Order Number 8818289

An empirical investigation of EDP audit judgments and consensus between external and internal audit experts

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University of Arkansas, 1987

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AN EMPIRICAL INVESTIGATION OF EDP AUDIT JUDGMENTS AND CONSENSUS BETWEEN EXTERNAL AND INTERNAL AUDIT EXPERTS

AN EMPIRICAL INVESTIGATION OF EDP AUDIT JUDGMENTS AND CONSENSUS BETWEEN EXTERNAL AND INTERNAL AUDIT EXPERTS

A dissertation submitted in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy

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August 1987
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ACKNOWLEDGEMENTS

I would first like to thank my committee for their advice, support, and guidance on this dissertation. Drs. Bill Letzkus, Chairman, came to the rescue in time of need, Paul Cronan hung in there through thick and thin, and Jack White for his unending support.

A special word of thanks goes to Newton Bruce, who's initial help with the content of the questionnaire was invaluable to this study.

To my fellow graduate students, for the many times you have helped my progress without even knowing it - thanks.

Finally, to Mom and Pop, I dedicate this dissertation to you.

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CHAPTER I

INTRODUCTION

The Effect of the Computer

The role of the computer in today's business organizations is very important and is having a greater impact than ever before.[1] Data that are stored using computer files and are subsequently lost, damaged, or fraudulently manipulated can have a major effect on a company's survival.[2] Because of the important role that computers perform in processing data, it is important that proper controls be in place to monitor the ever-growing utilization and dependence on computers. In a study conducted by Mautz et.al. [1980, p.41], respondents stated that electronic data processing (EDP) was their "greatest concern from an internal control point of view."

Within a computerized environment, traditional audit goals such as safeguarding assets, maintaining data integrity, effectively achieving organizational goals, and using resources efficiently must continue to be maintained.

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[1] Companies were asked by Aasgaard et.al. [1979] how long they would be able to operate without the information processing capabilities of computers. The companies asserted that without the use of the computer, about 91% of the operational activities would cease by the end of the tenth day (on average).

[2] See Allen [1977].

In order to achieve these goals, a company must set up a system of internal controls with regard to the computer system [Davis (1968), p.106-7]. Important components of internal control that should be maintained include separation of functions, delegation of authority and responsibility, hiring and training of personnel, management supervision, a system of authorizations, comparison of recorded accountability with assets, and limited access to assets. In either a computerized or manual environment these controls must exist; however, the implementation of these controls is different in an automated system as opposed to a manual system [Weber (1982), p.10].

The Effect of the Computer on the Audit

Tests performed by an external financial auditor[3] determine whether or not internal controls are in place and functioning. Prior to the introduction of the computer, this testing was a common and necessary procedure that could be handled by any experienced external auditor. Research by Ashton [1974], Joyce [1976], Brown [1983], Gaumnitz et.al. [1982], and Hamilton and Wright [1982] indicated that external auditors in their judgments of

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[3] A description of the auditors used in this study is found in Table 1.1 on page 5.

internal control in a manual system were at a moderate to high level of consensus among themselves.

With the introduction of computer-based accounting systems, the external auditor must also review the EDP controls. According to Taylor and Glezen [1985, p.428-9], a general approach to an evaluation of EDP controls by the external auditor is as follows:

1. Conduct a preliminary review of the internal accounting control system.
2. Make an assessment of the EDP controls on which some reliance might be placed in determining the nature, timing, and scope of related substantive tests.
3. Complete the review process by reviewing, in detail, those general and application controls on which the auditor might wish to rely.
4. Make an assessment (preliminary evaluation) of the effectiveness of the EDP controls that were reviewed; determine the degree of reliance, if any, that will be placed on individual EDP controls.
5. Conduct tests of compliance on the EDP controls on which some reliance is to be placed.
6. Make a re-evaluation of the extent of reliance on the EDP controls that were compliance tested.
7. Complete the design of the substantive tests and make the appropriate alterations to these tests.

As shown in the steps outlined above, auditing "around the computer" is no longer feasible. The auditor now must

review computer controls as an integral part of the audit process.

The Role of the EDP Auditor

With a major part of a company's activities computerized, external financial auditors may lack the required skills necessary to continue the EDP audit review at some point in the process. According to the Statement on Auditing Standards (SAS) No. 48, the auditor

> ...should consider whether specialized skills are needed to consider the effect of computer processing on the audit, to understand the flow of transactions, to understand the nature of internal accounting control procedures, or to design and perform audit procedures. If specialized skills are needed, the auditor should seek the assistance of a professional possessing such skills...

Those auditors who possess the required skills are known as EDP auditors (as opposed to financial auditors). These EDP auditors may work for public accounting firms (i.e. external) or in the private sector (i.e. internal). A description of these auditors is found in Table 1.1.

TABLE 1.1
AUDITOR DESCRIPTIONS

External Financial: an auditor working for a public accounting firm whose primary responsibilities include the non-computer related aspects of an audit.

External EDP: an auditor working for a public accounting firm whose primary responsibilities include the evaluation and testing of controls on a client's computer system. These auditors may also be referred to as computer audit specialists.

Internal Financial: an auditor working for a private company whose primary responsibilities include auditing all aspects of their company's activities except computer-related areas.

Internal EDP: an auditor working for a private company whose primary responsibility is to examine, evaluate, and test their company's EDP systems.

If the EDP system is beyond the expertise of the external financial auditor, Davis, Adams, and Schaller [1983, p.9-10] state three possible alternatives. First, the external financial auditor can learn the skills needed to develop an expertise in this area. Second, the external financial auditor may use the expertise of an EDP audit specialist (external EDP auditor) to assist in the audit. Third, the external financial auditor can have a management services computer specialist (another type of external EDP auditor) assigned to the audit team. If the external financial auditor lacks the expertise to continue in any part

of the EDP audit process, he may rely upon the judgment of the external EDP auditor.

The Roles of the External and Internal Auditor

If a client has an internal audit or an EDP audit department, the external financial auditor may make use of the work of internal auditors (both financial and EDP) according to Section 322.10 of the AICPA Professional Standards. General control #19 in the AICPA guide The Auditor's Study and Evaluation of Internal Control in EDP Systems states that the work of a client's internal auditors may be used and general control #20 gives the guidelines to be followed if the external financial auditor is to rely upon the work of the internal auditor (financial and EDP).

In a study conducted by Ward and Robertson [1980, p.65], external and internal auditors were surveyed concerning the areas where the external auditor could rely on the internal auditor's work. In the area of EDP systems, 48% of the external auditors stated they relied upon the work of internal auditors. Therefore, it follows that any work done by the internal auditors in evaluating controls in an EDP system should be done under the assumption that their work

may be used by the external financial auditor. Brown [1984, p.16] states:

> It is crucial for internal auditors to understand what factors are deemed important for reliance by independent auditors for a very basic reason: internal auditors' perceptions must be the same perceptions reached by independent auditors. Only then can strong (and cost-effective) reliance take place.

Therefore, the work of internal EDP auditors in certain circumstances may be an important facet that is relied upon by the external financial auditor during the process of evaluating and testing EDP controls.

Berry [1985, p. 57-58] extends the relationship between external and internal auditors even further. He reports that many large companies view their total audit coverage as a "single audit" that includes both the internal and external audit. Under these conditions, this "single audit" should be executed under the most cost-effective manner. According to Berry's research, not only does the external auditor rely on the work of the internal auditor, but the internal auditor may also rely on the work of the external auditor to meet certain internal audit objectives. Furthermore, many audit committees are asking external auditors "...to demonstrate that proposed exclusive coverage cannot be performed by the internal auditors...and, therefore, must be performed by the external auditor." In light of this, it appears the future

role of the external and internal auditor may have many overlapping features.

EDP Audit Controls and Methods

The methods used in testing the controls in a computer system are changing as rapidly as the field of EDP auditing itself. New techniques are developed and old ones are eliminated. Watne and Turney [1984, p.121] stated, "There are dozens of techniques available to the computer auditor. Selecting a technique appropriate to the task at hand, however, can be difficult."

In the actual EDP audit of the computer system, there are many options, methods, and EDP auditing procedures available. With respect to external financial auditors and EDP auditing techniques, Abdel-khalik et.al. [1983] state:

> ...an informed assessment of the relative benefits of various EDP auditing techniques may be highly important to the planning and conduct of the external audit examination... (p.216)
>
> ...The increasing computerization of information processing by client organizations and the additional demands for verification of internal control systems are two factors likely to lead to closer scrutiny of the relationship between the EDP auditing techniques employed by internal auditors and the external audit examination...Furthermore, the impact of a client's use of these techniques...will become an increasingly significant issue. (p.225)

For the internal EDP auditor, an ongoing audit of the computer system is vital to ensure a quality system of internal controls. As stated in the Systems Auditability and Control Study [1977, p.55] conducted by the Stanford Research Institute:

> Considerable variations exist in the way internal auditors approach their work, depending upon experience levels in both audit and data processing, and the level of sophistication of the data processing environment...Many organizations still rely on the ingenuity of internal auditors and the basic discipline inherent in the general approach to auditing.

In summary, the importance of EDP audit work is evident. Since testing procedures are becoming very complex, the evaluation of computer controls by auditors in a computer-based accounting system is an issue which should be addressed by the auditing community.

The Audit Judgment

Internal control judgments made on manual systems were regarded by Ashton [1974, p.145] as important because of their effect on the audit opinion expressed on the financial statements. Testing the controls of the computer-based system by external or internal EDP auditors may also affect the audit opinion. This is especially true since there are no absolute guidelines for all EDP audit situations, and the judgment of the auditor therefore plays a key role.

Ashton [1974] and Joyce [1976] both discussed the effect that inconsistent judgments among external financial auditors could have on the audit opinion. This current study investigates whether inconsistent judgments exist between and among external auditors and internal auditors whose responsibility extends to the evaluation and testing of computer controls in an EDP environment. It therefore follows that a central concern is the extent of agreement (consensus) among these groups of auditors in the testing of computer controls.

The evaluation and testing of computer controls requires the use of judgment by the auditor. However, it has been demonstrated that judgment is difficult to measure in terms of "good", "accurate", "correct" etc. A study conducted by Ashton [1985] has shown that in certain circumstances, an appropriate surrogate to measure judgment may be consensus (level of agreement).

The Importance of Consensus and Consistency

Because it has been very difficult to give concrete guidelines in all audit situations, the role of professional judgment is an important component of the audit process. This exercise of professional judgment in turn makes it difficult to determine whether a "correct" judgment has been made. Mautz and Sharaf [1961, p.132] in their discussion of due audit care, state that "He (the auditor) must exercise as

sound judgment as would another (auditor) possessed of the same extent of information available to him at that time." Hicks [1974, p.39] agrees with Mautz and Sharaf, but goes one step further. Not only must the auditor apply the same judgment, but in the best of all worlds, he should apply the same auditing procedures as well. Based on the above statements, agreement between auditors in this study is termed consensus, while agreement of one auditor with himself given the same information at different points in time is referred as consistency.

Ashton [1985, p.185] empirically tested consensus and found that to a certain degree, consensus implied accuracy. Joyce [1976, p.30] sums it up very well in stating:

> ...if there exists a common core of knowledge germane to auditing, and if the education, certification, and training process auditors undergo are successful in imparting that knowledge, one would expect to find agreement among the judgments of different auditors in the same audit situation.

Although the extent of agreement among auditors has been an area that has received much attention in accounting research, the principle subject of the studies has been the external financial auditor. Only the Davis and Weber study [1983] used EDP auditors (internal). Table 1.2 summarizes several of these consensus studies and the levels of consensus found

in each. These studies are discussed in detail in the literature review chapter.

TABLE 1.2
SUMMARY OF CONSENSUS STUDIES

Researcher	Avg. "Level of Consensus"
External Financial Auditors:	
Ashton [1974]	.70
Joyce [1976]	.373
Trottman et.al. [1983]	.56
Gaumnitz et.al. [1982]	.704
Hamilton & Wright [1982]	.71
Brown [1983]	.70
Ashton & Brown [1980]	.86
Bailey [1981]	.7468
Internal EDP Auditors:	
Davis & Weber [1983]	.145

The level of consensus among external financial auditors found in these studies ranged from .373 (Joyce) to .86 (Ashton and Brown) and was categorized as "moderate to high" levels of consensus by the researchers. All of these studies except for the study by Davis and Weber used external financial auditors in various audit situations (such as payroll, accounts receivable, cash receipts and others) requiring judgment by the auditor.

The study by Davis and Weber[4] used internal EDP auditors instead of external financial auditors. As indicated in Table 1.2, the level of consensus among these auditors was much lower (.145) than the other studies. This comprehensive study examined the extent of agreement among internal EDP auditors over various advanced EDP systems. These advanced systems were defined as online/realtime, database, and distributed systems. The Davis and Weber study examined the degree of consensus among these auditors concerning changes in an organization's data processing environment when it changed to one of the more advanced data processing systems.

Purpose of the Study

Previous studies have examined consensus and consistency among external financial auditors, internal financial auditors, and internal EDP auditors. However, with the exception of Bailey [1981], all other studies investigated consensus using only one particular type of auditor, and only the Davis and Weber [1983] study involved an EDP environment. Due to the overlapping nature of the roles of external and internal auditors, whether they agree with one another in the

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[4] There are several other studies (Stanford Research Institute [1977] and Tobison and Davis [1981]) involving EDP auditors, but these studies have used survey techniques only. As of this date, the study by Davis and Weber appears to be the only published study which used EDP auditors and empirical methods in its analysis.

evaluation of controls in a computer-based system is an important aspect which needs to be examined. Therefore, the purpose of this study is to investigate the degree of agreement (both consensus and consistency) among and between external and internal auditors whose primary responsibility involves the examination of computer controls in an EDP environment.

The Research Questions

In order to assess the accuracy and correctness of the judgment process, the level of agreement between and among external and internal EDP auditors was examined. The following research questions were therefore addressed in this study:

> What is the level of consistency of external EDP auditors and internal EDP auditors?
>
> What is the level of consensus of external EDP auditors and internal EDP auditors?
>
> Are the levels of consensus different between these groups of auditors?
>
> What factors affect the level of consensus within the groups of auditors?

In order to examine the research questions, eight hypotheses were developed.

Before consensus could be examined, the level of consistency for the auditors was tested. According to Einhorn [1974], a high level of consistency is a necessary

condition for expert status. If an individual auditor cannot agree with himself, then agreement with other auditors cannot be expected either. Therefore, the first hypothesis tested was the following:

H_{o1}: There is no difference in the level of consistency of audit judgments between external and internal EDP auditors.

The second hypothesis examined the degree of consensus between these different groups of auditors. If the roles overlap and one group may rely on another, then differences in levels of consensus may hinder cooperative efforts between these auditors. The second hypothesis examines the levels of consensus between these auditors as follows:

H_{o2}: There is no difference in the level of consensus of audit judgments between external and internal EDP auditors.

Previous research suggests that a lack of consensus among (external) auditors may be caused by several factors. Experience (Weber [1980]), educational background (Weber [1982], and management level (Trottman et.al. [1983]) have been cited as possible factors which may cause differences in levels of consensus. These factors were tested in hypotheses three through five. These hypotheses were examined for external and internal auditors separately in order to avoid

any confounding effects the combining of the two groups of auditors would have on the factors being tested.

H_{o3}: There is no difference in the level of consensus of audit judgments between experienced and inexperienced auditors.

H_{o4}: There is no difference in the level of consensus of audit judgments between accounting educated and data processing educated auditors.

H_{o5}: There is no difference in the level of consensus of audit judgments between auditors in different levels of management.

Consensus was also examined in specific computer control areas such as separation of functions controls, program code change controls, and logical and physical security access controls. In these areas, the auditors ranked and weighted individual control questions. Hypotheses six and seven tested for differences.

H_{o6}: There is no difference in the rankings of the computer control questions between external and internal EDP auditors.

H_{o7}: There is no difference in the weighting of the computer control questions between external and internal EDP auditors.

The final hypothesis tested the level of consensus for external auditors in different firms. Whereas Hamilton and Wright [1982] found differences among external financial auditors in different firms, this hypothesis examines whether the level of consensus among EDP auditors of one Big Eight

firm was different than the level of consensus among EDP auditors in the other Big Eight firms.

$H_0 8$: There is no difference in the level of consensus of audit judgments between auditors in different Big Eight firms.

In addition to the above hypotheses, a discriminant model was developed based upon the variables tested in the hypotheses. This discriminant model classified auditors into two groups: those auditors with having a low level of consensus and those auditors having a high level of consensus.

Contributions of This Study

Inconsistent judgments (lack of consensus) among auditors can be costly and in direct opposition to the training and education practices of several accounting organizations. Although not tested empirically, the American Institute of Certified Public Accountants (AICPA), the EDP Auditors Association (EDPAA), and major accounting firms are expending resources[5] to reduce inconsistent judgments among auditors [See Joyce (1976), p.3.].

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[5] For example, the AICPA publishes standards and suggested audit guidelines to be followed by its members; the EDPAA offers training seminars in various computer audit areas; and the major accounting firms are expending funds on in-house training facilities for their employees.

Since the testing of computer controls in an automated system is an important part of the audit process, identification of a lack of consensus will provide evidence that the judgments of auditors may be inconsistent. Inconsistent auditor judgment can have a detrimental effect on the quality of the audit.

For external financial auditors who use the work of internal EDP auditors to assist in the audit of an EDP system, results of this study will provide evidence as to the level of professionalism and competence of the internal EDP audit field.

The study by Davis and Weber [1983, p.126] suggested future research to investigate why EDP auditors had a low level of consensus. The present study examines selected factors which may help explain any lack of consensus among these auditors.

Chapter Summary

The computer has had a considerable effect on business operations, the audit process, the development of controls, and the auditor. As part of the audit, computer controls must be evaluated. This evaluation is usually done by an expert, namely, an EDP auditor. This EDP auditor may be part of the external audit team or employed by the client company as an internal EDP auditor. Based on the "single audit" concept and the trend toward increased use of the work of the

internal auditor, similarities of judgments between external and internal EDP auditors is an important issue which this study addresses.

Several hypotheses were formulated as a basis for testing levels of consistency and consensus between and among external and internal EDP auditors. In addition, variables such as experience, educational background, management level, and firm affiliation were examined as possible factors which might account for any differences in consensus among these auditors.

CHAPTER II

LITERATURE REVIEW

Much of the behavioral research in accounting has been concerned with the judgments of external financial auditors. These auditors have been asked to evaluate various subsystems of a basically manual accounting system. There have been very few empirical studies where external financial auditors were asked to evaluate a computerized system. However, the approach taken by several researchers, and the methodology that has been developed can provide a point of reference to begin examining the extent of agreement among auditors concerning the evaluation of controls in an EDP environment.

This chapter is divided into four sections in order to review the relevant literature related to this study. The first section discusses the nature of EDP controls, their development and importance, and implications for auditors. The second section of this chapter discusses the role of consensus and its relationship to agreement as a surrogate for "correctness" as found in the literature. The third section examines some of the contributions made by the psychology literature to auditing research and its implications for this study. The fourth section reviews the auditing literature involving auditor's judgments and the evaluation of controls in various types of accounting subsystems.

The Development of EDP Controls

In 1961, Mautz and Sharaf published The Philosophy of Auditing. In it they stated

> ...It must be recognized that the evaluation of internal control is at best a difficult subjective weighing of imponderables...[p.145]

Even without the introduction of the computer, internal control evaluation was a difficult task. However as the computer became an integral part of normal business operations, it became apparent that the auditor needed to include testing the computer controls as part of the audit. With the introduction of the computer, some of the controls normally used for reliance purposes have ceased or changed. The first attempt at examining these controls and current practices and procedures was made by the AICPA in 1966. This task force attempted:

1. To guide CPA's in auditing business enterprises which uses computers for record keeping.

2. To provide a starting point for building a consensus of expert opinion on auditing practices for examining such companies.

3. To suggest the utility and applicability of different auditing methods where experience is still lacking.

4. To provide source materials for training and informational purposes.

This study, however, did not establish actual auditing standards; but only represents the views of the committee members' experienced judgments.

In 1974 the AICPA issued Statement on Auditing Standards No. 3: The Effects of EDP on the Auditor's Study and Evaluation of Internal Control. This standard "...describes the effects of EDP on the essential characteristics of accounting control." [p.4] In addition, this statement requires the auditor to "...understand the entire system sufficiently to enable him to identify and evaluate its essential accounting controls features" [p.2]. This may be a difficult task in light of the advanced EDP systems of today.

In 1977 the AICPA issued the Audit and Accounting Guide: The Auditor's Study and Evaluation of Internal Control in EDP Systems which should be interpreted only as recommended procedures that may be used by auditors in the evaluation of computer controls. Even though this guide gives insight into what controls the auditor needs to be aware of, the evaluation of these controls often is up to the auditor's judgment since there are "...no existing standards for the specific combination of controls that a client should utilize in a given system."[p.2] For advanced systems, just as in the 1966 AICPA study, this guide foregoes making any statement about accounting controls because "...considerably

more experience ... will be required before a consensus about accounting controls develops."[p.3]

In 1984 the AICPA released SAS No. 48 The Effects of Computer Processing on the Examination of Financial Statements. This statement superseded SAS No. 3. It is important to note that this statement again emphasizes that the auditor needs to understand the accounting controls in a computerized environment. It states, however, that when the auditor recognizes that specialized skills may be needed to do this, he may call upon a qualified professional for assistance. This raises several questions which have not been answered by the statement and still remain unanswered. At what level of complexity in an EDP environment does the auditor call upon an EDP specialist? Has the level of computer complexity reached such a point that the auditor is now totally dependent upon computer specialists? As stated by the EDP Task Force in 1966, until "...a consensus of expert opinion on auditing practices..." is reached, these questions will remain unanswered.

The Role of Consensus

Based upon the accounting literature, it is evident that there is an absence of an objective external criterion with which to measure judgment accuracy. This is particularly true in the field of audit judgment research. One of the goals of this type of research is to improve the decision.

However, a problem arises: What measurement scale will "improvement of the decision" be measured against? The answer to this by accounting researchers has been to offer a surrogate for the objective criterion - consensus as a substitute for accuracy (and the measurement scale). A recent study by Ashton [1985] empirically examined the role of consensus as a surrogate for accuracy.

Ashton, A.H.

In her study titled "Does Consensus Imply Accuracy in Accounting Studies of Decision Making?", Ashton examined the relationship between consensus and accuracy in two areas. The first area was a managerial task and the second area was in the audit field. The basis for this study was that if a relationship could be found between consensus and accuracy in a setting where objective external criteria are available, then this relationship should also exist in areas where there are no objective criteria.

The first part of the experiment involved thirteen business executives who made forty-two predictions of a budgeting task based on five cues. In this part, accuracy was measured against actual results.

The second part of the experiment involved twenty-seven audit partners. The partners were asked to predict whether any of forty firms presented to them would have going concern problems within one year. The auditors made their

predictions based on five financial ratios. The auditors then indicated their decision on a six point scale.

Results from the first part of the experiment using a Pearson (Spearman) correlation coefficient ranged from .954 to .009 for pairwise consensus with the average being .765. This indicates a strong relationship between accuracy and consensus. In addition, pairwise comparisons were measured in absolute terms with the average correlation coefficient measuring .688 which again strongly supports the first measurement. Similar statistical analysis was applied to the second task, with the Pearson (Spearman) correlation coefficient measuring .625. In the final analysis, although Ashton suggests further study, the results indicate that to a certain degree consensus implies accuracy.

Psychology Literature

Previous research in psychology has been used extensively by accounting and auditing researchers. Since in previous studies as well as this study the auditor is viewed as an expert in his field, literature in the area of expert judgment is relevant. In particular, research by Einhorn has made a great contribution to this area and, as it affects this study, is discussed.

Einhorn

Einhorn [1974] examined the requirements for "expert" judgment. He states that in situations where it is difficult to measure the accuracy of judgments, certain surrogate criteria should be used. According to Einhorn, there are three necessary (but not sufficient) conditions in the evaluation of expert judgment.

First, experts should agree on the clustering of variables when identifying and organizing cues. In other words, agreement on the clustering of variables pertains to the ability of the expert judges to extract relevant information from a background of noise.

Second, there should be high intrajudge reliability in repeated judgments of the same cues. Intrajudge reliability, otherwise known as consistency, is crucial. "It should be obvious that unless the expert can reproduce his measurement of the cues, there is little more that can be said in defense of his expertise."

Third, expert judges should weight and combine information in a similar manner. In other words, there should be agreement (consensus) among expert judges. This consensus can be examined in two ways: agreement "in fact" and agreement "in principle". Agreement "in fact" refers to the degree of agreement of the final evaluation no matter how the evaluation was arrived at. Agreement "in principle"

refers to the degree of agreement of how (i.e. the weighting and combining of cues) the final judgment was formed.

Consensus Studies Involving Auditors

American Institute of Accountants

The Committee on Auditing Procedure of the American Institute of Accountants [1955] examined the degree of agreement among eight auditors. Given the same case material, the auditors were asked to devise summary audit programs. Due to the fact that no statistics were used in this study and the small sample size, no empirical results were given. However, the Committee did note that substantial inter-auditor differences (in the audit programs) existed.

Aly and Duboff

Aly and Duboff [1971] examined how auditors would respond to statistical versus judgmental sampling of accounts receivable confirmations in a retail environment. Each of the 158 auditors sampled received a mailed questionnaire with identical case descriptions of an actual industrial supplier retail store. The auditors were asked to decide which type and extent of accounts receivable confirmations would be appropriate.

The results showed a wide range of opinion as to the extent of requisite accounts receivable confirmations

(from 10% to 100%). Based upon these results, a lack of agreement among the auditors was evident.

Corless

Corless [1972] investigated whether the auditor could reconcile "his belief" of what the audit sample should be to the statistical evaluation of what the audit sample should be. The subjects were 88 certified public accountants with practical audit experience. The subjects were given a case with a set of questions about the payroll error rate. After answering these questions, they were given another case and asked for their revised probability estimates.

In his conclusions, Corless expected "considerable similarity" because all auditors were given the same facts. However, he reports a "...considerable variability...by different auditors for each case."

Ashton, R.

Ashton [1974] was one of the first researchers to investigate the judgment processes of auditors and report a moderate to high level of consensus. Ashton based his study on the idea that judgment is the most important factor in an audit, yet no one has specifically determined how to apply judgment in the audit process.

In order to analyze the judgment process, Ashton set up an experiment involving sixty-three auditors. These auditors

were asked to judge the strength of the internal control in a payroll subsystem. This judgment was based on six pre-answered questions (cues) on an internal control questionnaire. Thirty-two different combinations of "yes" and "no" answers for these six questions were chosen according to a one-half fractional replication of a 2^6 factorial design. The thirty-two combinations of "yes" and "no" answers on the internal control questionnaire represented the thirty-two different cases.

Each case was analyzed for consensus (across all auditors) and consistency (among individual auditors). Correlation statistics and analysis of variance were used to analyze the data. Consensus across auditors averaged .70 while consistency among auditors averaged .81. In the final analysis, Ashton classified this as a fairly high level of consensus and consistency.

Joyce

Joyce [1976] examined the judgment processes of auditors. Like Ashton, Joyce argued that precise guidelines do not exist for information collection and evaluation, therefore judgment is extremely important. In addition, Joyce suggested that audit firms and the AICPA do things that are consistent with the hypothesis that individual differences are costly. Based upon this, Joyce concentrated upon individual differences and predicted that factors

leading to variances among auditors are more powerful than those which tend to reduce such variances.

Joyce's research involved thirty-five auditors who formulated a summary audit program for an accounts receivable subsystem over sixteen different cases in one experiment and thirty-two different cases in a second experiment. The differences in auditors' judgments were examined using correlational statistics.

The results showed a much lower level of consensus than Ashton's work. The inter-rater reliability (level of consensus) was found to be .373. The level of consistency among auditors (test-retest or intra-rater reliability) was .853. Although the results are consistent with Joyce's predictions, limitations such as a small, non-random sample, lack of control of the task administration, and lack of generalizability to other audit situations may hinder interpretation of the results.

Weber

Weber [1978] analyzed the judgment process of independent auditors in assessing the overall reliability of internal control involving an inventory system. One of the main issues addressed by Weber was whether there was consensus among auditors concerning the impact of internal control weaknesses on the amount of dollar error the system could produce. This was important because "If auditors were

not in agreement at this stage, lack of consensus at later stages in the auditor decision process will magnify the lack of consensus during this first stage..." [p.371]. In addition, Weber tested to see if three variables - dogmatism, risk-taking propensity, and experience (all three of which were found to be important in the psychology literature) are factors to be accounted for in an audit context.

The subjects in this study were practicing auditors from several Big Eight accounting firms. Each auditor was given a case study involving the inventory section of an audit which had been partially completed. The subjects then had to estimate the dollar error in inventories, assess the sensitivity of the dollar error to internal control weaknesses, and estimate the number of man-hours required to substantiate inventories. The subjects were divided into two groups. The first group was the control group, and the second group used a simulation decision aid to assist in the decision process.

The result of the hypothesis involving consensus among the auditors concerning the sensitivity of the dollar error using the mean paired correlation coefficient measured .379. Although Weber had succeeded in simulating a real world scenario in his experiment, it appears the task complexity may have impaired the results at the cost of being too realistic. Weber, however, suggests that this low consensus

may be due to a lack of proper training in systems concepts for auditors in the decision process involving internal control strengths and weaknesses.

Reckers and Taylor

Reckers and Taylor [1979] based their study on the basis that

> ...while technical competence is a necessary component of an effective audit, it does not ensure sound professional judgment...The degree or extent of substantive testing of transactions or balances is not an independent decision ... it is a direct consequence of the auditor's evaluation of internal control..." [p.44].

The experiment in this study used an extension of the payroll instrument first used by Ashton. However, instead of the six cues which Ashton had used, Reckers and Taylor obtained a more comprehensive payroll questionnaire from a large accounting firm. Five cases of varying combinations of "yes" and "no" answers to simulate neither extremely poor nor extremely good internal control were developed. The volunteer subjects were thirty practicing auditors from large firms. Each auditor evaluated all five cases.

The results of this experiment for inter-auditor consensus using an average inter-rater correlation was .1554. The authors interpreted this level as very poor in light of the task being common to the audit practice. In addition, Reckers and Taylor examined various levels of experience to

see if greater experience yielded a higher degree of consensus. For those auditors with less than seven and one-half years of experience, the inter-auditor rating was slightly lower than the overall group rating at .135. For auditors with experience greater than seven and one-half years, the average inter-rater correlation was somewhat higher at .3570. Given these results, Reckers and Taylor concluded that Ashton's findings must be the exception and sided with those researchers who had found a low level of consensus. They stated that their study is only another piece of research showing that significant differences do exist in critical judgment areas of auditors.

Ashton, R. and Brown

Ashton and Brown [1980] replicated several other previous studies involving auditor judgment. However, instead of six cues[6], two additional cues were added from which auditors were to evaluate internal control. In addition, the cue order was changed, and more interactions were allowed.

Thirty-one auditors evaluated 128 different cases and thirty-two repeat cases of a payroll subsystem. The auditors

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[6] The term "cue" as used in this study represents a particular question that was answered on the internal control questionnaire.

were also asked to weigh the importance of the eight cues by distributing 100 points across them. Results from the correlation statistics indicated a mean level of consensus of .67 and a mean level of consistency of .86.

Ashton and Brown also tested for differences based upon levels of experience and found no significant differences. However, they did find that consistency of judgment and level of consensus increase with the level of experience.

Bailey

Bailey [1981] in his dissertation investigated the differences between external auditors' and internal auditors' evaluations of internal controls in a manual accounting system. An important assumption which provided the basis for his study was that in the "preliminary evaluation" of internal accounting controls, both external and internal auditors would find a common ground on which any differences between the groups could be further analyzed.

The experiment involved mailing out a questionnaire to samples of auditors taken from the membership lists of the AICPA and the Institute of Internal Auditors (IIA). Twelve pre-answered "yes" and "no" questions on an internal control questionnaire were varied to produce eight different cases of internal control involving a cash receipts subsystem. The sample of auditors was divided into eight groups. Each auditor in each group answered only one of the eight cases.

Consensus was primarily analyzed using analysis of variance techniques. The results indicated there were significant differences in the mean evaluations of the audit judgments by the external auditors and the mean evaluations of the audit judgments by the internal auditors. However, based upon the actual ratings of how important each of the twelve questions on the internal control questionnaire was, a high level of consensus (.7468) was found among the groups as measured by the Pearson Product Moment correlation coefficient.

Gaumnitz, Nunamaker, Surdick, and Thomas

Gaumnitz, Nunamaker, Surdick, and Thomas [1982] extended the internal control evaluation by an additional step. In actual practice, after the evaluation of internal control is made, the amount of substantive testing is then determined. In Gaumnitz et.al.'s study, the level of consensus was examined in two respects: first, in the actual internal control judgment and second, the amount of substantive testing that followed. (The amount of substantive testing was based on each auditor's initial internal control judgment.)

Thirty-five auditors evaluated twenty audit situations. Statistical analysis revealed the level of consensus in the evaluation of internal control to be .704. The level of consensus for the next phase (i.e. determining the audit

hours of testing required) was lower at .617. Intra-auditor consensus (consistency) was .825 which was much higher than any previous studies.

Hamilton and Wright

Hamilton and Wright [1982] expanded upon several other studies of consensus and specifically concentrated on the relationship between judgment consensus and the level of experience. A major assumption of their study was that expert judgment is a function of experience. In addition, Hamilton and Wright examined whether the accounting firm that employed an auditor made any difference in judgment.

The experiment involved seventy-eight auditors and two groups of auditing students. All three groups evaluated thirty-two different cases. The results of this experiment were in conflict with those of previous studies. Less experienced auditors were found to have a slightly higher level of consensus than experienced auditors (.73 versus .71). In addition, Hamilton and Wright found highly significant differences among auditors in different firms.

Abdel-khalik, Snowball, and Wragge

Abdel-khalik, Snowball, and Wragge [1983] investigated the level of consensus among external auditors concerning their judgments in planning audit programs. This study used thirty-two different cases representing all possible

combinations of five internal audit variables which were answered by fifty-nine respondents. The results of this study indicated a low level of consensus (.32) pertaining to the auditors' judgments of reliance on internal control.

In addition, the auditors also judged in importance several EDP auditing techniques. The auditors evaluated each of the EDP audit techniques (test deck, integrated test facility, generalized audit software) in this study to be equal in importance. The criteria for choosing the techniques were that they had to be common in use and readily identified by a general staff auditor. This criteria may have influenced the results of this study where the EDP auditing techniques were concerned.

Brown

Brown [1983] also investigated the level of consensus and how it is affected by experience. However, instead of using an accounting subsystem, Brown had auditors evaluate internal audit functions based on the premise that external auditors utilizing the work of internal auditors can offer cost savings to the client.

This research involved 101 auditors who evaluated forty-eight different cases. Statistical tests showed the average level of consensus was .70, and the level of consistency was .79. Similar to the findings of Hamilton and Wright [1982], Brown also found that those auditors with less experience had

a slightly higher level of consensus than those auditors with more experience (.72 versus .70).

Davis and Weber

Davis and Weber [1983] studied the control and audit of advanced EDP systems. When an organization changes from an existing data processing system to a more advanced system, two areas must be addressed by the auditor. These areas are control changes and changes in evidence collection and evaluation. These areas were examined by Davis and Weber when changes were made to three types of advanced EDP systems - online/realtime, database, and distributed systems.

Because of the technical nature of the study, the researchers chose internal EDP auditors over external EDP auditors. For each type of advanced system, ten responses were obtained from the auditors in the types of control changes and changes in evidence collection and evaluation. Correlational statistics showed very low levels of consensus for the auditors over all three areas of advanced systems compared to previous consensus studies. The online/realtime system showed a level of consensus over general audit concerns to be .239. The level of consensus for the database management system was lower at .104, and the distributed system was even lower at .092. Based upon the low levels of consensus among the auditors, two possible conclusions were reached by the researchers: either (1) there were problems

in the methodology or (2) there were genuine differences among the auditors.

Trottman, Yetton, and Zimmer

Trottman, Yetton, and Zimmer [1983] investigated whether group evaluations of internal controls were more effective than individual judgments. Trottman et.al. based their research on the premise that in actual practice internal controls were evaluated by groups rather than by individuals.

The participants in this study were students in an advanced auditing course. The students first individually evaluated the degree of internal control in thirty-two different cases of a payroll subsystem. After this, they were divided into two and three-person groups and made the same evaluations again.

The findings showed that the level of consensus found among the three-person groups was higher than two-person groups which in turn was higher than individual consensus (.79, .69, .56 respectively). However, these findings must be interpreted in light of the fact that students were used as subjects with each student's opinion carrying equal weight. In actual practice, a senior auditor's opinion would carry more weight than a junior auditor's opinion.

Chapter Summary

The development and evaluation of controls "is at best a difficult subjective weighing of imponderables" (Mautz and Sharaf [1961]). The AICPA [1977] recommended certain audit procedures, but the evaluation of EDP controls is still based primarily on the auditor's judgment.

In areas where there is no objective criteria with which to measure accuracy or correctness, consensus according to a study by A.H. Ashton [1985] implies accuracy. Several psychological studies by Einhorn support Ashton's results. Einhorn [1974] states that experts should agree with themselves over time (consistency) as well as with other experts (consensus). The implications of Einhorn's studies are that experts tend to converge (agree) towards a solution in areas where there is no objective answer.

A review of the studies concerning consensus among auditors shows a wide range of results. Ashton and Brown [1980] found the highest level of consensus among external financial auditors to be .86, while Joyce [1976] found auditors had a consensus level of only .373. These studies used a manual accounting environment (i.e. accounts receivable and payroll) where the audit tasks were structured. In an advanced EDP environment and using internal EDP auditors, consensus levels were even lower (.145) according to Davis and Weber [1983].

CHAPTER III

METHODOLOGY

The purpose of this study is to determine whether differences exist in the levels of consistency and consensus between and among external and internal EDP auditors. Through the use of a survey instrument, auditors were asked to make judgments as to the strength of certain EDP auditing controls in a computer-based accounting system. Based upon these judgments, the levels of consistency and consensus are tested. Consistency is defined as the degree of agreement an auditor has with himself over a period of time on the same subject and consensus is defined as the degree of agreement among auditors over the same subject.

This study extends the work of previous researchers by examining the responses of both external and internal auditors. Previous research concentrated on the judgments of external financial auditors. Only a few included internal financial auditors, and even fewer used any type of (external or internal) EDP auditor. This present study examines differences between external and internal EDP auditors in their evaluation of controls in an EDP audit environment.

Sample

Initial efforts were made to randomly select external auditors from the American Institute of Certified Public

Accountants (AICPA) membership directory. Internal auditors were also randomly sampled from the membership list of the EDP Auditors Association (EDPAA).

The response rate from the external auditors was very poor (2.2%). Due to the nature of this study, this small response was not unexpected. Because such a small response may not be representative of the group of external auditors, this sample and the internal auditor sample were abandoned. At the cost of giving up randomness, the Big Eight firms were contacted and asked to supply external auditors for this study. The limitations of this are discussed in a later section. In addition, the EDP Auditors Association also supplied a new sample of internal auditors.

For the sample of external audit experts, a letter was sent to all the Big Eight firms' national headquarters requesting their assistance in supplying about ten of their EDP auditors (computer audit specialists) to complete the instrument. Follow-up letters were sent several weeks later to those firms that had not initially responded.[7] When a firm agreed to participate in this study[8], the survey instruments were mailed to the auditor in charge who then

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[7] Copies of all initial and follow-up letters are contained in Appendix B.

[8] In order to encourage participation, the firms were told they would not be individually identified by name.

passed out the instrument to auditors selected to participate. Some firms gathered all the responses and mailed them back together. Other firms had the respondents individually mail back their responses.

To secure the sample of internal audit experts, a letter was sent to the EDP Auditors Association requesting permission to use its membership directory. Since this association contains many types of auditors, certain restrictions were placed on the sample gathering procedures. First, these auditors had to be internal EDP and work for a Fortune 500 company. One hundred auditors were randomly selected by the EDP Auditor's Association and letters were sent to these auditors requesting that they participate in this study. Follow-up letters were sent a few weeks later.

A cutoff-point from the initial mailout of the survey instrument to both groups of auditors was set at about six weeks. Any survey instrument that was not returned by this time was not statistically tested.

Survey Instrument

The survey instruments[9] were mailed to participating Big Eight firms and individual internal EDP auditors. The instrument contained an explanation of the study, detailed instructions of how to respond, a place for the respondent to

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[9] A copy of the instrument is contained in Appendix A.

request results of this study, demographic questions, and EDP audit cases to be evaluated.

The demographic information requested from the auditors included internal or external classification, years experience in financial and EDP auditing, position level in the company, number of coursework hours taken in accounting and data processing subjects, and number of hours taken in CPE courses covering EDP auditing topics. Auditor responses to each of these questions formed the basis to classify the respondents for the testing of the hypotheses.

All auditors were asked to respond to seven[10] different cases that contained a pre-answered EDP audit checklist. The checklist covered three areas that are commonly reviewed during an audit of a computer-based accounting system. These areas were separation of functions, program code change controls, and logical and physical security access controls.[11] Each of these areas contained a list of control questions which were already checked as "yes" (in place) or

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[10] Initially, problems arose as to how many cases would be appropriate for this study. The practical constraints were that too many cases would be detrimental to a good response rate, while too few cases would adversely affect validity of the test-retest (consistency) of the respondents. Based on this, it was decided that seven cases would be adequate for this study.

[11] These three areas were decided upon after much discussion with several practicing EDP auditors and field testing as to what should be included in the instrument.

"no" (not in place). The questions answered under each of the three control areas are shown in Table 3.1.

Each control area had a six point Likert scale on which the respondent evaluated the strength of computer controls based on various combinations of the controls in place and not in place. The ends of the scale were labeled as "extremely weak" to "adequate to strong".[12] In addition, the auditors evaluated the overall adequacy of the controls in each of the seven cases.

To assist in insuring validity in the test-retest parts of the instrument, all control questions within each control area were randomized. In addition, the order in which the control area appeared within each case was randomized.

Finally, all auditors ranked and weighted each of the control questions based on perceived importance. The control questions were ranked within each area using the numbers one through six where one was considered most important and six was considered least important. The auditors then indicated the relative importance of the controls in each area by allocating a total of one hundred points among the six controls in each area.

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[12] A similar type of Likert scale was used by Ashton [1974], Hamilton and Wright [1982], and Ashton and Brown [1980] in their research. Not only does the scale appear appropriate for this research, but use of the same scale will allow for some comparisons among the results of these studies.

TABLE 3.1
COMPUTER CONTROL QUESTIONS

Separation of Functions

1. Is there an adequate separation of operators, programmers, and systems analysts' duties within the data processing department?
2. Is there a regular internal audit of the data processing department?
3. Does the data processing department have authority to initiate changes on the master files?
4. Does the user review master file changes?
5. Is there a separate access control and security function?
6. Is there a separate librarian function whose charge is custody of files, programs, and documentation?

Physical and Logical Security Over Programs and Data

1. Does the data processing librarian keep a record of all data files used?
2. Is there a periodic inventory of program libraries and data files?
3. Is the physical access to computer facilities restricted?
4. Are security codes for logical access to data controlled?
5. Is library control software used to control programs in source and object code, and control test and production versions?
6. Do excessive logical access violations cause users to be disconnected which then require supervisor approval to reconnect?

Program Changes

1. Are program changes approved before being made?
2. Are program changes reviewed by the user?
3. Are operations personnel authorized to make application program changes?
4. Are program changes tested before being used?
5. Is the documentation of the maintenance of applications adequate?
6. Is a library control software package used to control source versions and object programs?

Field Testing and Validation of Survey Instrument

The construction of the survey instrument began with many discussions with individuals who are experts in the EDP audit field. These experts came from the oil and gas industry, banking, and public accounting. The instrument was field tested with three local groups of EDP Auditors Association members. After each field test, revisions were made as suggested by those auditors answering the instrument. A final copy of the instrument was sent to the EDP Auditors Association regional vice-president and research committee for their review before mailing.

Factor Analysis

Factor analysis was used to validate the survey instrument. The theoretical basis for using factor analysis is to identify some underlying factors which are responsible for the covariation among the observed variables. These variables were the responses of the auditors to the three control areas and the overall evaluation within each of the seven cases in the survey instrument.

Using the auditors' responses to each of the questions, "R" factor analysis was applied to a correlation matrix of the responses using a common factor model. The common factor model was chosen over the principal components model because of the unknown amount of error variance that had to be eliminated.

Uncorrelated factors were not assumed in this study because many EDP controls tend to overlap and are analyzed in the light of how other controls are implemented. Therefore, an oblique solution was used to rotate the factor axes. The VARIMAX method of rotation in the Statistical Analysis System accomplished the oblique rotation.

Next, a scree plot was used to identify the appropriate number of factors to be extracted. After the factors were extracted, the loadings under each of the factors were examined and labels were given to the factors.

Hypothesis Testing

The first hypothesis examines the consistency of external and internal auditors' judgments. The second hypothesis investigates whether consensus (i.e. agreement) levels between external and internal auditors' judgments differ. The third through the fifth hypotheses test whether type of experience, educational background or management level contribute to consensus among external auditors and internal auditors. Hypotheses six and seven examine whether differences exist between external and internal auditors in the ranking and perceived importance of individual controls. Hypothesis eight tests for differences in consensus levels between auditors in different Big Eight firms.

Following the hypotheses is the discriminant model which is used to classify auditors with a low level of consensus from those auditors with a high level of consensus.

Hypothesis 1:

H_o: There is no difference in the level of consistency of audit judgments between external and internal EDP auditors.

H_a: There is a difference in the level of consistency of audit judgments between external and internal EDP auditors.

Examination of this first hypothesis is very important to this study for several reasons. First, one of the criteria required for expert status is that an individual have high intra-judgmental consistency (Einhorn [1974, p.563]). In other words, if an individual in evaluating a particular case (test) is later evaluating the same case (re-test), the evaluations should be consistent. Those individuals who lack this characteristic do not qualify as experts. Second, tests on this hypothesis may identify outliers (as defined later in this section). These outliers were removed from the data and not used in any further testing. Third, consistency represents the upperbounds of consensus according to Einhorn [1974, p.564]. If consistency is low, consensus will be as low or lower. Therefore, a low level of consistency for either group of auditors would

negate the need to test for levels of consensus between the external and internal auditors.

Consistency was determined by the test-retest method. Each case in the survey instrument contained three control areas. These three areas were separation of functions, program change controls, and physical and logical security access controls. With seven separate cases, there were a total of twenty-one sections which were evaluated by the respondents. Eighteen sections were original "test" sections, and the other three sections were repeated as "retest" sections. These "retest" sections (one for each of the control areas) were randomly placed in the survey instrument.

In order to determine a level of consistency, the Pearson Product Moment Correlation (r) was computed. The following formula was used:

$$r = \frac{n\,(\Sigma XY)-(\Sigma X)(\Sigma Y)}{([n(\Sigma X^2)-(\Sigma X)^2][n(\Sigma Y^2)-(\Sigma Y)^2])^{1/2}} \qquad (1)$$

where: X = evaluations on the "test" sections

Y = evaluations on the "retest" sections

The r statistic for the test-retest sections in each control area was calculated and an average for the three sections was calculated. This was the mean correlation coefficient that measured the level of consistency for each

of the individual auditors. A mean correlation coefficient was then calculated for all respondents. Next, each individual was then classified as an external or internal auditor, and a mean correlation coefficient was calculated for each group. These mean correlation coefficients were used as a standard to compare how individuals perform relative to their group average and to the entire sample's average.

The first hypothesis was examined statistically using a pooled Student's t-test. While the correlation coefficient generally measures the degree of association, further evidence for consistency can be provided by using a t-test to see if the means are equal between groups. In order to test for differences in consistency between groups using the t-test, the following working models were used:

$$u_1 = u_2 \qquad (2)$$

where: u_1 = group mean of the Pearson Correlation Coefficient of external auditors

u_2 = group mean of the Pearson Correlation Coefficient of internal auditors

After the statistical tests noted above have been calculated, hypothesis one will be examined using the results of the Pearson Product Moment Correlation statistic and the t-test for a difference in means. Rejection of the null

hypothesis means there is a difference in the level of consistency between these groups of external and internal auditors. As stated earlier, if consistency is low, consensus will be as low or lower which could possibly negate the need to test consensus.

Hypothesis 2:

H_o: There is no difference in the level of consensus of audit judgments between external and internal EDP auditors.

H_a: There is a difference in the level of consensus of audit judgments between external and internal EDP auditors.

Since the computer plays an important role in the generation of financial statements for many businesses, agreement in the evaluation of computer controls between the external and internal auditor is very important due to the interaction of these groups. According to Felix and Kinney [1982, p.245], the financial statement audit should be carried out using the same process regardless of whether the auditor is internal, independent (external) or governmental.

An integral part of the financial statement audit is the evaluation of computer controls. The evaluation of the

computer controls based on the auditor's judgment is crucial to the audit. This decision, according to Weber,

> ...impacts whether the auditor will continue with the audit, whether the internal control system can be relied upon, what controls are critical to the audit and how they should be tested...and...whether or not the system has satisfactorily safeguarded assets, maintained data integrity, and achieved system effectiveness and efficiency. [1982, p.33]

Identification of any differences in the levels of consensus between external and internal auditors concerning their evaluation of computer controls may have a major impact on future auditing practices.

Consensus (as opposed to consistency's test-retest method) in general was measured by computing the association of one auditor's responses to the questions in all seven cases to a second auditor's responses to those same questions. The first auditor's responses were then compared to a third auditor's responses to the questions. This procedure was repeated until all auditors' responses had been paired with all other auditors' responses to all the questions.

In this part of the study, consensus was examined in three ways. Based on the procedure mentioned above, an overall level of consensus was calculated for each auditor by comparing responses with all other auditors. A second level of consensus was calculated for each external auditor by

comparing only with all other external auditors. And third, a level of consensus was calculated for each internal auditor based on agreement with all other internal auditors.

This second hypothesis concerning differences in the levels of consensus among auditors was statistically tested using the Pearson Product Moment Correlation (r) and a t-test for a difference in means. The Pearson Product Moment Correlation (r) was used to calculate a level of consensus for all auditors combined, for external auditors, and for internal auditors. The following formula was used:

$$r = \frac{n\,(\Sigma XY)-(\Sigma X)(\Sigma Y)}{([n(\Sigma X^2)-(\Sigma X)^2][n(\Sigma Y^2)-(\Sigma Y)^2])^{1/2}} \qquad (3)$$

where:

X = evaluation of one auditor for a given question

Y = evaluation of another auditor on the same question

Consensus was next tested using a t-test to see if the mean levels of consensus between auditors are different. The following working model was tested:

$$u_1 = u_2 \qquad (4)$$

where: u_1 = mean consensus level of external auditors

u_2 = mean consensus level of internal auditors

After all the statistical tests were completed, hypothesis two was examined using the Pearson Product Moment Correlation r-statistic and the results from the T-tests for differences in the means. If the null hypothesis is rejected, this indicates there is a difference in the level of consensus between external and internal auditors in their evaluation of computer controls.

Hypothesis 3:

H_o: There is no difference in the level of consensus between experienced and inexperienced auditors.

H_a: There is a difference in the level of consensus between experienced and inexperienced auditors.

Previous studies which have examined the relationship between experience and consensus among external auditors show conflicting results. Weber [1980] and Libby [1985] found a positive association between experience and consensus. However, no positive relationship was found between experience and consensus by Ashton and Kramer [1980] and Hamilton and Wright [1982]. In this study, it was hypothesized that there is a positive relationship between certain types of experience and consensus. Therefore, the judgments of the more experienced auditors will tend to have

less variability than the judgments of inexperienced auditors.[13]

In this hypothesis, the definition of experience was refined further. Previous studies defined experience in auditing as encompassing all types of audit experience. In this study, experience was categorized into two types: (1) financial and/or operational auditing experience and (2) EDP auditing experience. Previous studies such as Ashton and Brown [1980] and Hamilton and Wright [1982] have used less than three years of auditing experience to designate an "inexperienced" auditor and greater than three years experience to designate an "experienced" auditor. After a review of the relevant literature and discussions with practitioners, it was decided that experience would be best classified into three levels: (1) low (less than three years of appropriate experience; (2) medium (at least three years but no more than ten years of appropriate experience); and (3) high (greater than ten years of appropriate experience).

Consensus among the three levels of auditing experience was examined by a two factor analysis of variance (ANOVA) model. In using any ANOVA model, it is important to test that the model is appropriate for the application. One of

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[13] As mentioned in Chapter 1, hypotheses three through five examined factors only within each of the auditor groups. Testing the factors across the groups may confound the results of these hypotheses.

the assumptions of this model was normality of the data. In addition, the residuals (e_{ij}) were examined for nonconstancy, nonindependence, and outliers. However, since ANOVA is considered robust, only serious departures from the conditions assumed by the model would affect the results (Neter and Wasserman [1974. p.501]).

The two factors used in the two-factor ANOVA model were financial/operational auditing experience and EDP auditing experience. Neter and Wasserman [1974, p.588] offered the following strategy for analyzing factor effects in a two-factor ANOVA model which was used in this study:

1. Examine whether the two factors interact.

2. If they do not, examine the factor effects separately in terms of the factor level means.

3. If the factors do interact, examine if the interactions are important or unimportant.

4. If they are unimportant, examine the factor effects separately.

5. If they are important, determine whether the interactions can be made unimportant by a meaningful transformation of scale. If so, make the transformation and examine the factor effects separately.

6. For interactions that cannot be made unimportant, analyze the two factor effects jointly in terms of the treatment means.[14]

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[14] Treatment is defined in this study as each combination of factor level A (financial/operational auditing experience) and factor level B (EDP auditing experience).

The following working model was used to test for differences in the level of consensus between experienced and inexperienced auditors:

model: $Y = u.. + A_i + B_j + (AB)_{ij} + e_{ij}$ (5)

where: Y = level of consensus

$u..$ = constant

A_i = main effect of financial/operational auditing experience at the i^{th} level

B_j = main effect of EDP auditing experience at the j^{th} level

$(AB)_{ij}$ = interaction effect of financial/operational auditing experience and EDP auditing experience when financial/operational auditing experience is at the i^{th} level and EDP auditing experience is at the j^{th} level

e_{ij} = error term

Table 3.2 shows the treatment levels for the two factors.

TABLE 3.2
TREATMENT LEVELS FOR FACTORS A AND B

treatment level	Factor A financial/operational experience	Factor B EDP experience
1	low	low
2	low	medium
3	low	high
4	medium	low
5	medium	medium
6	medium	high
7	high	low
8	high	medium
9	high	high

If the null hypothesis is rejected, this indicates that there is a difference in the level of consensus between auditors with different levels of experience. However, this does not indicate which levels of experience are significantly different from each other. The Scheffé Method of Multiple Comparisons[15] was used to identify those treatment levels which were significantly different from the other treatment levels.

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[15] Scheffé Method of Multiple Comparisons computes a single value for each of the treatment levels. The differences in these values are then compared to determine which treatment levels are significantly different from each of the other treatment levels. (See Neter and Wasserman [1974, p. 730])

Hypothesis 4:

H_o: There is no difference in the level of consensus of audit judgments between accounting educated and data processing educated EDP auditors.

H_a: There is a difference in the level of consensus of audit judgments between accounting educated and data processing educated EDP auditors.

Educational background has been found to cause differences among auditors' levels of consensus.[16] In a study conducted by Campbell and Landry [1985, p.32], EDP auditors (both external and internal) with different educational backgrounds (accounting versus data processing) showed significant differences in their responses to an EDP auditing survey. (Also see Weber [1982, p.52-53].)

In addition to the basic educational background (i.e. undergraduate degree), this study examined additional education obtained by an auditor. This additional education includes coursework beyond the undergraduate degree as well as continuing professional education (CPE) hours in the computer audit area.

For this hypothesis, the levels of consensus between auditors with different educational backgrounds were tested using a three-factor ANOVA design. This design is similar in

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[16] In this hypothesis, the external and internal auditors are tested separately.

all respects to the two-factor ANOVA model used to examine the third hypothesis except that one additional factor has been added.

The following working model was used to test for differences in the level of consensus between auditors with different educational backgrounds:

Model: (6)

$$Y=u...+A_i+B_j+C_k+(AB)_{ij}+(AC)_{ik}+(BC)_{jk}+(ABC)_{ijk}+e_{ijk}$$

where:

- Y = level of consensus
- $u...$ = constant
- A_i = main effect of accounting education at the i^{th} level
- B_j = main effect of data processing education at the j^{th} level
- C_k = main effect of CPE at the k^{th} level
- $(AB)_{ij}$ = interaction effect of accounting and data processing education when accounting is at the i^{th} level and data processing is at the j^{th} level
- $(AC)_{ik}$ = interaction effect of accounting education and CPE when accounting is at the i^{th} level and CPE is at the k^{th} level
- $(BC)_{jk}$ = interaction effect of data processing education and CPE when data processing is at the j^{th} level and CPE is at the k^{th} level
- $(ABC)_{ijk}$ = interaction effect of accounting and data processing education and CPE when accounting is at the i^{th} level, data processing is at the j^{th} level and CPE is at the k^{th} level
- e_{ijk} = error term

Accounting education and data processing education were each divided into two levels. With respect to formal education, if an auditor had less than 30 hours in either area, this was classified as a low amount of coursework. If an auditor had 30 or more hours in either area, this was classified as a high amount of coursework. For CPE, 30 hours or less constituted a low amount while greater than 30 hours was considered a high amount of CPE hours in the EDP audit area. Table 3.3 shows the various treatment levels which were examined in this hypothesis.

TABLE 3.3
TREATMENT LEVELS FOR FACTORS A, B, AND C

treatment level	FACTOR A accounting	FACTOR B data processing	FACTOR C CPE
1	low	low	low
2	low	high	low
3	low	low	high
4	high	low	low
5	high	high	low
6	high	low	high
7	low	high	high
8	high	high	high

If any significant differences were found to exist whereby the null hypothesis would be rejected and the alternate hypothesis accepted, this would indicate that educational background does make a difference in the judgment

processes of computer auditors in this sample. Additional testing would then be necessary using Scheffé's Method of Multiple Comparisons. Scheffé's method would determine which treatment level (amount and type of educational background and CPE) was significantly different from the other treatment levels.

Hypothesis 5:

H_o: There is no difference in the level of consensus of audit judgments among EDP auditors in different levels of management.

H_a: There is a difference in the level of consensus of audit judgments among EDP auditors in different levels of management.

In this hypothesis, various levels of management were examined to see if significant differences in judgment can be accounted for across various levels of management.[17] Trottman et.al. [1983, p.291] stated that they expected differences to occur across the various levels (from junior to partner) because of different weights that each level of management carries in the decision process. This study also incorporated various management levels of internal auditors in addition to the management levels of external auditors.

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[17] In this hypothesis, the external and internal auditors are tested separately.

A single-factor ANOVA model was used to test the levels of consensus between auditors in different levels of management. The following working model was used to test the hypothesis:

model: $Y = u. + A_i + e_{ij}$ (7)

where: Y = level of consensus

$u.$ = constant

A_i = main effect of management level at the i^{th} level

e_{ij} = error term

In this hypothesis, the variable under scrutiny was the level of management or position an auditor held. Table 3.4 indicates the three treatment levels that were examined for each group of auditors.

TABLE 3.4
FACTOR A: TREATMENT LEVELS

treatment level	FACTOR A Management Level (external)	(internal)
1	junior	staff
2	senior	supervisor
3	manager/partner	department head

If the results from the model are significant, and the null hypothesis is rejected, then the auditor's position in management may have accounted for differences in the level of consensus. As in the previous hypotheses, if a difference exists, further examination using Scheffé's Method of Multiple Comparisons is used to determine which of the treatment levels (i.e. management level) is significantly different from the other treatment levels.

Hypothesis 6:

H_o: There is no difference in the rankings of the computer controls between external and internal EDP auditors.

H_a: There is a difference in the rankings of the computer controls between external and internal EDP auditors.

For this hypothesis, the auditors were asked to rank the six control questions found in each of three control areas. These control areas were separation of functions, program code change controls, and logical and physical security access controls. The auditors ranked the control questions (within each section) in order of most important to least important by numbering the questions from one to six where one was most important and six was least important.

This hypothesis was examined as follows. Each of the six questions found in the three control areas was examined

separately. The following working model was used to examine this hypothesis:

$$u_1 = u_2 \qquad (8)$$

Where: u_1 = group mean of external auditors

u_2 = group mean of internal auditors

The mean rank for the group of external auditors was then compared to the mean rank of internal auditors for that particular control question using a t-test. This was repeated for each of the eighteen control questions.

Rejection of the null hypothesis leads to acceptance of the alternate hypothesis which states that external auditors rank computer control questions in a different manner than internal auditors. Perception of how important certain controls are is very important to the audit. With more cooperation taking place between the external and internal auditor in the audit process, judgments by both groups in evaluating controls should be very similar.

Hypothesis 7:

H_o: There is no difference in the weightings of the computer controls between external and internal EDP auditors.

H_a: There is a difference in the weightings of the computer controls between external and internal EDP auditors.

In this hypothesis, the auditors were asked to weight the six control questions found in each of the three control areas. The auditors ranked the six control questions by allocating a total of 100 points between them. This was done for each control area (separation of functions, program code change controls, and logical and physical security access controls).

This hypothesis was examined as follows. The mean weighting of each of these control questions was computed for the two groups of auditors. The following working model was used to examine this hypothesis:

$$u_1 = u_2 \qquad (9)$$

Where: u_1 = group mean of external auditors

u_2 = group mean of internal auditors

The mean weight for the group of external auditors was then compared to the mean weight of internal auditors for that particular control question using a T-test. This was repeated for each of the eighteen control questions.

If the results from the model are significant, and the null hypothesis is rejected, then the weighting applied to the control questions by external auditors is different than the weighting applied by the internal auditors.

Hypothesis 8:

H_o: There is no difference in the level of consensus of audit judgments among auditors in different Big Eight firms.

H_a: There is a difference in the level of consensus of audit judgments among auditors in different Big Eight firms.

Previous research by Hamilton and Wright [1982] found differences between one firm's auditors and another firm's auditors. This hypothesis examines whether differences exist between Big Eight firm's auditors in the EDP audit area. Consensus in this hypothesis was measured by comparing the level of consensus of one firm's auditors with the level of consensus of auditors in another firm.

External auditors were categorized by firm. Then responses of one auditor were compared only to the responses of other auditors within the same firm. A mean level of consensus was then calculated for each auditor within that

firm using the Pearson Product Moment Correlation Coefficient using the following formula:

$$r = \frac{n(\Sigma XY) - (\Sigma X)(\Sigma Y)}{([n(\Sigma X^2) - (\Sigma X)^2][n(\Sigma Y^2) - (\Sigma Y)^2])^{1/2}} \quad (10)$$

where:

X = evaluation of one Big 8 auditor for a given question

Y = evaluation of another Big 8 auditor on the same question

This procedure was repeated for all the Big Eight firms.[18] A mean correlation coefficient was then computed for each of the firms.

This hypothesis concerning differences in the levels of consensus among Big 8 auditors was statistically tested using a single factor analysis of variance model whereby the treatment levels would be the different Big Eight firms. The following working model was used to test the hypothesis:

model: $Y = u. + A_i + e_{ij}$ (11)

where: Y = level of consensus

$u.$ = constant

A_i = main effect of the Big Eight firms at the i^{th} level

e_{ij} = error term

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[18] Although all the Big 8 firms were represented in this study, there were only four firms which provided a sufficient number of auditors to compare differences in the level of consensus among the firms.

Each of the Big Eight firms would represent a particular level within the factor A. After all the statistical tests were completed, if the null hypothesis is rejected and the alternate hypothesis accepted, this indicates there was a difference in the level of consensus between auditors in different Big 8 firms in their evaluation of computer controls.

The Discriminant Model

Previous studies used regression and analysis of variance techniques as their only statistical tests in examining differences in consensus levels between auditors. Instead of limiting the analysis to these techniques, this study used another technique, multiple discriminant analysis (MDA) to construct a model that would distinguish those auditors who tended to have a high level of consensus (i.e. individual auditor consensus level above the average consensus level for all auditors) from those auditors who tended to have a low level of consensus (i.e. individual consensus levels below the average consensus level for all auditors).

The full discriminant model will take the form

$$Z = W_1X_1 + W_2X_2 + W_3X_3 + \ldots + W_nX_n \qquad (12)$$

where Z = the discriminant score

W = the discriminant weight

X_1 = type of auditor

X_2 = years experience in EDP auditing

X_3 = years experience in non-EDP auditing

X_4 = accounting education

X_5 = data processing education

X_6 = management level

X_7 = hours of continuing education in EDP

The variables in this model were chosen based on the previous hypotheses examined in this study as well as other prior studies (already cited in the literature review chapter). The type of auditor (X1) was classified as external or internal. The variable experience was divided into three levels of EDP audit experience (X2) and three levels of financial/operational auditing experience (X3). The first level of experience was less than three years experience. The second level was three to ten years of experience, and the third level was greater than ten years of experience. Education was divided between accounting (X4) and data processing (X5) while management (or position in the

company) (X6) was made up of three levels (staff, middle, and upper). The final variable, hours of continuing education (or CPE credit hours) (X7) was divided into two levels - low was thirty hours or less and high was greater than thirty hours.

After the variables were chosen, the next step was to decide whether or not to split the sample in order to calculate the discriminant function. Two alternatives existed. The first alternative was to randomly stratify the sample into two groups - an analysis group (to derive the discriminant function) and a holdout group (to test the discriminant function). This procedure has the advantage of eliminating an upward bias in prediction accuracy that would occur if the sample used to develop the classification matrix was also used in computing the function. However, the sample has to be at least one hundred to be considered sufficiently large (Hair et.al. [1984, p.95]) to use this procedure. Since the sample totaled only eighty-five, this first alternative was not considered appropriate.

The second alternative was used in this study whereby a jackknife approach was used to develop the discriminant model.

Two general methods were used to develop the classification model - logit analysis and discriminant

analysis. Logit analysis is based on the cumulative logistic probability function and takes the following form:

$$P_i = f(Z_i) = \frac{1}{1 + e^{-(a + bXn)}}$$

Discriminant analysis is the classification of an observation x, possibly multivariate, into one of several populations, each of which have density functions. If these densities can be assumed to be normal with equal covariance matrices, then Fisher's linear discriminant function (LDF) is used. If the matrices are unequal, a quadratic discriminant function is appropriate. The methods assume multivariate normality.

The analysis involves deriving the linear combination of the independent variables that best discriminates between the a priori defined groups (i.e. those auditors with high consensus and those auditors with low consensus). This is achieved by maximizing the between group variance relative to the within group variance.

The sample of auditors was used to develop the classification model. A stepwise regression procedure was first used to determine the "best" set of variables to be used in the logit model. The criteria for choosing the best set was that combination of variables which resulted in a significant increase in the marginal R^2 when another variable

entered, and which resulted in no significant decrease in the marginal Mean Square Error (MSE) when another variable entered into the model.

The procedure for selecting the "best" set of variables for the discriminant model used the BMDP7M discriminant analysis program. This program uses a forward stepping procedure and computes internal and jackknifed classification rates. The set of variables which produced the highest classification rate was considered the best discriminant model.

The derived models were validated using an internal classification (resubstitution) rate and the jackknife classification rate. The internal classification rate is the percent correctly classified when all observations are used to develop the model. These same observations are then used to test the function. The jackknife procedure systematically withholds each observation and develops a discriminant function on the remaining observations. That function is then used to classify the withheld observation. The percent correctly classified is the jackknife rate.

Chapter Summary

In this chapter, the procedures used to gather the data and test the hypotheses were discussed. A survey instrument containing seven EDP audit cases was mailed to external EDP auditors from Big Eight firms and internal EDP auditors from

the EDP Auditor's Association membership directory (and employed by Fortune 500 companies). Eight hypotheses which investigated judgment consistency and consensus differences between and among external and internal auditors were examined based upon the responses to the instrument. These hypotheses were tested using T-tests and analysis of variance models. Finally, a discriminant model was constructed to classify those auditors with high judgment consensus from those auditors with low judgment consensus.

CHAPTER 4

RESULTS AND ANALYSIS OF HYPOTHESES' TESTS

This chapter presents a description of the sample, the results of testing the hypotheses, and the discriminant model. Each hypothesis was tested based on the method described in the previous chapter, and the results were analyzed. In addition, the results of this study were compared against the results of previous research.

Sample Characteristics

Table 4.1 summarizes the responses for the external and internal auditors. As shown in the table, the external

TABLE 4.1
RESPONSE RATES FOR EXTERNAL AND INTERNAL AUDITORS

Big Eight Firm[19]	Mailed Out	Received
1	10	8
2	10	7
3	10	6
4	10	7
5	10	1
6	10	1
7	10	1
8	10	2
Totals	80	33
Internal Auditors	100	52

[19] In order to encourage participation, the firms were told they would not be individually identified by name.

auditor response rate was 41% (33/80) while the response rate for internal auditors was 52% (52/100).

The sample of thirty-three external auditors consisted of one staff auditor, six senior auditors, twenty managers, and six who were at the partner level. The sample of fifty-two internal auditors consisted of fourteen staff auditors, eighteen who were at the supervisory level, and twenty who were at least at the level of department head. Table 4.2 summarized the years of experience in the EDP and financial auditing areas, and Table 4.3 shows the educational background for the sample of external and internal auditors.

TABLE 4.2
EXPERIENCE IN EDP AND FINANCIAL AUDITING
EXTERNAL AND INTERNAL AUDITORS

External Auditors	Less than 3 years	3-10 years	Greater than 10 years
EDP Auditing	10	18	5
Financial Auditing	6	21	6
Internal Auditors			
EDP Auditing	8	36	8
Financial Auditing	34	13	5

TABLE 4.3
EDUCATIONAL BACKGROUND
EXTERNAL AND INTERNAL AUDITORS

External Auditors	H 0-15	O	U 16-30	R	S >30
Accounting	1		16		16
Data Processing	20		7		6
CPE		4*			29
Internal Auditors					
Accounting	11		24		17
Data Processing	13		22		12
CPE		17			35

* CPE was measured in two categories: less than or equal to 30 hours and greater than 30 hours.

Hypothesis 1: Differences in Consistency

H_o: There is no difference in the level of consistency of audit judgments between external and internal EDP auditors.

As described in the previous chapters, consistency is an essential characteristic for an individual to qualify as an expert (Einhorn [1974]). Ashton [1974] stated that inconsistent judgments can have a detrimental effect on the quality of an audit. If an auditor in the sample showed inconsistent judgment, that auditor was excluded from any further testing because of a lack of expertise.

The level of consistency was calculated using Pearson Product Moment Correlation Coefficient for each of the auditors on the test-retest sections in the survey instrument. Consistency levels were calculated for both external and internal auditors. A frequency distribution of the levels of consistency for the groups of auditors is shown in Table 4.4.[20]

TABLE 4.4
FREQUENCY DISTRIBUTION OF CONSISTENCY LEVELS

	External		Internal	
Level	Number	%	Number	%
.90 - 1.00	12	36	17	33
.80 - 0.89	3	9	10	19
.70 - 0.79	1	3	1	2
.60 - 0.69	5	15	9	17
.50 - 0.59	8	25	10	19
.40 - 0.49	0	0	0	0
.30 - 0.39	0	0	0	0
.20 - 0.29	0	0	0	0
.10 - 0.19	4	12	5	10
.00 - 0.09	0	0	0	0
Totals	33	100	52	100

As can be seen from Table 4.4, there was considerable similarity in the levels of consistency between external and

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[20] Frequency distributions of the external and internal auditors to all the cases can be found in Appendices C and D.

internal auditors. Both groups had individuals who scored very high in consistency levels. Each group of auditors had individuals who were wholly consistent in their judgments (i.e. scoring 1.00). Eight of the thirty-three external auditors and ten of the fifty-two internal auditors were able to do this. In addition, both groups had about the same percentage (88% for external auditors and 90% for internal auditors) of auditors with consistency levels of at least 0.50.

On the low side, each group of auditors had several individuals who scored very low relative to the other consistency levels. The external auditor group had four individuals who scored in the .10 to .19 range, whereas the internal auditor group had five persons in this range. Within this range, each group had one individual with the lowest level of consistency at .11.

The average consistency level of the external auditors, as shown in Table 4.5, was .69; whereas the average level for the internal auditors was .72.[23] These results were somewhat lower than the consistency levels found in most of the previous research. Ashton [1974] found a consistency level of .81; Joyce [1976] and Ashton and Brown [1980] found levels of about .86; and Brown [1983] found a consistency level of .79. However, the work of these previous researchers used external financial auditors only and a more structured task

while this study used both external and internal EDP auditors in an unstructured task environment.

TABLE 4.5
LEVELS OF CONSISTENCY

	low	high	mean	std. dev.	n
External	.11	1.00	.69	.2895	33
Internal	.11	1.00	.72	.2657	52
T statistic		0.4423			
p-value		0.6597			

To test the first hypothesis, a t-test was used to examine whether the level of consistency of external auditors was significantly different from the level of consistency of internal auditors. The results of the test are reported in Table 4.5. A t-statistic of .4423 with a p-value of .6597 was not significant at the .05 level.

Given these test results, the first null hypothesis is not rejected, and it may be concluded that no significant differences in consistency levels were found between external and internal auditors in the evaluation of computer controls. Any significant differences found with latter hypotheses thus may be attributed to the variables tested and not to initial differences in consistency levels among the auditors themselves.

Hypothesis 2: Differences in Consensus

H_0: There is no difference in the level of consensus of audit judgments between external and internal EDP auditors.

Consensus in the second hypothesis was defined as the extent of agreement between external and internal auditors. Since there was no objective criterion with which to measure correctness or accuracy of the auditor's evaluation of the computer controls, the level of consensus between auditors was used as a surrogate measure for accuracy (see Ashton [1985]). Therefore, in this hypothesis the level of consensus among external auditors was compared with the level of consensus among internal auditors.

The level of consensus for each individual auditor was calculated using the auditor's evaluation of each of the control areas (separation of functions, program code change controls, and logical and physical security access controls) in all seven cases. Each external auditor's responses were correlated with every other external auditor's responses to all the questions using the Pearson Product Moment Correlation Coefficient (r). A mean level of consensus was then calculated for each external auditor. This procedure was repeated for all internal auditors. Table 4.6 summarizes the frequency distribution of the different levels of consensus for external and internal auditors.

TABLE 4.6
FREQUENCY DISTRIBUTION OF CONSENSUS LEVELS

Level	External		Internal	
	Number	%	Number	%
.55 - 0.60	11	33	3	6
.50 - 0.54	7	22	13	25
.45 - 0.49	6	18	13	25
.40 - 0.44	4	12	10	19
.35 - 0.39	3	9	5	10
.30 - 0.34	2	6	5	10
.25 - 0.29	0	0	3	5
.00 - 0.24	0	0	0	0
Totals	33	100	52	100

The frequency distribution of consensus levels shows that 85% of the sample of external auditors had consensus levels between .40 and .60, while only 75% of the sample of internal auditors fell in this range. On the low side, only 6% of the external auditors were found in the .30 to .34 range while 15% of the internal auditor sample was in this range and lower. Compared to previous research, the range of consensus was much tighter with less dispersion. Ashton [1974] reported a range of consensus of .06 to .93 while Joyce [1976] showed an even greater range of consensus of -.687 to .937.

External and internal auditors were similar in several respects. The highest consensus levels were .60 for external

auditors and .58 for internal auditors. The standard deviations of the consensus level (.0806 for external auditors and .0811 for internal auditors) were also approximately equal. However, the internal auditor group accounted for the lowest level of consensus (.25 versus .32) and a lower mean level of consensus (.44 versus .49) than the external auditor group.

Even though the external auditor group had a higher mean level of consensus than the internal auditor group (.49 versus .44), these levels were low compared with most of the previous research. Ashton and Brown [1980] reported consensus levels of .86. Several other research efforts (Ashton [1974], Gaumnitz et.al. [1982], Hamilton and Wright [1982], Brown [1983], and Bailey [1981]) found consensus levels around .70.

Conversely, the results of this study were higher than consensus levels of .373 and .145 found by Joyce [1976] and Davis and Weber [1983] respectively. With the exception of the Davis and Weber study [1983], it appears the nature of the cases (EDP controls) versus the simplified manual systems used in previous research may have been a contributing factor to the lower consensus levels found by this study.

A t-test compared the consensus level of .49 for external auditors with the .44 consensus level of internal auditors. The results of the test (reported in Table 4.7)

show a t-statistic of 2.8125 with a p-value of .0064 which is significant at the .05 level. Therefore, the null hypothesis is rejected, therefore, significant differences exist in judgment consensus between external and internal auditors.

TABLE 4.7
LEVELS OF CONSENSUS

	low	high	mean	std. dev.	n
External	.32	0.60	.49	.0806	33
Internal	.25	0.58	.44	.0811	52
T statistic		2.8125			
p-value		0.0064 *			

* significant at the .05 level

Hypothesis 3: Consensus and Experience

H_0: There is no difference in the level of consensus of audit judgments between experienced and inexperienced auditors.

Experience has been studied in previous research as a possible factor that may account for differences in the level of consensus among auditors. The premise is that experienced auditors would tend to be more similar (converge) in their judgments than inexperienced auditors. However, there have been mixed findings as to the relationship between experience and consensus. Weber [1980] and Libby [1985] found that

judgment was stronger among more experienced auditors whereas Ashton and Kramer [1980] and Hamilton and Wright [1982] found no significant positive correlations between experience and consensus.

Two definitions of experience were defined in the present study: financial/operational auditing experience and EDP auditing experience.[21] This hypothesis was separately tested for both external auditors and internal auditors.

For the external auditors, Table 4.8 presents the results of the two factor analysis of variance used to examine the third hypothesis. For external auditors, the overall model was not significant although differences in experience levels in EDP auditing may warrent further investigation. No interaction was found for financial/operational auditing experience and level of consensus among external auditors.

The overall model also was not significant for the group of internal auditors as shown in Table 4.8.

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[21] Because of the size of the samples in the analysis of variance computations, some cells contained missing values or a small number of values. In order to insure that the model was properly used, the data were collapsed into two levels rather than the originally planned three levels. The first level included auditors with less than three years of appropriate experience (financial/operational or EDP) and was labeled as "inexperienced". The second level categorized auditors with more than three years of appropriate experience as "experienced" auditors.

TABLE 4.8
EXPERIENCE AND LEVEL OF CONSENSUS

External Auditors Type of Experience	F value	p-value
Overall Model	1.92	.1492
Independent Variables Within Model:		
financial/operational	0.27	.6040
EDP	5.26	.0293
interaction of financial/ operational and EDP	0.21	.6478

Internal Auditors Type of Experience	F value	p-value
Overall Model	0.86	.4702
Independent Variables Within Model:		
financial/operational	0.52	.4737
EDP	0.02	.8789
interaction of financial/ operational and EDP	2.02	.1613

Based on the statistical results presented above, no significant differences were found in the level of consensus as explained by experience for external or internal auditors. In other words, experienced auditors did not tend to have consensus levels higher or lower than inexperienced auditors. Therefore, the null hypothesis was not rejected.

Hypothesis 4: Consensus and Education

H_0: There is no difference in the level of consensus of audit judgments between accounting educated and data processing educated EDP auditors.

The level of consensus and three types of educational background were examined using external and internal auditors. Previous research such as Rittenberg [1977], Weiss [1977], and Perry [1977] discussed educational background and the amount and type of training needed to improve the judgment processes of computer auditors. The three types of educational backgrounds tested in this study were accounting education, data processing education, and continuing professional education (CPE) related to EDP auditing.

Table 4.9 separately presents the results of a three factor analysis of variance model for external and internal auditors. As shown in the table, the overall models for both the external and internal auditors were not significant at the .05 level of significance. Therefore, no significant differences were found in consensus levels as explained by educational background for either group of auditors. However, within the overall model for internal auditors, the interaction of an accounting and data processing background for internal auditors, suggests that further investigation of this interaction may be warrented.

TABLE 4.9
EDUCATION AND LEVEL OF CONSENSUS

External Auditors

Type of Education	F value	p-value
Overall Model	0.85	.5062
Independent Variables Within Model:		
Accounting	0.71	.4050
Data processing	1.84	.1862
CPE	0.03	.8662
interaction of accounting and data processing	-	-
interaction of accounting and CPE	-	-
interaction of data processing and CPE	0.82	.3740
interaction of accounting, data processing, and CPE	-	-

Internal Auditors

Type of Education	F value	p-value
Overall Model	1.92	.0890
Independent Variables Within Model:		
Accounting	0.66	.4197
Data processing	0.03	.8738
CPE	1.35	.2508
interaction of accounting and data processing	10.36	.0024
interaction of accounting and CPE	0.03	.8673
interaction of data processing and CPE	0.45	.5059
interaction of accounting, data processing, and CPE	0.56	.4596

In summary, no apparent relationship was found between type of educational background and the level of consensus for external or internal auditors. In other words, the type of educational background an auditor possesses does not insure that consensus levels will be similar with other auditors of the same educational background. Therefore, the null hypothesis was not rejected for either group of auditors.

Hypothesis 5: Consensus and Management Level

H_o: There is no difference in the level of consensus of audit judgments among auditors in different levels of management.

Hypothesis five examines the relationship between level of consensus and the management level to which each auditor belonged. It was hypothesized that auditors in similar management positions would have similar audit judgments, thus leading to a higher level of consensus.

For the external auditors, management levels were categorized into three levels: staff level auditors, senior auditors, and a combined level of managers and partners. Management levels for internal auditors were also classified three ways: staff auditors (similar to the external auditor classification), supervisory level internal auditors, and department heads.

Table 4.10 displays the results of a single factor analysis of variance relating consensus with management level.

TABLE 4.10
MANAGEMENT LEVEL AND CONSENSUS

External Auditors Management Level	F value	p-value
Overall Model	4.22	.0242
Internal Auditors **Management Level**	**F value**	**p-value**
Overall Model	1.60	.2131

For external auditors the management level of the auditor was significant. However, the ANOVA test only indicates that at least one of the means of the management levels is different from the other levels. It does not show which means significantly differ from each other. The Scheffé Method of Multiple Comparisons Test was applied, with the results shown in Table 4.11.

The lower and upper limits exhibited in the Table 4.11 give a distribution of differences in consensus between the management levels as found in the Scheffe tests. Mean differences equal to zero indicate that consensus between

these management levels is equal. However, based on the results of the Scheffe test, none of the levels were found to be significant at the .05 level of significance. It is possible that the differences in consensus as explained by each level of management may not be large enough to be detected by the Scheffe test.

TABLE 4.11
SCHEFFÉ TEST FOR MANAGEMENT LEVEL DIFFERENCES
FOR EXTERNAL AUDITORS

Management Level	Lower Limit	Upper Limit
junior vs. senior	-0.30388	0.07451
junior vs. manager/partner	-0.34782	0.00918
senior vs. manager/partner	-0.13397	0.02470

Internal auditor results from the single factor analysis of variance model are exhibited in Table 4.10. No difference in consensus can be explained by management level for internal auditors.

To summarize the test results, an association was found between management level and level of consensus for external auditors, thus the null hypothesis was rejected that no differences exist. Conversely since an association between level of management and level of consensus was not found for

the group of internal auditors, the null hypothesis was not rejected for this group.

Hypothesis 6: Ranking Control Questions

H_0: There is no difference in the rankings of the computer controls between external and internal EDP auditors.

For this study, each control area (separation of functions, program code change controls, and logical and physical security access controls) contained six control questions which the auditors ranked from one (most important) to six (least important). The mean ranks of the external auditors were compared against the mean ranks of the internal auditors to see if any differences existed.

Tables 4.12 through 4.14 present the mean ranks and statistical results of the t-tests for separation of function control questions, the program code change control questions, and the logical and physical access security control questions, respectively.

TABLE 4.12
T-TEST OF MEAN RANKS BY EXTERNAL AND INTERNAL AUDITORS
SEPARATION OF FUNCTIONS

1. Is there an adequate separation of operators, programmers, and systems analysts' duties within the data processing department?

External Mean	Internal Mean	t-statistic	p-value
1.909	1.903	0.02	.9837

2. Is there a regular internal audit of the data processing department?

External Mean	Internal Mean	t-statistic	p-value
5.060	4.750	1.09	.2797

3. Does the data processing department have authority to initiate changes on the master files?

External Mean	Internal Mean	t-statistic	p-value
3.061	3.327	-0.75	.4535

4. Does the user review master file changes?

External Mean	Internal Mean	t-statistic	p-value
2.969	2.846	0.35	.7296

5. Is there a separate access control and security function?

External Mean	Internal Mean	t-statistic	p-value
3.515	4.058	-1.64	.1056

6. Is there a separate librarian function whose charge is custody of files, programs, and documentation?

External Mean	Internal Mean	t-statistic	p-value
4.484	4.077	1.43	.1553

TABLE 4.13
T-TEST OF MEAN RANKS BY EXTERNAL AND INTERNAL AUDITORS
PROGRAM CODE CHANGES

1. Are program changes approved before being made?

External Mean	Internal Mean	t-statistic	p-value
2.636	3.538	0.34	.7364

2. Are program changes reviewed by the user?

External Mean	Internal Mean	t-statistic	p-value
3.697	3.865	-0.56	.5758

3. Are operations personnel authorized to make application program changes?

External Mean	Internal Mean	t-statistic	p-value
3.030	3.231	-0.54	.5905

4. Are program changes tested before being used?

External Mean	Internal Mean	t-statistic	p-value
2.152	2.519	-1.48	.1430

5. Is the documentation of the maintenance of applications adequate?

External Mean	Internal Mean	t-statistic	p-value
5.455	4.981	1.75	.0844

6. Is a library control software package used to control source versions and object programs?

External Mean	Internal Mean	t-statistic	p-value
4.030	3.885	0.39	.6962

TABLE 4.14
T-TEST OF MEAN RANKS BY EXTERNAL AND INTERNAL AUDITORS
LOGICAL AND PHYSICAL SECURITY ACCESS CONTROLS

1. Does the data processing librarian keep a record of all data files used?

External Mean	Internal Mean	t-statistic	p-value
5.121	4.539	2.47	.0157

2. Is there a periodic inventory of program libraries and data files?

External Mean	Internal Mean	t-statistic	p-value
5.273	4.904	1.76	.0831

3. Is the physical access to computer facilities restricted?

External Mean	Internal Mean	t-statistic	p-value
4.030	2.558	4.53	.0001

4. Are security codes for logical access to data controlled?

External Mean	Internal Mean	t-statistic	p-value
1.273	1.962	-3.77	.0003

5. Is library control software used to control programs in source and object code, and control test and production versions?

External Mean	Internal Mean	t-statistic	p-value
2.363	3.077	-2.85	.0055

6. Do excessive logical access violations cause users to be disconnected which then require supervisor approval to reconnect?

External Mean	Internal Mean	t-statistic	p-value
2.939	4.019	-4.27	.0001

Table 4.12 and 4.13 show that no significant differences (at the .05 level of significance) in ranking between the external and internal auditors were found for the separation of function control questions and the program change control questions. In addition, neither group consistently rated these particular control questions higher or lower than the other group.

However, Table 4.14 presents the results of the T-tests comparing the mean ranks of the control questions found in the logical and physical security access control area. All the logical and physical security access control questions with the exception of question two, were ranked significantly different by external and internal auditors (at the .05 level of significance).

In summary, the null hypothesis was rejected and the alternate hypothesis accepted that external and internal auditors do rank the control questions differently. However, it is only the logical and physical security access control questions that accounted for differences between these auditors. No differences were found between external and internal auditors concerning the separation of functions and program code change control questions.

Hypothesis 7: Weighting Control Questions

H_0: There is no difference in the weightings of the computer controls between external and internal EDP auditors.

To test hypothesis seven, external and internal auditors were asked to allocate a total of 100 points among the six control questions in each control area. Whereas the previous hypothesis examined differences on an ordinal scale, this hypothesis examined the magnitude of the differences between the ranks based on the allocation of points among the control questions.

This hypothesis tested the mean weights allocated by the auditors using a t-test comparison of the differences. Each control area and question were examined separately. Table 4.15 reports the results of the tests for the separation of functions control questions, Table 4.16 shows the results for the program code change control questions, and Table 4.17 shows the results of the logical and physical access security control questions.

TABLE 4.15
T-TEST OF MEAN WEIGHTS BY EXTERNAL AND INTERNAL AUDITORS SEPARATION OF FUNCTIONS

1. Is there an adequate separation of operators, programmers, and systems analysts' duties within the data processing department?

External Mean	Internal Mean	t-statistic	p-value
27.242	24.600	0.88	.3808

2. Is there a regular internal audit of the data processing department?

External Mean	Internal Mean	t-statistic	p-value
9.667	11.380	-1.36	.1774

3. Does the data processing department have authority to initiate changes on the master files?

External Mean	Internal Mean	t-statistic	p-value
16.576	17.560	-0.57	.5729

4. Does the user review master file changes?

External Mean	Internal Mean	t-statistic	p-value
19.061	21.260	-0.81	.4207

5. Is there a separate access control and security function?

External Mean	Internal Mean	t-statistic	p-value
15.485	12.880	2.04	.0462

6. Is there a separate librarian function whose charge is custody of files, programs, and documentation?

External Mean	Internal Mean	t-statistic	p-value
10.970	12.240	-1.09	.2888

TABLE 4.16
T-TEST OF MEAN WEIGHTS OF EXTERNAL AND INTERNAL AUDITORS PROGRAM CODE CHANGES

1. Are program changes approved before being made?

External Mean	Internal Mean	t-statistic	p-value
19.333	20.060	-0.51	.6111

2. Are program changes reviewed by the user?

External Mean	Internal Mean	t-statistic	p-value
15.909	15.860	0.03	.9785

3. Are operations personnel authorized to make application program changes?

External Mean	Internal Mean	t-statistic	p-value
18.333	17.340	0.46	.6497

4. Are program changes tested before being used?

External Mean	Internal Mean	t-statistic	p-value
22.000	20.740	0.76	.4479

5. Is the documentation of the maintenance of applications adequate?

External Mean	Internal Mean	t-statistic	p-value
9.273	11.020	-1.39	.1695

6. Is a library control software package used to control source versions and object programs?

External Mean	Internal Mean	t-statistic	p-value
15.000	14.980	0.01	.9936

TABLE 4.17
T-TEST OF MEAN WEIGHTS BY EXTERNAL AND INTERNAL AUDITORS
LOGICAL AND PHYSICAL SECURITY ACCESS CONTROLS

1. Does the data processing librarian keep a record of all data files used?

External Mean	Internal Mean	t-statistic	p-value
7.939	10.800	-2.68	.0088

2. Is there a periodic inventory of program libraries and data files?

External Mean	Internal Mean	t-statistic	p-value
7.970	8.860	-1.04	.3011

3. Is the physical access to computer facilities restricted?

External Mean	Internal Mean	t-statistic	p-value
14.485	21.280	-3.64	.0005

4. Are security codes for logical access to data controlled?

External Mean	Internal Mean	t-statistic	p-value
30.121	26.800	1.52	.1324

5. Is library control software used to control programs in source and object code, and control test and production versions?

External Mean	Internal Mean	t-statistic	p-value
21.576	18.720	1.62	.1082

6. Do excessive logical access violations cause users to be disconnected which then require supervisor approval to reconnect?

External Mean	Internal Mean	t-statistic	p-value
17.758	13.560	3.02	.0036

With respect to the separation of functions control questions (Table 4.15), only question five (Is there a separate access control and security function?) showed significant differences in weighting between the two groups of auditors. No significant differences were found in the weighting of the program code change control questions (Table 4.16) between external and internal auditors.

With respect to logical and physical security access controls, however, differences were found in the weighting of these questions. Question one (Does the data processing librarian keep a record of all data files used?), question three (Is the physical access to computer facilities restricted?), and question six (Do excessive logical access violations cause users to be disconnected which then require supervisor approval to reconnect?) showed significant differences in the allocation of the points by the auditors.

In summary, the results of this hypothesis indicate that external and internal auditors may be similar in their perception of importance regarding the separation of functions and program code change control questions. However, just as in hypothesis six, the weighting of the logical and physical security access controls accounted for most of the differences between external and internal auditors. Therefore, the null hypothesis was rejected and it was concluded that differences do exist in the weighting

applied to these control questions between external and internal auditors.

Hypothesis 8: Consensus Between Big Eight Firms

H_o: There is no difference in the level of consensus of audit judgments among auditors in different Big Eight firms.

To test this hypothesis, consensus levels of auditors within the same firm were compared against other auditors in other firms.[23] As Mautz and Sharaf [1961] and others have stated, auditors with the same information should be similar in their judgments concerning that information.

In order to test this hypothesis, a mean level of intra-firm consensus was calculated for each auditor with other auditors in the same firm. The mean consensus levels of one firm's auditors were then compared to the mean levels of other firms. The results from a single factor analysis of variance test are presented in Table 4.18.

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[23] Only four of the Big Eight firms were used in this test. As mentioned previously, in order to encourage response, these firms were told they would remain anonymous. Therefore, they are referred to as Big Eight firms one through four.

TABLE 4.18
EXAMINATION OF CONSENSUS BETWEEN BIG EIGHT FIRMS

Source	F value	p-value
Big Eight firms	4.50	.0122 *

* significant at the .05 level

There were significant differences in the levels of consensus among Big Eight firms. However, the F-value only indicates that the means of the firms are significantly different from each other. It does not show which means differ from each other. In order to determine this, the Scheffé Method of Multiple Comparisons Test was applied, with the results shown in Table 4.19.

TABLE 4.19
SCHEFFÉ TEST FOR BIG EIGHT FIRM DIFFERENCES

Big 8 Firm	Lower Limit	Upper Limit	
#1 vs. #2	-0.38871	0.04117	
#1 vs. #3	-0.14380	0.30478	
#1 vs. #4	-0.17020	0.25969	
#2 vs. #3	0.02320	0.48531	*
#2 vs. #4	-0.00348	0.44050	
#3 vs. #4	-0.26680	0.19531	

* significant differences at the .05 level

Based on Table 4.19, only Big Eight firm #2 was significantly different from Big Eight firm #3 at the .05 level of significance. In addition, comparison of Big Eight firm #2 with the other three firms showed that the chances of consensus levels being equal (i.e. mean differences equal to zero), falls only within the extreme tails of the confidence limits. Looking at the comparison of Big Eight firm #2 with firm #1 shows the upper limit is only 0.04117 while comparison with firm #4 shows the lower limit is only -0.00348. The fact that the value zero falls close to the extreme tails in these two comparisons shows that chances of consensus levels being equal between firms #2 and #1, and #2 and #4 are not probable.

In summary, the null hypothesis that no difference in the level of consensus between Big Eight firms was rejected. Based on this, it is apparent that some differences do exist between Big Eight firms. Much of the difference may be attributed to one firm (#2).

The Discriminant Model Results

Based on previous tests, each auditor had a level of consensus that was statistically derived. Discriminant analysis was then used to develop a model that would correctly classify auditors according to their consensus level (i.e. either high consensus or low consensus).

The results of the forward stepping and jackknife procedures showed that the best model was the two variable model made up of the variables field (external versus internal) and accounting education (low amount of credit hours versus a high amount of credit hours). However, the model only correctly classified auditors as having high or low consensus 57.6% of the time. A chance model would predict 50% of the time. Hair et.al. [1985, p.103] suggest that the model's classification ability should be at least 25% greater than by chance. Therefore, based on the classification ratio, this model was considered to be not significant in its ability to discriminate those auditors with high consensus from those auditors with low consensus.

Chapter Summary

No differences in level of consistency (i.e. the extent of agreement an auditor has with himself over the same material at different points in time) were found between external and internal auditors. However, differences in level of consensus (i.e. the amount of agreement between different auditors over the same material) were found between external and internal auditors. Compared with previous research, levels of consensus in this study were found to be much lower.

It was hypothesized that certain types of audit experience (financial/operational and EDP), education background (accounting and data processing), management level, and the firm to which an external auditor belonged may cause differences in consensus levels among these auditors. Management level and the firm to which an external auditor belonged were found to be significant; education background was only marginally not significant, and type of experience was found not significant.

Ranking and weighting of the individual control questions by external and internal auditors revealed that differences exist between these groups. Accounting for most of the variation between these auditors were the logical and physical access security control questions.

Finally, the discriminant model resulted in a classification rate of only 57.6%. Based on these results, it is apparent that none of the variables tested in the model adequately discriminates those auditors with high consensus from those auditors with a low level of consensus.

CHAPTER 5

SUMMARY AND IMPLICATIONS, LIMITATIONS, SUGGESTIONS FOR FUTURE RESEARCH AND CONCLUSIONS

This study has examined relationships between external auditors and internal auditors concerning their degree of agreement over various EDP auditing cases. Several factors were also tested as possible explanatory variables that may have accounted for differences between and among these auditors. In this chapter, the basis for this study and the findings are summarized and discussed as they may affect the role of the external and internal auditor in the field of EDP auditing.

The Basis for the Study and the Research Question

In the area of internal control for computer-based accounting systems, the roles of the external and internal auditor may overlap. In addition, the external auditor often relies upon the work of the internal auditor. Thus, any differences in judgments between these groups of auditors with respect to evaluation of controls may have a detrimental effect on an EDP audit if one group is relying upon the other group's judgments. Identification of any differences between these auditors thus is important to the quality of future audits.

The primary research question of this study addressed whether there were differences in the level of consensus between external and internal auditors. The level of consensus was examined over several EDP audit cases and the ranking and weighting of specific computer control questions. In addition, experience, education, and management level were examined as possible factors that may contribute to any lack of consensus among each of the groups of auditors.

Summary Results of this Study

This study has examined the audit judgments of external and internal EDP auditors in an EDP audit environment. Some significant differences were found in the audit judgments of the two groups. Study results are summarized below by relevant hypothesis.

Hypothesis One

Einhorn [1974] has shown that one of the necessary conditions for expert status is a high level of consistency. Differences in levels of consistency between external and internal auditors may be a reason for differences in judgments between the groups. The first hypothesis examined whether this necessary condition for expert status was evident for each of the auditors tested.

Based on the statistical tests, the null hypothesis was not rejected. No significant differences in the average levels of consistency were found between external and internal auditors. This finding suggests that a similar level of consistency exists between these groups of auditors. Thus neither group was considered to have more of this characteristic of expertise than the other group in evaluating the computer controls.

Hypothesis Two

The second hypothesis examined the level of consensus between these two groups of auditors concerning their audit judgments in the EDP audit area. The extent of agreement among external auditors was compared with the extent of agreement among internal auditors.

A significant difference in the level of consensus between external and internal auditors was found. The level of agreement was greater among external auditors than among internal auditors. Bailey [1981, p.107] compared the two groups and found similar results. His study showed that internal auditors were found to have a greater variance in their audit judgments than external auditors.

Compared to other previous research which involved only external auditors and more structured tasks (i.e. payroll subsystems, accounts receivable subsystems, etc.), the results of this study suggest more disagreement among

external auditors. The cause for the different results attained by this study may be the nature of the task. Whereas evaluating controls for a payroll or accounts receivable subsystem is relatively structured, this is not so in the evaluation of computer controls.

Hypothesis Three

The third hypothesis separately examined the relationship between experience and consensus within the groups of external and internal auditors. Previous research showed much disparity. Experience was found to be significant in some studies and not significant in others as an explanatory variable in determining consensus. In testing this hypothesis, it was proposed that specific types of experience (i.e. financial/operational audit experience or EDP audit experience) rather than general audit experience would be more appropriate.

In this study, the level of consensus as explained by experience was found to be not significant for both the external and internal auditor groups.

Hypothesis Four

In this hypothesis, the relationships between both type of educational background (accounting and data processing) and continuing education (CPE) in the EDP audit area were

separately compared to the level of consensus among external and internal auditors.

No relationship was found between type of educational background, CPE, and level of consensus for external auditors. Thus, whether an auditor had an accounting background, a data processing background or any amount of CPE in the EDP audit area did not make any difference in the level of consensus.

For internal auditors, no correlation was found between type of education, CPE, and level of consensus. However, a highly significant interaction between accounting education and data processing education was found. It appears that neither accounting education by itself nor data processing education by itself was sufficient to produce similar evaluations among internal auditors, but the interaction of these two disciplines and level of agreement among these auditors was found to be highly related.

Hypothesis Five

The fifth hypothesis analyzed the relationship between management level and level of consensus. The expectation was that judgments of auditors in similar positions would tend to converge.

A significant difference in levels of agreement was found among external auditors in different management positions in their firms. However, no significant

differences in levels of consensus were found among internal auditors in different management positions in their organizations.

Hypothesis Six

Differences in the way external and internal auditors ranked the control area questions were examined by this hypothesis. In two of the three EDP control areas, namely, separation of functions and program code changes, no significant differences were found between the auditor groups, and neither group tended to be consistently lower or consistently higher in its rankings than the other group.

In the area of logical and physical security access controls, however, external and internal auditors ranked significantly different the following control questions:

> #1: Does the data processing librarian keep a record of all data files used?
>
> #3: Is the physical access to computer facilities protected?
>
> #4: Are security codes for logical access to data controlled?
>
> #5: Is library control software used to control programs in source and object code, and control test versions and production versions?
>
> #6: Do logical access violations cause users to be disconnected which then require supervisor approval to reconnect?

Hypothesis Seven

For the seventh hypothesis, the auditors indicated their perceived importance of the control questions. Except for one control question, no significant differences in importance were found between external and internal auditors in the separation of functions and program code changes areas. The only question which was significantly different between the auditors was separation of function control question number five which asked:

> Is there a separate access control and security function?

Similar to the results in hypothesis six, neither external nor internal auditors weighted the control questions in the separation of functions and program code change control areas consistently higher or consistently lower in importance than the other.

In the area of logical and physical security access controls, however, significant differences were found between the auditor groups for the following control questions:

> #1: Does the data processing librarian keep a record of all data files used?
>
> #3: Is the physical access to computer facilities protected?
>
> #6: Do logical access violations cause users to be disconnected which then require supervisor approval to reconnect?

Differences in these control questions suggest that this may represent a potential problem area in the audit process. Should external auditors use some of the internal auditor's work in this control area where differences exist, the quality of the audit may be affected.

Hypothesis Eight

The eighth hypothesis examined whether differences existed in the level of auditor consensus among Big Eight firms. Only one Big Eight firm (of four tested) was found to be significantly different from the other Big Eight firms.

The Discriminant Model

Using a jackknife procedure, a two variable discriminant model consisting of type of auditor and amount of accounting education was the best discriminant model developed. However, this model had a classification rate of only 57.6% which was considered to be only slightly better than a chance classification model. Based upon the results of the discriminant model, none of the factors that were used in the model provided adequate discrimination whereby auditors could be classified as either possessing a high level of consensus or a low level of consensus.

Limitations of the Study

The results of this study should be considered in light of the following limitations:

(1) The design of the survey instrument represents a tradeoff of "realism" and subject fatigue. To simulate the "real world", the instrument would have to include all crucial variables in each of the cases. At the same time, the survey instrument had to be of such a length that auditors would respond to it meaningfully. In satisfying both constraints, perhaps certain key variables were omitted which may have affected the results of this study. However, the final form and variables in the survey instrument were considered only after many discussions with practitioners and several pilot tests.

(2) Computer control evaluations normally include discussions with other EDP auditors. Auditors were asked in this study to make control evaluations on an individual basis. Interaction with fellow auditors thus was not tested, and the possible effect of this interaction is not included in the results of this study.

(3) The survey instruments were individually mailed to a random sample of internal auditors. However, the survey instruments were mailed to specific partners in the Big Eight firms. These individuals then chose a "random sample" of

external auditors who volunteered to participate in this study.

Suggestions for Future Research

The questionnaire approach has been widely used to examine the judgments of auditors. However, several auditors who commented on the instrument stated that its lack of realism may have affected their responses. Others asked about the status of controls which were not identified in the survey instrument. A solution for this would be to incorporate more of these variables and expand the questionnaire. However, unless respondents were to commit beforehand to participate in the study, a mailed questionnaire of this length would probably have a poor response rate.

Another approach would be to use some type of Delphi technique where pre-established groups of (expert) auditors would evaluate the cases. After the cases were evaluated, the auditors would be able to see the responses of other auditors within their group, discuss their answers, and be allowed to change their initial response. This would be repeated until some consensus level was reached for each group of auditors. Comparisons could then be made between the groups. This has an advantage in that audit judgments are usually made under the influence and suggestions of both

peers and superiors and the Delphi approach may best simulate this process.

A possible extension of this study would be to use analysis of covariance procedures in the methodology. This procedure could answer the question of what causes the differences in consensus between external and internal auditors.

Previous consensus studies have shown agreement among and between auditors in structured environments to be moderately high. The only other study to investigate agreement among auditors in an unstructured (EDP) environment found consensus levels which were considerably lower. The results of this study support the lower consensus levels among auditors in unstructured environments. Further research as to why consensus levels are lower needs to be conducted.

Those areas examined in this study where the overall model was not significant but interactions were found, those interactions may warrant further investigation.

Conclusions

In this study, the audit judgments of external and internal auditors were examined to see if differences in judgments existed. The results of this study indicate that some differences in audit judgments exist between these groups of auditors. However, these differences do not

indicate that one group demonstrated any less expertise than the other group. In light of possible overlapping roles and increased reliance on the work of the internal auditor, the audit judgments of external and internal auditors in the EDP audit area need to be similar.

The levels of consensus found for both the external and internal auditors (.49 and .44, respectively) was found to be lower than the consensus levels found by previous consensus studies. For the most part, these other studies reported consensus levels of approximately .70. These other studies, however, involved a structured task and a manual system. The one prior study which addressed the computer audit environment found a lower consensus level (.145) than did this study. It thus appears that the dynamic nature of the computer audit environment and/or the unstructured task involved in this study may be contributing factors to lower consensus levels.

Differences between external and internal auditors in examining controls in a computer-based accounting environment is an issue which should not be ignored. Cooperation between these groups is essential in order to insure quality EDP audits. Consensus between external and internal auditors can provide a strong basis with which to begin this cooperative effort.

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Appendix A

EDP Auditing
A Case Study

You have been randomly selected to take part in an experiment designed to examine the extent of agreement among auditors as to the adequacy of selected EDP controls. The controls being tested are separation of functions, program change controls, and logical and physical security access controls. For each of seven cases, you are provided an internal control questionnaire which has been completed so as to indicate the presence or absence of stated controls. You are simply asked to evaluate the overall adequacy of these controls.

Please note that there are no "incorrect" answers. It is the pattern of responses from all respondents which is the focus of this study. Your answers are very important and will be kept strictly confidential.

A return envelope is enclosed to mail back your response.

If you would like a copy of the results, please fill in your name and address below.

_____

_____

_____

Thank you very much for your time and effort.

Ray Landry
Department of Accounting
College of Business Administration
University of Arkansas
Fayetteville, Arkansas 72701

In order to analyze responses, please fill in the demographic information below:

Position and/or Title _____

Your primary field:

external financial	external EDP	mgmt. consulting	internal financial	internal EDP	other (specify) _____
[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

Years experience in auditing:

	≤3 yrs.	3-10 yrs.	>10 yrs.
financial/operational.....	[ ]	[ ]	[ ]
EDP.....	[ ]	[ ]	[ ]

If in public accounting, your level:

junior [ ] senior [ ] manager [ ] partner [ ] other [ ]_____

If not in public accounting, your level:

staff [ ] supervisor [ ] department head [ ] other [ ]_____

Semester hours taken in the following areas (including all undergraduate and graduate education):

	0-15	16-30	>30
accounting.....	[ ]	[ ]	[ ]
data processing/computer science.....	[ ]	[ ]	[ ]

CPE hours in any EDP audit area taken in the past three years:

0-30 hours	>30 hours
[ ]	[ ]

The number of audit professionals: at your location _____ company wide _____ (est.)

INSTRUCTIONS

Below is information about a hypothetical company (Floppy Disk Company), its data center characteristics, and the audit objectives and scope. There are seven independent cases to be answered. Each case consists of the three sections to be examined - separation of functions, program change controls, and logical and physical security access controls. Each section contains a list of specific controls which have already been answered as "yes" or "no". Following each section of the case, you are to evaluate the strength of the control based upon the pre-answered control checklist. At the end of each case, you are to evaluate the overall strength of all the controls combined.

The last page of this questionnaire contains a list of the controls from each of the sections. On this page you are asked to rank the controls from most important to least important, and allocate 100 points among them.

THE COMPANY

The Floppy Disk Company is a manufacturer of various data storage devices throughout the country. There are several plants located throughout the southwest region of the United States. The company is large enough to qualify for the Fortune 500 list based upon asset size and annual sales.

The corporate headquarters house the administrative offices as well as the centralized data processing activities. In addition, there are separate internal and EDP audit departments within the organization. Floppy Disk Company has a Data Center with the following characteristics:

1. Large mainframe hardware
2. Complex operating system
3. Teleprocessing monitor system
4. Online and batch application systems -

   accounts receivable
   accounts payable
   payroll
   inventory

5. Data Center staffing profile -

   DP manager
   Operations supervisor
   System programmers
   Application system program supervisor

6. Data Center operates 3 shifts/day and 6 days per week

AUDIT OBJECTIVES AND SCOPE

The audit objective is to review and evaluate general controls. The scope of the audit will encompass the following general controls:

1. Organization and management to include separation of functions
2. Program change control (system and application)
3. Security (physical and logical access)

Based on a preliminary review, it is determined that certain controls are in existence as shown on the following pages.

CASE 1 COMPUTER CONTROL QUESTIONNAIRE

Please evaluate each section independent of your answer in the other sections.

Section 1: Separation of Functions

	YES	NO
1. Is there an adequate separation of operators, programmers, and systems analysts' duties within the data processing department?	[✓]	[ ]
2. Is there a regular internal audit of the data processing department?	[✓]	[ ]
3. Does the data processing department have authority to initiate changes on the master files?	[ ]	[✓]
4. Does the user review master files changes?	[ ]	[✓]
5. Is there a separate access control and security function?	[ ]	[✓]
6. Is there a separate librarian function whose charge is custody of files, programs, and documentation?	[✓]	[ ]

Please evaluate the strength of the separation of functions control based upon the responses to the checklist above.

Extremely Weak [ ] [ ] [ ] [ ] [ ] Adequate to Strong [ ]

Section 2: Physical and Logical Security Over Programs and Data

	YES	NO
1. Does the data processing librarian keep a record of all data files used?	[✓]	[ ]
2. Is there a periodic inventory of program libraries and data files?	[✓]	[ ]
3. Is the physical access to computer facilities restricted?	[ ]	[✓]
4. Are security codes for logical access to data controlled?	[ ]	[✓]
5. Is library control software used to control programs in source and object code, and control test and production versions?	[✓]	[ ]
6. Do excessive logical access violations cause users to be disconnected which then require supervisor approval to reconnect?	[✓]	[ ]

Please evaluate the strength of the physical and logical security control based upon the responses to the checklist above.

Extremely Weak [ ] [ ] [ ] [ ] [ ] Adequate to Strong [ ]

Section 3: Program Changes

	YES	NO
1. Are program changes approved before being made?	[✓]	[ ]
2. Are program changes reviewed by the user?	[✓]	[ ]
3. Are operations personnel authorized to make application program changes?	[✓]	[ ]
4. Are program changes tested before being used?	[✓]	[ ]
5. Is the documentation of the maintenance of applications adequate?	[ ]	[✓]
6. Is a library control software package used to control source versions and object programs?	[✓]	[ ]

Please evaluate the strength of the program changes control based upon the responses to the checklist above.

Extremely Weak [ ] [ ] [ ] [ ] [ ] Adequate to Strong [ ]

Please evaluate the overall strength of this case based on the responses to all three sections combined.

Extremely Weak [ ] [ ] [ ] [ ] [ ] Adequate to Strong [ ]

CASE 2 COMPUTER CONTROL QUESTIONNAIRE

Please evaluate each section independent of your answer in the other sections.

Section 1: Physical and Logical Security Over Programs and Data

	YES	NO
1. Is the physical access to computer facilities restricted?	[ ]	[✓]
2. Does the data processing librarian keep a record of all data files used?	[✓]	[ ]
3. Is library control software used to control programs in source and object code, and control test and production versions?	[✓]	[ ]
4. Is there a periodic inventory of program libraries and data files?	[✓]	[ ]
5. Are security codes for logical access to data controlled?	[✓]	[ ]
6. Do excessive logical access violations cause users to be disconnected which then require supervisor approval to reconnect?	[ ]	[✓]

Please evaluate the strength of the physical and logical security control based upon the responses to the checklist above.

Extremely Weak [ ] [ ] [ ] [ ] [ ] Adequate to Strong [ ]

Section 2: Program Changes

	YES	NO
1. Are operations personnel authorized to make application program changes?	[ ]	[✓]
2. Are program changes approved before being made?	[✓]	[ ]
3. Is the documentation of the maintenance of applications adequate?	[ ]	[✓]
4. Are program changes reviewed by the user?	[ ]	[✓]
5. Are program changes tested before being used?	[✓]	[ ]
6. Is a library control software package used to control source versions and object programs?	[✓]	[ ]

Please evaluate the strength of the physical and logical security control based upon the responses to the checklist above.

Extremely Weak [ ] [ ] [ ] [ ] [ ] Adequate to Strong [ ]

Section 3: Separation of Functions

	YES	NO
1. Does the data processing department have authority to initiate changes on the master files?	[✓]	[ ]
2. Is there an adequate separation of operators, programmers, and systems analysts' duties within the data processing department?	[✓]	[ ]
3. Is there a separate access control and security function?	[ ]	[✓]
4. Is there a regular internal audit of the data processing department?	[✓]	[ ]
5. Does the user review master files changes?	[✓]	[ ]
6. Is there a separate librarian function whose charge is custody of files, programs, and documentation?	[✓]	[ ]

Please evaluate the strength of the separation of functions control based upon the responses to the checklist above.

Extremely Weak [ ] [ ] [ ] [ ] [ ] Adequate to Strong [ ]

Please evaluate the overall strength of this case based on the responses to all three sections combined.

Extremely Weak [ ] [ ] [ ] [ ] [ ] Adequate to Strong [ ]

CASE 3 COMPUTER CONTROL QUESTIONNAIRE

Please evaluate each section independent of your answer in the other sections.

Section 1: Program Changes

	YES	NO
1. Is a library control software package used to control source versions and object programs?	[✓]	[ ]
2. Are program changes tested before being used?	[✓]	[ ]
3. Are operations personnel authorized to make application program changes?	[✓]	[ ]
4. Are program changes approved before being made?	[✓]	[ ]
5. Are program changes reviewed by the user?	[✓]	[ ]
6. Is the documentation of the maintenance of applications adequate?	[ ]	[✓]

Please evaluate the strength of the program changes control based upon the responses to the checklist above.

Extremely Weak [ ] [ ] [ ] [ ] [ ] Adequate to Strong [ ]

Section 2: Separation of Functions

	YES	NO
1. Is there a separate librarian function whose charge is custody of files, programs, and documentation?	[✓]	[ ]
2. Does the user review master files changes?	[✓]	[ ]
3. Does the data processing department have authority to initiate changes on the master files?	[✓]	[ ]
4. Is there an adequate separation of operators, programmers, and systems analysts' duties within the data processing department?	[✓]	[ ]
5. Is there a regular internal audit of the data processing department?	[ ]	[✓]
6. Is there a separate access control and security function?	[✓]	[ ]

Please evaluate the strength of the separation of functions control based upon the responses to the checklist above.

Extremely Weak [ ] [ ] [ ] [ ] [ ] Adequate to Strong [ ]

Section 3: Physical and Logical Security Over Programs and Data

	YES	NO
1. Do excessive logical access violations cause users to be disconnected which then require supervisor approval to reconnect?	[✓]	[ ]
2. Are security codes for logical access to data controlled?	[ ]	[✓]
3. Is the physical access to computer facilities restricted?	[✓]	[ ]
4. Does the data processing librarian keep a record of all data files used?	[✓]	[ ]
5. Is there a periodic inventory of program libraries and data files?	[✓]	[ ]
6. Is library control software used to control programs in source and object code, and control test and production versions?	[ ]	[✓]

Please evaluate the strength of the physical and logical security control based upon the responses to the checklist above.

Extremely Weak [ ] [ ] [ ] [ ] [ ] Adequate to Strong [ ]

Please evaluate the overall strength of this case based on the responses to all three sections combined.

Extremely Weak [ ] [ ] [ ] [ ] [ ] Adequate to Strong [ ]

CASE 4 COMPUTER CONTROL QUESTIONNAIRE

Please evaluate each section independent of your answer in the other sections.

Section 1: Physical and Logical Security Over Programs and Data

	YES	NO
1. Is there a periodic inventory of program libraries and data files?	[✓]	[ ]
2. Does the data processing librarian keep a record of all data files used?	[✓]	[ ]
3. Are security codes for logical access to data controlled?	[ ]	[✓]
4. Do excessive logical access violations cause users to be disconnected which then require supervisor approval to reconnect?	[ ]	[✓]
5. Is library control software used to control programs in source and object code, and control test and production versions?	[✓]	[ ]
6. Is the physical access to computer facilities restricted?	[✓]	[ ]

Please evaluate the strength of the physical and logical security control based upon the responses to the checklist above.

Extremely Weak [ ] [ ] [ ] [ ] [ ] Adequate to Strong [ ]

Section 2: Separation of Functions

	YES	NO
1. Is there a regular internal audit of the data processing department?	[✓]	[ ]
2. Is there an adequate separation of operators, programmers, and systems analysts' duties within the data processing department?	[✓]	[ ]
3. Does the user review master files changes?	[✓]	[ ]
4. Is there a separate librarian function whose charge is custody of files, programs, and documentation?	[ ]	[✓]
5. Is there a separate access control and security function?	[ ]	[✓]
6. Does the data processing department have authority to initiate changes on the master files?	[ ]	[✓]

Please evaluate the strength of the separation of functions control based upon the responses to the checklist above.

Extremely Weak [ ] [ ] [ ] [ ] [ ] Adequate to Strong [ ]

Section 3: Program Changes

	YES	NO
1. Are program changes reviewed by the user?	[✓]	[ ]
2. Are program changes approved before being made?	[✓]	[ ]
3. Are program changes tested before being used?	[ ]	[✓]
4. Is a library control software package used to control source versions and object programs?	[✓]	[ ]
5. Is the documentation of the maintenance of applications adequate?	[ ]	[✓]
6. Are operations personnel authorized to make application program changes?	[ ]	[✓]

Please evaluate the strength of the program changes control based upon the responses to the checklist above.

Extremely Weak [ ] [ ] [ ] [ ] [ ] Adequate to Strong [ ]

Please evaluate the overall strength of this case based on the responses to all three sections combined.

Extremely Weak [ ] [ ] [ ] [ ] [ ] Adequate to Strong [ ]

CASE 5 COMPUTER CONTROL QUESTIONNAIRE

Please evaluate each section independent of your answer in the other sections.

Section 1: Program Changes

	YES	NO
1. Are program changes tested before being used?	[ ]	[✓]
2. Are operations personnel authorized to make application program changes?	[ ]	[✓]
3. Is a library control software package used to control source versions and object programs?	[✓]	[ ]
4. Are program changes approved before being made?	[✓]	[ ]
5. Are program changes reviewed by the user?	[ ]	[✓]
6. Is the documentation of the maintenance of applications adequate?	[✓]	[ ]

Please evaluate the strength of the program changes control based upon the responses to the checklist above.

Extremely Weak [ ] [ ] [ ] [ ] [ ] Adequate to Strong [ ]

Section 2: Physical and Logical Security Over Programs and Data

	YES	NO
1. Are security codes for logical access to data controlled?	[✓]	[ ]
2. Is the physical access to computer facilities protected?	[ ]	[✓]
3. Do excessive logical access violations cause users to be disconnected which then require supervisor approval to reconnect?	[✓]	[ ]
4. Does the data processing librarian keep a record of all data files used?	[✓]	[ ]
5. Is there a periodic inventory of program libraries and data files?	[✓]	[ ]
6. Is library control software used to control programs in source and object code, and control test and production versions?	[ ]	[✓]

Please evaluate the strength of the physical and logical security control based upon the responses to the checklist above.

Extremely Weak [ ] [ ] [ ] [ ] [ ] Adequate to Strong [ ]

Section 3: Separation of Functions

	YES	NO
1. Does the user review master files changes?	[✓]	[ ]
2. Does the data processing department have authority to initiate changes on the master files?	[✓]	[ ]
3. Is there a separate librarian function whose charge is custody of files, programs, and documentation?	[ ]	[✓]
4. Is there an adequate separation of operators, programmers, and systems analysts' duties within the data processing department?	[✓]	[ ]
5. Is there a regular internal audit of the data processing department?	[✓]	[ ]
6. Is there a separate access control and security function?	[✓]	[ ]

Please evaluate the strength of the separation of functions control based upon the responses to the checklist above.

Extremely Weak [ ] [ ] [ ] [ ] [ ] Adequate to Strong [ ]

Please evaluate the overall strength of this case based on the responses to all three sections combined.

Extremely Weak [ ] [ ] [ ] [ ] [ ] Adequate to Strong [ ]

CASE 6 COMPUTER CONTROL QUESTIONNAIRE

Please evaluate each section independent of your answer in the other sections.

Section 1: Separation of Functions

	YES	NO
1. Is there an adequate separation of operators, programmers, and systems analysts' duties within the data processing department?	[✓]	[ ]
2. Does the data processing department have authority to initiate changes on the master files?	[✓]	[ ]
3. Does the user review master files changes?	[✓]	[ ]
4. Is there a regular internal audit of the data processing department?	[✓]	[ ]
5. Is there a separate access control and security function?	[ ]	[✓]
6. Is there a separate librarian function whose charge is custody of files, programs, and documentation?	[✓]	[ ]

Please evaluate the strength of the separation of functions control based upon the responses to the checklist above.

Extremely Weak [ ] [ ] [ ] [ ] [ ] Adequate to Strong [ ]

Section 2: Program Changes

	YES	NO
1. Are program changes approved before being made?	[✓]	[ ]
2. Are operations personnel authorized to make application program changes?	[ ]	[✓]
3. Are program changes tested before being used?	[✓]	[ ]
4. Are program changes reviewed by the user?	[✓]	[ ]
5. Is the documentation of the maintenance of applications adequate?	[ ]	[✓]
6. Is a library control software package used to control source versions and object programs?	[ ]	[✓]

Please evaluate the strength of the program changes control based upon the responses to the checklist above.

Extremely Weak [ ] [ ] [ ] [ ] [ ] Adequate to Strong [ ]

Section 3: Physical and Logical Security Over Programs and Data

	YES	NO
1. Does the data processing librarian keep a record of all data files used?	[ ]	[✓]
2. Is the physical access to computer facilities restricted?	[✓]	[ ]
3. Are security codes for logical access to data controlled?	[✓]	[ ]
4. Is there a periodic inventory of program libraries and data files?	[✓]	[ ]
5. Is library control software used to control programs in source and object code, and control test and production versions?	[✓]	[ ]
6. Do excessive logical access violations cause users to be disconnected which then require supervisor approval to reconnect?	[ ]	[✓]

Please evaluate the strength of the physical and logical security control based upon the responses to the checklist above.

Extremely Weak [ ] [ ] [ ] [ ] [ ] Adequate to Strong [ ]

Please evaluate the overall strength of this case based on the responses to all three sections combined.

Extremely Weak [ ] [ ] [ ] [ ] [ ] Adequate to Strong [ ]

CASE 7 COMPUTER CONTROL QUESTIONNAIRE

Please evaluate each section independent of your answer in the other sections.

Section 1: Physical and Logical Security Over Programs and Data

	YES	NO
1. Do excessive logical access violations cause users to be disconnected which then require supervisor approval to reconnect?	[✓]	[ ]
2. Is library control software used to control programs in source and object code, and control test and production versions?	[✓]	[ ]
3. Does the data processing librarian keep a record of all data files used?	[✓]	[ ]
4. Is the physical access to computer facilities restricted?	[ ]	[✓]
5. Is there a periodic inventory of program libraries and data files?	[✓]	[ ]
6. Are security codes for logical access to data controlled?	[ ]	[✓]

Please evaluate the strength of the physical and logical security control based upon the responses to the checklist above.

Extremely Weak [ ] [ ] [ ] [ ] [ ] Adequate to Strong [ ]

Section 2: Program Changes

	YES	NO
1. Is a library control software package used to control source versions and object programs?	[✓]	[ ]
2. Is the documentation of the maintenance of applications adequate?	[ ]	[✓]
3. Are program changes approved before being made?	[✓]	[ ]
4. Are operations personnel authorized to make application program changes?	[ ]	[✓]
5. Are program changes reviewed by the user?	[ ]	[✓]
6. Are program changes tested before being used?	[✓]	[ ]

Please evaluate the strength of the program changes control based upon the responses to the checklist above.

Extremely Weak [ ] [ ] [ ] [ ] [ ] Adequate to Strong [ ]

Section 3: Separation of Functions

	YES	NO
1. Is there a separate librarian function whose charge is custody of files, programs, and documentation?	[✓]	[ ]
2. Is there a separate access control and security function?	[ ]	[✓]
3. Is there an adequate separation of operators, programmers, and systems analysts' duties within the data processing department?	[✓]	[ ]
4. Does the data processing department have authority to initiate changes on the master files?	[ ]	[✓]
5. Is there a regular internal audit of the data processing department?	[ ]	[✓]
6. Does the user review master files changes?	[✓]	[ ]

Please evaluate the strength of the separation of functions control based upon the responses to the checklist above.

Extremely Weak [ ] [ ] [ ] [ ] [ ] Adequate to Strong [ ]

Please evaluate the overall strength of this case based on the responses to all three sections combined.

Extremely Weak [ ] [ ] [ ] [ ] [ ] Adequate to Strong [ ]

COMPUTER CONTROL RANKS AND WEIGHTING

In the first column, please rank the controls in each section using the numbers 1-6 where "1" is most important and "6" is least important.

In the second column, for each section please allocate 100 points among the six controls to indicate your perceived weighting of the importance of each control.

Separation of Functions

	Rank	Points
1. Is there adequate separation of operators, programmers, and systems analysts' duties within the data processing department?	____	____
2. Is there a regular internal audit of the data processing department?	____	____
3. Does the data processing department have authority to initiate changes on the master files?	____	____
4. Does the user review master file changes?	____	____
5. Is there a separate access control and security function?	____	____
6. Is there a separate librarian function whose charge is custody of files, programs, and documentation?	____	____

Program Change Controls

	Rank	Points
1. Are program changes approved before being made?	____	____
2. Are program changes reviewed by the user?	____	____
3. The operations personnel are not authorized to make application program changes.	____	____
4. Are program changes tested before being used?	____	____
5. Is the documentation of the maintenance of applications adequate?	____	____
6. Is a library control software package used to control source program versions and object programs?	____	____

Security Over Programs and Data

	Rank	Points
1. Does the data processing librarian keep a record of all data files used?	____	____
2. Is there a periodic inventory of program libraries and data files?	____	____
3. Is the physical access to computer facilities protected?	____	____
4. Are security codes for logical access to data controlled?	____	____
5. Is library control software used to control programs in source and object code, and control test versions and production versions?	____	____
6. Do logical access violations cause users to be disconnected which then require supervisor approval to reconnect?	____	____

Please use this page for any comments you may have.

Appendix B

UNIVERSITY OF CENTRAL FLORIDA

SCHOOL OF ACCOUNTING COLLEGE OF BUSINESS ADMINISTRATION

ORLANDO, FLORIDA 32816-0991 (305) 275-2463

We are currently conducting research that investigates the degree of agreement among EDP auditors. We are asking permission to use several of your EDP auditors (or computer audit specialists) to answer a questionnaire which should take less than one hour to complete. Our intent is to seek EDP auditor participation from all of the Big Eight firms.

Specifically, we would like to have about ten EDP auditors or specialists from your firm individually complete our questionnaire. All results will be anonymous, and neither the individual nor the firm will be identified.

We would like to mail ten questionnaires for you to forward to these individuals. If you will help us in this way, please sign and return the attached copy of this letter. If there is someone else to whom we should send this material, please indicate this.

Your participation in this study is very important and will be greatly appreciated.

Thank you very much.

Sincerely,

Gary L. Holstrum
Professor

Raymond Landry Jr.
Assistant Professor

(Signed)
Comments:

UNIVERSITY OF CENTRAL FLORIDA

SCHOOL OF ACCOUNTING — COLLEGE OF BUSINESS ADMINISTRATION

ORLANDO, FLORIDA 32816—0991 (305) 275-2871

October 20, 1986

Dear Sir:

The EDP Auditor's Association is supporting research that is part of my doctoral dissertation and is intended to be helpful to EDP auditors. This research examines the extent of agreement among different types of EDP auditors. You have been selected to participate in this study as a member of the association. The results of this study will be published in a future issue of The EDP Auditor's Journal.

If you are willing to participate, a questionnaire will be mailed to you. The questionnaire should take less than one hour to complete, and your answers will be held in the strictest confidence.

Please indicate your willingness to take part in this study by signing your name on the enclosed copy of this letter and writing the address where you would like to receive the questionnaire.

Thank you very much.

Sincerely,

Raymond Landry Jr.

Raymond Landry Jr.
Assistant Professor

____
(Signed)

Address:

____

____

____

UNIVERSITY OF CENTRAL FLORIDA

SCHOOL OF ACCOUNTING COLLEGE OF BUSINESS ADMINISTRATION

ORLANDO, FLORIDA 32816-0991 (305) 275-2463

Thank you very much for assisting us and taking part in this study. Your participation was very important.

As soon as we have processed and analyzed the data, we will send you a copy of the final results.

Thanks again for your help with this study.

Sincerely,

Gary L. Holstrum
Professor

Raymond Landry Jr.
Assistant Professor

Appendix C

RESPONSE DISTRIBUTION TO CASES
EXTERNAL AUDITORS

CASE	Extremely Weak 1	2	3	4	5	Adequate to Strong 6
1.1*	1	3	6	13	9	1
1.2	5	8	8	7	4	1
1.3	1	7	7	7	10	1
1.4	2	6	10	10	5	0
2.1	0	5	3	11	13	1
2.2	1	3	13	10	5	1
2.3	2	3	8	8	11	1
2.4	1	2	9	15	6	0
3.1	1	5	7	6	11	3
3.2	1	1	5	10	11	5
3.3	4	13	11	3	2	0
3.4	2	6	12	10	2	1
4.1	2	14	7	9	1	0
4.2	1	3	6	12	10	1
4.3	5	11	9	7	1	0
4.4	3	7	13	8	2	0
5.1	8	12	6	6	1	0
5.2	1	5	10	10	6	1
5.3	1	0	5	7	17	3
5.4	2	6	12	11	2	0
6.1	1	2	6	8	12	4
6.2	0	3	10	11	7	2
6.3	0	0	7	13	12	1
6.4	0	1	7	14	11	0
7.1	4	12	6	6	4	1
7.2	2	5	9	11	5	1
7.3	1	2	5	14	9	2
7.4	3	2	12	10	5	1

* n.1 - n.3 are the three computer areas within each case, namely, separation of functions, program code change controls, and logical and physical security access controls. n.4 is the overall control evaluation.

Appendix D

RESPONSE DISTRIBUTION TO CASES
INTERNAL AUDITORS

CASE	Extremely Weak 1	2	3	4	5	Adequate to Strong 6
1.1*	4	5	8	17	16	2
1.2	12	17	14	7	1	1
1.3	5	10	11	13	12	1
1.4	4	13	15	19	1	0
2.1	5	9	16	11	9	2
2.2	4	9	9	20	8	2
2.3	5	5	11	18	12	1
2.4	6	6	15	18	6	1
3.1	4	6	10	17	12	3
3.2	2	10	10	12	13	5
3.3	13	13	15	8	3	0
3.4	7	12	14	15	4	0
4.1	7	13	18	10	3	1
4.2	0	7	8	21	14	2
4.3	13	10	13	10	5	1
4.4	7	12	18	12	3	0
5.1	13	15	10	10	4	0
5.2	9	13	16	11	3	0
5.3	4	9	9	17	12	1
5.4	10	10	18	13	1	0
6.1	2	8	13	13	13	3
6.2	2	9	11	14	13	3
6.3	0	6	5	23	14	4
6.4	1	6	14	17	13	1
7.1	11	11	21	8	0	1
7.2	3	9	11	19	8	2
7.3	2	6	9	19	10	6
7.4	4	12	17	15	3	1

* n.1 - n.3 are the three computer areas within each case, namely, separation of functions, program code change controls, and logical and physical security access controls. n.4 is the overall control evaluation.

Appendix E

DISTRIBUTION OF RANKS BY AUDITORS TO CONTROL QUESTIONS SEPARATION OF FUNCTIONS

1. Is there an adequate separation of operators, programmers, and systems analysts' duties within the data processing department?

	1	2	3	4	5	6
external auditors.....	15	9	7	1	1	0
internal auditors.....	30	9	5	4	4	0

2. Is there a regular internal audit of the data processing department?

	1	2	3	4	5	6
external auditors.....	0	2	1	6	8	16
internal auditors.....	1	4	6	9	8	24

3. Does the data processing department have authority to initiate changes on the master files?

	1	2	3	4	5	6
external auditors.....	6	9	4	7	5	2
internal auditors.....	6	14	11	7	6	8

4. Does the user review master file changes?

	1	2	3	4	5	6
external auditors.....	8	5	9	5	3	3
internal auditors.....	13	12	11	8	2	6

5. Is there a separate access control and security function?

	1	2	3	4	5	6
external auditors.....	4	5	8	6	6	4
internal auditors.....	1	7	11	9	17	7

6. Is there a separate librarian function whose charge is custody of files, programs, and documentation?

	1	2	3	4	5	6
external auditors.....	0	3	4	8	10	8
internal auditors.....	1	7	8	14	15	7

Appendix F

DISTRIBUTION OF RANKS BY AUDITORS TO CONTROL QUESTIONS PROGRAM CODES CHANGES

1. Are program changes approved before being made?

	1	2	3	4	5	6
external auditors.....	5	12	11	2	1	1
internal auditors.....	14	14	12	8	2	2

2. Are program changes reviewed by the user?

	1	2	3	4	5	6
external auditors.....	1	6	8	7	9	2
internal auditors.....	5	3	9	18	11	6

3. Are operations personnel authorized to make application program changes?

	1	2	3	4	5	6
external auditors.....	10	3	5	8	5	2
internal auditors.....	11	8	10	10	7	6

4. Are program changes tested before being used?

	1	2	3	4	5	6
external auditors.....	12	11	3	7	0	0
internal auditors.....	7	22	16	3	4	0

5. Is the documentation of the maintenance of applications adequate?

	1	2	3	4	5	6
external auditors.....	0	1	3	0	5	24
internal auditors.....	2	4	0	6	15	25

6. Is a library control software package used to control source versions and object programs?

	1	2	3	4	5	6
external auditors.....	5	0	3	9	13	3
internal auditors.....	13	0	5	8	14	12

Appendix G

DISTRIBUTION OF RANKS BY AUDITORS TO CONTROL QUESTIONS LOGICAL AND PHYSICAL SECURITY ACCESS CONTROLS

1. Does the data processing librarian keep a record of all data files used?

	1	2	3	4	5	6
external auditors.....	0	0	0	8	13	12
internal auditors.....	2	3	7	8	17	15

2. Is there a periodic inventory of program libraries and data files?

	1	2	3	4	5	6
external auditors.....	0	0	2	2	14	15
internal auditors.....	0	2	4	9	19	18

3. Is the physical access to computer facilities restricted?

	1	2	3	4	5	6
external auditors.....	2	2	6	12	5	6
internal auditors.....	19	10	8	8	4	3

4. Are security codes for logical access to data controlled?

	1	2	3	4	5	6
external auditors.....	26	5	2	0	0	0
internal auditors.....	20	23	2	6	0	1

5. Is library control software used to control programs in source and object code, and control test and production versions?

	1	2	3	4	5	6
external auditors.....	3	19	7	4	0	0
internal auditors.....	9	9	16	10	3	5

6. Do excessive logical access violations cause users to be disconnected which then require supervisor approval to reconnect?

	1	2	3	4	5	6
external auditors.....	2	7	16	7	1	0
internal auditors.....	2	5	14	11	9	11

Appendix H

AVERAGE WEIGHTING OF CONTROL QUESTIONS
SEPARATION OF FUNCTIONS

	External Auditor	Internal Auditor
1. Is there an adequate separation of operators, programmers, and systems analysts' duties within the data processing department?	26.94	24.26
2. Is there a regular internal audit of the data processing department?	9.76	12.08
3. Does the data processing department have authority to initiate changes on the master files?	17.18	16.86
4. Does the user review master file changes?	18.91	21.96
5. Is there a separate access control and security function?	16.39	12.88
6. Is there a separate librarian function whose charge is custody of files, programs, and documentation?	10.82	12.24

Appendix I

AVERAGE WEIGHTING OF CONTROL QUESTIONS
PROGRAM CODE CHANGES

	External Auditor	Internal Auditor
1. Are program changes approved before being made?	19.18	19.76
2. Are program changes reviewed by the user?	15.42	15.96
3. Are operations personnel authorized to make application program changes?	18.94	17.14
4. Are program changes tested before being used?	22.00	20.94
5. Is the documentation of the maintenance of applications adequate?	9.15	11.22
6. Is a library control software package used to control source versions and object programs?	15.15	14.98

Appendix J

AVERAGE WEIGHTING OF CONTROL QUESTIONS
PHYSICAL AND LOGICAL SECURITY ACCESS

	External Auditor	Internal Auditor
1. Does the data processing librarian keep a record of all data files used?...	7.67	10.80
2. Is there a periodic inventory of program libraries and data files?.....	7.79	8.86
3. Is the physical access to computer facilities restricted?.....	14.18	21.28
4. Are security codes for logical access to data controlled?.....	30.27	27.34
5. Is library control software used to control programs in source and object code, and control test and production versions?.....	21.58	18.72
6. Do excessive logical access violations cause users to be disconnected which then require supervisor approval to reconnect?.....	18.36	13.66

Appendix K

FACTOR LOADINGS				
Separation of of Functions	Factor 1	Factor 2	Factor 3	Factor 4
Case 1	-.03283	.09394	.06770	.11243
Case 2	.43992	.21824	.35192	-.07624
Case 3	.82260	.14016	-.02436	.17687
Case 4	.03058	.00752	.39496	.18614
Case 5	.71908	.22770	-.13116	.32780
Case 6	.52845	.21555	-.07005	.29345
Case 7	.07140	.07654	.09896	.18707
Physical and Logical Security				
Case 1	.18983	.80289	.04379	.04013
Case 2	.14131	.29837	.06585	.36446
Case 3	.31814	.56678	.28605	.49257
Case 4	.23777	.46163	.49875	.16820
Case 5	.43331	.33214	-.00476	.60664
Case 6	-.02312	.01344	.37934	.55900
Case 7	.30693	.76485	.07353	.24289
Program Change Controls				
Case 1	.74333	.22025	.21356	.09800
Case 2	.31806	.13643	.50850	.01299
Case 3	.72082	.16327	.37611	.18855
Case 4	.07806	.15826	.68099	.24141
Case 5	.01770	-.05982	.73586	.29411
Case 6	.23630	-.00344	.16333	.76743
Case 7	.25475	.16045	.42443	-.18172
Overall Evaluation				
Case 1	.41462	.65533	.21728	.01839
Case 2	.22993	.25245	.41396	.18736
Case 3	.66316	.45913	.25783	.27084
Case 4	.17226	.38060	.74678	.21167
Case 5	.46040	.27952	.29000	.54887
Case 6	.26905	.15074	.26137	.75174
Case 7	.23780	.54938	.27494	.01111

Appendix L

VARIANCE OF MODEL ACCOUNTED FOR BY FACTORS

Factor	Variance	Total Variance
1	41.07%	41.07%
2	8.81%	49.88%
3	6.56%	56.44%
4	5.78%	62.22%

AN EMPIRICAL INVESTIGATION OF EDP AUDIT JUDGMENTS AND CONSENSUS BETWEEN EXTERNAL AND INTERNAL AUDIT EXPERTS

Abstract of dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy

By

RAYMOND M. LANDRY JR.
B.S. Clemson University, 1975
M.B.A. The Citadel, 1981

August 1987
University of Arkansas

This abstract is approved by:

William C. Letzkus

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ABSTRACT

Within a computerized environment, traditional audit goals must be maintained. However, how these controls are implemented and evaluated is different than in a manual accounting system. To evaluate these computer controls requires a new type of auditor - a computer audit specialist (external) and EDP auditor (internal). In such a crucial area as computer controls, agreement between (consensus) and among (consistency) these auditors concerning computer controls is necessary to ensure the quality of the audit.

The evaluation of computer controls is subject to the judgment of the auditor. This study examined whether differences in consensus between external and internal auditors existed in the evaluation of computer controls. Auditors were asked to evaluate computer controls in three areas -separation of functions controls, program code change controls, and logical and physical security access controls.

The results of this study showed that neither group of auditors were more consistent in their judgments than the other group. However, the group of external auditors had greater consensus among themselves than the group of internal auditors.

Several variables were examined as possible explanatory factors that would account for the particular level of consensus within each of the auditor groups. For external auditors, differences in the level of consensus were explained by the auditor's management level. In addition, consensus level differences among external auditors were also attributed to the particular Big Eight firm to which an auditor belonged. For internal auditors, differences in consensus levels within the internal auditor group could not be attributed to experience, education background or management level.

Auditors were also asked to rank and weight the control questions within the questionnaire. Significant differences between external and internal auditors were found primarily in the logical and physical access control questions.

Previous studies have found higher consistency and consensus levels than this study. The nature of the task (evaluation of computer controls versus evaluation of a payroll or accounts receivable subsystem), may account for the lower consistency and consensus levels.

In conclusion, this study found that some differences exist between external and internal auditors in the evaluation of computer controls. In light of the "single audit" concept and increased reliance on the work of internal auditors, agreement among these auditors is important to ensure the quality of future EDP auditing.