
</thead>
<tbody>
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<td>.1378</td>
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<td>47</td>
<td>.1323</td>
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</tr>
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<td>.4255</td>
<td>.4597</td>
<td>48</td>
<td>.3572</td>
<td>.3900</td>
</tr>
<tr>
<td>3</td>
<td>.2130</td>
<td>.5267</td>
<td>49</td>
<td>.1945</td>
<td>.4569</td>
</tr>
<tr>
<td>4</td>
<td>.0838</td>
<td>.6527</td>
<td>50</td>
<td>.1926</td>
<td>.4206</td>
</tr>
<tr>
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<td>.2977</td>
<td>.4612</td>
<td>51</td>
<td>.1252</td>
<td>.4180</td>
</tr>
<tr>
<td>6</td>
<td>.3248</td>
<td>.7517</td>
<td>52</td>
<td>.6134</td>
<td>.2655</td>
</tr>
<tr>
<td>7</td>
<td>.0990</td>
<td>.5870</td>
<td>53</td>
<td>.1451</td>
<td>.4961</td>
</tr>
<tr>
<td>8</td>
<td>.0947</td>
<td>.4946</td>
<td>54</td>
<td>.0427</td>
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# Table 1-4

Flattened Subject Weights for The Auditability Respondents

<table>
<thead>
<tr>
<th>Subject</th>
<th>Weight</th>
<th>Subject</th>
<th>Weight</th>
<th>Subject</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-0.8208</td>
<td>31</td>
<td>0.7550</td>
<td>61</td>
<td>-0.7450</td>
</tr>
<tr>
<td>2</td>
<td>-0.6982</td>
<td>32</td>
<td>-0.6127</td>
<td>62</td>
<td>-0.8364</td>
</tr>
<tr>
<td>3</td>
<td>2.6677</td>
<td>33</td>
<td>-0.1285</td>
<td>63</td>
<td>-0.3220</td>
</tr>
<tr>
<td>4</td>
<td>-0.1060</td>
<td>34</td>
<td>0.8204</td>
<td>64</td>
<td>0.1828</td>
</tr>
<tr>
<td>5</td>
<td>1.7246</td>
<td>35</td>
<td>0.1107</td>
<td>65</td>
<td>-0.5634</td>
</tr>
<tr>
<td>6</td>
<td>-0.1831</td>
<td>36</td>
<td>0.7679</td>
<td>66</td>
<td>-0.9103</td>
</tr>
<tr>
<td>7</td>
<td>0.0222</td>
<td>37</td>
<td>0.4499</td>
<td>67</td>
<td>-0.3334</td>
</tr>
<tr>
<td>8</td>
<td>-0.7601</td>
<td>38</td>
<td>-0.9608</td>
<td>68</td>
<td>0.1180</td>
</tr>
<tr>
<td>9</td>
<td>-0.3062</td>
<td>39</td>
<td>-0.3896</td>
<td>69</td>
<td>-2.1623</td>
</tr>
<tr>
<td>10</td>
<td>-0.3339</td>
<td>40</td>
<td>0.2166</td>
<td>70</td>
<td>-0.0254</td>
</tr>
<tr>
<td>11</td>
<td>-0.3696</td>
<td>41</td>
<td>-0.4835</td>
<td>71</td>
<td>1.9276</td>
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<tr>
<td>12</td>
<td>-0.7101</td>
<td>42</td>
<td>1.7677</td>
<td>72</td>
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</tr>
<tr>
<td>13</td>
<td>-0.6251</td>
<td>43</td>
<td>-0.2155</td>
<td>73</td>
<td>0.6675</td>
</tr>
<tr>
<td>14</td>
<td>0.7267</td>
<td>44</td>
<td>-0.5654</td>
<td>74</td>
<td>-0.8163</td>
</tr>
<tr>
<td>15</td>
<td>-0.2348</td>
<td>45</td>
<td>0.2231</td>
<td>75</td>
<td>-0.6957</td>
</tr>
<tr>
<td>16</td>
<td>5.3706</td>
<td>46</td>
<td>-0.0700</td>
<td>76</td>
<td>-0.4239</td>
</tr>
<tr>
<td>17</td>
<td>1.6142</td>
<td>47</td>
<td>0.0780</td>
<td>77</td>
<td>0.1991</td>
</tr>
<tr>
<td>18</td>
<td>-1.3201</td>
<td>48</td>
<td>0.2805</td>
<td>78</td>
<td>0.2846</td>
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<tr>
<td>19</td>
<td>-0.0217</td>
<td>49</td>
<td>0.1955</td>
<td>79</td>
<td>-0.9132</td>
</tr>
<tr>
<td>20</td>
<td>0.6709</td>
<td>50</td>
<td>-0.1013</td>
<td>80</td>
<td>-1.8407</td>
</tr>
<tr>
<td>21</td>
<td>-0.6790</td>
<td>51</td>
<td>-0.4533</td>
<td>81</td>
<td>-0.2896</td>
</tr>
<tr>
<td>22</td>
<td>-0.1096</td>
<td>52</td>
<td>-0.2700</td>
<td>82</td>
<td>-0.8393</td>
</tr>
<tr>
<td>23</td>
<td>0.8577</td>
<td>53</td>
<td>-0.3152</td>
<td>83</td>
<td>0.5302</td>
</tr>
<tr>
<td>24</td>
<td>-0.8494</td>
<td>54</td>
<td>-0.3955</td>
<td>84</td>
<td>1.0970</td>
</tr>
<tr>
<td>25</td>
<td>-1.0681</td>
<td>55</td>
<td>-0.5265</td>
<td>85</td>
<td>-0.8546</td>
</tr>
<tr>
<td>26</td>
<td>0.6815</td>
<td>56</td>
<td>-0.4739</td>
<td>86</td>
<td>-0.2386</td>
</tr>
<tr>
<td>27</td>
<td>1.1474</td>
<td>57</td>
<td>-0.6171</td>
<td>87</td>
<td>-0.3561</td>
</tr>
<tr>
<td>28</td>
<td>-0.0239</td>
<td>58</td>
<td>0.3511</td>
<td>88</td>
<td>-0.7782</td>
</tr>
<tr>
<td>29</td>
<td>1.1280</td>
<td>59</td>
<td>-1.3552</td>
<td>89</td>
<td>-0.3066</td>
</tr>
<tr>
<td>30</td>
<td>0.4549</td>
<td>60</td>
<td>2.3257</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX J

ANALYSIS OF DEMOGRAPHIC AND ATTITUDINAL DATA
Analysis of Demographic and Attitudinal Data

Information on 20 variables was collected to determine whether certain demographic or attitudinal characteristics influenced subjects' similarity judgments and, therefore, could provide a basis for grouping respondents for further analysis. To simplify the discussion, both demographic and attitudinal variables will be included under the title of demographic data.

Demographic Analysis for Controllability Subjects

Examination of responses, correlations among the variables, and correlations among the variables and the coordinates of the activities in the controllability group solution (referred to as dimension coordinates) resulted in the selection of six variables for further investigation. This reduction was necessary to meet the recommendation that the total number of variables (demographic and dimension) included in a canonical correlation analysis should be less than the number of stimuli (the nine activities) (Schiffman, Reynolds, and Young (1981)).

The results of the canonical correlation analysis are shown in Table J-1. The test of the hypothesis that the second canonical correlation was different could not be rejected at the .05 level. Trial and error addition and deletion of one or two demographic variables could not improve the p-value for the significance test. The six demographic variable solution was chosen as parsimonious because the first variate included the job classification
As shown in Table J-1, job classification was the only highly weighted (over .5) variable in the first variate. The only highly weighted variable in the second variate was "other" role. The "other" internal auditor roles listed by respondents were not considered to be adequate for subgrouping respondents.

Demographic Analysis for Auditability Subjects

Examination of responses, correlations among the demographic variables, and correlations among the variables and the dimension coordinates were used to reduce the number of demographic variables for the canonical correlation analysis in the auditability group. However,
the minimum number of demographic variables for the canonical correlation was found to be seven. Further reductions were attempted, but the hypothesis that the correlation coefficients were equal to zero could not be rejected.

With the seven variable analysis, only the first correlation led to rejection of the hypothesis that the correlation coefficient was equal to zero. However, the variables with the highest weights are included in the first canonical variate. Adding another demographic variable to the analysis resulted in significance for both canonical correlations. The variable weights in the eight demographic variable analysis were very similar to those in the seven variable analysis, and, therefore, support the reliability of the latter solution. The reader must exercise caution when attempting to reach conclusions based solely upon the canonical analysis due to the fact that the number of variables analyzed could not be reduced to meet the requirements suggested by Schiffman et al. (1981) for ensuring robust estimates of the canonical weights. The major use for the canonical weights in this study was to aid in the investigation of subject differences.

The variable weights on the two variates are shown in Table J-2. "Years" and "Opinions Concerning the Internal Auditor's Role as Participant in Design" have the highest weights, and, consequently, were found to significantly influence internal auditors' similarity judgments.
Auditability respondents were divided into groups based upon these two variables as an aid in investigating the subject spaces.

<table>
<thead>
<tr>
<th>Variable</th>
<th>First Variate</th>
<th>Second Variate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Years</td>
<td>.5918</td>
<td>.2035</td>
</tr>
<tr>
<td>Training</td>
<td>-.3194</td>
<td>.3420</td>
</tr>
</tbody>
</table>

Opinions Concerning:
- Role of Independent Appraiser: -.3971 .3385
- Role of Consultant: .4580 .2574
- Role of Participant in Design: .5831 -.2166
- Role of Future User of System: .4480 -.4482

<table>
<thead>
<tr>
<th>Canonical Correlations</th>
<th>Correlation Coefficients</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>First</td>
<td>1.0000</td>
<td>.0000</td>
</tr>
<tr>
<td>Second</td>
<td>.8289</td>
<td>.8506</td>
</tr>
</tbody>
</table>
APPENDIX K

COMPARISON OF MDS SOLUTIONS OF CONTROLLABILITY AND AUDITABILITY SUBGROUPS
K-1. COMPARISON OF CONTROLLABILITY SUBGROUPS

The controllability respondents were divided into EDP and non-EDP subgroups. Table K-1 presents a comparison of the activity clusters for the two subgroups.

The non-EDP group solution resulted in a higher r-square than either the total controllability group or the EDP group (r-squares of .518, .421, and .440, respectively). In other words, the dimensions in the non-EDP solution explained the general internal auditors' similarity judgments better than the dimensions in the total controllability solution explained the judgments of all of the respondents.

The primary/secondary activity clusters derived in the EDP group and the non-EDP group MDS solutions are presented in Table K-1 and in Figures K-1 and K-2. Activities with less than absolute 20 on a dimension were omitted from the activity clusters on that dimension. Also several activities were considered as "secondary" because they were separated from the major activity cluster(s) on a dimension and they were located relatively near the origin.

Although the rank order differs, the activities in the primary independent activity cluster on dimension one for both subgroups are activity five, "recommend controls", activity four, "provide several control solutions", activity two, "identify control weaknesses", and activity one, "review/evaluate controls". The only difference is that the non-EDP group also includes activity seven, "act
TABLE K-1
A COMPARISON OF PRIMARY/SECONDARY ACTIVITIES IN THE EDP AND NON-EDP GROUPS

a. DIMENSION ONE: THE ACTIVITY'S EFFECT ON INTERNAL AUDITOR INDEPENDENCE

(1) PRIMARY/SECONDARY INDEPENDENT APPRAISER ACTIVITIES:

<table>
<thead>
<tr>
<th>EDP GROUP</th>
<th>NON-EDP GROUP</th>
</tr>
</thead>
<tbody>
<tr>
<td>FIVE</td>
<td>FOUR</td>
</tr>
<tr>
<td>(-1.0993)</td>
<td>(-1.0314)</td>
</tr>
<tr>
<td>FOUR</td>
<td>FIVE</td>
</tr>
<tr>
<td>(1.0230)</td>
<td>(-0.8720)</td>
</tr>
<tr>
<td>TWO</td>
<td>TWO</td>
</tr>
<tr>
<td>(-0.9977)</td>
<td>(-0.7872)</td>
</tr>
<tr>
<td>ONE</td>
<td>ONE</td>
</tr>
<tr>
<td>(-0.8691)</td>
<td>(-0.7742)</td>
</tr>
</tbody>
</table>

SECONDARY ACTIVITIES:
THREE (-0.3190)

(2) PRIMARY PARTICIPANT IN DESIGN ACTIVITIES:

<table>
<thead>
<tr>
<th>EDP GROUP</th>
<th>NON-EDP GROUP</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIX</td>
<td>SIX</td>
</tr>
<tr>
<td>(1.3176)</td>
<td>(1.5041)</td>
</tr>
<tr>
<td>NINE</td>
<td>NINE</td>
</tr>
<tr>
<td>(1.2776)</td>
<td>(1.4113)</td>
</tr>
<tr>
<td>SEVEN</td>
<td>EIGHT</td>
</tr>
<tr>
<td>(1.0259)</td>
<td>(1.1633)</td>
</tr>
<tr>
<td>EIGHT</td>
<td></td>
</tr>
<tr>
<td>(0.6870)</td>
<td></td>
</tr>
</tbody>
</table>

b. DIMENSION TWO: ASSURANCE PROVIDED BY APPRAISER ACTIVITIES

(1) PRIMARY/SECONDARY LEAST-ASSURANCE ACTIVITIES:

<table>
<thead>
<tr>
<th>EDP GROUP</th>
<th>NON-EDP GROUP</th>
</tr>
</thead>
<tbody>
<tr>
<td>THREE</td>
<td>THREE</td>
</tr>
<tr>
<td>(-1.8576)</td>
<td>(2.0829)</td>
</tr>
<tr>
<td>FOUR</td>
<td>SEVEN</td>
</tr>
<tr>
<td>(-0.7691)</td>
<td>(0.7569)</td>
</tr>
<tr>
<td>SIX</td>
<td>SIX</td>
</tr>
<tr>
<td>(-0.3652)</td>
<td>(0.4147)</td>
</tr>
<tr>
<td>NINE</td>
<td></td>
</tr>
<tr>
<td>(-0.2793)</td>
<td></td>
</tr>
</tbody>
</table>

(2) PRIMARY/SECONDARY MOST-ASSURANCE ACTIVITIES:

<table>
<thead>
<tr>
<th>EDP GROUP</th>
<th>NON-EDP GROUP</th>
</tr>
</thead>
<tbody>
<tr>
<td>EIGHT</td>
<td>EIGHT</td>
</tr>
<tr>
<td>(1.7816)</td>
<td>(-1.3370)</td>
</tr>
<tr>
<td>ONE</td>
<td>ONE</td>
</tr>
<tr>
<td>(0.9208)</td>
<td>(-1.1140)</td>
</tr>
<tr>
<td>TWO</td>
<td>TWO</td>
</tr>
<tr>
<td>(0.8287)</td>
<td>(-0.8918)</td>
</tr>
</tbody>
</table>

SECONDARY ACTIVITIES:
FIVE (-0.2121)
EDF Subgroup Solution: Controllability Respondents

Dimension 1 (Horizontal): Primary Cluster

Dimension 2 (Vertical): Primary Cluster

- Identify Control Weakness
- Review/Evaluate Controls
- Recommend Controls
- Act As Control Consultant
- Assist In Design
- Serve As Member of Development Team
- Provide Several Control Solutions
- Provide Checklist of Controls
- Design
- Sign-Off
Non-EDP Subgroup Solution: Controllability Respondents

- Provide Checklist of Controls
- Act as Control Consultant
- Serve as Member of Development Team
- Several Control Solutions
- Recommend Controls
- Identify Control Weaknesses
- Review/Evaluate Controls
- Sign-Off

Dimension 1 (Horizontal): Primary Cluster
Dimension 2 (Vertical): Primary Cluster
as a control consultant," in their cluster. Also on
dimension one, the participant-in-design activity clusters
for both subgroups include activity six, "a member of the
development team," activity nine, "assist in design", and
activity eight, "sign-off", but the EDP group adds activity
seven, "act as a control consultant". Therefore, the
placement of activity seven is the major distinction
between the two subgroups on dimension one.

On dimension two, Assurance Provided, both subgroup
solutions reveal activity three, "provide a checklist of
controls" as the activity providing the least assurance.
The EDP group solution includes activity four, "provide
several control solutions", activity six, "member of
development team" and activity nine, "assist in design", in
a second primary least-assurance cluster. The non-EDP
group also includes activity six in their second primary
least-assurance cluster, but substitutes activity seven,
"act as a control consultant", for activity four.

Both subgroups agree on the activities which provide
the most assurance: first, activity eight ("sign-off");
second, activity one ("review/evaluate"); and third,
activity two ("identify control weaknesses"). However, the
EDP group solution shows activity eight, "sign-off", as
much more effective in assuring controllability than either
activity one, "review/evaluate controls" or activity two,
"identify control weaknesses". The non-EDP group solution
presents activities eight and one as very similar, whereas the EDP group presents activities two and one as very similar.

K-2. A COMPARISON OF AUDITABILITY SUBGROUPS

Two demographic variables were found to influence the similarity of the auditability subjects. Therefore, the subjects were divided into subgroups based upon these variables.

Years of Experience Subgroups

Auditability subjects were divided into three years of experience subgroups. Table K-2 compares the activity clusters for each year subgroup.

On dimension one, all three year group solutions (Figures K-3, K-4, and K-5) place activities eight ("sign-off"), one ("review/evaluate"), and two ("identify audit weaknesses") as the primary appraisal activities. Year group two respondents, internal auditors with the least experience and who are probably the most recent college graduates of the three subgroups of respondents, perceived activity eight, "sign-off", as very similar to activity one, "review/evaluate". In contrast, the solutions of subgroups three and four reveal a large distance between activities one and two, which were judged as very similar, and between activity eight.
Table K-2
A Comparison of Primary/Secondary Activities in Year Groups Two, Three, and Four

A. Dimension One: The Internal Auditor's Role in Assuring Auditability

1. Primary/Secondary Appraisal Activities

<table>
<thead>
<tr>
<th>Year Group</th>
<th>Year</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two</td>
<td>Eight (1.5344)</td>
<td>Eight (1.9708)</td>
</tr>
<tr>
<td>One</td>
<td>One (1.4581)</td>
<td>One (0.7706)</td>
</tr>
<tr>
<td>Two</td>
<td>Two (1.1090)</td>
<td>Two (0.7141)</td>
</tr>
</tbody>
</table>

Secondary Activities:

Five (0.2128)

2. Primary Potential Auditability Activities

<table>
<thead>
<tr>
<th>Year Group</th>
<th>Year</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two</td>
<td>Seven (-1.1900)</td>
<td>Nine (-0.8090)</td>
</tr>
<tr>
<td>Three</td>
<td>Four (-1.1984)</td>
<td>Three (-1.1699)</td>
</tr>
<tr>
<td>Four</td>
<td>Seven (-1.3815)</td>
<td>Three (-1.0650)</td>
</tr>
</tbody>
</table>

B. Dimension Two: Assurance Provided by Each Activity

1. Primary Least-Assurance Activities

<table>
<thead>
<tr>
<th>Year Group</th>
<th>Year</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Three</td>
<td>Two (1.4407)</td>
<td>Two (1.3504)</td>
</tr>
<tr>
<td>Two</td>
<td>One (1.0070)</td>
<td>One (1.2346)</td>
</tr>
<tr>
<td>Four</td>
<td>Three (1.0047)</td>
<td>Three (0.3848)</td>
</tr>
<tr>
<td>Seven</td>
<td>Four (0.4362)</td>
<td>Four (0.5625)</td>
</tr>
<tr>
<td>One</td>
<td>One (0.3228)</td>
<td></td>
</tr>
</tbody>
</table>

2. Primary Most-Assurance Activities

<table>
<thead>
<tr>
<th>Year Group</th>
<th>Year</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Six</td>
<td>Five (-1.2497)</td>
<td>Five (-1.2430)</td>
</tr>
<tr>
<td>Five</td>
<td>Six (-1.2220)</td>
<td>Six (-1.2425)</td>
</tr>
<tr>
<td>Nine</td>
<td>Nine (-1.0079)</td>
<td>Nine (-1.2022)</td>
</tr>
<tr>
<td>Eight</td>
<td>Eight (-0.7318)</td>
<td></td>
</tr>
</tbody>
</table>

Secondary Activities:

Seven (-0.2967)
Year group two respondents classified all the remaining activities on dimension one as potential auditability activities, while year groups three and four include only three activities in this primary activity cluster. Groups three and four both include activities three, "provide general audit requirements", and four, "provide several auditability solutions". Year group three adds activity seven, "consultant for audit requirements", while year group four adds activity five, "submit audit specifications".

For all three "year" groups on dimension two, activities six ("member of development team") and nine ("assist in design") were considered most-assurance activities. Groups two and three also agreed that activity five ("submit audit specifications") is a most-assurance activity, but year group four did not consider this dimension when judging the similarity of activity five (coordinate of .0050) with the rest of the activities. Group two was the only group to include activity eight ("sign-off"), and group four was the only group to include activity seven ("consultant for audit requirements") among the primary most-assurance activities. All groups agreed that activities two ("identify audit weaknesses"), one ("review/evaluate"), four ("provide several auditability solutions"), and three ("provide general audit requirements") were activities providing the least
Year Subgroup Three Solution: Auditability Respondents

1. Review/Evaluate Auditability
2. Identity Audit Weaknesses
3. Provide General Audit Requirements
4. Provide Several Auditability Solutions
5. Submit Audit Specifications
6. Member of Development Team
7. Consultant for Audit Requirements
8. Sign-Off

Dimension 1 (Horizontal): Primary Cluster
Dimension 2 (Vertical): Primary Cluster
Subgroup Four Solution: Auditability Respondents

2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5

Dimension 1 (Horizontal): Primary Cluster
Dimension 2 (Vertical): Primary Cluster

1. Identify Audit Weaknesses
2. Submit Audit Specifications
3. Provide General Audit Requirements
4. Provide Several Auditability Solutions
5. Proceed Evaluate Auditability
6. Member of Development Team
7. Consultant for Audit Requirements
8. Assist in Design
assurance of systems auditability. Group two also considered activity seven, "act as consultant", as a least-assurance activity. The perceptions of year groups three and four concerning the activities providing the least assurance were very similar. Activities one, "review/evaluate", and two, "identify audit weaknesses", are revealed as the activities providing the least assurance, while activities three, "provide general audit requirements", and four "provide several auditability solutions", are included in a second cluster of primary least-assurance activities. Year group two respondents also perceived two primary least assurance clusters, but the activities included in these clusters differ from those included in the clusters of subgroups three and four. The cluster judged as providing the least assurance consists of activities three ("provide general audit requirements"), two ("identify audit weaknesses"), and four ("provide several auditability solutions"). The second cluster of the year group two solution includes activities seven ("act as consultant") and one ("review/evaluate").

Opinion Concerning Participation Subgroups

For the demographic variable, "opinion concerning the internal auditor's role as a participant in design," both the PID and NPID subgroups were found in the analysis of flattened subject weights to have a higher percentage of respondents relying on dimension two of the total auditability group solution (Assurance Provided) than
PID Subgroup Solution: Auditability Respondents

1. Review/Evaluate Auditability
2. Identify Audit Weaknesses
3. Provide General Audit Requirements
4. Submit Audit Specifications
5. Assist in Design
6. Sign-Off

Consultant for Audit Requirements
Member of Development Team

Dimension 1 (Horizontal): Primary Cluster
Dimension 2 (Vertical): Primary Cluster
TABLE K-3
A COMPARISON OF THE PRIMARY/SECONDARY ACTIVITIES IN THE PID AND NPID GROUPS

A. PRIMARY APPRAISAL ACTIVITIES

<table>
<thead>
<tr>
<th>PID GROUP</th>
<th>NPID GROUP</th>
</tr>
</thead>
<tbody>
<tr>
<td>ONE</td>
<td>EIGHT</td>
</tr>
<tr>
<td>TWO</td>
<td>TWO</td>
</tr>
<tr>
<td>EIGHT</td>
<td>ONE</td>
</tr>
<tr>
<td></td>
<td>(1.7559)</td>
</tr>
<tr>
<td></td>
<td>(1.1852)</td>
</tr>
<tr>
<td></td>
<td>(1.0624)</td>
</tr>
</tbody>
</table>

B. PRIMARY/SECONDARY CONSULTANT OR POTENTIAL AUDITABILITY ACTIVITIES

<table>
<thead>
<tr>
<th>PID GROUP</th>
<th>NPID GROUP</th>
</tr>
</thead>
<tbody>
<tr>
<td>SEVEN</td>
<td>THREE</td>
</tr>
<tr>
<td>NINE</td>
<td>FOUR</td>
</tr>
<tr>
<td>FIVE</td>
<td>SEVEN</td>
</tr>
<tr>
<td>SIX</td>
<td>SIX</td>
</tr>
<tr>
<td>THREE</td>
<td>NINE</td>
</tr>
<tr>
<td></td>
<td>FIVE</td>
</tr>
<tr>
<td></td>
<td>(-1.1030)</td>
</tr>
<tr>
<td></td>
<td>(-1.0051)</td>
</tr>
<tr>
<td></td>
<td>(-0.9017)</td>
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<tr>
<td></td>
<td>(-0.4269)</td>
</tr>
<tr>
<td></td>
<td>(-0.2976)</td>
</tr>
<tr>
<td></td>
<td>(-0.2692)</td>
</tr>
</tbody>
</table>

C. PRIMARY/SECONDARY LEAST ASSURANCE ACTIVITIES

<table>
<thead>
<tr>
<th>PID GROUP</th>
<th>NPID GROUP</th>
</tr>
</thead>
<tbody>
<tr>
<td>THREE</td>
<td>THREE</td>
</tr>
<tr>
<td>FOUR</td>
<td>ONE</td>
</tr>
<tr>
<td>FIVE</td>
<td>TWO</td>
</tr>
<tr>
<td>TWO</td>
<td>FOUR</td>
</tr>
<tr>
<td></td>
<td>SEVEN</td>
</tr>
<tr>
<td></td>
<td>(-0.5902)</td>
</tr>
<tr>
<td></td>
<td>(0.9705)</td>
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<tr>
<td></td>
<td>(0.8953)</td>
</tr>
<tr>
<td></td>
<td>(0.7592)</td>
</tr>
<tr>
<td></td>
<td>(0.6804)</td>
</tr>
</tbody>
</table>

D. PRIMARY/SECONDARY MOST ASSURANCE ACTIVITIES

<table>
<thead>
<tr>
<th>PID GROUP</th>
<th>NPID GROUP</th>
</tr>
</thead>
<tbody>
<tr>
<td>EIGHT</td>
<td>SIX</td>
</tr>
<tr>
<td>SIX</td>
<td>FIVE</td>
</tr>
<tr>
<td>NINE</td>
<td>NINE</td>
</tr>
<tr>
<td>SEVEN</td>
<td>(1.3260)</td>
</tr>
<tr>
<td></td>
<td>(-1.3108)</td>
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<tr>
<td></td>
<td>(-1.2798)</td>
</tr>
<tr>
<td></td>
<td>(0.3711)</td>
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</table>

SECONDARY ACTIVITIES:
on dimension one (The Internal Auditor's Role in Assuring Auditability). However, 17.1% of the PID group respondents held an extreme position (subject weights greater than one) on the importance of dimension one. Therefore, when considering the average weights, Assurance Provided was the first dimension for the NPID group (Figure K-7), but the second dimension for the PID group (Figure K-6).

Table K-3 presents a comparison of the activity clusters for the subgroups. The appraisal cluster for both groups includes activities one ("review/evaluate"), two ("identify audit weaknesses"), and eight ("sign-off"). The NPID MDS solution reveals two primary potential auditability activities clusters. The first cluster includes activities three ("provide general audit requirements"), four ("provide several auditability solutions"), and seven ("act as a consultant"). The second cluster includes activities six ("member of development team"), nine ("assist in design"), and five ("submit audit specifications"). The PID group MDS solution reveals one large primary potential auditability activities cluster which is composed of activities seven ("act as a control consultant"), nine ("assist in design"), five (submit audit specifications") and six ("member of development team"). Activity three ("provide general audit requirements") may be considered part of this last cluster or it may be interpreted as a secondary activity.
On the Assurance Provided dimension (dimension one for the NPID group and dimension two for the PID group), respondents in both subgroups divided activities into those providing the least assurance and those providing the most assurance of auditability. The NPID group MDS solution (Figure K-7) shows a tight cluster of most-assurance activities. The activities included in this cluster are six ("member of development team"), five ("submit audit specifications"), and nine ("assist in design"). The PID group MDS solution reveals that these respondents considered activity eight, "sign-off", as an activity which provides the most assurance of auditability. A second, tight, primary most-assurance cluster includes activities five, nine, six, which were included in the NPID most-assurance cluster, and adds activity seven, "act as a consultant."

The activities judged as providing the least assurance of auditability by the NPID respondents are included in one large cluster. These activities are: three ("provide general audit requirements"), one ("review/evaluate"), two ("identify audit weaknesses"), four ("provide several auditability solutions"), and seven ("act as consultant"). The PID group MDS solution reveals two primary least-assurance clusters. The first cluster contains activities four ("provide several auditability solutions") and three ("provide general audit requirements"), and the second
cluster includes activities five ("submit audit specifications") and two ("identify audit weaknesses").
VITA

Margaret Virginia Cerullo, daughter of Mr. and Mrs. Shelby S. Ruffin, was born in Laurel, Mississippi, on June 9, 1945. She received her elementary and secondary education in the Laurel and Jackson, Mississippi, public school systems, graduating from William B. Murrah High School in May, 1963. In September of 1963, she entered Belhaven College, Jackson, Mississippi, where on May 27, 1967, she completed the requirements for the degree of Bachelor of Arts with a major in Accounting. Upon receiving a graduate assistantship in the Department of Accounting at Louisiana State University, she entered the graduate school as a candidate for the degree of Master of Science in Accounting, which was completed in 1969. Soon afterwards, she obtained the Certified Public Accountant certificate.

Candidate: Margaret Virginia Cerullo

Major Field: Accounting

Title of Dissertation: A STUDY OF INTERNAL AUDITOR PERCEPTIONS OF SELECTED AUDIT ACTIVITIES PERFORMED DURING THE DESIGN PHASE OF SYSTEMS DEVELOPMENT

Approved:

[Signature]
Major Professor and Chairman

[Signature]
Dean of the Graduate School

EXAMINING COMMITTEE:

[Signatures]

Date of Examination:

July 9, 1990