

**The Effects of Computer Assurance Specialist Competence and Auditor Accounting  
Information System Expertise on Auditor Planning Judgments**

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## **Dedications**

To my wife Kyla, whose constant love, strength, and support provide me with the courage to do things I am afraid to do.

It was a high counsel that I once heard given to a young person, ‘Always do what you are afraid to do.’

Ralph Waldo Emerson (1803-1882)

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**ABSTRACT**

The Effects of Computer Assurance Specialist Competence and Auditor Accounting Information System Expertise on Auditor Planning Judgments

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Christopher P. Agoglia, Ph.D.

While auditors' interactions with complex accounting information systems (AIS) and computer assurance specialists (CAS) play a critical role in determining audit quality (POB 2000), little prior research has examined these topics. This study investigates the effects of CAS competence and auditor AIS expertise on auditor planning judgments in a complex AIS environment. The audit literature has typically examined auditors' evaluations of evidence provided by sources with expertise structures similar to their own. However, the natural variation in knowledge structures that occurs between CAS and auditors likely results in a more complex relationship than those previously examined.

Auditors were given a quasi-experimental case where the competence of the CAS was manipulated as high and low between auditors and auditor AIS expertise was measured. The case required auditors to evaluate evidence related to the audit of a complex AIS client to which a CAS had been assigned, assess current year inherent and control risks, and plan the nature, timing, and extent of substantive procedures for a transaction cycle.

Results indicate that auditors with higher AIS expertise assessed both inherent and controls risks at higher levels and designed corresponding substantive tests that were greater in scope to mitigate those risks. For high AIS expertise auditors, both the quality of their risk assessments and the effectiveness of their scope of tests exceeded those of

low AIS expertise auditors. Auditors were also sensitive to the reliability of CAS as an evidence source and assessed control risk higher when provided with control testing evidence from a CAS with low competence. When planning substantive procedures, auditors' AIS expertise levels moderated their reaction to CAS competence. Specifically, under conditions of low CAS competence, auditors with higher AIS expertise expanded the scope of their audit testing beyond the scope designed by auditors with lower AIS expertise. No such AIS expertise effect occurred under conditions of high CAS competence. These results suggest that auditor AIS expertise can play a significant role in complex AIS environments and in their ability to compensate for potential CAS competence deficiencies by increasing the scope of substantive tests.



## CHAPTER 1: INTRODUCTION

### 1.1 Introduction

The American Institute of Certified Public Accountants (AICPA) has recently stated that financial statement auditors need to change their audit strategies in reaction to the all-encompassing changes in information technology (IT) at their clients (AICPA 2001). IT applications, such as Enterprise Resource Planning (ERP) systems, have significantly changed the way companies operate their businesses. These complex and pervasive IT systems have allowed companies to better manage supply chains, perform business process reengineering, and re-organize their accounting processes along with providing numerous other functions (Brown 1997; Moore and Warrick 1998; Scheer and Habermann 2000). Changes brought about by ERP systems have also affected the ways in which auditors perform their duties (Helms 1999; POB 2000). For example, the implementation and utilization of ERP systems at many major corporations has increased audit-related risks such as business interruption, database security, process interdependency, and overall control risk (Hunton et al. 2001).

The significant effect of IT advancements on the audit profession is evident in the release of two auditing standards that address the impact of technology on the audit. Statement on Auditing Standards (SAS) No. 80 (AICPA 1996) suggests that, with respect to clients that process a significant portion of their transactions electronically, auditors may not be able to reduce audit risk to an appropriate level via additional substantive procedures and may need to perform more control testing. SAS No. 94 (AICPA 2001) indicates that, in computer intensive environments, auditors should assign one or more

computer assurance specialists (CAS) to the engagement in order to appropriately determine the effect of IT on the audit, gain an understanding of controls, and design and perform tests of IT controls. Clearly, the increased complexities and pervasiveness of IT should affect auditor planning (e.g., the application of the audit risk model) and increase the role of CAS as a source of evidence within the audit engagement team.

As technological developments continue, auditors will need to expand their technological knowledge and skills in order to perform effective and efficient audits (POB 2000; Kinney 2001). Recent research has shown that (a) auditors are not apt to recognize the heightened inherent and control risks present in ERP environments, and (b) there is an accounting information system (AIS) expertise gap between auditors and CAS (Hunton et al. 2001). Therefore, auditors' AIS expertise levels may affect their planning judgments<sup>1</sup> and their ability to appropriately evaluate the audit evidence provided by CAS.

## **1.2 Purpose of the Study and Proposed Research Questions**

Expertise in the AIS domain may make auditors more cognizant of AIS-specific risks (Hunton et al. 2001) and provide them with the sophisticated audit skills required in such settings (Lilly 1997). This study investigates whether variation in auditors' AIS expertise affects their ability to recognize inherent and control risks associated with

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<sup>1</sup> For the purposes of this paper, audit "judgments" will refer to evaluations/assessments of the current state of affairs or the forming of an opinion. Audit "decisions" will be defined as conclusions drawn with respect to the issue at hand and the resulting action to be taken (Bonner 1999; Peecher and Solomon 2001). For example, assessments of inherent and control risks represent judgments, and the determination of the scope of substantive procedures (i.e., audit budgets and programs) denotes a decision. For the purposes of simplicity, when discussing the audit planning process in its entirety, the word "judgment" will be used to describe all judgments and decisions present in the process.

complex AIS. In addition, while CAS are expected to be an increasing source of evidence for auditors in these complex and pervasive AIS environments (AICPA 2001), prior research has not examined the CAS/auditor relationship. More importantly, prior studies have typically investigated scenarios where the source of audit evidence maintained a similar expertise structure as the auditor (e.g., audit staff, internal auditors, client accounting staff). Auditors and CAS typically have different expertise structures (Curtis and Viator 2000; Hunton et al. 2001), and these differences could make judgments related to CAS evidence difficult for auditors. For example, while auditors are typically able to compensate for low levels of subordinate auditor competence by employing additional procedures themselves, auditors with limited AIS expertise may not have the knowledge structure to compensate for low CAS competence levels. Therefore, the purpose of this study is to examine how auditor AIS expertise and CAS competence affect auditor planning judgments in a complex AIS environment. Specifically, the study is designed to address the following research questions:

1. In complex AIS environments, does the level of auditor AIS expertise affect the form and effectiveness of auditor planning judgments?
2. Does the level of CAS competence affect auditor evaluations of CAS evidence reliability and related auditor judgment processes?
3. When confronted with CAS competence deficiencies, does the level of auditor AIS expertise affect the form of auditor planning judgments?

### **1.3 The Audit Risk Model**

SAS No. 47 (AICPA 1983) provides the conceptual underpinning for the audit risk model, and its concepts permeate Generally Accepted Auditing Standards (GAAS) (POB 2000). The auditor applies the audit risk model during the planning phase of the audit by making judgments concerning client risks and the scope of audit tests. Audit risk

(AR) is the risk that the auditor may unknowingly fail to appropriately modify his or her opinion on financial statements that are materially misstated. Audit risk is the product of the following interrelated factors:

Inherent Risk (IR) = the risk that a financial statement assertion is susceptible to a material misstatement, assuming there are no related controls

Control Risk (CR) = the risk that the entity's internal control structure or procedures will not prevent or detect, in a timely manner, a material misstatement which could occur in a financial statement assertion

Detection Risk (DR) = the risk that the auditor will not detect a material misstatement that exists in a financial statement assertion

Thus, the mathematical depiction of the model is  $AR = IR \times CR \times DR$ , with each risk level assessed by the auditor as a percentage of 1.0 (e.g., IR = 40% or .40). Despite the precision implied by the mathematical model, in reality its application is a highly judgmental process (Anderson and Malletta 1994; POB 2000; Wright and Bedard 2000). The model is generally applied in practice as follows: AR is first set by the partner in-charge of the audit engagement at an acceptably low level (e.g., 5%). Next, IR and CR are assessed via the auditor's knowledge of client operations, testing of internal controls, prior history with the client, etc. Lastly, given the assessed levels of IR and CR, the scope of planned substantive procedures (i.e., the nature, timing, and extent of substantive testing procedures), or DR, is adjusted by the auditor to obtain the desired level of AR ( $DR = AR / (IR \times CR)$ ). Therefore, as IR and CR increase (decrease) the auditor is expected to compensate with substantive procedures that are greater (lesser) in

scope.<sup>2</sup>

Two recent SASs, among other factors, have affected the way in which the model is applied in advanced AIS environments. First, SAS No. 80 (AICPA 1996) states that, with the electronic processing of transactions and the reduced reliability associated with the resulting audit evidence, auditors may not be able to adequately reduce detection risk by increasing the scope of substantive procedures. In these types of environments, it is suggested that the auditor focus on internal controls to determine whether they are designed, and in use, to assure the accuracy and reliability of data in electronic form (AICPA 1996). This change in focus from detection risk to control risk may be troublesome for auditors as, in the past, they have been hesitant to test and rely on internal controls and have instead focused on substantive testing to maintain a desired level of audit risk (Waller 1993; Haskins and Dirsmith 1995; Davis 1996). Second, SAS No. 94 (AICPA 2001) indicates that the utilization of CAS as a source of audit evidence, especially in the testing of internal controls, should increase on audit engagements where AIS are advanced and pervasive. Given the differences in expertise structures between auditors and CAS, auditor evaluations of, and reactions to, CAS evidence may become more complex when auditor AIS expertise is low. Lastly, the implementation and utilization of advanced AIS has been found to expose clients to numerous risks (e.g., lack of segregation of duties, business interruption). An awareness of these AIS-related risk

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<sup>2</sup> For example, if AR, IR, and CR are assessed at 5%, 35%, and 60%, respectively, then the scope of planned substantive procedures is designed to reduce DR to 24% ( $.24 = .05 / (.35 \times .60)$ ). Increasing (decreasing) the scope of substantive testing procedures generally reduces (increases) DR. The scope of substantive testing is increased by increasing the number of substantive tests and the grade of labor used (nature), performing substantive tests at fiscal year-end rather than at an interim date (timing), and increasing the budget associated with substantive tests (extent).

factors might increase the inherent and control risk assessments of auditors (Hunton et al. 2001).

#### **1.4 ERP Systems and Auditor AIS Expertise**

ERP systems are defined as “information systems packages that integrate information and information-based processes within and across functional areas in an organization” (Kumar and Hillegersberg 2000, 22). The implementation and utilization of ERP systems by companies represents a radical change from the legacy systems of the past as business functions (e.g., accounting, sales, manufacturing, etc.) are integrally linked through workflow automation and relational databases. ERP systems represent the computing environment of choice among corporations of all sizes because they have the potential to provide real-time data, lower operating costs, shorten cycle times (e.g., inventory production, financial statement preparation), and increase customer satisfaction (Brown 1997; O’Leary 2000; Hunton et al. 2001).

Despite all of the positive attributes associated with ERP systems, there are significant risks associated with their adoption (Wright and Wright 2002). The complexity, level of integration, and pervasiveness of these systems often lead to heightened risks caused by inappropriate access, incorrect input and output, poorly trained personnel, business interruption, inadequate internal controls, and implementation problems (O’Leary 2000; Scheer and Haberman 2000; Soh et al. 2000; Hunton et al. 2001; Wright and Wright 2002). In general, the pervasiveness of, and increased risks associated with ERP systems can lead to a greater potential for financial misstatements, misclassifications, and defalcations, especially in the periods immediately following their

implementation (Gibbs and Keating 1995; Helms 1999; Lilly 1997; Manello and Rocholl 1997; Pfenning 1999; Turner 1999; Wah 2000). The effects of these risks should be of concern to auditors, as professional skepticism should be exercised to achieve reasonable assurance that material misstatements are detected (AICPA 1988a).

As AIS, like the accounting-related modules of ERP systems, have become more dominant and complex, auditors' abilities to "audit around" the system (e.g., perform their audits without evaluating the reliability of the AIS) have been significantly reduced (Ellis 1989; AICPA 1996; Bell et al. 1998, 16; Burnaby and Klein 2000; AICPA 2001). ERP systems require sophisticated auditing capabilities (Lilly 1997), and a recent study by Hunton et al. (2001) found that AIS knowledge increases auditors' concerns for, and recognition of, audit risks in an ERP setting. This increased concern and recognition are likely to have implications for auditors' risk assessments and substantive planning decisions.

Based on the discussion above, it is reasonable to expect that, in ERP environments, auditors with greater AIS expertise will assess both inherent and control risks at higher levels than auditors with lower expertise. Given their higher risk assessment levels and their superior ability to design AIS-related substantive procedures, auditors with higher AIS expertise should also plan substantive procedures that are greater in scope than auditors with lower expertise.

### **1.5 Computer Assurance Specialist Competence**

According to SAS No. 94 (AICPA 2001), in audit engagements where a client's AIS is deemed to be dominant and/or complex, the auditor should obtain the assistance of

one or more computer assurance specialists (CAS). In practice, CAS are typically from the same firm as the auditor, are considered part of the engagement team, and play a large role in both gaining an understanding of, and testing, the internal controls of audit clients with advanced AIS (Ayers and Nagy 1998; Curtis and Viator 2000; Hunton et al. 2001; Wright and Wright 2002). Also, the role of CAS as a source of audit evidence will likely increase as clients with complex and pervasive AIS become more prevalent (POB 2000).<sup>3</sup>

The inferential value or reliability of audit evidence must always be considered in light of the perceived competence of its source (Hirst 1994). While a number of source competence studies have been conducted in the audit environment (e.g., Bamber 1983; Schneider 1984; Rebele et al. 1988; Anderson et al. 1994; Hirst 1994), none have investigated the relationship between auditors and CAS. Prior research has found that auditors are typically sensitive to the competence of their evidence sources and these competence levels affect their judgment processes (e.g., Brown 1983; Schneider 1984; Margheim 1986).

While not explicitly examined in the literature, it appears that in practice there is variability in CAS competence. To gain additional insight into auditors' perceptions of CAS competence, a survey was completed by nine audit seniors and managers from four offices of a large, international public accounting firm (see Appendix A for survey). Eight of the nine auditors believed that the level of CAS competence had been an issue of concern on their audit engagements. In addition, Hunton et al. (2001) found that auditors

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<sup>3</sup> As discussed in SAS No. 94 (AICPA 2001), CAS are a source of audit evidence for the auditor who evaluates and relies on their evidence during the control risk assessment process. Specifically, CAS evidence is a workpaper documenting the system controls of the client, CAS tests of those controls, and the result of that testing (e.g., AIS controls appear reliable).

were unlikely to engage the services of CAS in ERP environments, thus concluding that “auditors do not appear to recognize and respect their skills” (Hunton et al. 2001, 27).

Given the findings of prior source competence research, and that a major role of CAS is to provide the auditor with assurance in relation to internal controls, it is reasonable to expect that auditors will be sensitive to the competence of CAS when evaluating their evidence and adjust their risk assessments and scope of testing accordingly.<sup>4</sup> Specifically, it is expected that auditors should judge evidence provided by CAS with higher (lower) competence as more (less) reliable. Further, given positive internal control testing evidence (i.e., AIS controls appear reliable) from a more (less) competent CAS, auditors should assess control risk at a lower (higher) level and, in turn, reduce (increase) the scope of planned substantive audit procedures.

## **1.6 CAS Competence and Auditor AIS Expertise**

One aspect of the CAS/auditor relationship that differs from virtually all prior source competence studies is that CAS represent a source of audit evidence with a different expertise structure than auditors (Curtis and Viator 2000; Hunton et al. 2001).<sup>5</sup>

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<sup>4</sup> All participants in this study will receive positive testing results from a CAS (i.e., AIS controls appear reliable). Inadequately discounting negative control test results from a low competence CAS would be a failure to reduce the assessed level of control risk. Inadequately discounting positive control test results from a low competence CAS would be a failure to increase the assessed level of control risk. While inadequately discounting negative results when CAS competence is low may impact the efficiency or the profitability of the audit, inadequately discounting positive results under low CAS competence may lead to more deleterious conditions such as audit failure (Hirst 1994). In addition, audit guidance that promotes professional skepticism in the audit environment (e.g., AICPA 1988a) might mitigate the discounting of negative testing results even when CAS competence is perceived to be low.

<sup>5</sup> Hirst (1994) manipulated source competence by describing the evidence source as either a specialist in an industry related to the evidence (test of inventory obsolescence) or not. Participants were asked to evaluate the inferential value of evidence provided by the specialists, but were not asked to make related judgments that may have challenged the knowledge structures of the auditors (e.g., prepare an audit program). Therefore, the effects of any variation in auditor expertise on their related source competence judgments could not be identified.

The Public Oversight Board's (POB) recent study on audit effectiveness stressed the importance of CAS/auditor interactions and the role of auditor AIS expertise in these relationships. The POB indicated that, in advanced AIS environments, CAS and auditors will need to "work as a team" and auditors will need to "expand their technological knowledge and skills," as they "cannot cede all technological matters" to CAS (POB 2000, 171).

In prior source competence investigations, where the evidence source and the auditor maintain similar expertise structures (e.g., audit staff, internal audit, client accounting personnel), little variation is expected in auditors' abilities to perform additional procedures when an evidence source with low competence is encountered. For example, the majority of senior auditors are aware of, and competent to perform, additional substantive testing to substitute for inadequate tests performed by an assistant with low competence. Given a specified level of CAS competence, the size of the expertise gap between the evidence source (CAS) and the evidence examiner (auditor) is dependent on the auditor's level of AIS expertise. As the AIS gap between the CAS and the auditor widens (i.e., lower auditor AIS expertise), it becomes less likely that the auditor will have the ability to compensate for perceived CAS competence deficiencies (i.e., inadequate control testing).<sup>6</sup> Auditors with low self-assessed AIS expertise may be

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<sup>6</sup> The strength of internal control tests should be affected by the competence of CAS (Bamber 1983; Hirst 1994). Thus, the strength of internal control tests, one factor in determining the internal control risk assessment (Libby et al. 1985; Maletta and Kida 1993), will be manipulated between participants in this study via exposing them to either low or high CAS competence. The results of control tests (e.g., AIS controls appear reliable), an additional factor that affects internal control risk assessments (Libby et al. 1985; Maletta and Kida 1993), will be kept constant between all groups (i.e., all participants will receive positive control testing results from CAS). See footnote 4 for further explanation. While prior research has shown that auditors are extremely sensitive to the results of internal controls tests (e.g., Dusenbury et al. 2000), little is known about how auditors use information about strength of tests (Reimers et al. 1993).

more apt to rely on CAS evidence and not increase internal control risk assessment levels or expand the scope of planned substantive procedures. Auditors with higher AIS expertise, on the other hand, may be more likely to act on CAS competence deficiencies (i.e., increase control risk assessment levels and the scope of planned substantive procedures) because they are better able to plan and competently perform the additional audit procedures required to compensate for the deficiencies.

Within advanced AIS environments, auditors will find it necessary to fully understand the risks associated with these systems and the controls needed to respond to those risks (POB 2000). Prior auditor expertise research has shown that domain-specific expertise, determined by the nature of auditor experience and training, improves the domain-specific performances of auditors (Bonner 1990; Bonner and Lewis 1990). With respect to the domain of AIS expertise, Hunton et al. (2001) found that AIS knowledge positively affects auditors' concerns for, and recognition of, audit risks in an ERP setting.

The above discussion suggests an interaction between CAS competence and auditor AIS expertise. The differences between high AIS expertise auditors' and low AIS expertise auditors' control risk assessments will be greater when CAS competence is low than when it is high. Also, the differences between high AIS expertise auditors' and low AIS expertise auditors' scope of substantive tests will be greater when CAS competence is low than when it is high. In conditions where CAS competence is high, the positive effect of auditor AIS expertise on planning judgments is expected to lessen, as it is more appropriate to rely on CAS evidence in this condition (Bamber 1983; Hirst 1994). See Figure 1 for a graph depicting this interaction. Also, in complex AIS settings (e.g., ERP

systems), higher levels of auditor AIS expertise should improve the quality of their risk assessments and, in turn, the effectiveness of their substantive planning decisions.

### **1.7 Overview of the Study**

While auditors' interactions with complex AIS and CAS play a critical role in determining the effectiveness of audits (POB 2000), little prior research has examined these topics. The purpose of this study is to examine the effects of CAS competence and auditor AIS expertise on auditor planning judgments in an advanced AIS environment. Prior source competence studies have typically examined auditors' evaluations of evidence reliability, and their related judgments, in response to evidence sources with similar expertise structures to those of auditors. Under such circumstances, compensating for source competence deficiencies is typically not a complex task for the auditor. Given a specified level of CAS competence, the size of the expertise gap between the CAS and the auditor is determined by the individual auditor's level of AIS expertise. Variation in knowledge gaps between CAS and auditors likely results in a more complex relationship than those previously examined. Additionally, while a number of studies have investigated the application of the audit risk model, none have examined this judgment process in a complex AIS environment where auditor AIS expertise may significantly affect this procedure.

Through the use of a quasi-experimental case, auditors were placed in an environment where a complex AIS system related to a transaction cycle (sales and accounts receivable cycle) had been implemented in the current year. In the case, a CAS was assigned to assist the auditor in gaining an understanding of, and testing, the controls

related to the transaction cycle. The competence of the CAS was manipulated as high and low between auditors. Auditors' self-reported AIS expertise levels were measured via a post-experimental questionnaire. The auditors were required to make several planning judgments based on the evidence provided in the case. Hypotheses were developed regarding the effects of both CAS competence and auditor AIS expertise on planning judgments in an advanced AIS environment. Possible implications of this study include the identification of AIS-related risks and auditor AIS expertise as important factors in explaining auditor planning judgments and the illustration of the complexities surrounding CAS/auditor interactions.

## CHAPTER 2: LITERATURE REVIEW

### 2.1 Introduction

This chapter reviews several areas of literature to develop a framework for studying the effects of computer assurance specialist (CAS) competence and auditor accounting information system (AIS) expertise on auditor planning judgments. The second section of this chapter reviews the audit guidance related to the audit risk model and the relevant literature investigating its application. The third section examines the extant literature devoted to audit risks associated with enterprise resource planning (ERP) systems. The fourth and fifth sections discuss the role of CAS competence and auditor AIS expertise, respectively, within advanced AIS settings.

### 2.2 The Audit Risk Model

Statement on Auditing Standards (SAS) No. 47 (AICPA 1983) provides the conceptual underpinning for the audit risk model and its concepts permeate Generally Accepted Auditing Standards, or GAAS (POB 2000). The model serves as the major conceptual framework for the audit process (Akresh et al. 1988; Cushing et al. 1995; Messier and Austen 2000), and a considerable amount of research has studied auditors' applications of the model (e.g., Haskins and Dirsmith 1993; Mock and Wright 1993; Waller 1993; Davis 1996; Hackenbrack and Knechel 1997; Messier and Austen 2000; Wright and Bedard 2000). How auditors apply the audit risk model, through the assessment of client risks and the design of substantive testing procedures, substantially influences the effectiveness and efficiency of an audit (Mock and Wright 1993). In

addition, two relatively recent Statements on Auditing Standards, SAS No. 80 (AICPA 1996) and No. 94 (AICPA 2001), have changed the ways in which the model is applied in advanced AIS environments.

The audit risk model, as described in SAS No. 47 (AICPA 1983), operationalizes a risk-based approach to selecting the amount of substantive testing necessary for an audit to be effective and efficient (Dusenbury et al. 2000). The auditor applies the model during the planning/internal control evaluation phase of the audit (i.e., pre-substantive testing). Audit risk (AR) is the risk that the auditor may unknowingly fail to appropriately modify his or her opinion on financial statements that are materially misstated. Audit risk is the product of the following interrelated factors:

Inherent Risk (IR) = the risk that a financial statement assertion is susceptible to a material misstatement, assuming there are no related controls

Control Risk (CR) = the risk that the entity's internal control structure or procedures will not prevent or detect, in a timely manner, a material misstatement which could occur in a financial statement assertion

Detection Risk (DR) = the risk that the auditor will not detect a material misstatement that exists in a financial statement assertion

Thus, the mathematical depiction of the model is  $AR = IR \times CR \times DR$ , with each risk level assessed by the auditor as a percentage of 1.0 (e.g., IR = 40% or .40). The model is applied in practice by the auditor first setting AR at an acceptably low level (e.g., 5%). Next, IR and CR are assessed via the auditor's knowledge of client operations, testing of internal controls, prior history with the client, etc. Lastly, given the assessed levels of IR and CR, DR or the scope of planned substantive procedures is adjusted by the auditor to obtain the desired level of AR (i.e.,  $DR = AR / (IR \times CR)$ ). For example, if AR, IR, and CR are assessed at 5%, 35%, and 60%, respectively, then the scope of

planned substantive procedures is designed to reduce DR to 24% (i.e.,  $24 = .05 / (.35 \times .60)$ ). Increasing (Decreasing) the scope of substantive testing procedures generally reduces (increases) DR. Therefore, as IR and CR increase (decrease) the auditor is expected to compensate with substantive procedures that are greater (lesser) in scope (POB 2000).<sup>7</sup>

Despite the precision implied by the mathematical model, in reality its application is a highly judgmental process (Anderson and Malletta 1994; POB 2000; Wright and Bedard 2000). The Public Oversight Board's (POB) recent study on audit effectiveness provides some insight as to how the audit risk model is applied in practice (POB 2000). The objective of the POB's Panel on Audit Effectiveness (Panel) was to review and evaluate the way actual audits are performed. According to the Panel's report, prior to SAS No. 47 (AICPA 1983), many auditors employed some of the audit risk model in practice despite the lack of an explicit model embedded in GAAS. Still, audits tended to be conducted with a focus on substantive tests with less reliance on risk judgments. After the issuance of SAS No. 47, the Panel found evidence that many audits continued to use a substantive testing approach, while "defaulting" to an assumption that risks were at a maximum level (POB 2000, 178). As indicated in the discussion of SAS No. 80 (AICPA 1996) and No. 94 (AICPA 2001) below, such a lack of consideration given to the risk assessment process may be insufficient in environments where the electronic processing of transactions may reduce the reliability of evidence used in substantive tests. The Panel's report suggests that some firms are making changes in their audit methodologies

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<sup>7</sup> For example, if control risk associated with the sales/accounts receivable cycle is assessed at a higher level in the current year in comparison to the prior year, *ceteris paribus*, the auditor may consider increasing the number of accounts receivable confirmations tested in the current year over that of the prior year (POB 2000).

to more sufficiently incorporate risk. Overall, the Panel concluded that the audit risk model was appropriate, although they perceived that it might need to be enhanced, updated, and implemented by auditors more consistently.

Academic research has examined the application of the audit risk model through the use of archival, survey, and experimental methods. In addition, and with few exceptions, these descriptive studies have either focused on auditors' assessments of inherent and control risks or preparations of audit programs and budgets (i.e., planned substantive procedures). As will be the focus of this study, this literature has also typically attempted to gain an understanding of the factors that affect auditors' applications of the audit risk model.

### **2.2.1 Risk Assessment**

There has been a limited amount of research that has investigated auditors' risk assessments utilizing either archival or survey methods. Houghton and Fogarty (1991), through the results of an error survey of 480 audits, analyzed the relationship between inherent risk assessments and auditor financial statement adjustments. The objective of the study was to determine the environmental characteristics and other factors that would enable auditors to properly identify areas of high inherent risk during the planning process. The results of the study provide evidence that non-systematically processed transactions have a greater likelihood of error than systematically processed transactions. Also, auditors with a greater knowledge of their client's operations were more likely to identify inherent risks in those audit areas having the greatest risk of error. This second finding represents the first empirical support for the positive effect of domain-specific expertise on auditors' risk assessment processes.

Similar to Houghton and Fogarty (1991), Wallace and Kreutzfeldt (1995) measured client attributes tied to inherent and control risks and then evaluated the effectiveness of these attributes in explaining audit adjustments. Client attribute data was obtained via survey, while adjustment data was acquired from actual workpapers. The results of this study were consistent with that of Houghton and Fogarty, showing support for a significant joint effect of inherent and control risks on client error rates.

Waller (1993) represents an empirical study that examined applications of the audit risk model in field settings. The paper reports the results from a statistical analysis of auditors' inherent and control risk assessments drawn from actual audit workpapers. Contrary to expectations suggested by *a priori* research that inherent and control risk assessments are statistically dependent on one-another (e.g., Cushing and Loebbecke 1983), Waller found that the empirical evidence supported an insignificant association between these risk assessments in practice. The data also provides a description of the form of auditors' risk assessments. On average, auditors assessed inherent risk at moderate levels while control risks were generally assessed as high (more than 80 percent of the sample placed no reliance on controls).

While the results of Waller (1993) support the belief that the assessments of inherent and control risk are statistically independent judgments made by the auditor, the findings of Haskins and Dirsmith (1995) suggest that auditors use the same environmental factors in both risk assessments. Haskins and Dirsmith surveyed auditors with respect to the relevance of 48 client attributes to both their inherent and control risk assessments. Contrary to the definition of inherent risk which assumes the existence of no related controls (AICPA 1983), several of the top-ranked control risk factors were also

noted as highly relevant to the assessment of inherent risk by the survey participants. Similar to Waller, Haskins and Dirsmith found auditors to often place an insufficient reliance on risk assessments (i.e., over-reliance on substantive testing). Their survey suggested that while auditors were predominately sensitive to unfavorable control conditions, they were unlikely to reduce the scope of planned audit procedures when provided with favorable inherent and control risk information.

Unlike the limited amount of studies that have used archival or survey data to examine the risk assessment process, many researchers have used experimental methods to study this process. Colbert (1988) was the first study designed to examine auditor risk judgments, specifically the assessment of inherent risk. Prior research relating risk factors to financial statement errors had shown the identification of inherent risk factors to be a difficult task (e.g., Willingham and Wright 1984; Ham et al. 1985). Colbert manipulated four risk factors as high and low to determine their effects on auditor inherent risk assessments. All four risk factors (turnover of the controller, financing pressure, accounting system complexity, and quality of accounting personnel) were important to auditors when providing inherent risk assessments, with the quality of accounting personnel having the most significant effect.

Reimers et al. (1993) investigated whether the form of the control risk assessment itself, either linguistic or numerical, affects the assessments of auditors provided with the same environmental risk factors. While SAS No. 47 (AICPA 1983) treats the two response modes as equivalents, the results of this experiment did not support this premise. Specifically, auditors utilizing a numerical scale provided lower assessments than those using a linguistic scale, and there was a higher level of consensus (a surrogate

for accuracy in this study) among auditors who used the linguistic scale. This finding was consistent across both high and low risk environments. The implication of this finding is that the level and accuracy of risk assessments, regardless of risk level, may be dependent on the form of the assessment measure.

Building on the source reliability literature (e.g., Brown 1983; Schneider 1984; Margheim 1986), Maletta (1993) examined the impact of inherent risk on auditors' decisions to use internal auditors. This study's results showed that auditors combine inherent risk levels and the source objectivity (reliability) of the internal auditor when deciding whether to use the internal auditor. Such processing was consistent with the findings of Brown and Solomon (1990) who found the presence of configural decision-making in a control risk assessment task. Maletta ascertained that when inherent risk levels were high, auditors were appropriately sensitive to the objectivity of internal auditors (i.e., more likely to use a high objectivity source of audit evidence). On the other hand, when inherent risk conditions were low, the objectivity level of the internal auditors did not impact the amount of reliance auditors placed on this evidence source.

Maletta and Kida (1993) continued this stream of research, investigating the joint effect of inherent and control risk levels on auditors' source reliability judgments (i.e., reliance on internal audit to reduce planned audit work). Similar to Maletta (1993), Maletta and Kida documented that auditors' source reliability judgments can be quite complex when elements of the risk environment are explicitly considered. Their results indicated that inherent and control risk levels interact to affect auditors' decisions to rely on internal auditors. Under high inherent risk conditions, auditors were more likely (less likely) to use internal audit if control risk levels were low (high). Under low inherent risk

conditions, the decision to use internal audit was unaffected by the control risk level. In addition, under both higher inherent and control risk conditions, auditors were more apt to consider all of the components of source reliability provided to them (i.e., objectivity, competence, and work performed). The results of Maletta (1993) and Maletta and Kida (1993) provide evidence that auditors are sensitive to the reliability of their evidence sources during the planning phase of the audit, and their sensitivity increases in higher risk scenarios.

Anderson and Maletta (1994) studied whether experience played a role in auditors' control risk assessments. They found that experience affected auditor attendance to information during the control risk assessment process, with less experienced auditors attending to more negative information. Interestingly, while the less experienced auditors (audit staff vs. audit seniors) attended to more negative information, their control risk assessments did not differ from the more experienced group. Davis (1996) also investigated how experience affects the control risk assessment process. The findings of this study demonstrated that greater experience might lead to a higher level of selective attention to relevant information, but not to greater assessment accuracy. In Davis' experiment, regardless of information cues provided, both the experienced and the inexperienced tended to not (a) rely on controls and (b) audit through the computer. Nevertheless, the results of these two studies do suggest that experience or expertise may play a significant role in auditors' applications of the audit risk model.

The research question investigated by both Anderson and Maletta (1999) and Monroe and Ng (2000) was whether auditors' applications of the audit risk model are subject to order effects. Anderson and Maletta found auditors to be susceptible to order

effects, specifically primacy effects, when preparing budgets only under low inherent risk conditions. Higher inherent risk conditions appeared to increase auditor effort, thus mitigating the effect of these biases. In their study of inherent risk assessments, Monroe and Ng found that the judgment was not affected by the order of information provided to the auditors. In addition, and similar to other studies (e.g., Davis 1996), Monroe and Ng noted that their results suggest that auditors' judgments of risk may be biased towards conservatism (i.e., higher risk assessment levels).

The existence of a conditional dependency between inherent and control risks has been the subject of both archival and survey research (Waller 1993; Haskins and Dirsmith 1995). This prior research has found evidence to both support and reject such a conditional relationship. Both Messier and Austen (2000) and Dusenbury et al. (2000) attempted to investigate this research question utilizing experimental methods and found evidence to support the dependence assumption. The auditors in Messier and Austen's experiment used both pervasive and account-specific inherent and control risk factors in both their inherent and control risk assessments. The results of that study also indicated a significant positive correlation between the auditors' inherent and control risk assessments. Similarly, Dusenbury et al. found conditional dependencies between auditors' inherent and control assessments. Specifically, audit risk model judgments explained "down stream" or subsequent judgments (e.g., inherent risk levels explained control risk levels, control risk levels explained substantive planning decisions, etc.).

### **2.2.2 Planned Substantive Procedures**

Much like the research devoted to gaining a greater understanding of the risk assessment process, researchers have used archival, survey, and experimental measures to

investigate the planning of substantive procedures. After assessing audit, inherent, and control risk levels, auditors attempt to formulate an appropriate, cost-effective substantive testing strategy for a particular client via program planning and budgeting (Libby et al. 1985; Kaplan 1985; Mock and Wright 1993). Mock and Wright's (1993) exploratory study examined the relationship between assessed risks and substantive planning decisions and provided a great deal of insight into this process. Utilizing risk assessments, audit programs, and budgets extracted from actual workpapers, the data revealed moderate cross-sectional risk variation accompanied with little change in the nature of evidence gathered (e.g., types of substantive tests). Instead, the extent of tests (e.g., preparing a smaller or larger budget for a substantive test) appeared to be the primary mechanism used to mitigate variation in risk. Additional findings of this study included a significant reliance by auditors on prior year risk assessments (i.e., anchoring) when performing current year assessments and, for 41% of the engagements in the sample, a change of information system was associated with a shift in risk assessment.

Via a survey of audit partners in-charge of a sample of 1,000 audits, O'Keefe et al. (1994) examined the empirical relationship between client characteristics and the nature and mix of labor resources used on audits (i.e., the number of hours required and the rank of employee performing the audit procedures). Results of the study indicated that client size, complexity, and business/inherent risks explained approximately 80% of the cross-sectional variation in audit hours. Client size and the risk measures were also associated with significant changes in the mix of labor inputs (e.g., level of staff used for specific substantive tests). Lastly, auditor reliance on client controls seemed to have no systematic effects on either the level or mix of audit labor inputs. Utilizing similar

methods to those of O'Keefe et al., Hackenbrack and Knechel (1997) found that client size, complexity, and risk were generally positively associated with both the amount audit hours and the grade of labor used in audits. Positive relationships between the above client characteristics and the nature of audit testing performed were also noted in the study. In addition, their results pointed to no association between control reliance and audit effort. The findings of these studies indicate the importance of measuring audit programs/budgets that are disaggregated by substantive test and the rank of auditor assigned to the task. Also, and contrary to the guidance set forth by SAS No. 47 (AICPA 1983), auditors appeared to not adjust detection risk appropriately (i.e., reduce the scope of substantive procedures) when a control reliance strategy is adopted.

Gist and Davidson (1999) provide an excellent summary of the literature devoted to the study of audit budgets. According to the researchers, prior studies have shown that the factors that impact audit budgets can be classified into four categories: client, audit firm, environmental, and individual auditor. The size, complexity, and risk associated with a client have been shown to have a major, positive effect on the number of hours needed to complete audits (O'Keefe et al, 1994; Davidson and Gist 1996). Audit firm factors include such variables as size of firm (Francis 1984) and the type and level of audit technology used (McDaniel 1990; Gist 1994). Budgets have also been shown to be influenced by such environmental factors as the economy (Kaplan 1985) and competition (Marxen 1990; Maher et al. 1992). Lastly, the characteristics of the individual auditor that appear to influence budgets include their experience and expertise (Bedard 1991) and attitude toward risk (Poneman 1992). Clearly, prior research has provided ample evidence that the preparation of audit budgets is a complex and multi-faceted activity.

The objective of Gist and Davidson's (1999) archival study, which used data from actual workpapers of several international accounting firms, was to investigate the effect of client factors on the achievement of audit budgets. Similar to research studying planned and actual audit hours (e.g., Davidson and Gist 1996; O'Keefe et al, 1994), results indicated that the client characteristics of size, complexity, and risk appeared to positively explain deviations of actual audit hours from audit time budgets. The authors also point to the interesting finding that the audit budgets in their sample seemed to be relatively inaccurate when compared to actual hours recorded. This latter result suggests that effective budget setting is a difficult task in the audit environment and, as documented by Bedard (1991), auditor expertise may play a significant role in this process.

Experimental research has investigated research questions relating to both the audit program and budget preparation processes of auditors. Margheim (1986) examined auditors' reactions to the source reliability levels of internal auditors by measuring the nature and extent of planned substantive procedures. Auditors reduced planned audit hours if the internal auditor had a high level of competence, but they did not alter their tests in response to changes in the degree of internal auditor objectivity. Thus, variation in the source competence of an evidence provider may impact the budgets of auditors utilizing that evidence source.

Houston (1999) experimentally examined the joint effects of fee pressure and client risk on auditors' risk assessments and audit budgets. Consistent with hypotheses, these two factors interacted, with auditors being less responsive (e.g., fewer budgeted hours) to increased client risk in the face of fee pressure. Contrary to audit guidance

(AICPA 1983), this result documents evidence that the application of the audit risk model is often a function of non-risk factors.

Utilizing verbal protocol, Wright and Bedard (2000) investigated how variation in inherent risk factors affected auditors' inherent risk assessments and their development of audit programs. Their paper was motivated by the lack of studies investigating the entire planning process: from risk analysis, through risk assessments, and finally to the planning of substantive procedures. Some prior research had unexpectedly found little to no association between risk factors and auditors' planning judgments (e.g., Wright and Wright 1997; Zimbleman 1997). The authors also wanted to examine the variation in auditors' awareness of risks, interpretation of risks, and abilities to appropriately adapt the audit plan found in prior studies. Wright and Bedard wanted to test the effect of domain-specific expertise on the strength of the link between risk factors and planning judgments. The researchers used verbal protocol methods on a small sample of auditors to explore these issues. Overall, results supported significant links among the planning stages of risk recognition, risk assessment, and substantive planning. The findings of the study suggest a positive effect of domain-specific expertise on the effectiveness of auditors' planning judgments. For example, more experienced auditors incorporated the high complexity and judgmental nature of an accounting system into their planning judgments, while less experienced auditors failed to do so. In addition, increased risk factors were found to affect the nature of planned tests, but not the extent.

Because auditor planning judgments are often made under ambiguous circumstances, Guess et al. (2000) attempted to study the role of ambiguity on auditors' consideration of risk factors and their subsequent determinations of audit budgets. The

results revealed that both risk and ambiguity have a significant effect on auditors' budgets, but the effect of ambiguity was limited to scenarios with lower control and inherent risk levels. According to the authors, the effect of ambiguity is possibly mitigated in high risk scenarios because of the conservative bias found among auditors in prior research (e.g., Smith and Kida 1991; McMillan and White 1993). One other unique attribute of this study is that one of the inherent/control risk factors manipulated was the effect of new client accounting software on client operations. Given the significant, direct effect of risk factors on audit budgets, their study provides some evidence that auditors are sensitive to the risk factors associated with changing accounting information systems.

Bierstaker and Wright (2000) point to other factors that may affect auditors' application of the audit risk model. In their experiment, these researchers manipulated partner preferences between audit effectiveness and efficiency in a high-risk client environment and examined their effects on the budgeting and program decisions of auditors. Consistent with expectations, auditors budgeted more (fewer) hours in response to a partner preference for effectiveness (efficiency). In addition, there was a significant interaction between auditors' risk assessments and partner preferences. Analysis of the interaction suggests that that a positive relationship between risk assessments and planned substantive procedures existed only in the condition when there was a partner preference for effectiveness. The results of this study provide further evidence that factors not explicitly documented in SAS No. 47 (AICPA 1983) may affect auditors' applications of the audit risk model.

In summary, prior research investigating the audit risk model has provided some descriptive evidence of auditors applying the model in accordance with the guidance set

forth by SAS No.47 (AICPA 1983). More importantly, a review of this literature also shows that, when assessing risks and planning substantive procedures, factors excluded from the audit risk model appear to affect auditors' planning judgments. In addition, there is a dearth of research that has investigated the entire risk model application: from risk analysis, through risk assessment, and to the planning of substantive procedures. Prior research has typically studied either the beginning or the end of this process. Lastly, this research stream has yet to fully consider the impact of complex, computerized, and pervasive AIS on the risk model application process. As will be described below, recent audit guidance has attempted to provide direction to auditors in advanced AIS environments.

### **2.2.3 New Auditing Standards**

Two recent Statements on Auditing Standards (SAS) have affected the ways in which the audit risk model is applied in advanced AIS environments. First, SAS No. 80 (AICPA 1996), which amended SAS No. 31 (1980), changes the way in which risk is handled in an electronic environment. Specifically, SAS No. 80 states that with the electronic processing of transactions and the reduced reliability associated with the resulting audit evidence, auditors may not be able to reduce detection risk adequately by increasing the scope of substantive procedures. Most of the auditors' work in forming an opinion on financial statements consists of obtaining and evaluating evidential matter. In advanced AIS settings, it is suggested that the auditor should focus on internal controls to determine whether they are designed, and in use, to assure the accuracy and reliability of data in electronic form. This change in focus from detection risk to control risk may be troublesome for auditors as, in the past, they have been hesitant to test and rely on

internal controls and have instead focused on substantive testing to maintain a desired level of audit risk (e.g., Waller 1993; Haskins and Dirsmith 1995; Davis 1996). Also, SAS No. 80 requires auditors to consider the time during which electronic (vs. hard copy) information exists or is available when determining the nature, timing, and extent of substantive testing.

Second, SAS No. 94 (AICPA 2001), which amended SAS No. 55 (AICPA 1988b), indicates that the utilization of computer assurance specialists (CAS) as a source of audit evidence should increase on audit engagements where AIS are complex and pervasive. These specialists should be used by the auditor to gain an understanding of, and test, AIS-related controls. An auditor who uses such a specialist should follow the supervision guidance set forth by SAS No. 22 (AICPA 1978). As members of the engagement team, CAS require the same degree of supervision and review as any assistant. However, unlike auditors and their assistants, prior research has documented differences in expertise structures between auditors and CAS (Curtis and Viator 2000; Hunton et al. 2001). These differences could make judgments related to CAS evidence difficult for auditors. For example, while auditors are typically able to compensate for low levels of subordinate auditor competence by employing additional procedures themselves, auditors with limited AIS expertise may not have the knowledge structure to compensate for low CAS competence levels. Similar to SAS No. 80, this SAS requires the auditor to consider the possible ineffectiveness of an audit strategy that assesses control risk at maximum and performs only substantive tests in advanced AIS settings.

## **2.3 ERP Systems and Auditor AIS Expertise**

Enterprise resource planning (ERP) systems are defined as “information systems packages that integrate information and information-based processes within and across functional areas in an organization” (Kumar and Hillegersberg 2000, 22). These systems have become the information technology environment of choice among companies of all sizes because they have the potential to provide real-time data, lower operating costs, shorten cycle times (e.g., inventory production, financial statement preparation), and increase customer satisfaction (Brown 1997; O’Leary 2000; Hunton et al. 2001). Over the past decade, corporations have experienced both successful and disastrous ERP implementations and the benefits, complexities, and risks of ERP systems have been documented in the popular press (Wright 2001). Also, a limited amount of academic research has investigated the effects of ERP systems on issues of concern to auditors (e.g., internal controls). This research suggests that the level of auditor accounting information system (AIS) expertise may significantly influence their planning judgments in ERP environments (e.g., Hunton et al. 2001). Lastly, ERP systems may induce auditors to rely on the heuristic of anchoring and adjustment to cope with the complexities of these systems. The utilization of this heuristic during planning judgments may also be dependent on the auditor’s level of AIS expertise (Joyce and Biddle 1981; Monroe and Ng 2000).

### **2.3.1 ERP Systems: Benefits, Complexities, and Risks**

“ERP systems are computer-based systems designed to process an organization’s transactions and facilitate integrated and real-time planning, production and customer response” (O’Leary 2000, 27). These systems are composed of various types of

application modules (e.g., accounting, materials management, sales and distribution, etc.), with the objective of optimizing business functions by connecting business processes and technology (Helms 1999). Other characteristics of ERP systems include their ability to facilitate process reengineering, process accounting transactions, and automate manufacturing processes (Brown 1997; Moore and Warrick 1998; O'Leary 2000).

The major vendors of ERP systems are SAP, Oracle, PeopleSoft, and JD Edwards (Brown 1997). ERP systems represent a significant change from the legacy systems of the past, and are typically implemented and customized to companies' business processes over a one to five year period with the assistance of consultants (Brown 1997; Scheer and Haberman 2000; Hanseth et al. 2001). The costs of such implementations represent one of the most expensive capital outlays for corporations, with the combined cost of the system and its implementation sometimes exceeding \$100 million (Brown 1997). In 1999, 70% of the Fortune 1000 firms were either implementing or planning to implement ERP systems in the near future (Cerullo and Cerullo 2000). Also, large corporations are not the only organizations implementing ERP systems. Midmarket companies, with annual revenues between \$50 to \$500 million, have gravitated towards ERP systems to plan and manage their operations (Stein and Carrillo 1998; Stein 1998).

The recent explosion in the number of ERP adoptions has been a result of the numerous benefits these systems provide to the companies that implement them.<sup>8</sup>

Hammer's (1990) highly influential article on reengineering sparked the corporate

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<sup>8</sup> O'Leary (2000) provides a more detailed and exhaustive summary of the benefits of ERP implementation. These other benefits include, but are not limited to: being the first dominant corporate application of client-server computing, integrating firm activities, standardizing the organization, eliminating information asymmetries, and facilitating intra and inter-organizational communication and collaboration.

world's interest in obliterating existing processes and replacing them with more efficient processes. ERP systems provide the primary tool for guiding these efforts (O'Leary 2000). Hammer (1997) has stated that "ERP systems equal forced reengineering" and Gendron (1996) calls ERP systems the "electronic embodiment of reengineering." Under legacy systems, the production of some system data and reports took days or weeks. ERP systems offer the advantage of providing and disseminating information online and in real time. ERP systems allow for simultaneous access to data across business functions via the use of a single database, with data entered only once at the transaction source. For example, shipping transactions are entered by the shipping department when goods are shipped (Cerullo and Cerullo 2000; O'Leary 2000). These systems thus allow for a more timely analysis of information and, as a result, more effective decision-making (Wagle 1998). ERP systems also incorporate best practices or the best ways of performing processes. For example, SAP's R/3 system includes over one thousand of these practices. ERP vendors obtain these best practices from prior implementation experiences and learning from the best ways their clients manage their processes. Thus, as new best practices are found and embedded each year, current/late adopters of ERP systems benefit from this wealth of stored knowledge (O'Leary 2000).

While offering many benefits, ERP systems are extremely complex (Hunton 2002), needing teams of consultants to implement and maintain them (Brown 1997). According to Soh et al. (2000), the complexities of ERP implementations include cross-module integrations, data standardization, adoption of best practices, compressed implementation schedules, and the involvement of a large number of stakeholders (e.g., consultants, IT personnel, internal and external auditors). As such, ERP systems require

extensive training and expertise from those involved with their use (Torode 1998). With respect to auditors who service clients with ERP systems, the complexities of these systems currently represent a challenge to their knowledge structures, as sophisticated audit skills are required in these settings (Lilly 1997). For example, the change from a paper to an electronic audit trail may require the auditor to use computer-assisted audit methods (Helms 1999). Auditors will need to expand their technological knowledge and skills in order to perform effective and efficient audits in such advanced AIS environments (POB 2000; Kinney 2001).

The pervasiveness of, and increased risks associated with ERP systems can lead to a greater potential for financial misstatements, misclassifications, defalcations, and internal control problems, especially in the periods immediately following their implementation (Gibbs and Keating 1995; Helms 1999; Lilly 1997; Manello and Rocholl 1997; Pfenning 1999; Turner 1999; Cerullo and Cerullo 2000; Wah 2000). The effects of these risks should be of concern to auditors, as professional skepticism should be exercised to achieve reasonable assurance that material misstatements are detected during their audits (AICPA 1988). ERP-specific inherent and control risks that have been documented in the popular press and the research literature include a decreased level of system security requiring the implementation/integration of additional internal control packages (Turner 1999). Also, a recent longitudinal survey indicated substantial increases in the use of computer technology by businesses between 1988 and 1998, but the lack of a corresponding increase in the amount of internal auditor time devoted to system design and controls (Burnaby and Klein 2000). These integrated and automated systems also remove traditional internal controls such as segregation of duties and supervisory review

(Moore and Warrick 1998; Weinberg 1998). Lastly, there are increased possibilities of material misstatements being entered into the system as lack of employee training is a significant issue in ERP settings (Glover et al. 1999; O’Leary 2000; Ferrando 2001).<sup>9</sup> In summary, while providing many benefits, ERP implementations are fraught with risk. Given the complexities of these systems, one might expect that the level of auditor AIS expertise may play a role in their risk analyses and assessments.

### **2.3.2 Auditing ERP Systems**

There has been a limited amount of academic literature that has studied the effects of ERP systems on various aspects of financial statement audits. Wright and Wright (2002) represents an exploratory study that attempted to gain an understanding of the unique audit risks associated with the implementation and operation of ERP systems. This investigation was motivated by the study of Bell et al. (1998), which found significant variations in the frequency and causes of error in computerized AIS versus manual systems. Wright and Wright used semi-structured interviews with experienced information systems auditors (i.e., CAS) to examine risk issues in ERP environments. The results of the interviews indicated that the “implementation process of ERP systems has an important impact on system reliability” (Wright and Wright 2002, 2). In addition, several implementation risks were explicitly cited by the specialists including improperly trained personnel, compromised controls (e.g., inadequate access controls), and poorly

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<sup>9</sup> A more comprehensive list of ERP-related risks would include: implementation failures/problems (Scheer and Habermann 2000; Girard and Farmer 1999; Greenemeier 2001; Glover et al. 1999), an electronic audit trail (Helms 1999), inadequate testing of systems, reduction in internal controls (Cerullo and Cerullo 2000), integration of systems (Hanseth et al. 2001; Romeo 2001), improper transferal of legacy files to the ERP system (Turek 1998), outsourcing ERP services (Greenemeier 2001), the use of implementation consultants unaware of client reporting/control issues (Cameron and Meyer 1998; Glover et al. 1999), the risk exposure due to the linking of systems with suppliers and customers (Helms and Mancino 1999), and the lack of internal audit involvement in the implementation process (Glover et al. 1999).

executed data conversions/interfaces with legacy systems. The authors conclude that ERP implementations, if not performed properly, avail themselves to heightened risks that are of concern to auditors (i.e., inherent and control risks). Given the exploratory nature of this study, the authors also note additional research is needed to evaluate the impact of ERP utilization on audit services.

In a recent study, Grabski et al. (2002) investigated the relationships between risks, controls, and the success of ERP implementations. The paper examined whether groups of complementary controls, versus single/substitutable modes of control, need to be employed when implementing ERP systems. Chief information officers and internal auditors were surveyed to obtain data on controls used and the perceived success of the implementation. Consistent with their hypothesis that complementary controls lead to more successful ERP implementation than substitutable controls, the results revealed a positive interaction between all five control factors identified in the study and perceived implementation success. This need for a mix of overlapping and redundant control mechanisms provides support for the understanding that ERP implementations are often complex, difficult, and risky processes for organizations (e.g., Cameron and Meyer 1998; Davenport 1998; Deutsch 1998; O'Leary 2000).

Given the number of highly publicized, troubled ERP implementations in the recent past (e.g., Whirlpool, Hershey's, Waste Management), Wright (2001) studied the link between manager and worker resistance to technology and ERP failure. The author used the technology acceptance model and a survey of thirty ERP specialists to research this relationship. Analysis of the survey data indicated managers were less likely to use ERP systems as its perceived usefulness decreases. Factors reducing perceived usefulness

included lack of involvement in system design and problems with information provided by the system. Workers, or those that gather data and process transactions, were more likely to resist the system if perceived ease of use was low. Process reengineering, system design, and lack of worker training were found to reduce the ease of system use for workers. As part of the study, the survey asked the ERP specialists to provide the biggest problems/issues frequently faced when implementing ERP. Lack of user involvement in the system design and inadequate training were noted by 70% and 50% of the respondents, respectively. These issues should cause auditors, who are cognizant of such potential problems, to consider the possibilities of increased inherent and control risks associated with client ERP adoptions.

Hunton et al. (2001) examined the extent to which auditors, with differing levels of AIS expertise, recognize differences in the nature and extent of unique business risks associated with ERP systems. The researchers used a quasi-experiment to investigate their research question, manipulating the system type between auditor participants (ERP and non-ERP) and employing two types of auditors as participants: information system auditors (i.e., CAS) and financial statement auditors (auditors). The participants were provided with a case study which, among other things, (a) informed them of the type of system used by the client, (b) contained a seeded control weakness, and (c) measured the participants' perceptions with respect to risk. Results indicated that, relative to auditors, CAS were significantly more aware of, and concerned with, the following risk factors in an ERP setting: business interruption, network security, database security, application security, process interdependency, and overall control risk. It should be noted that these risk factors were not actively manipulated or explicitly noted in the case study, rather

simply the manipulation of system type caused CAS to note these heightened risk factors in ERP settings. The auditors also failed to recognize a seeded control weakness in both the ERP and non-ERP system conditions. These results have three important implications for future research. First, given the auditors poor performance, future research should investigate auditors' risk assessment processes in ERP settings. Second, there appears to be a significant knowledge gap between CAS and auditors with respect to AIS. Further research is needed to determine if this gap affects their interactions during the course of the audit. And third, with respect to auditors in general (i.e., CAS and auditors), the results of this study suggest that increases in AIS expertise should affect the level and quality of auditor risk assessments.

As previously stated, Hunton et al. (2001) reported that CAS perceived higher risks in an ERP setting versus a non-ERP setting. This expert perception supports prior research and statements in the popular press (as discussed above) that inherent and control risks increase within ERP environments. In addition, Hunton et al. (2001) found that auditors were unlikely to engage the services of CAS in ERP environments, suggesting that auditors may question the value CAS provide to the effectiveness and efficiency of their engagements. One reason auditors may underutilize CAS in ERP settings is that they question their competence levels. Further research is needed to investigate how auditors react to variations in CAS competence.

In summary, the ERP-related literature generally indicates that inherent and control risks are heightened in ERP environments, especially in the periods immediately following their implementation. Also, given the complexities of ERP systems, it appears that auditor AIS expertise may influence the risk assessment processes of auditors. These

complexities may also cause auditors with less AIS expertise to view risk assessment as a significantly difficult task. Prior research indicates that auditors often use the heuristic of anchoring and adjustment when confronted with such tasks (e.g., Joyce and Biddle 1981; Brazel et al. 2004). With respect to planning judgments affected by AIS, this suggests that auditors with less AIS expertise may be more likely to rely on prior year workpapers as an anchor.

### **2.3.3 Anchoring and Adjustment**

Prior research investigating human behavior provides evidence that humans have limited information-processing capacity (Miller 1956; Slovic and Lichtenstein 1971; Newell and Simon 1972), and the type of task that a person is presented with plays a large role in determining the judgment strategies employed by the individual (Edwards 1971; Simon and Newell 1971; Payne 1976; Slovic et al. 1977; Einhorn and Hogarth 1981). This literature suggests that when humans are confronted with a complex/difficult judgment they resort to cognitively tractable decision strategies known as heuristics (Joyce and Biddle 1981). In other words, humans tend to use heuristics, or rules of thumb, to reduce complex inference tasks to manageable proportions (Libby 1981). While the use of heuristics is sometimes highly economical and effective, they often lead to systematic judgment errors (biases) that can provide significantly less than optimal outcomes (Kahneman et al. 1982). Heuristics lead to biased judgments that often imply fundamentally different cognitive activity than normative models (e.g., Bayes' Theorem). Variables present in normative models are often ignored in heuristically-based judgments and vice versa (Joyce and Biddle 1981).

In many tasks, individuals are responsible for evaluating a sequence of new information. When evaluating such information, an initial value or starting point (anchor) is sometimes used by judges as a reference point for processing all new information. After processing the new information, this anchor is adjusted to account for the new information or to make a judgment. This adjustment is typically in the normatively appropriate direction, but generally not of sufficient magnitude (Joyce and Biddle 1981). That is, different starting points yield different outcomes, which are biased towards their starting points (Kahneman et al. 1982). This phenomenon is generally referred to as the anchoring heuristic (Tversky and Kahneman 1974).

Judges involved in a similar task may use the same anchor for a given judgment. For example, auditors often use prior year risk assessments, programs, and budgets during the planning/internal control phase of a current year audit (Libby 1981). Prior research indicates that auditors often rely or anchor on the contents of prior year workpapers during the course of their current year audits.

Joyce and Biddle (1981) was the first study of anchoring in the audit environment. They found that when auditors were presented with a judgment regarding the extent of current year substantive tests, their reactions to current year internal control information were affected by the prior year's assessments of internal controls at the client (the anchor). Therefore, auditor adjustments to certain current year information depended on certain conditions in the prior year. This evidence suggests that the use of anchors in an audit setting may not be a highly effective strategy (e.g., it may promote under-auditing). In addition, this investigation showed that experienced auditors could be influenced by

anchoring in the same manner as the naïve subjects in Tversky and Kahneman's (1974) original study of the anchoring heuristic.<sup>10</sup>

The experimental study by Kinney and Ueker (1982) revealed that auditors were susceptible to the anchoring heuristic when performing analytical reviews and compliance sampling (two commonly performed duties during an auditing engagement). They also extended the findings of Biddle and Joyce (1981), in that they found that the anchoring effect did not always occur. These results suggested that the magnitude of the anchoring effect might be moderated by other factors. While the study did not identify any specific moderating factors, this finding provides evidence that the anchoring effect may vary between individuals and tasks. Butler (1986) continued this stream of research and found that auditors used the anchoring heuristic when performing their substantive tests of details.

SAS No. 47 (AICPA 1983) requires auditors to assess the risks associated with a current year audit and to incorporate these risks into their planned substantive procedures. Monroe and Ng (2000) view these current year planning judgments as belief revision tasks with the auditor's prior year assessments, audit programs, etc. serving as anchors that are revised, often insufficiently, by succeeding pieces of evidence or information (e.g., current year implementation of an ERP module). The Belief Adjustment Model (Hogarth and Einhorn 1992), which predicts that the belief revision process will be affected by the judge's sensitivity towards the evidence and utilization of heuristics, will

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<sup>10</sup> Tversky and Kahneman (1974) used students as subjects performing tasks with which they maintained little to no experience or expertise (e.g., estimating the percentage of African countries in the United Nations based on an arbitrary starting point). Evidence supporting the use of heuristics by experienced auditors should be of little surprise, given the belief held by researchers in the field of psychology that anchoring is common to naïve and sophisticated subjects (Kahneman et al. 1982).

be used in this study to predict auditor planning judgments. Auditors' AIS expertise levels and CAS competence (see section 2.4) are expected to influence their reactions to audit evidence, while the effect of the anchoring heuristic on their planning judgments is explicitly considered. While prior research has used other models to predict auditors' belief revisions (e.g., Cascaded Inference Theory (Schum and DuCharme 1971)), a study by Krishnamoorthy et al. (1999) found that the Belief Adjustment Model best predicted auditor belief revision in a planning judgment.

Prior research has found that auditors use the anchoring heuristic when making planning judgments. For example, in their analysis of actual audit workpapers, Mock and Wright (1993) observed little variation in risk assessments for clients over time. Similar results were found for the extent of substantive tests, as they were strongly related to actual hours expended in the prior year. Mock and Wright suggest that these findings indicate an anchoring and adjustment strategy "that may not be sufficiently adaptive" (Mock and Wright 1993, 49).<sup>11</sup> Wright and Bedard (2000) found, via experimental methods, that auditors anchored their budgeting decisions on the prior year audit hours and did not sufficiently adjust for differences in risks. Protocol analysis revealed that all auditors in the high-risk condition evaluated prior year figures before developing their current year budget.

As stated previously, heuristics research suggests that the influence of a heuristic on a judgment is positively related to the complexity of the judgment. Therefore, the

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<sup>11</sup> SAS No. 22 (AICPA 1978) requires that all workpapers be reviewed by a more senior auditor. Thus, the finding of an anchoring and adjustment strategy in actual workpapers indicates that the utilization of anchoring or other heuristics among auditors may not always be mitigated by the review process as suggested by prior research (e.g., Kennedy 1993, Tan 1995). This utilization of the anchoring heuristic by auditors, despite the anticipation of a review, is also supported by the experimental results of Brazel et al. (2004).

influence of a particular anchor (e.g., prior year workpapers) on a given judgment may be dependent on the judge's own perceptions of task or judgment complexity. Reliance on prior year workpapers appears to be an effort-reducing process used by auditors (Brazel et al. 2004). For an auditor, the decision to rely on prior year workpapers may also depend on the trade-off between (a) the costs of exerting effort to reduce reliance on prior year workpapers and (b) the benefits obtained from such effort (Beach and Mitchell 1978; Payne 1982). In advanced AIS environments (e.g., ERP systems), both the perceived complexity of auditor judgments related to the system and the cost/benefit tradeoff of anchoring to prior year workpapers may be influenced by the auditor's self-perceptions of AIS expertise.

Bell et al. (1998) state that while auditors may understand many control concepts in traditional information systems, this understanding may be lacking when applied to technology-based information systems, since controls are implemented much differently in such an environment. The evolution of information technology will require auditors to upgrade their ability to evaluate systems as the systems themselves become more complicated (Elliot 1997; POB 2000). Therefore, as auditor AIS expertise increases, perceptions of task complexity may decrease in areas affected by AIS. This reduction in task complexity should lead to lower perceived costs (effort) associated with reducing reliance on prior year workpapers. Auditors with higher AIS expertise may also believe that this additional effort will produce greater benefits, as they will be able to use their knowledge base to increase audit effectiveness. Thus, it is expected that auditors with greater AIS expertise will have a lower reliance on prior year workpapers that will allow them to more fully incorporate the heightened risks associated with advanced AIS

(as described in section 2.3.1) into their planning judgments (e.g., increase inherent risk assessments). For auditors with lower self-perceived AIS expertise, it is expected that they will view planning judgments affected by AIS as being more complex and thus rely more on prior year planning judgments. Given their limited AIS expertise set, these auditors may perceive that the effort (cost) required to reduce reliance on prior year workpapers exceeds the limited benefits that any additional effort may produce.

#### **2.4 Computer Assurance Specialist Competence**

The goal of any audit of a client's financial statements is to determine whether the financial statements fairly present the results of operations and the financial position of the entity in conformity with generally accepted accounting principles (GAAP). During the course of their audits, standard guidance in the profession requires auditors to gather sufficient, competent evidential matter to support their opinion regarding the financial statements under audit (AICPA 1988a). Evidence is defined as any information used by the auditor to determine whether the financial statements being audited are in accordance with GAAP (Arens et al. 2003). The ability of the auditor to gather and evaluate this evidence will, in turn, play a role in determining both the overall effectiveness and efficiency of an audit (American Accounting Association 1973; Hirst 1994). Along with the gathering and evaluating of evidence that occurs within audit engagement teams consisting of auditors (e.g., evidence from management, subordinate auditors, internal auditors), auditors often rely on other professional or specialist opinions when examining the financial statements of a client (Brown 1983). For example, an auditor may rely on the opinion of an attorney when evaluating the reasonableness of a client's contingent

liability calculation. Prior literature has demonstrated that the perceived reliability or inferential value of such evidence is typically dependent on the reliability of its source, and these perceptions affect related auditor judgments (e.g., Bamber 1983; Brown 1983; Margheim 1986).

#### **2.4.1 Computer Assurance Specialists**

According to SAS No. 94 (AICPA 2001), in audit engagements where client accounting information systems (AIS) are deemed to be dominant and/or complex, one or more computer assurance specialists (CAS) should be used on the engagement. In practice, CAS are typically from the same firm as the auditor, are considered part of the engagement team, and play a large role in both gaining an understanding of, and testing, the internal controls of clients with advanced AIS (Ayers and Nagy 1998; Curtis and Viator 2000; Hunton et al. 2001; Wright and Wright 2002). Also, the role of CAS as a source of audit evidence will likely increase as clients with complex and pervasive AIS become more prevalent (POB 2000).

Unlike other specialists whose opinions relate to the reasonableness of specific client assertions (e.g., an actuary's opinion with respect to a client's fiscal year end pension liability), the quality of CAS work affects the efficiency and effectiveness of the audit in relation to all areas that are affected by the client's AIS. As discussed in section 2.3 above, advanced AIS (e.g., ERP systems) have become so dominant that typically all account balances/transactions are affected by the reliability of the AIS. As AIS have become more dominant and complex, auditors' abilities to "audit around" the system have been significantly reduced (Ellis 1989; Bell et al. 1998, 16). Therefore, the use of

CAS and the evaluation of their evidence has become an imperative activity for auditors during the planning and internal control evaluation phases of their audits (POB 2000).

Auditor interactions with specialists who are external to the audit firm (e.g., actuaries, appraisers) are governed by SAS No. 73 (AICPA 1994), which addresses using the work of a specialist in an audit. SAS No. 73 places limited requirements on the auditor with respect to the supervision and review of the external specialists. As CAS are generally within-firm specialists and considered part of the engagement team, SAS No. 94 (AICPA 2001) states that auditors who use such a specialist should follow the supervision and review guidance set forth by SAS No. 22 (AICPA 1978). SAS No. 22 dictates that CAS require the same degree of supervision and review as audit assistants. As such, research is needed to investigate how auditors interact with CAS.

#### **2.4.2 Source Reliability**

As stated earlier, one of the essential responsibilities of an auditor is the evaluation of audit evidence (e.g., management provided calculations; CAS internal control testing workpapers). Indeed, generally accepted auditing standards, such as SAS No. 53 (AICPA 1988a), require auditors to exercise a proper degree of professional skepticism when evaluating evidence. A major dimension of the process of evaluating audit evidence is assessing its reliability (Rebele et al. 1988). According to Mautz (1958), one characteristic of evidence that can affect its reliability is the reliability of the source from which the evidence is obtained (e.g., client management, CAS). Therefore, the auditor must assess the source reliability of audit evidence, in conjunction with other issues<sup>12</sup>, before it can be accepted in support of an audit opinion. If an auditor does not

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<sup>12</sup> For example, the materiality of the item being audited may affect the process of evidence evaluation.

appropriately consider source reliability, the efficiency or effectiveness of an engagement may be reduced. If unreliable evidence is overweighted, underauditing can ensue. Placing undue reliance on unreliable evidence could increase the risk of audit failure (Hirst 1994).

Source reliability is generally viewed as being a function of the source's objectivity and competence (Margheim 1986; Rebele et al. 1988; Hirst 1994; Anderson et al.; Peecher 1996; Haynes 1999). Auditors obtain evidence from a variety of sources during the course of an audit engagement. Often the source of audit evidence or information is a subordinate member of the engagement team (e.g., a CAS provides the auditor in-charge of audit fieldwork with internal control testing workpapers). When auditors review such evidence, the competence of the subordinate (source) is evaluated to determine the extent to which their work can be relied on by the auditor when making his or her own judgments (Bamber 1983).<sup>13</sup> Within an engagement team, source objectivity is generally considered a less relevant component of a source's reliability, as members of the audit engagement team should be independent of the client.

### **2.4.3 Prior Source Competence Research**

Competence is defined as “the state or quality of being adequately qualified; ability” (The American Heritage College Dictionary 1997, 284). Prior research has shown that auditors are sensitive to the competence of their evidence sources and these competence levels affect auditors' judgments in relation to the audit evidence. Bamber (1983) examined auditor sensitivity to the competency of their own staff, specifically

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<sup>13</sup> An audit is usually conducted by an audit team that is characterized by a hierarchical structure and a division of labor (Bamber 1983). Thus, the representations or conclusions of subordinates are often relied on when their superiors make judgments. For example, an audit manager relies on an audit senior's sales cut-off testing when making judgments with respect to the reasonableness of the sales account or whether an audit adjustment may be necessary.

audit manager evaluations of evidence provided by senior auditors. Results indicated that auditors were sensitive to experimental manipulations of source competence. Audit managers discounted the inferential value of evidence provided by a less competent senior.

Brown (1983), Schneider (1984), and Margheim (1986) all studied auditor evaluations of the source competence levels of internal auditors. Brown (1983) found that internal auditor competence was positively related to the degree of reliability placed on the internal audit function by auditors. The objective of Schneider's (1984) investigation was to develop a descriptive model of the way auditors use information regarding internal auditor competence, objectivity, and prior year performance when evaluating the strength of internal audit. An additive model was determined to be most appropriate, with all three factors having a positive and significant impact on auditor perceptions of internal audit strength. Margheim (1986) examined whether auditors adjust the scope of their audit procedures in reaction to variation in the source competence of internal auditors. The results of the study indicated that auditors reduced planned audit hours when confronted with higher levels of internal auditor competence.

Auditors often rely on representations or evidence provided by client management or accounting personnel. Rebele et al. (1988) and Anderson et al. (1994) both documented that auditor reliance on management representations was positively affected by the competence level of management. When forming their judgments of the true value of a client's uncollectable receivables, auditors placed more reliance on evidence obtained from client personnel with greater expertise (Rebele et al. 1988). Auditors obtaining explanations for unexpected account fluctuations were also found to be

sensitive to the competence of management (Anderson et al. 1994). Explanations received from a client manager possessing high competence were judged to be more reliable by auditors. However, and contrary to expectations, auditor reliability judgments were not dependent on when the competence information was received by the auditor. Haynes (1999) used the cascaded-inference (i.e., multi-level) paradigm to investigate how auditors evaluate evidence received during management inquiry. Contrary to predictions made by cascaded-inference theory, auditors were more sensitive to variations in source reliability (i.e., first level of inference) than variation in evidence uncertainty (i.e., second level of inference).

Hirst (1994) asked audit seniors to judge the inferential value of evidence related to an inventory balance. The evidence was provided by a specialist who was either highly or not highly competent with respect to the specific type of inventory presented in the case. The results of Hirst's study were consistent with prior source competence research, in that evidence reported by a more competent specialist was considered more diagnostic than evidence obtained from a less competent specialist.

While not explicitly examined in the literature, it appears that in practice there is variability in CAS competence. To gain additional insight into auditors' perceptions of CAS competence, nine auditors at either the senior or manager level completed a survey (see Appendix A for the survey). Eight of the nine auditors believed that the level of CAS competence had been an issue of concern on their audit engagements. The results of this survey indicate that variation in CAS competence exists and auditors appear to be sensitive to that variation. In addition, Hunton et al. (2001) found that auditors were unlikely to engage the services of CAS in ERP environments, suggesting that auditors

may question the value CAS provide with respect to the effectiveness and efficiency of their engagements.

The findings of prior source competence studies indicate that auditor judgment processes, evidence reliability judgments, and related planning judgments are all affected by the competence of evidence sources (e.g., Brown 1983; Schneider 1984; Margheim 1986). As stated above, CAS represent a significant source of internal control testing evidence in advanced AIS environments and auditors have reported variation in CAS competence.<sup>14</sup> Therefore, it is reasonable to expect that variation in CAS competence should affect the internal control-related judgments of auditors. Specifically, as CAS competence levels increase, auditors' perceptions regarding the reliability of their internal control testing evidence should increase. Also, control risk assessment levels should be decreased in reaction to increased test strength (Libby et al. 1985; Maletta and Kida 1993). It is therefore expected that auditors should perceive the tests of a more competent CAS to be stronger, and thus assess control risk at lower levels than auditors interacting with a less competent CAS. Lastly, as CAS competence increases, auditors should plan audit procedures that are smaller in scope, because auditors utilizing a CAS with low competence should mitigate higher control risk assessments via additional substantive procedures (AICPA 1983; Margheim 1986).

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<sup>14</sup> Unless provided with evidence to the contrary, audit guidance states that auditors are to assess risk levels at maximum levels (AICPA 1983). As discussed in detail in footnote 4, CAS evidence in this study will be positive in nature (i.e., AIS internal controls appear reliable). Thus, positive CAS evidence provides auditors with support to reduce their control risk assessment levels below maximum (consistent with the prior year's assessment).

## **2.5 Auditor Accounting Information System Expertise**

One aspect of the CAS/auditor relationship that differs from virtually all prior source competence studies is that CAS represent a source of audit evidence with a different expertise structure than that of auditors (Curtis and Viator 2000; Hunton et al. 2001). Given a specified level of CAS competence, the size of the AIS expertise gap between the evidence source (CAS) and the evidence examiner (auditor) depends on the level of expertise the auditor maintains in the AIS domain (POB 2000). As the AIS gap between the CAS and the auditor widens (i.e., lower auditor AIS expertise), it may become less likely that the auditor will have the ability to compensate for CAS competence deficiencies (i.e., weak control testing). Also, prior audit expertise research has shown that domain-specific expertise, determined by the nature of auditor experience and training, improves the domain-specific performances of auditors (Bonner 1990; Bonner and Lewis 1990; Hunton et al. 2002). These findings suggest that, in complex AIS settings (e.g., ERP systems), higher levels of auditor AIS expertise may improve the quality of their risk assessments, and in turn, the effectiveness of their substantive planning decisions.

### **2.5.1 AIS Expertise Gap**

Prior source competence studies have typically examined scenarios where the evidence source and the auditor maintain similar expertise structures. For example, Bamber (1983) and Rebele et al. (1988) studied auditor sensitivity to changes in the competence of audit seniors and client accounting personnel, respectively. With these studies, little variation is expected in auditors' abilities to perform additional procedures or mitigate risks when evidence sources with low competence are encountered. For

example, the majority of senior auditors are aware of, and competent to perform, additional substantive testing to substitute for inadequate tests performed by an assistant with low competence. Indeed, a review of the source competence literature offers no evidence of variation in the performances of auditors when confronted with less competent evidence sources.

Hirst (1994) represents the only source competence study that used specialists as the source of evidence. In the study, source competence was manipulated by describing the evidence source as either a specialist in an industry related to the evidence (test of inventory account) or not. Participants were asked to evaluate the inferential value of evidence provided by the specialists, but were not asked to provide judgments that might have challenged their knowledge structures (e.g., make and document risk assessments, prepare an audit program). Therefore, the effects of any variation in auditor expertise on their related source competence judgments could not be identified. In addition, Hirst's task was the evaluation of an inventory obsolescence account, a task where auditors are generally uniformly educated/trained. Variation in inventory-related expertise between auditors may not have been significant enough to moderate their source competence reactions. Lastly, in Hirst's study the evidence provided to subjects was a report examining an unexpected fluctuation in inventory. Participants were informed that the evidence source was either a specialist in the retail industry (high competence) or a specialist in the banking and insurance industry (low competence). Specialists in banking and insurance industry generally have little competence beyond the typical auditor with respect to inventory, as these industries do not produce or sell inventory as their main line of business. Therefore, while Hirst did manipulate the competence or technical ability of

the evidence source, it is possible that the participants in his study did not perceive the banking and insurance specialist to be a specialist in relation to the evidence provided. In this study, the appropriate specialist (CAS) was assigned to the task of evaluating AIS internal controls in all experimental conditions. Source competence was manipulated between participants by providing them with information regarding the competence level of the CAS.

As stated previously, CAS represent a source of audit evidence with a different expertise structure than that of auditors (Curtis and Viator 2000; Hunton et al. 2001). The experience and training of CAS focuses on AIS processes, controls, etc., while auditors devote more resources to improving their knowledge of generally accepted accounting principles, auditing standards, etc. Given these divergent expertise structures, it is reasonable to assume that there is an AIS expertise gap between CAS and auditors. The Public Oversight Board's (POB) recent study on audit effectiveness stressed the importance of auditor AIS expertise as a key determinant of the successfulness of CAS/auditor interactions. The POB indicated that, in advanced AIS environments, CAS and auditors will need to "work as a team" and auditors will need to "expand their technological knowledge and skills," as they "cannot cede all technological matters" to CAS (POB 2000, 171).

Given a specified level of CAS competence (e.g., high or low), the size of the expertise gap between the evidence source (CAS) and the evidence examiner (auditor) is dependent on the level of AIS expertise maintained by the auditor. Sophisticated audit skills are required in advanced AIS settings (Lilly 1997; Hunton et al. 2001). Thus, as the size of the expertise gap widens (i.e., auditor AIS expertise decreases), it becomes less

likely that the auditor will compensate for any perceived CAS competence deficiencies (i.e., inadequate control testing). First, auditors with low AIS expertise may not have the abilities or confidence to design and perform additional/alternative procedures to mitigate the risks induced by low CAS competence. This expectation is consistent with the theory of planned behavior (Ajzen 1985, 1987) and Bandura's (1977, 1982) compatible concept of perceived self-efficacy. Under these theories, perceived behavioral control or self-efficacy beliefs can influence: choice of activities, preparation for an activity, effort expended during performance, and thought patterns. Prior studies (Bandura et al. 1977; Bandura et al. 1980) have shown that "people's behavior is strongly influenced by their confidence in their ability to perform" the behavior (Ajzen 1991).

Secondly, as auditor AIS expertise decreases, the difficulty of assessing control risk and planning the scope of substantive procedures increases (see section 2.3 for a more detailed discussion of this topic). In such scenarios, auditors with lower AIS expertise may be more apt to rely (anchor) on prior year control risk assessments, audit programs, and budgets (as discussed in section 2.3). Auditors with higher levels of AIS expertise, on the other hand, may be more likely to act on CAS competence deficiencies (i.e., increase control risk assessment levels and the scope of planned substantive procedures) because they are better able to plan and competently perform the additional audit procedures required to compensate for a lack of CAS competence. The above discussion suggests that the level of auditor AIS expertise may affect the magnitude of an auditor's reactions (i.e., control risk assessment levels and the scope of planned substantive procedures) to low CAS competence. In conditions where CAS competence is high, the effect of auditor AIS expertise on planning judgments is expected to be

reduced as it is more appropriate to rely on CAS evidence in this condition (Bamber 1983; Hirst 1994).

### **2.5.2 Judgment Quality and Effectiveness**

Within advanced AIS environments, auditors will find it necessary to fully understand the risks associated with these systems and the controls needed to respond to those risks (POB 2000). Chi et al. (1982, 8) define expertise as “the possession of a large body of knowledge and procedural skill.” Given the significant risks and complexities associated with ERP systems, AIS expertise may be an important factor in planning effective and efficient audits in such settings (Wright and Wright 2002; Guess et al. 2000). Prior research has shown that increased levels of expertise in specific domains can improve the domain specific performances of auditors (Bonner 1990; Bonner and Lewis 1990; Hunton et al. 2001).

Expertise studies in auditing have “mainly used the contrastive cross-sectional approach, where groups of experts and novices are compared on various dimensions” (Bedard and Chi 1993, 23). While these studies are useful in identifying the differences between more and less experienced auditors, they offer little explanation for the causes of these differences (Bedard and Chi 1993) and do not examine why variation exists in the performances of auditors with same level of general audit expertise.

Bonner (1990) examined whether task/domain-specific knowledge aids the performances of auditors. The study noted the importance of investigating domain-specific expertise (vs. general audit experience) when attempting to explain differences in task performance in environments that challenge specific forms of knowledge (e.g., the role of auditor AIS expertise in ERP settings). Bonner compared the performances of

experienced and inexperienced auditors in two tasks: analytical risk assessment and control risk assessment. The paper documents that the domain-specific expertise gap between experienced and inexperienced auditors should be larger in the analytical risk assessment and smaller in the control risk assessment, provided their respective experiences and training. Given these differences, the study hypothesized that the differential performance between more and less experienced auditors would be greatest in the analytical risk assessment. Consistent with this hypothesis, results indicated that domain-specific knowledge aided the performance of experienced auditors in both cue selection and cue weighting in the analytical risk assessment. In other words, experience interacted with task to affect auditor performance. These results indicate that researchers should consider the characteristics of a given task to determine the form of domain-specific expertise most responsible for variation in performance.

Bonner and Lewis (1990) attempted to distinguish between the effects of general audit experience and domain-specific expertise on auditor performance in information-processing tasks. Specifically, the study used various types of knowledge and ability measures to explain cross-sectional variation in auditors' performance in several audit tasks. These results were then compared to the explanatory power of general audit expertise. The data revealed that, while the more experienced auditors outperformed less experienced auditors, domain-specific knowledge provided a more powerful explanation of auditor performance. Given the study's findings, the authors "suggest that researchers pay more attention to the criteria used to designate subjects as experts, either directly by the use of objective performance measures or indirectly by the use of well-specified measures of knowledge and ability" (Bonner and Lewis 1990, 2).

Presently, no prior research studies have attempted to investigate if variation in auditors' AIS expertise (a form of domain expertise) explains differences in their performance levels in complex AIS environments. While not an exception to this premise, Hunton et al. (2001) do provide some evidence that auditor AIS expertise levels may affect their performance in AIS-related tasks. Their study examined the extent to which different types of auditors, CAS and financial statement auditors, recognize differences in the nature and extent of unique business risks associated with ERP systems. The authors hypothesized that knowledge differences between these two types of auditors would affect their risk recognition performance. Results indicated that, relative to auditors, CAS were significantly more aware of, and concerned with the following risk risks in an ERP setting: business interruption, network security, database security, application security, process interdependency, and overall control risk. Unlike CAS, auditors also failed to recognize a seeded control weakness in the ERP system. While not explicitly examining the effect of AIS expertise between auditors of financial statements, this study does suggest that, as AIS expertise increases, performance in AIS-related audit tasks should improve.

Prior research has shown that domain-specific expertise should improve domain-specific performance. Given the significant risks and complexities associated with ERP systems, auditor AIS expertise (a form of domain-specific knowledge) is an important factor in planning effective and efficient audits in such settings (Wright and Wright 2002). Therefore, it is expected that, as auditor AIS expertise increases, performance in AIS-related planning judgments should improve. First, as auditor AIS expertise increases, so should the quality of their risk assessments. Second, auditors equipped with higher

levels of AIS expertise should have more of the knowledge base required to prepare effective audit programs and budgets in advanced AIS settings. Also, the audit risk model (AICPA 1983) states that substantive planning should be affected by the risk assessments of auditors (see section 2.2). Thus, since auditors with higher levels of AIS expertise are predicted to make higher quality risk assessments, their substantive planning judgments should also be more effective.

## CHAPTER 3: HYPOTHESES AND METHODOLOGY

### 3.1 Introduction

This study examines the effects of computer assurance specialist (CAS) competence and auditor accounting information system (AIS) expertise on auditor planning judgments in a complex AIS environment. Both the form (e.g., level of the inherent risk assessment) and the effectiveness (e.g., quality of the inherent risk assessment) of auditors' planning judgments are investigated. Hypotheses are developed in this chapter. Tests for these effects involved a quasi-experimental auditing case that placed audit practitioners (participants) in the planning/internal control phase of a client audit with a computer-dominated accounting system.

Participants were informed that an Enterprise Resource Planning (ERP) system module (Sales and Distribution) was implemented in the current year. After receiving planning materials related to the transaction cycle affected by the ERP module implementation (sales and accounts receivable), participants were asked to assess the preliminary inherent risk level associated with the cycle. In addition, participants were told that a CAS was assigned to the engagement to assist the auditor in obtaining an understanding of the system and testing the internal controls of the cycle. The competence of the CAS as a source of audit evidence was manipulated between participants as high and low. After receiving internal control testing evidence from the CAS and learning about the competence of the CAS, participants' perceptions regarding the reliability of CAS evidence were measured. Next, they assessed the preliminary control risk level for the transaction cycle and prepared audit programs and budgets for

substantive tests.<sup>15</sup> Lastly, participants' self-assessed accounting information system (AIS) expertise, along with other variables, were measured via a post-experimental questionnaire.

The quality of the participants' risk assessments and the effectiveness of their scope of planned substantive procedures were determined by two groups of audit experts. Each expert group reviewed the case under one of the two CAS competence conditions (i.e., high or low). Participants' risk assessment quality was measured via their absolute deviation from the mean assessments of the experts assigned to their case and the effectiveness of participants' planned substantive procedures was evaluated individually by the group of experts that reviewed and completed their respective case (i.e., high or low CAS competence).

## **3.2 Hypotheses**

### **3.2.1 ERP Systems and Auditor AIS Expertise**

While the positive aspects of enterprise resource planning (ERP) systems (e.g., real time data, shortened cycle times) have made them the computing environment of choice among many corporations (Brown 1997; O'Leary 2000; Hunton et al. 2001), there are significant risks associated with their implementation (Wright and Wright 2002). Inherent risks are heightened in the periods immediately following ERP implementations as issues such as inadequately trained personnel, improper data input, and interdependencies among business processes can lead to an increased potential for

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<sup>15</sup> Separate, rather than joint, assessments of inherent and control risk were made by the participants in this study. In a recent examination of inherent and control risk assessments, Messier and Austen (2000) found that seventy-five percent of their subject pool of Big 6 auditors indicated that their firm made separate assessments of inherent and control risks.

financial statement misstatements, misclassifications, and defalcations (e.g., Gibbs and Keating 1995; Helms 1999; Lilly 1997; Manello and Rocholl 1997; Pfenning 1999; Turner 1999; O’Leary 2000; Soh et al. 2000; Wah 2000; Hunton et al. 2001). ERP implementations have also been found to increase control risk, as the focus shifts from segregation of duties to greater access. Also, minimal supervisory review is performed, and supplemental internal control applications are often not properly integrated with the ERP system (Turner 1999; Wright and Wright 2002). These increased inherent and control risks associated with ERP systems are expected to be greatest in the periods immediately following implementation as, over time, companies are more likely to address these issues. Audit guidance prescribes (and prior research suggests) that auditors typically do react to increased risks by increasing risk assessments and the scope of planned substantive procedures (AICPA 1983; Houston 1999; Wright and Bedard 2000). However, in advanced AIS environments, the magnitude of these planning judgments (e.g., level of the inherent risk assessment) may be dependent on the auditor’s level of AIS expertise.

Monroe and Ng (2000) view the auditor risk assessment process as a belief revision task, with the individual’s prior year assessment serving as an anchor. This anchor is then revised, often insufficiently, by succeeding pieces of evidence or information (e.g., current year implementation of an ERP module) to create a current year assessment. For auditors, reliance on prior year assessments as an anchor tends to increase as task difficulty increases (Joyce and Biddle 1981).<sup>16</sup>

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<sup>16</sup> The Belief Adjustment Model (Hogarth and Einhorn 1992), which predicts that the belief revision process will be affected by the judge’s sensitivity towards the evidence and use of heuristics, is used in this study’s development of Hypotheses 1-5. Auditors’ AIS expertise levels and CAS competence (see section

Auditors with low self-assessed AIS expertise may feel that the task of increasing or changing current year risk assessments from those of the prior year is beyond their knowledge base/abilities (Ajzen 1991). These auditors may therefore be more prone to rely on the prior assessments as an anchor. On the other hand, high AIS expertise auditors should assess current year risks as higher than low AIS expertise auditors. Auditors with high expertise are expected to be more aware of the possible risks associated with a current year ERP system implementation. Hunton et al. (2001) found that auditors with higher levels of AIS expertise were more cognizant of risks related to ERP systems. This increased awareness of risks among high AIS expertise auditors should typically lead to higher assessed preliminary risk levels, as professional skepticism should be exercised to achieve reasonable assurance that material misstatements are detected (AICPA 1988a).<sup>17</sup>

Auditors with higher AIS expertise will follow the audit risk model guidance and therefore increase the scope of planned audit procedures beyond that of low AIS expertise auditors to mitigate their higher risk assessments (AICPA 1983). In addition to following the model's guidance, it is expected that auditors with greater AIS expertise will have the knowledge to plan and competently perform expanded audit procedures to effectively mitigate such risks. Low AIS expertise auditors, on the other hand, may

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3.3.4.1 for a discussion of CAS competence) are expected to influence their reactions to audit evidence, while the effect of the anchoring heuristic on their planning judgments is explicitly considered in the development of hypotheses. While prior research has used this and a variety of other models to predict auditor belief revision (e.g., Cascaded Inference Theory (Schum and DuCharme 1971)), a study by Krishnamoorthy et al. (1999) found that the Belief Adjustment Model best predicted auditor belief revision in a planning judgment.

<sup>17</sup> One of the primary purposes of this study is to investigate how auditor AIS expertise influences their awareness and reactions to possible risks associated with an ERP system implementation. As such, no explicit list of possible inherent and control risks related to the current year implementation was provided to participants. Auditors were asked to provide preliminary assessments of inherent and control risk and to document specific risk issues to be further investigated or that support their assessment. As auditor AIS expertise should increase auditor awareness of ERP risks, it is predicted that as auditor AIS expertise increases the preliminary risk assessments of auditors should increase. For ease of presentation, these preliminary assessments are sometimes referred to as "assessments."

perceive that expanding substantive tests will only decrease audit efficiency. For example, increasing the budget of a substantive test, which does not increase the audit's effectiveness in an advanced AIS setting, would lead to a decrease in audit efficiency.

The above discussion suggests that auditors with greater AIS expertise will assess both inherent and control risks at higher levels than auditors with lower AIS expertise in advanced AIS environments. Auditors with higher AIS expertise should also increase the scope of planned substantive audit procedures beyond that of low AIS expertise auditors.

Thus, the following hypotheses are tested:

H1a: Auditors with high AIS expertise will assess inherent risk at a higher level than auditors with low AIS expertise.

H1b: Auditors with high AIS expertise will assess control risk at a higher level than auditors with low AIS expertise.

H1c: Auditors with high AIS expertise will plan substantive audit procedures that are greater in scope than auditors with low AIS expertise.

### **3.2.2 Computer Assurance Specialist Competence**

Prior research has consistently found auditors to be sensitive to the perceived competence of their evidence sources. This literature has shown that auditors discount the inferential value/reliability of evidence received from sources of lower competence (e.g., Bamber 1983; Brown 1983; Anderson et al. 1994; Hirst 1994). Given their tendency to be sensitive to source competence, auditors are likely to consider CAS competence when evaluating evidence provided by CAS. Specifically, auditors should judge evidence from a more (less) competent CAS as more (less) reliable. Consequently, the following hypothesis is investigated:

H2: Auditors will judge evidence from a CAS with high competence as more reliable than evidence from a CAS with low competence.

CAS primarily test, and provide evidence regarding the reliability of, internal controls for computer-dominant audit clients (AICPA 2001). Prior research has described the control risk assessment as consisting of: (1) client control strength, (2) auditor test strength, and (3) auditor test results (Libby et al. 1985; Maletta and Kida 1993). SAS No. 47 (AICPA 1983) advises auditors that, absent contradictory evidence, risk levels should be assessed at their maximum. Also, prior research suggests that auditors will likely perceive tests of internal controls (i.e., auditor test strength) performed by a CAS of higher competence to be stronger than those of a less competent CAS (Bamber 1983; Hirst 1994). Thus, when provided with evidence from a CAS which specifies the system controls are reliable, an increase in the perceived level of CAS competence should lead to larger reductions of control risk by auditors (Arens et al. 2003).<sup>18</sup> Specifically, when CAS competence is higher, auditors may perceive CAS control test strength as stronger and, given CAS tests that support a reduction of control risk below maximum, decrease the level of control risk accordingly. On the other hand, similar positive evidence obtained from CAS with low competence is likely to result in less reliance on that evidence and, in turn, control risk assessments that are higher or closer to the maximum level. It is also proposed that as CAS competence increases, the scope of planned substantive procedures should be decreased, as auditors should decrease procedures to compensate for lower control risk levels (AICPA 1983). Therefore, the following hypotheses are examined:

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<sup>18</sup> As described in footnote 4, the results of CAS tests of controls were positive and kept constant between subjects (i.e., AIS controls appear reliable). Therefore, Hypothesis Sets 3 and 4 were developed given that the results of CAS tests of controls should warrant an assessment of control risk below the maximum level (i.e., 100 percent). Also, the prior year control risk assessment was set at 40% or indicated a reduction of control risk from the maximum level. Thus, the positive current year control testing results from the CAS should justify an auditor control risk assessment that is below the maximum level and relatively consistent with the prior year.

H3a: Auditors using positive evidence from a CAS with high competence will assess control risk at a lower level than auditors using positive evidence from a CAS with low competence.

H3b: Auditors using positive evidence from a CAS with high competence will plan substantive audit procedures that are lesser in scope than auditors using positive evidence from a CAS with low competence.

### **3.2.3 Auditor Accounting Information System Expertise**

While it is expected that auditors will be sensitive and react to variation in CAS competence, the magnitude of auditors' reactions to CAS may not be homogenous. CAS and auditors maintain different expertise structures (Curtis and Viator 2000; Hunton et al. 2001), and the size of the AIS expertise gap between CAS of low competence and auditors may affect auditors' planning judgments. Under conditions of low CAS competence, auditors with high AIS expertise may be more likely to assess control risk near the maximum level because they have the ability and confidence to plan and perform additional substantive procedures to compensate for CAS competence deficiencies/higher control risk levels (Ajzen 1991). Under the same condition, auditors with low AIS expertise may be more apt to rely on CAS evidence and not change control risk assessments and substantive procedures from that of the prior year indicating moderate risk, since compensating for CAS competence deficiencies represents a significantly more difficult task for them. The anchoring and adjustment literature suggests that these auditors will be more likely to rely on prior year control risk assessment levels and planned substantive tests rather than increasing their levels and testing, respectively (e.g., Joyce and Biddle 1981). In contrast, auditor AIS expertise effects on their control risk assessments and scope of tests are expected to be reduced when CAS competence is high, as it is more appropriate to rely on the favorable CAS control testing evidence (Bamber

1993; Hirst 1994). The above discussion suggests that CAS competence and auditor AIS expertise may interact to affect auditor planning judgments (see Figure 1 for an illustration of the expected interaction). Thus, the following hypotheses are investigated:

H4a: The difference between high AIS expertise auditors' and low AIS expertise auditors' control risk assessments will be greater when CAS competence is low than when it is high.

H4b: The difference between high AIS expertise auditors' and low AIS expertise auditors' scope of planned substantive audit procedures will be greater when CAS competence is low than when it is high.

Research investigating auditor expertise has found that domain-specific expertise improves auditor performance. Among auditors with the same level of general audit experience, the nature of their experience and training has been shown to differentiate their domain-specific performances (Bonner 1990; Bonner and Lewis 1990). Given the significant risks and complexities associated with ERP systems, AIS expertise (a form of domain-specific expertise) is an important factor in planning effective and efficient audits in such settings (Wright and Wright 2002). For example, Hunton et al. (2001) found that higher levels of AIS expertise increased auditor risk recognition performance in an ERP system environment. Auditors with greater AIS expertise were more likely to recognize a seeded control risk in the study's experimental case. As a result, it is expected that auditor AIS expertise should positively affect the judgment quality of their risk assessments and, in accordance with the audit risk model (AICPA 1983), the effectiveness of their scope decisions. The following hypotheses are therefore tested:<sup>19</sup>

H5a: The quality of inherent risk assessments will be greater for auditors with high AIS expertise than auditors with low AIS expertise.

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<sup>19</sup> See Figure 4 for a matrix summarizing the hypotheses tested in this study. Appendix B models the hypotheses of this study.

H5b: The quality of control risk assessments will be greater for auditors with high AIS expertise than auditors with low AIS expertise.

H5c: Auditors with high AIS expertise will plan more effective substantive audit procedures than auditors with low AIS expertise.

### **3.3 Methodology**

#### **3.3.1 Overview**

The hypotheses of this study were tested via a quasi-experiment using practicing auditors as participants. The task placed the participants in the planning phase of an audit where the client had implemented an ERP system module (Sales and Distribution) in the current year. Participants were provided with instructions, a portion of the audit risk model guidance, background information on the client, prior year and current year workpapers, and information regarding the current year module implementation. After reviewing this information, they were asked to provide a preliminary assessment of inherent risk associated with the transaction cycle (sales and accounts receivable) that was affected by the ERP implementation. Participants were then informed that a CAS was assigned to the engagement team to assist in the understanding and testing of internal controls related to the ERP system. While the types of CAS tests and the final results of those tests were kept constant between subjects (e.g., AIS controls appear reliable, see footnote 4), the competence of the CAS was manipulated between subjects as high and low. After receiving internal control testing evidence from the CAS and learning about the competence of the CAS, participants' perceptions regarding the reliability of CAS evidence were measured. Lastly, they assessed the preliminary control risk level for the transaction cycle and prepared audit programs and budgets for substantive tests.

After the completion of the task, a post-experimental questionnaire was used to measure participants' perceptions of their own AIS expertise, the competence of the CAS (i.e., a manipulation check), and several other variables. The quality of the participants' risk assessments and the effectiveness of their scope of planned substantive procedures were determined by two groups of audit experts (each consisting of three senior managers/partners) who completed the case under one of the two CAS competence conditions (i.e., high or low).

### **3.3.2 Participants**

Practicing auditors from large, international and national public accounting firms served as participants for this study. Participants were audit seniors (auditors in-charge of audit fieldwork). Discussions with several audit managers revealed that this is the level of staff typically responsible for interacting with CAS assigned to test internal controls. In addition, seniors' duties include the evaluation of inherent and control risks, as well as the preparation of audit budgets and programs (Messier and Austen 2000; Houston 1999). Lastly, seniors from large, international and national public accounting firms were used because their client base generally consists of companies that perform the type of ERP implementation that is described in the quasi-experimental task.

### **3.3.3 Quasi-Experimental Task**

The audit seniors (participants) were provided with a cover letter and an experimental instrument by the experimenter (see Appendix C for the quasi-experimental instrument). The cover letter provided a brief description of what the experiment would require of participants. The instrument required approximately 20 to 30 minutes of the participants' time. The experimental instrument contained client background data, the

task objective, audit guidance, client financial statements, prior and current year workpapers, current year information, and a post-experimental questionnaire. These materials were created with the assistance of audit practitioners and pilot tested with audit seniors to enhance the clarity of the instructions, ensure the proper manipulation and measurement of variables, and increase the perceived realism of the case.

The background and task objective sections included a brief description of the client and the experimental task. Specifically, the participants were told to assume they were the audit senior assigned to the year-end audit engagement of a mid-sized manufacturing client that their firm has audited for over ten years. A manufacturing client was used because auditors are most likely to be familiar with the manufacturing industry (Colbert 1988). They were also informed that past audits have always resulted in unqualified audit opinions for the financial statements of the client. In addition, and similar to the prior year, the partner in-charge of the engagement had set audit risk at a low level (i.e., .05). Lastly, participants were told that their task objective was to assess the current year risks and plan the scope of substantive testing for the client's sales and accounts receivable cycle.

A short description of the audit risk model, adapted from SAS No. 47 (1983), was supplied to all participants to assist their understanding of the terminology used in the case (Colbert 1988). Additional client background data provided to the participants at this time included the audited financial statements for the two prior years, plus unaudited financial statements for the current year. The only difference between the financial statements was a reasonable line item increase of 5%, on average, to account for inflation. While providing some additional realism to the experimental setting, the stable

nature of the financial statements presented should not influence participants' risk assessments and audit scope decisions in the current year (Colbert 1988). In addition to the financial statements, participants were provided with monetary precision figures (i.e., tolerable error) for the prior and current years. These figures reflected the average 5% increase that occurred in the financial statements. All of the financial statement and monetary precision information were included in an appendix to the case study.

Prior year workpapers for the sales and accounts receivable cycle (the transaction cycle affected by the current year module implementation) indicated that the prior year inherent and control risk assessments were moderate, and substantive testing programs and budgets reflected these moderate assessments. The provision of prior year workpapers is consistent with practice, as auditors use prior year workpapers when preparing current year workpapers (Libby 1981; Wright 1988). Prior year risk assessments, audit programs, and budgets reflected moderate conditions to allow participants the opportunity to either reduce or increase their risk assessments and scope of substantive procedures in the current year.

Participants were provided with a current year planning workpaper that conveyed information regarding the current year implementation of an enterprise resource planning (ERP) system module by the client. A client environment depicting a current year system change was chosen because in periods where no system change occurs, the role of CAS within the audit team is reduced and auditors become less reliant on their own AIS expertise. Participants were informed that the client was currently in the second year of a planned four-year implementation of an ERP system. Further, participants learned that the client implemented both the Financial Accounting and Materials Management

modules of the system in the prior year and that the Sales and Distribution module was implemented in the current year.<sup>20</sup> Audit engagement management (the audit partner and manager) had concluded that the transaction cycle affected by the current year module implementation was the sales and accounts receivable cycle and that cycle had been deemed to be “computer dominant and complex” for the first time in the current year. The conclusion reached by this workpaper is that audit staff would be used to test the manual internal controls of the system, while a CAS from the firm would be used to test the system controls. After reviewing the planning workpaper, participants were asked to assess and document a preliminary inherent risk level associated with the sales and accounts receivable cycle.

After making their inherent risk assessments, participants were provided with the CAS competence manipulation (See section 3.3.4.1 below) and the internal control testing workpaper prepared by the CAS. With respect to the testing of manual controls, all participants were told that the audit staff assistant who performed the manual control testing was competent and the results of those tests indicated that manual controls for the cycle were reliable. The CAS’s internal control workpaper indicated the types of controls tested in relation to the sales and accounts receivable cycle as well as the results of those tests.<sup>21</sup> The workpaper also concluded system controls to be “reliable.” After receiving the CAS competence information and CAS workpaper, participants’ perceptions of CAS

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<sup>20</sup> In the initial year of ERP implementations, the majority of companies implement the Financial Accounting module that directly affects every transaction cycle (O’Leary 2000). The investigation of such an implementation is beyond the scope of this study. The second year of a planned four-year, phased implementation was chosen because modules that affect specific transaction cycles directly are often implemented at this time (e.g., Sales and Distribution) and risks are greater in the earlier, rather than latter, phases of implementations (O’Leary 2000).

<sup>21</sup> Prior research has described control risk as consisting of (1) control strength, (2) test strength, and (3) test results (Libby et al. 1985; Maletta and Kida 1993).

evidence reliability were measured. Participants were then asked to assess and document a preliminary control risk level associated with the sales and accounts receivable cycle.

After the completion of their risk assessments, participants prepared two audit programs: one for the substantive testing of the sales account and one for accounts receivable. Participants also provided a budget for each substantive procedure within the two programs. The audit programs and budgets allowed participants to determine the nature (i.e., procedures performed and staff level used), timing (i.e., interim or final testing), and extent (i.e., budget) of substantive procedures related to the accounts. As in practice, participants had prior year workpapers available when providing both their current year risk assessments and substantive testing decisions.

When participants finished their audit programs and budgets, they completed a post-experimental questionnaire. First, a CAS competence manipulation check was measured along with some participant perceptions regarding aspects of the case. Next, participants completed a series of questions that measured the independent variable of AIS expertise (see section 3.3.4.2 below). Lastly, participants responded to questions that measured demographic and control variables (e.g., experience levels with: ERP implementations, assessing risks, etc.). See Figure 2 for a diagram of the quasi-experimental task.

### **3.3.4 Discussion of Manipulation and Measurement of the Independent Variables**

#### **3.3.4.1 Computer Assurance Specialist Competence**

The construct of source competence has been operationalized by prior audit research in many different ways. Participants (auditors) in these experiments were exposed to sources of audit evidence that varied in their technical ability, prior work

evaluations received, previous year's audit performance, training, supervision, years of experience, knowledge of the client, education, and defined responsibilities (Bamber 1983; Brown 1983; Schneider 1984; Margheim 1986; Rebele et al. 1988; Anderson et al. 1994; Hirst 1994). While the format of the source competence manipulations have typically differed in prior studies, manipulations of this variable were always high and low competence. A high and low manipulation of source competence was used in this study in order to facilitate comparison of its results to those of the prior literature.

In order to determine how to manipulate the conditions of high and low CAS competence, a survey was developed with the assistance of an audit senior and manager as suggested by Brown (1983) and Joyce (1979) (see Appendix A for the survey). Three seniors and six newly promoted managers from three offices of a large, international accounting firm completed the survey. After some demographic and CAS interaction questions, the survey asked the participants to provide the indicators that most influenced their perceptions of CAS competence. Survey participants were provided with factors used in prior source competence studies along with some additional indicators unique to the CAS context. The survey then asked the auditors to supply any additional areas in which CAS competence is evaluated in order to ensure that factors excluded from the survey were considered. All of the respondents had experience interacting with CAS and evaluating their audit evidence. From the results of the survey it was clear that one aspect of the CAS/auditor relationship significantly affects auditors' perceptions of CAS competence. Eight of the nine auditors responded that CAS experience in auditing systems (in years) was an indicator of CAS competence.

The identification of experience as an indicator of general source competence is consistent with prior research (Schneider 1984; Rebele et al. 1988; Anderson et al. 1994). Given the context of this study and the nature of prior source competence manipulations, follow-up discussions with the survey respondents indicated that CAS training with complex AIS and prior CAS job performance would also influence their competence perceptions. The use of training and prior performance as indicators of competence is consistent with prior source competence studies in the audit environment (Bamber 1983; Brown 1983; Margheim 1986; Rebele et al. 1988; Anderson et al. 1994). Since the majority of the respondents considered all three indicators of CAS competence (experience, training, and prior job performance) during the course of their engagements, it is unclear which of the three aspects of CAS competence are most important to auditor judgments. Accordingly, the manipulation of CAS competence in this study made use of all three facets of the construct as suggested by Kadous and Magro (2001). These three indicators were manipulated, concurrently, as either high or low between subjects. To gain further insight into which facets are most important to auditor perceptions of CAS competence, participants were asked in a post-experimental questionnaire the importance of each facet to their CAS competence judgment.

From further discussions with practicing auditors and a review of source competence manipulations found in the literature, it was determined how each of these three factors would be manipulated as either high or low. CAS experience was manipulated by informing participants of the year(s) of experience the CAS had in testing the reliability of system controls (Schneider 1984; Rebele et al. 1988). For the high and low CAS competence groups the experience was four years and eight months,

respectively.<sup>22</sup> Consistent with other studies that have used training as an indicator of competence (e.g., Anderson et al. 1994), the high (low) competence group was told that the CAS had received (had yet to receive) training in relation to the specific AIS implemented by the client in the current year. Lastly, similar to the source competence manipulation by Bamber (1983), the CAS's prior performance on another audit was conveyed to participants. The high (low) CAS competence group was informed that a fellow senior received strong (weak) tests of controls from the CAS in a previous audit.

### **3.3.4.2 Auditor AIS Expertise**

#### **3.3.4.2.1 Development of Auditor AIS Expertise Measure**

While the level of CAS competence is a trait associated with the audit engagement, auditor AIS expertise is a trait associated with the individual auditor. Similar to other domains of audit expertise (Abdolmohammadi and Shanteau 1992), an objective standard or observable measure of AIS expertise either does not exist or would be infeasible to measure. Also, in this study it is predicted that as auditor self-assessments of AIS expertise increase, perceptions of self-efficacy with respect to planning judgments affected by the AIS will increase. Ajzen (1991) suggests that when self-efficacy perceptions are expected to affect behavior, one must directly measure the construct that determines the level of self-efficacy. Thus, since one cannot readily manipulate factors such as forms of intelligence (Peecher and Solomon 2001) and an observable measure of AIS would be infeasible to obtain, similar to Bonner and Lewis (1990), auditors' self-assessments of their AIS expertise were measured via a post-experimental questionnaire.

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<sup>22</sup> In their study of ERP system risks, Wright and Wright (2002) used experienced CAS in their semi-structured interviews. The mean experience level (in years with their firm) of these CAS was 3.97 years.

Given that no measure of auditor AIS expertise exists in the literature, prior research examining the construct of expertise, along with Ajzen's studies of self-efficacy, were reviewed to create a multiple-item scale designed to assess auditors' self-perceptions of AIS expertise. Additional measurement items suggested from surveys with accounting students were added to the scale to complement the items indicated by prior research. Lastly, the multiple-item scale created for the purposes of this study was pre-tested for internal consistency (reliability) and construct validity with 45 practicing audit seniors.

Prior research has focused on the role that domain-specific experience plays in expertise (e.g., Bonner 1990; Bonner and Lewis 1990; Ashton 1991; Mauldin and Ruchala 1999). Experience is presumably the basis for obtaining the knowledge needed to become an expert (Abdolmohammadi and Shanteau 1992). As such, included in the multiple-item scale were measures of auditor's perceptions of their experience levels with auditing AIS, their time spent auditing AIS, and how early in their careers they began auditing AIS. Training in a given domain is expected to combine with experience to increase domain-specific expertise levels (Bonner and Lewis 1990; Bedard and Chi 1993). Therefore, the level of perceived AIS training of auditors, both formal and informal, was measured.

As discussed previously, Ajzen (1991) suggests that when self-efficacy perceptions are expected to affect behavior, one must directly measure the construct that determines the level of self-efficacy. Thus, in addition, auditor perceptions of AIS expertise were directly measured. Lastly, from surveys with accounting students, four other measures of AIS expertise were found to both converge with the aforementioned

measures of perceived AIS expertise and reliably measure the construct. These additional items were: their perceived comfort with auditing AIS, their enjoyment received from auditing AIS, the role of AIS in their future careers, and the importance of AIS in their day-to-day audit activities.<sup>23</sup>

Auditors were asked to evaluate their AIS expertise relative to other audit seniors (in-charges). This reference point is appropriate given that the effects of auditor AIS expertise were measured between participants. It is also most applicable to seniors because their skills or expertise are rated against their fellow seniors during the promotion and compensation process. Thus, seniors are generally informed with regard to their expertise levels in relation to those of their peers. The nine questions and the eight-point Likert scale that were used to measure auditor self-assessments of AIS expertise are provided in Appendix D.

The AIS expertise score of each participant was their average score from the nine responses. The participants in this study were partitioned in half as possessing high and low AIS expertise via the median auditor AIS expertise score. Due to the subjectiveness of the construct, the median score of the sample was used, as it is impossible to declare with certainty the exact point at which an auditor has or has not achieved high AIS expertise (Baron and Kenny 1986).

After the sample of participants was (a) randomly assigned to CAS competence treatments of high and low and (b) post-experimentally split in half as possessing high and low AIS expertise, this study contained four groups or cells (see Figure 3).

Measuring participant AIS expertise pre-experimentally and then assigning participants

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<sup>23</sup> In the pre-tests with accounting students, the word “computer” was used instead of “auditing” and “AIS” (e.g., the importance of computers in their day-to-day activities).

to CAS competence conditions based on their AIS expertise level would ensure approximately equal cell sizes, but constraints on participant access make such a method impractical. In addition, while splitting the two CAS competence groups in half via the median AIS expertise score in each of these two groups may ensure relatively equal cell sizes, such a split may cause participants' AIS expertise classifications (high or low) to be a factor of which CAS competence treatment they were assigned. Therefore, the AIS expertise split did not occur within CAS competence groups, but rather at the participant level as described in the previous paragraph. Provided that participants are randomly assigned to CAS competence groups, such a split should assure approximately equal cell sizes. Section 3.3.4.2.2 offers a discussion and statistical analysis of such a dichotomization of the pre-test AIS expertise data. Lastly, additional analyses were performed (see footnote 32) that studied the effects of auditor AIS expertise as a continuous, rather than dichotomous, independent variable (i.e., mean participant score from questionnaire).

#### **3.3.4.2.2 Assessment of Auditor AIS Expertise Measure**

As indicated above, the nine-item scale used to measure auditor AIS expertise was pre-tested with 45 practicing senior auditors. The results from this pre-test indicate the nine-item scale does possess significantly high levels of both internal consistency (reliability) and construct validity. Cronbach's alpha was calculated to assess the internal consistency of the nine-item scale. Results from the pre-test provide an alpha level of 0.9404, well above the generally accepted threshold of 0.70 recommended by Nunnally (1978).

The assessment of construct validity (i.e., convergent and discriminant validity) for the nine-item measure of auditor AIS expertise was performed via exploratory factor analysis. Pre-test participants' general audit experience levels, both in months of experience and year/level within firm, were included in the analysis to determine whether or not AIS expertise and general audit experience appear to measure the same factor (i.e., discriminant validity). Exploratory factor analysis via the Principle Components Analysis method was performed on the pre-test data (see Appendix E).

First, a correlation matrix was produced for all eleven measures. Panel 1 of Appendix E contains the Spearman correlation matrix. Panel 1 depicts that all nine items intended to measure AIS expertise are significantly positively correlated at the alpha = .05 level. In addition, with the exception of the correlation between audit experience (AUDITEXP) and auditors' perceptions of the role AIS will play in their career in the future (AISROLE), all correlations between the nine AIS items and the two general audit experience items are negative and not significant at the alpha = .05 level. The negative and significant correlation between AUDITEXP and AISROLE suggests that less experienced auditors perceive that AIS will play a larger role in their career in the future. Next, factors (components) were extracted for all eleven items via Principal Components Analysis. See Panels 2 – 4 for the results of the factor extraction. Panel 2 provides the communalities of the eleven items. None of the extraction communalities for the items can be considered low or less than .50 (Gardner 2001); thus the factor analysis appears to account for much of the variance associated with these items. The eigenvalues and variance explained by each factor is presented in Panel 3. Utilizing Kaiser's (1960) eigenvalue-one criterion, Panel 3 shows that 2 factors were extracted from the data (i.e.,

the results show two components have eigenvalues exceeding one). Panel 4 contains the principal components factor matrix, which presents how each of the eleven items loaded on the two factors identified in Panel 3. Inspection of Panel 4 reveals that Factor (Component) One loadings for all nine items intended to measure AIS expertise were satisfactorily greater than the commonly used threshold of .50 (Nunnally 1978). Panel 4 also depicts that the two measures of audit experience, AUDITEXP and YEARINFI, had satisfactory loadings greater than .50 on Factor Two. Lastly, and not documented in Appendix E, orthogonal (Varimax) and oblique (Direct Oblimin) rotations of the factors do not qualitatively change the results depicted in Panel 4.

Section 3.3.4.2.1 discusses how the sample of participants was partitioned in half as possessing high and low AIS expertise via the median participant AIS expertise score. Such a split was performed on the pre-test data and the data was analyzed. As indicated above, the pre-test used the nine scales listed in Appendix D, but the scales were six, rather than eight, point. Similar to the scales noted in Appendix D, the six-point scales ranged from 1 (strongly disagree) to 6 (strongly agree). Participant scores were measured as their average response to the nine, six-point scales (i.e., average AIS expertise score). The mean and median scores of the pre-test sample were 3.291 and 3.111, respectively. The sample was then split in half, with participants scoring below and above 3.111 being classified as low and high AIS expertise, respectively. Next, a one-tailed independent-samples t test was performed to determine whether the mean for the high AIS expertise group was significantly greater than the mean of the low AIS group. The mean for the high AIS expertise group was significantly greater than that of the low AIS expertise group (means = 4.061 and 2.556, respectively,  $p < .001$ ). Also, the group means indicate

that, on average, the high AIS expertise group “agreed” that their AIS expertise exceeded other in-charge auditors, while the low AIS expertise “disagreed” with such an assessment. These differences between the high and low AIS expertise groups obtained from the pre-test data provide evidence that the auditor AIS expertise measure should supply two groups that maintain significantly different perceptions with respect to their own AIS expertise level.

In summary, the results of the pre-test of the nine-item scale developed to measure auditors’ self-assessments of AIS expertise show that the measure does have a high level of internal consistency and construct validity (i.e., convergent and discriminant validity). The Cronbach’s alpha associated with the items was found to be satisfactory and all nine items loaded heavily on one factor. Given that the nine items were designed to measure auditor self-assessments of AIS expertise, this factor will be labeled “auditor AIS expertise” for the purposes of this study. In addition, the pre-test results suggest that self-assessments of AIS expertise are a unique and separate domain of expertise from that of general audit experience (i.e., evidence of discriminant validity). In fact, Panel 1 depicts that the correlation between audit experience and self-assessments of AIS expertise were insignificant and negative for the auditors participating in the pre-test. Lastly, additional analysis of the pre-test data indicates that the auditor AIS expertise measure should supply two groups that maintain significantly different perceptions with respect to their own AIS expertise level.

After participants have been randomly assigned to high and low CAS competence conditions and post-experimentally classified as possessing either high or

low AIS expertise, this study contained four experimental groups or treatments. See Figure 3 for a depiction of these groups.

### **3.3.5 Dependent Variables**

#### **3.3.5.1 Inherent and Control Risk Assessments**

Each participant provided a preliminary inherent risk assessment for the sales and accounts receivable cycle after receiving all planning information related to the cycle, but before receiving the CAS competence manipulation and internal control testing workpapers. As discussed in sections 2.2 and 2.3, while the competence of CAS should affect the strength of internal control tests/control risk assessments, the competence of CAS should have no effect on inherent risk assessments. After being provided with the CAS competence manipulation and all internal control testing information, participants assessed preliminary control risk for the cycle. SAS No. 47 (1983) requires auditors to consider risks at the either the account-balance or class-of-transactions (cycle) level. Consistent with other audit risk assessment studies (e.g., Anderson and Maletta 1994; Davis 1996; Messier and Austen 2000), a transaction cycle, rather than an account-balance, was chosen for examination. Additionally, cycle assessments were chosen because (a) ERP systems are customized to, and thus affect, companies' business cycles and (b) discussions with practitioners indicated that cycle assessments are commonly performed in practice.

Prior research concerning auditor application of the audit risk model has measured inherent and control risk assessments via separate scales (e.g., Reimers et al. 1993; Anderson and Maletta 1994; Dusenbury et al. 2000; Messier and Austen 2000). While the qualitative descriptions of scales in these studies have differed in presentation,

these scales have generally had endpoints indicating “low risk” and “high risk.” This study adopted the scales used by Messier and Austen (2000) because the qualitative descriptions and percentages used in the scales are similar to the types of response mechanisms employed in practice (POB 2000). The scales ranged from 0 to 100 percent, with percentages labeled in increments of 10. Also, 0, 50, and 100 percent were labeled “low risk,” “moderate risk,” and “high risk,” respectively. Participants responded to the scale by inputting any whole number between 0 and 100 on a line below the scale. After providing each risk assessment, participants were asked to document their assessment levels as required by SAS No. 47 (1983) and SAS 55 (1988b). Because participants provided preliminary (versus final) risk assessments, they were asked to document possible risk issues or items requiring further examination (e.g., a review of employee turnover, training related to the ERP system implementation).

### **3.3.5.2 Evidence Reliability Judgment**

After receiving the CAS competence manipulation and the current year internal control workpaper, each participant provided a judgment regarding the perceived reliability of the CAS audit evidence (i.e., CAS testing of system-related controls). The judgment was made on a scale adapted from Brown (1983) that ranges from 1 (“not reliable”) to 10 (“very reliable”).

### **3.3.5.3 Scope of Planned Substantive Procedures**

After completing their risk assessments, participants were asked to prepare two audit programs for the substantive testing of the sales and accounts receivable accounts and a budget for each substantive procedure. As described by SAS No. 47 (1983), the audit program and budget allowed participants to design the nature (i.e., procedures

performed and staff level used), timing (i.e., interim or final testing), and extent (i.e., budget) of substantive procedures related to the accounts. The “nature” of participants’ scope decisions was measured in two ways: (1) as the total number of procedures planned (Procedures) similar to Low (2004), and (2) as the total number of procedures assigned to a more senior-level auditor than staff assistant (Labor) as suggested by O’Keefe et al. (1994) and Low (2004). Consistent with SAS No. 47 (1983), the “timing” of participants’ scope decisions (Timing) was computed as the total number of procedures to be tested at fiscal year-end (versus interim), and the “extent” of their decisions (Extent) refers to the total number of budgeted audit hours (Mock and Wright 1993). With respect to the four variables used to measure “scope,” more planned procedures, more procedures assigned to senior-level auditors, more procedures tested at fiscal year-end, or more budgeted hours indicate audit procedures that are greater in scope (e.g., AICPA 1983; Mock and Wright 1993).<sup>24</sup> As in practice, participants had prior year workpapers available when providing both their current year risk assessments and substantive testing decisions.

#### **3.3.5.4 Quality of Risk Assessments and Effectiveness of Substantive Procedures**

Two groups, each with three expert auditors, reviewed the entire experimental case under one of the two CAS competence conditions (i.e., high or low). These experts then each assessed the inherent and control risk levels associated with the sales and accounts receivable cycle, along with providing justification for their assessments.

Similar to Tan (1995), the mean assessments of the experts served as the criteria for

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<sup>24</sup> In the case provided to participants, all prior year substantive tests of sales and accounts receivable were assigned to a staff assistant (see Appendix C). Assigning current year substantive tests to an auditor who is more experienced than a staff assistant (e.g., an audit senior) indicates an expansion of audit scope. Also, eight of twelve prior year substantive tests were performed at interim. Planning the performance of substantive tests at fiscal year-end indicates an expansion of audit scope (AICPA 1983).

measuring the judgment quality of the participants. The quality of a participant's inherent risk assessments was calculated as the absolute deviation of their assessment from the mean inherent risk assessment of all six experts (i.e., CAS competence is not hypothesized to affect inherent risk). Control risk assessment quality was measured as the absolute deviation of the participant's risk assessment from the mean assessment of the experts assigned to the same CAS competence condition. After providing their risk assessments, like Low (2004), the experts individually evaluated the effectiveness of the planned substantive procedures (i.e., programs and budgets) of each participant assigned to their condition. Experts provided their effectiveness evaluations via a 10-point Likert scale with endpoints of 1 and 10 labeled "very low" and "very high," respectively. The mean score from the three experts assigned to their condition was used as an effectiveness measure for the participants.

### **3.3.6 Other Measured Variables and Manipulation Check**

Several variables were measured in the post-experimental questionnaire for the purposes of determining their effects on the dependent variables of this study. Participants answered questions including their: amount of interaction with CAS, amount of audit work performed in ERP environments, experience with assessing risk and substantive planning decisions, perceptions of the likelihood that ERP implementations lead to increased inherent and control risks, confidence levels in their inherent and control risk assessments, perceptions of control strength, perceptions of test results, participant motivation, perceptions of the effect of financial statement changes on their planning judgments, and perceptions of the existence of CAS competence variation in practice. Demographic variables that were measured included participant experience,

level/year in firm, and experience auditing manufacturing clients. Lastly, a manipulation check of CAS competence levels was performed by measuring participant perceptions of CAS competence via a scale with endpoints of 1 (“very low”) and 10 (“very high”).

### **3.3.7 Conclusion**

This chapter developed the hypotheses of this study and the quasi-experimental method that was used to test those hypotheses. The next chapter will present and discuss the results of the data analysis.

## CHAPTER 4: RESULTS

### 4.1 Introduction

Chapter 3 developed the hypotheses and discussed the design of the study. The research methodology was designed to evaluate the main and interactive effects of computer assurance specialist (CAS) competence and auditor accounting information system (AIS) expertise on auditor planning judgments in a complex AIS environment. This chapter provides the results of the study and a discussion of the findings.

This chapter is organized as follows: a description of the participants is provided, various aspects of the quasi-experimental materials are analyzed, the hypotheses are tested, and the results are summarized.

### 4.2 Description of Participants

A total of one hundred-fourteen experimental packets were provided to firm liaisons at two national and four international public accounting firms. The offices of the firms that participated in the study were located in the Northeast, Mid-Atlantic, Southeast, Midwest, Southwest, and West regions of the United States. Firm liaisons were instructed to distribute the packets to senior-level auditors; responses were returned directly to Drexel University. Seventy-three usable responses were received.<sup>25</sup> The responses by cell/group are included in Table 1.

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<sup>25</sup> Reliable information could not be obtained from the firm liaisons as to how many of the 114 experimental packets were actually distributed to potential participants. It is known, however, that not all of the 114 packets were distributed. Also, the estimated minimal response rate for this study (64%) was similar to other investigations of auditor judgment processes that have distributed experimental materials in an analogous fashion (e.g., Ayers and Nagy 1998; Messier and Austen 2000; Taylor 2000).

Participants' total years of public accounting experience ranged from 1.00 to 10.92 years. Mean total years of public accounting experience equaled 3.68 years (44.21 months). Chapter 3 identified the appropriate participants as senior auditors (auditors with typically two to five years of audit experience) from national and international accounting firms. Based upon the participants' mean experience levels and rank, the sample appears to be appropriate for the study.

Tables 2 and 3 present a summary of the demographic backgrounds of the participants and the results of the statistical analyses of the demographic information, respectively. To examine whether there were pre-existing differences between the groups in terms of their demographic characteristics, a one-way ANOVA was performed for each of the following demographic variables: (1) audit experience, (2) experience interacting with CAS, (3) experience assessing risks, (4) experience planning substantive procedures, (5) experience with clients that have implemented enterprise resource planning (ERP) systems, (6) likelihood of being assigned to a similar audit engagement as the case study, and (7) manufacturing industry experience. None of the demographic variables were found to be significantly different between groups, indicating that any statistically significant results related to the hypotheses of this study are not likely to be attributable to these demographic variables.

### **4.3 Manipulation Check and Measurement of the Independent Variables**

#### **4.3.1 Manipulation Check for CAS Competence**

As noted in section 3.3.4.1, participants were randomly assigned to low and high CAS competence conditions. After completion of the case study, participants were asked

to respond, on a ten-point Likert-type scale, to the statement: “The competence (ability) level of the computer assurance specialist (CAS) Chris Smith assigned to the Madison Inc. audit engagement was,” with 1 being “very low” and 10 being “very high.” The independent-samples t test results are documented in Table 4. For the low and high competence groups, the mean responses were 3.77 and 7.91, respectively. These means were statistically significant ( $p < .001$ ) and in the expected direction, with participants in the low CAS competence group perceiving significantly lower CAS competence levels than participants in the high CAS competence group. Thus, it appears that the participants attended to and understood the intended manipulation.

This study used three factors to manipulate CAS competence and additional information regarding the manipulation is contained in section 3.3.4.1. Participants were provided with information concerning the CAS’s experience, training, and prior job performance (see section 3.3.4.1 for further information regarding how these factors were manipulated between the low and high CAS competence groups). Post-experimentally, participants were asked on a scale from 1 (“not important”) to 10 (“very important”) the importance of these factors when evaluating the competence of the CAS in the case study. Non-tabulated results indicate that all three factors were deemed to be relatively important by the participants with sample means of 7.12, 7.70, and 7.92 for experience, training, and prior job performance, respectively. In addition, the importance of the three factors were not significantly different between the low and high CAS competence groups (all  $p$ ’s  $> .150$ ). These results indicate that each factor, at both its high and low levels, served as a functional determinant of CAS competence.

To evaluate the realism of the low and high CAS competence manipulations, participants were asked to respond to the following two post-experimental questions: (a) “CAS similar to the CAS described in the case study exist at my firm” on a scale from 1 (“disagree”) to 10 (“agree”) and (b) “the likelihood that a CAS similar to the CAS described in this case study could be assigned to an audit engagement is” on a scale from 1 (“very low”) to 10 (“very high”). Non-tabulated results provide evidence that sample participants felt that the CAS presented in both the low and high conditions were similar to CAS at their respective firms. Mean responses for the low and high conditions for question (a) were 7.85 and 7.26, respectively, and for question (b) 6.90 and 6.62, respectively. All differences between low and high CAS competence groups were insignificant (all  $p$ 's > .150). Given the high mean responses to both of the questions and the lack of significant differences between the low and high CAS competence conditions, it appears the manipulation of CAS competence was equally realistic in both its low and high conditions.

#### **4.3.2 Measurement of Auditor AIS Expertise**

Nine items were used to measure auditor AIS expertise. Participants recorded their responses to these items on eight-point scales (see Appendix D for scale questions). Section 3.3.4.2 provides information regarding the development of the AIS expertise measure. Reliability and factor analysis results indicate that the nine-item measure does possess significantly high levels of both internal consistency (reliability) and construct validity. Cronbach's alpha was calculated to assess the internal consistency of the measure. Results from the sample provide an alpha level of 0.9649, well above the generally accepted threshold of 0.70 recommended by Nunnally (1978).

The assessment of construct validity (i.e., convergent and discriminant validity) for the nine-item measure of auditor AIS expertise was performed via exploratory factor analysis. Participants' general audit experience, in months, was also included in the analysis to determine whether or not AIS expertise and general audit experience appear to measure the same factor (i.e., discriminant validity). Exploratory factor analysis via the Principle Components Analysis method was performed on the sample data (see Tables 5 through 8).

First, a correlation matrix was produced for all ten measures (i.e., nine AIS expertise measures and one general audit experience measure). Table 5 contains the Spearman correlation matrix. Table 5 depicts that all nine items intended to measure AIS expertise were significantly positively correlated (all  $p$ 's < .001). In addition, none of the nine AIS expertise items were significantly correlated with the general audit experience item (all  $p$ 's > .25). The lack of correlation between the AIS expertise items and the measure of general audit experience suggests that auditor AIS expertise is a distinct domain of expertise maintained by auditors and not simply a by-product of general audit experience.

Next, factors (components) were extracted for all ten items via Principal Components Analysis. See Tables 6 through 8 for the results of the factor extraction. Table 6 provides the communalities of the ten items (i.e., measures of how much variance the items have in common with all the other items in the analysis). All of the extraction communalities for the items are well above the generally used threshold of .50 (Gardner 2001); thus the factor analysis illustrated in Tables 7 and 8 appears to account for a majority of the variance associated with these items. The eigenvalues and variance

explained by each component/factor are presented in Table 7. Utilizing Kaiser's (1960) eigenvalue-one criterion, Table 7 shows that two factors were extracted from the data (i.e., the results show two components have eigenvalues exceeding one). Table 8 presents the principal components factor matrix, which indicates how each of the ten items loaded on the two factors identified in Table 7. Inspection of Table 8 reveals that Factor (Component) One loadings for all nine items intended to measure AIS expertise were satisfactorily greater than the commonly used threshold of .50 (Nunnally 1978). Table 8 also depicts that the measure of audit experience (AUDEXP) had satisfactory loadings greater than .50 on Factor Two. Lastly, and not tabulated, orthogonal (Varimax) and oblique (Direct Oblimin) rotations of the factors do not qualitatively change the results depicted in Table 8.

Section 3.3.4.2.1 discusses how the sample of participants was partitioned into two groups possessing high or low AIS expertise via the median participant AIS expertise score. Such a split was performed on the sample data and the data was analyzed. Participants' mean AIS expertise scores were measured as their mean response to the nine items listed in Appendix D. Table 9 contains descriptive statistics and the frequency distribution for the mean AIS expertise scores. The mean and median scores of the sample were 3.513 and 3.222, respectively. In addition, the sample's mean AIS expertise scores appear to be well distributed.

The sample was then split into two groups, with participants scoring below and above 3.222 being classified as holding low and high AIS expertise, respectively.<sup>26</sup> A

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<sup>26</sup>Two participants provided mean AIS expertise scores equal to the sample median of 3.222. One of these two participants was randomly assigned to the low AIS expertise group and the other was randomly assigned to the high AIS expertise group. A reversal of assignment or exclusion of these two participants

one-tailed independent-samples t test (results not tabulated) was performed to determine whether the mean for the high AIS expertise group was significantly greater than the mean of the low AIS group, which was the case (means = 5.052 and 2.015, respectively,  $p < .001$ ). Based on the scale labels for AIS expertise measurement items, responses of 5 and 2 indicate that participants “mildly agreed” and “mostly disagreed” that their AIS expertise exceeded other in-charge auditors, respectively (see Appendix D for the nine items and the relevant eight-point response scales). These differences between the high and low AIS expertise groups indicate that participants in the two groups maintained significantly different perceptions of their own AIS expertise levels.

In summary, test results of the nine items developed to measure auditor AIS expertise show that the measure does have a high level of internal consistency and construct validity (i.e., convergent and discriminant validity). The Cronbach’s alpha associated with the items was found to be satisfactory, and all nine AIS expertise measurement items loaded heavily on one factor. Given that the nine items were designed to measure auditor self-assessments of AIS expertise, this factor was labeled “auditor AIS expertise” for the purposes of this study. In addition, the results suggest that auditor AIS expertise is a unique and separate domain of expertise from that of general audit experience (i.e., evidence of discriminant validity). This study’s random assignment of participants to high and low CAS competence conditions and post-experimental classification of participants into high or low AIS expertise groups provides four experimental groups or treatments (see Table 1).

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from the analyses below does not qualitatively affect the conclusions drawn with respect to hypothesis testing in section 4.5 below.

#### 4.4 Testing of Statistical Assumptions

As will be discussed in section 4.5 below, ANOVA and independent-samples t tests were used to test the hypotheses of this study. Three assumptions underlie these statistical analyses: (1) independence of dependent variables within and between treatment groups, (2) normal distribution of treatment populations, and (3) homogeneity of variances between treatment populations (Keppel 1991; Gardner 2001). The first assumption is that the observations must be independent. As the subjects were randomly assigned to CAS competence groups and the assignment of participants to auditor AIS expertise groups was not substantially dependent upon the membership of any other participant in their group or any other group, this assumption is met (Keppel 1991; Gardner 2001).

The second assumption is that the treatment populations are normally distributed. This assumption was tested by the Kolmogorov-Smirnov and Ryan-Joiner tests of normality. Normality tests were performed for each of the hypothesized dependent variables for each of the four groups (see Table 1 for a depiction of the four groups). Nontabulated results indicate violations of the normality assumption ( $p$ 's < .05) for all of the hypothesized dependent variables within some of the groups, with the exception of the inherent risk assessment (Hypothesis 1a). However, it has been shown that ANOVA and independent-samples t tests are robust with respect to violations of this assumption (Glass et al. 1972). Violations of the normality assumption do not appreciably influence Type I or Type II error, especially when cell sizes are greater than 12 and approximately equal (Keppel 1991; Gardner 2001).

The third assumption concerns the homogeneity of variances between treatment populations. This assumption was assessed by Levene's test of homogeneity of variances. Levene tests were performed for each of the hypothesized dependent variables for each of the four groups. Nontabulated results specify no violations of this assumption (all  $p$ 's  $> .150$ ), with the exception of the "evidence reliability" variable (i.e., the dependent variable of Hypothesis 2) with a  $p = .033$ . According to Wilcox (1987) and Keppel (1991), the absolute value of the independent-samples  $t$  statistic becomes biased in the positive direction (i.e., increasing the likelihood of a Type I error) when the largest within group variance divided by the smallest within group variance is 9 or greater. In order to evaluate the effects of heterogeneity of variances for the "evidence reliability" variable, such a calculation was performed with a result equaling 2.79. Thus, it appears the independent-samples  $t$  test for the "evidence reliability" variable will be relatively insensitive to the heterogeneity of variances present between groups.

In summary, while the sample data does, at times, violate the ANOVA and independent-samples  $t$  test assumptions of normality and homogeneity of variances, it appears that statistical analyses will be robust to these departures. Thus, all data analysis in section 4.5 below will use ANOVA and independent-samples  $t$  tests (parametric tests). However, the nonparametric Mann-Whitney test was also used for all of the hypothesis testing performed in section 4.5 due to the assumption violations noted above. The Mann-Whitney test does not require that the above assumptions be met by the sample data. The results of this nonparametric testing (not tabulated) are not qualitatively different from the results of parametric tests reported in section 4.5.

## **4.5 Hypothesis Testing**

### **4.5.1 Introduction**

The remainder of this chapter contains the results of hypotheses testing. These tests examine the effects of auditor AIS expertise and/or CAS competence on auditor planning judgments (e.g., inherent risk assessments, planned budgets, etc.). All hypotheses in chapter 3 depict relationships between one or two dichotomous independent variables and a single dependent variable. As such, hypothesis testing for this study was generally conducted within a 2X2 ANOVA framework or, where appropriate, independent-samples t tests were used.

### **4.5.2 Relationship Between Auditor AIS Expertise and Auditor Planning**

#### **Judgments (Hypothesis Set One)**

Hypothesis Set One predicts the effect of auditor AIS expertise on auditor inherent assessments, control risk assessments, and planned substantive audit procedures.

Hypothesis Set One, in the alternative form, states:

H1a: Auditors with high AIS expertise will assess inherent risk at a higher level than auditors with low AIS expertise.

H1b: Auditors with high AIS expertise will assess control risk at a higher level than auditors with low AIS expertise.

H1c: Auditors with high AIS expertise will plan substantive audit procedures that are greater in scope than auditors with low AIS expertise.

Each participant provided separate preliminary inherent and control risk assessments for the sales and accounts receivable cycle after evaluating all planning information related to the cycle. The risk scales ranged from 0 to 100 percent, with percentages labeled in increments of 10. Also, 0, 50, and 100 percent were labeled “low

risk,” “moderate risk,” and “high risk,” respectively. Participants responded to the scale by inputting any whole number between 0 and 100 on a line below the scale.<sup>27</sup>

After completing their risk assessments, participants were asked to prepare two audit programs, one each for the substantive testing of the sales and accounts receivable accounts, along with a budget for each substantive procedure. The audit programs and budgets allowed participants to design the nature (i.e., procedures performed and staff level used), timing (i.e., interim or final testing), and extent (i.e., budget) of substantive procedures related to the accounts.<sup>28</sup> The “nature” of participants’ scope decisions was measured in two ways: (1) the total number of procedures planned and (2) the number of procedures assigned to a more senior level auditor than staff assistant. The “timing” of participants’ scope decisions was measured as the total number of procedures to be tested at fiscal year-end, while the “extent” of their decisions was measured as the total number of budgeted audit hours. Thus, the scope of substantive procedures was measured with four dependent variables.<sup>29</sup>

Table 10 presents the results of Hypothesis Set One testing. An independent-samples t test was used to test Hypothesis 1a, as only AIS expertise is hypothesized to

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<sup>27</sup> As discussed in section 3.3.3, moderate inherent and control risk assessments from the prior year’s audit engagement (35% and 40%, respectively) were provided to participants. All prior year and current year audit workpapers included in the case study were prepared with the assistance of two senior managers and a partner from an international accounting firm.

<sup>28</sup> Audit programs and budgets from the prior year’s audit engagement were provided to participants. These materials contained a combined 12 audit procedures that were all performed by staff assistants. In addition, 4 of the 12 procedures were tested at year-end/final (vs. interim) and the combined budget totaled 93 hours. There was no limit as to the number of procedures and budgeted hours the participants could provide for the current year audit.

<sup>29</sup> Hypothesis 1c predicts that auditors with higher AIS expertise will plan substantive audit procedures that are greater in scope. With respect to the four variables used to measure “scope,” more planned procedures, more procedures assigned to senior-level auditors, more procedures tested at fiscal year-end, and more budgeted hours indicate audit procedures that are greater in scope.

effect auditors' inherent risk assessments.<sup>30</sup> Because both AIS Expertise and CAS competence are expected to affect auditors' control risk assessments and scope of substantive procedures, the F statistic for the main effect of auditor AIS expertise from the overall 2X2 ANOVA is presented for all other dependent variables in Table 10.<sup>31</sup> Significance levels presented in Table 10 are one-tailed due to the directional nature of the corresponding hypotheses (Keppel 1991). Mean inherent risk assessments for the low and high AIS expertise groups were 39.86 and 54.17, respectively. These means are in the hypothesized direction. Independent-samples t test results indicate a significant AIS expertise effect ( $t = -4.207, p < .001$ ). Thus, Hypothesis 1a is supported by the sample data. Mean control risk assessments for the two groups were significant (i.e., the difference between group means was statistically significant) and in the expected direction, with the mean assessments for the low and high AIS groups being 46.70 and 60.14, respectively ( $F = 12.266, p < .001$ ). Thus, there is support for Hypothesis 1b.

Table 10 also provides the descriptive statistics and ANOVA results for the dependent variables: (1) number of procedures planned (Procedures), (2) number of

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<sup>30</sup> Hypotheses 1a, 5a, 5b, and 5c predict that auditor AIS expertise will affect auditor inherent risk assessments, the quality of their inherent risk and control risk assessments, and the effectiveness of their substantive tests. Univariate tests of the hypothesized relationships are reported in sections 4.5.2 and 4.5.6. Because AIS expertise is expected to affect multiple dependent variables, MANOVA (including all of the aforementioned dependent variables) was conducted prior to performing all univariate tests in order to control the experimentwise Type I error rate (Gardner 2001). Non-tabulated MANOVA results indicate a significant AIS expertise effect ( $p = .001$ ), thus providing support that significant univariate test results reported herein are not the result of an inflated experimentwise Type I error rate (Gardner 2001).

<sup>31</sup> Hypotheses 1b, 1c, 3a, 3b, 4a, and 4b predict the main and interactive effects of auditor AIS expertise and CAS competence on auditor control risk assessments and their scope decisions. Univariate tests of the hypothesized relationships are reported in sections 4.5.2, 4.5.4, and 4.5.5. Because these independent variables are expected to affect multiple dependent variables, MANOVA (including all of the aforementioned dependent variables) was conducted prior to performing all univariate tests in order to control the experimentwise Type I error rate (Gardner 2001). Non-tabulated MANOVA results indicate significant or marginally significant effects for AIS expertise, CAS competence, and their interaction ( $p$ 's = .008, .089, and .115), thus providing support that significant univariate test results reported herein are not the result of an inflated experimentwise Type I error rate (Gardner 2001).

procedures assigned to a more senior level auditor than staff assistant (Labor), (3) number of procedures to be tested at fiscal year-end (Timing), and (4) the number of budgeted audit hours (Extent). *Ceteris paribus*, an increase in any of these four measures indicates an increase in scope (i.e., support for Hypothesis 1c). Mean Procedures for the low and high AIS expertise groups were significant and in the expected direction (12.00 and 12.97, respectively;  $F = 5.211$ ,  $p = .013$ ). Thus, on average, auditors with high expertise planned significantly more procedures than auditors with low AIS expertise. Mean Labor for the low and high AIS expertise groups were 2.32 and 3.31, respectively. These means were in the hypothesized direction and significant ( $F = 4.058$ ,  $p = .024$ ). Therefore, on average, auditors with higher AIS expertise also assigned more senior auditors to perform the procedures. Mean Timing for the low and high AIS expertise groups (4.89 and 5.67, respectively) were in the expected direction, though only significant at  $p = .125$  ( $F = 1.351$ ). Mean Extent for the low and high AIS expertise groups were 100.77 and 107.33, respectively. Again, these means are in the hypothesized direction, though significant at only the  $p = .130$  level ( $t = 1.296$ ).

Results support Hypotheses 1a, 1b, and 1c. The above results indicate that auditors with higher AIS expertise provided higher inherent and control risk assessments than auditors with lower AIS expertise. High AIS expertise auditors also planned substantive tests that were greater in scope. Specifically, they used the nature (Procedures and Labor) of audit procedures to expand their scope. Though not significantly, high AIS expertise auditors also expanded the scope of testing with respect to the timing and extent

of planned procedures.<sup>32</sup>

### **4.5.3 Relationship Between CAS Competence and Auditor Evidence Reliability**

#### **Judgments (Hypothesis Two)**

Hypothesis Two predicts the effect of CAS competence on auditor evidence reliability judgments. Hypothesis Two, in the alternative form, states:

H2: Auditors will judge evidence from a CAS with high competence as more reliable than evidence from a CAS with low competence.

After receiving the CAS competence manipulation and the CAS's current year internal control workpaper, each participant provided a judgment regarding the perceived reliability of the CAS audit evidence (i.e., CAS testing of system-related controls). The judgments were made on a scale that ranged from 1 ("not reliable") to 10 ("very reliable").

Table 11 presents the results of Hypothesis Two testing. The significance level presented in Table 11 is one-tailed due to the directional nature of the corresponding hypothesis. Mean evidence reliability judgments for the low and high CAS competence groups were 3.69 and 7.15, respectively, and in the hypothesized direction. Independent-samples t test results indicate a significant CAS competence effect ( $t = -7.880, p < .001$ ). Thus, Hypothesis Two is supported by the sample data.

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<sup>32</sup> In addition to the ANOVA and t tests used to test Hypothesis Sets One, Four, and Five, simple and multiple (with CAS competence as a (0,1) dummy variable) linear regressions were performed using each participants' mean AIS expertise score as an independent (i.e., continuous) variable. The regression results were generally consistent with the ANOVA and t test results presented in sections 4.5.2, 4.5.5, and 4.5.6.

#### **4.5.4 Relationship Between CAS Competence and Auditor Planning Judgments (Hypothesis Set Three)**

Hypothesis Set Three predicts the effect of CAS competence on auditor control risk assessments and planned substantive audit procedures. Hypothesis Set Three, in the alternative form, states:

H3a: Auditors using positive evidence from a CAS with high competence will assess control risk at a lower level than auditors using positive evidence from a CAS with low competence.

H3b: Auditors using positive evidence from a CAS with high competence will plan substantive audit procedures that are lesser in scope than auditors using positive evidence from a CAS with low competence.

Section 4.5.2 provides a description of the measurement of the dependent variables. Table 12 presents the results of Hypothesis Set Three testing. As both AIS expertise and CAS competence are expected to affect control risk and scope, the F statistic for the main effect of CAS competence from the overall 2X2 ANOVA is presented for all dependent variables in Table 12 (see footnote 31). Significance levels presented in Table 12 are one-tailed due to the directional nature of the corresponding hypotheses. Mean control risk assessments for the low and high CAS competence groups were 58.21 and 47.74, respectively. Consistent with Hypothesis 3a, these means were in the hypothesized direction and significant ( $F = 7.851, p = .004$ ).

Table 12 also provides the descriptive statistics and ANOVA results for the dependent variables: (1) number of procedures planned (Procedures), (2) number of procedures assigned to a more senior level auditor than staff assistant (Labor), (3) number of procedures to be tested at fiscal year-end (Timing), and (4) the number of budgeted audit hours (Extent). *Ceteris Paribus*, an increase in any of these four measures indicates

an increase in scope (i.e., support for Hypothesis 3b). Mean Procedures for the low and high CAS competence groups were in the expected direction (12.64 and 12.29, respectively), but the difference was insignificant ( $F = .974$ ,  $p = .164$ ). Labor means for the low and high CAS competence groups were 3.15 and 2.41, respectively. These means were in the hypothesized direction and significant at the  $p = .051$  level ( $F = 2.753$ ). As expected, mean Timing for the low CAS competence group was higher than that of the high CAS competence group (5.56 and 4.94, respectively), though this difference is not significant ( $F = .922$ ,  $p = .170$ ). Lastly, Extent means for the low and high CAS competence groups were 107.33 and 100.19, respectively. These means are in the hypothesized direction and significant at  $p = .085$  ( $F = 1.932$ ).

The above results indicate a significant CAS competence effect on auditors' control risk assessments, with higher CAS competence levels causing auditors to decrease their control risk assessments.<sup>33</sup> Thus, Hypothesis 3a is supported. Auditors also reacted to higher CAS competence by planning substantive audit procedures that were lesser in scope than auditors using evidence from a CAS with low competence. In particular, they used the nature (Labor) and extent of audit procedures to reduce their scope. Therefore, there is support for Hypothesis 3b.

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<sup>33</sup> As discussed in section 3.3.3, CAS evidence provided to the auditors was positive and concluded that system controls appear "reliable." Thus, the CAS evidence supports a reduction of control risk assessments and the scope of planned substantive procedures.

#### **4.5.5 The Interactive Effect of Auditor AIS Expertise and CAS Competence on Auditor Planning Judgments (Hypothesis Set Four)**

Hypothesis Set Four predicts an interactive effect of auditor AIS expertise and CAS competence on auditor control risk assessments and planned substantive audit procedures. Hypothesis Set Four, in the alternative form, states:

H4a: The difference between high AIS expertise auditors' and low AIS expertise auditors' control risk assessments will be greater when CAS competence is low than when it is high.

H4b: The difference between high AIS expertise auditors' and low AIS expertise auditors' scope of planned substantive audit procedures will be greater when CAS competence is low than when it is high.

Figure 1 presents a graphical illustration of Hypothesis Set Four. In order to test the interaction hypotheses above, participants were coded into four groups (1-4) as depicted in Table 1. Group 1 consisted of participants with high AIS expertise and assigned to the low CAS competence condition. Group 2 consisted of participants with high AIS expertise and assigned to the high CAS competence condition. The low auditor AIS expertise condition in which CAS competence was low (high) was labeled Group 3 (4). In terms of group dependent variable means, the above hypotheses were tested with the following planned contrast within a 2X2 ANOVA:

$(\text{Group 1 Mean} - \text{Group 3 Mean}) > (\text{Group 2 Mean} - \text{Group 4 Mean})$ .

Section 4.5.2 provides a description of the measurement of the dependent variables. Table 13 presents the results of Hypothesis Set Four testing (see footnote 31). Significance levels presented in Table 13 are one-tailed when the value of the contrast is consistent with the directional nature of the corresponding hypotheses (i.e., positive). Panel A of Table 13 presents the descriptive statistics for the dependent variables. Panel

B of Table 13 depicts the planned contrast for the dependent variable control risk assessment. The value of this contrast is -2.30 and insignificant (two-tailed  $p = .780$ ). Thus, Hypothesis 4a is not supported by the sample data.

Table 13 Panel B also provides planned contrasts for the dependent variables: (1) number of procedures planned (Procedures), (2) number of procedures assigned to a more senior level auditor than staff assistant (Labor), (3) number of procedures to be tested at fiscal year-end (Timing), and (4) the number of budgeted audit hours (Extent). *Ceteris paribus*, a positive and significant contrast value for any of these four measures indicates an interaction effect on scope (i.e., support for Hypothesis 4b). In Panel B of Table 13, the value of the contrast for Procedures is 1.05, in the hypothesized direction (i.e., positive), and marginally significant ( $p = .108$ ). Similarly, for Labor the value of the contrast is 1.37 and significant at  $p = .084$ . For the Timing of planned substantive tests, the value of the contrast is -.02 and insignificant (two-tailed  $p = .988$ ). The value of the contrast for Extent (23.58) is in the expected direction and significant at the  $p = .019$  level.<sup>34</sup>

Hypothesis 4b is supported. The difference between high AIS expertise auditors' and low AIS expertise auditors' scope of planned substantive audit procedures was greater when CAS competence was low than when it was high. Auditors' AIS expertise levels moderated their reaction to CAS competence with respect to the extent and, to some degree, the nature (Procedures and Labor) of planned audit procedures.

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<sup>34</sup> The overall 2X2 ANOVA indicated significant or moderately significant CAS competence and AIS expertise interaction effects for Procedures ( $p = .108$ ), Labor (.084), and Extent (.019). For clarity of presentation and in order to test the form of the interaction, only the planned contrast tests within the overall 2X2 ANOVA are tabulated.

Specifically, under conditions of low CAS competence, auditors with higher AIS expertise, on average, planned a higher number of substantive tests, assigned more procedures to a senior level auditor, and provided higher budgets than auditors with lower AIS expertise. Under conditions of high CAS competence, scope decision differences between high and low AIS expertise auditors were smaller.

#### **4.5.6 Relationship Between Auditor AIS Expertise and the Quality and Effectiveness of Auditor Planning Judgments (Hypothesis Set Five)**

Hypothesis Set Five predicts the effect of auditor AIS expertise on the quality of their inherent and control risk assessments and the effectiveness of their planned substantive audit procedures. Hypothesis Set Five, in the alternative form, states:

H5a: The quality of inherent risk assessments will be greater for auditors with high AIS expertise than auditors with low AIS expertise.

H5b: The quality of control risk assessments will be greater for auditors with high AIS expertise than auditors with low AIS expertise.

H5c: Auditors with high AIS expertise will plan more effective substantive audit procedures than auditors with low AIS expertise.

Section 4.5.2 provides a description of the measurement of auditors' (participants') inherent risk assessments, control risk assessments, and planned substantive audit procedures. Two groups of experts, each with three experienced auditors, completed the entire case under one of the two CAS competence conditions (i.e., low or high). The mean audit experience of the experts was 10.03 years.<sup>35</sup> Like the

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<sup>35</sup> Expert auditors were randomly assigned to cases with either low or high CAS competence conditions. Expert auditors in the low CAS competence condition consisted of one audit manager and two senior managers from one international accounting firm with a mean of 8.64 years audit experience. Expert auditors in the high CAS competence condition consisted of two senior managers and one partner from the same international accounting firm with a mean of 11.42 years audit experience.

study's participants, the experts assessed the inherent and control risk levels associated with the sales and accounts receivable cycle and planned substantive tests for the cycle.

The experts' mean risk assessments served as the criteria for measuring the quality of participants' risk assessments. Audit managers and a partner served as criterion groups since they evaluate the validity of approaches used by audit staff and are involved in final audit judgments (Tan 1995). Similar to Low (2004), one group of experts provided judgment quality criteria and evaluated the effectiveness of participants' scope decisions in one experimental condition (low CAS competence) and another group of experts served the same function in another experimental condition (high CAS competence). The mean inherent risk assessment for all six experts was used as a quality criterion because experts assessed inherent risk prior to the CAS competence manipulation. One group of experts provided a judgment quality criterion for control risk in the low CAS competence condition and another group of experts served the same function in the high CAS competence condition because it is hypothesized that CAS competence affects control risk assessments (i.e., H3a). Thus, the CAS competence manipulation is confounded with expert group for the dependent variables "quality of control risk assessments" and "effectiveness of substantive audit procedures" in Hypothesis Set 5.

The mean expert inherent risk assessment was 56.67. Mean expert control risk assessments in the low and high CAS competence conditions were both 63.33. The qualities of participants' inherent and control risk assessments were measured as the absolute value of the difference between their risk assessments and the mean assessments of the experts. Consistent with Tan (1995), lower absolute deviations are indicative of

greater judgment quality (i.e., closer to the expert criterion). After completing the case, like Low (2004), the experts individually evaluated the effectiveness of the planned substantive procedures (i.e., sales and accounts receivable audit programs) for each participant assigned to their condition. Experts provided their effectiveness evaluations by responding to the statement: “the audit effectiveness of this senior’s two audit programs above was:” on a 10-point Likert scale with endpoints of 1 and 10 labeled “very low” and “very high,” respectively. The mean score for the three experts assigned to each condition was used as an effectiveness measure for the participants in that condition.

Table 14 presents the descriptive statistics and results of Hypothesis Set Five testing (see footnote 30). Consistent with the statistical analyses of Low (2004), whose quasi-experimental design included one independent variable of interest and one independent variable confounded with expert group, F statistics for the main effect of auditor AIS expertise from the overall 2X2 ANOVA are presented for the dependent variables “inherent risk assessment quality” and “control risk assessment quality.” Also, and similar to Low (2004), the F statistic for the main effect of auditor AIS expertise from a 2X2 ANCOVA containing participants’ inherent and control risk assessments as covariates is presented for the dependent variable “effectiveness of planned substantive procedures.”<sup>36</sup> Significance levels presented in Table 14 are one-tailed due to the directional nature of the corresponding hypotheses. Mean absolute inherent risk

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<sup>36</sup> Similar to Low (2004), when evaluating the effectiveness of participants’ substantive testing, experts were provided participants’ inherent and control risk assessments. Therefore, participants’ risk assessments could have affected the experts’ evaluations. Informing the experts of the participants’ risk assessments is consistent with practice as audit managers and/or partners are typically aware of their subordinates’ risk assessments from their review of risk assessment workpapers (Low 2004).

assessment deviations for the low and high AIS expertise groups were 18.96 and 13.80, respectively. These means were in the hypothesized direction (i.e., lower absolute deviations for the high AIS expertise group) and significant ( $F = 6.266$ ,  $p = .008$ ). Thus, there is support for Hypothesis 5a. Mean absolute control risk assessment deviations for the two groups were significant and in the expected direction, with the mean deviations for the low and high AIS groups being 19.69 and 15.60, respectively ( $F = 2.840$ ,  $p = .048$ ). Therefore, there is support for Hypothesis 5b. Mean expert effectiveness ratings for the planned substantive tests of the low and high AIS expertise groups were 5.15 and 5.71, respectively. These means were in the hypothesized direction and ANCOVA results point to a significant AIS expertise effect ( $F = 1.809$ ,  $p = .092$ ), supporting H5c.

As discussed above, the CAS competence manipulation is confounded with expert group for the dependent variables “quality of control risk assessments” and “effectiveness of substantive audit procedures” in Hypothesis Set 5. In other words, any significant CAS competence effect upon these dependent variables in Hypothesis Set Five could be due to either the CAS competence manipulation or the use of two different expert groups assigned to high and low CAS competence conditions. Thus, no hypotheses predicting the effect of CAS competence on these variables are offered in this study. To address the impact of confounding CAS competence with expert group, Low (2004) suggests performing independent-samples *t* tests within each CAS competence condition/expert group to determine whether the results are consistent with those presented for Hypothesis Set 5 above. Within the low CAS competence condition, non-tabulated differences between the low and high AIS expertise groups for control risk quality were in the expected direction, but not significant ( $p = .163$ ). Differences for mean expert

effectiveness ratings were in the expected direction and significant ( $p < .001$ ). Within the high CAS competence condition, the difference between the low and high AIS expertise groups for control risk quality was in the expected direction and was significant ( $p = .090$ ) and differences for mean expert effectiveness ratings were insignificant ( $p = .235$ ). Thus, although not all differences were significant, they were directionally consistent with Hypothesis Set Five.

Using the risk assessments of audit experts as standards for judgment quality, the above results indicate that, in general, auditors with higher AIS expertise provided higher quality inherent and control risk assessments than auditors with lower AIS expertise. High AIS expertise auditors also planned substantive tests that were deemed more effective, on average, by expert auditors.

#### **4.6 Summary of Hypothesis Testing**

The results of this study indicate that both auditor AIS expertise and CAS competence affect auditor planning judgments in a complex AIS environment. Auditors with higher AIS expertise assessed inherent risk and control risk at higher levels and also planned substantive tests that were greater in scope than auditors with lower AIS expertise. In particular, auditors with higher AIS expertise used the nature of substantive tests to expand their scope beyond that planned by low AIS expertise auditors (i.e., greater number of procedures and higher grade of labor). Also, auditors with higher AIS expertise provided higher quality inherent and control risk assessments and planned more effective substantive tests than auditors with lower AIS expertise.

The competence of CAS used on the audit engagement also affected auditors' planning processes. Specifically, auditors judged positive internal control testing evidence provided by a CAS with higher competence as more reliable than similar evidence provided by a CAS with lower competence. In turn, auditors assigned to the high CAS competence condition provided lower control risk assessments than auditors receiving the low CAS competence treatment. Also, auditors in the high CAS competence group provided substantive tests that were lesser in scope than auditors in the low CAS competence group. Auditors receiving evidence from a highly competent CAS used the nature (i.e., assigning less senior staff to procedures) and extent (i.e., smaller budgets) of planned tests to differentiate themselves from auditors in the low CAS competence condition.

Lastly, while there was no interactive effect between auditor AIS expertise and CAS competence on control risk assessments, results indicated such an interaction was present for the scope of planned substantive tests. Under conditions of low CAS competence, auditors with higher AIS expertise expanded the scope of substantive tests (i.e., larger budgets and more procedures assigned to more senior-level engagement team members) beyond the scope set by auditors with lower AIS expertise. No such auditor AIS expertise effect occurred when auditors received evidence from a highly competent CAS.

## **CHAPTER 5: CONCLUSIONS, LIMITATIONS, AND IMPLICATIONS**

### **5.1 Introduction**

This study examined the effects of computer assurance specialist (CAS) competence and auditor accounting information system (AIS) expertise on auditor planning judgments. Senior-level auditors (participants) completed a quasi-experimental case which depicted a complex AIS audit environment and required them to assess inherent and control risks for a transaction cycle and plan related substantive tests. CAS competence was manipulated as high and low between participants and auditor AIS expertise was measured. In addition, the quality and effectiveness of the participants planning judgments were evaluated with the assistance of audit experts. The following sections offer conclusions, limitations, and implications for the study.

### **5.2 Conclusions**

In complex AIS environments, both auditor AIS expertise and their evaluations of CAS evidence play a critical role in determining audit quality (POB 2000). The audit literature has yet to investigate the role of auditor AIS expertise in their judgment processes, and complex AIS environments may require auditors to draw on this expertise when using CAS evidence. This study extends the literature by demonstrating that auditor AIS expertise and CAS competence significantly affect auditor planning judgments in advanced AIS settings. More importantly, auditors' AIS expertise levels appear to determine their ability to compensate for CAS competence deficiencies.

The results of this study indicate that, given a complex AIS environment, auditors with higher AIS expertise assessed inherent and control risk as higher than auditors with lower AIS expertise. Higher AIS expertise auditors also planned substantive tests that were greater in scope. Specifically, they planned significantly more procedures and assigned more senior level auditors to perform those procedures than their counterparts. Results also indicated that the higher risk levels and greater scope provided by auditors with higher AIS expertise were judged by audit experts to be of higher quality and more effective. Clearly, these results point to auditor AIS expertise playing a significant role in determining audit quality in complex AIS environments.

Auditors were also sensitive to the competence of CAS as an evidence source. When auditors received evidence supporting a control risk reduction from a highly competent CAS, they relied more on that evidence and, in turn, provided lower control risk assessments than auditors assigned to the low CAS competence condition. Auditors using a highly competent CAS also reduced the scope of their planned substantive tests below that set by auditors in the low CAS competence condition. Consistent with prior research (e.g., Bamber 1983), auditors appear to consider source competence when evaluating CAS evidence and variation in source competence affected their planning judgments.

Lastly, while there was no interactive effect between auditor AIS expertise and CAS competence on control risk assessments, results indicated such an interaction was present for the scope of planned substantive tests. Specifically, when CAS competence was low, auditors with higher AIS expertise planned a greater number of substantive tests, assigned more procedures to a senior-level auditor, and provided higher budgets

than auditors with lower AIS expertise. Under conditions of high CAS competence, scope decision differences between high and low AIS expertise auditors were smaller. Thus, while auditor AIS expertise plays an important role in complex AIS environments, it appears to be most critical when there are CAS competence deficiencies. This may represent a significant obstacle to firms, given practitioner concerns regarding CAS competence variability, as well as the perceived variability in their own AIS expertise.

### **5.3 Limitations**

The conclusions drawn from this study are subject to several limitations. First, all participants in this study were provided with positive evidence from the CAS (i.e., client system controls appear reliable). The decision was made to use positive instead of negative evidence because the use of the former could point to possible audit ineffectiveness while using the latter would focus the study on possible inefficiency issues. Failure to consider and react to source competence or over-rely on positive CAS evidence may lead to insufficient risk levels and under-auditing. On the other hand, failure to consider source competence in light of negative CAS evidence may cause auditors to over-rely on such evidence, increase risks beyond an appropriate level, and over-audit. In today's environment of audit failures, factors or scenarios which may lead to under-auditing are of particular importance (e.g., Weil 2004). In addition, informal discussions with audit professionals indicated that the majority of CAS evidence in practice is positive in nature and the probability of a CAS with low competence identifying system-related control weaknesses and providing the auditor with negative evidence is relatively low.

Second, because AIS expertise is a trait associated with the auditor, it was measured and not manipulated between the study's participants. Thus, conclusions drawn with respect to significant relationships between auditor AIS expertise and the study's dependent variables are limited to evidence of correlation and not causality. It should be noted, however, several other explanatory variables (e.g., general audit experience, experience with ERP implementations) were measured, analyzed, and controlled, and there is no evidence that they were responsible for the results obtained in this study. None of these other explanatory variables were found to be significant between AIS expertise groups (see Table 3). Also, non-tabulated ANCOVA results using AIS expertise as an independent variable and the explanatory variables as covariates were consistent with Hypothesis Set One, Four, and Five testing results presented in section 4.5.

Third, in order to investigate research questions for which little to no archival data is available to researchers (e.g., competence levels of CAS assigned to actual audit engagements), this study employed a quasi-experimental design to test its hypotheses. While the chief advantages of such a design are the ability to collect unavailable data and enhanced internal validity, the use of a quasi-experiment may reduce the study's external validity. Although the case materials were developed with the assistance of practicing auditors to ensure their realism, in an actual audit engagement auditors have access to a far richer set of information that is processed over a much longer period of time. In addition, participants were asked to provide judgments related to only one part of the audit process and were unable to interact with the CAS.

Lastly, the sample of participants was not a random sample from the population of all senior-level auditors. Because the nonrandom nature of this study's sample may

restrict the ability to generalize its results, great care was taken to involve as many large audit firms as possible in the study and to obtain participants from multiple regions of the United States.

#### **5.4 Implications**

The findings of this study have implications for practice and future research. Since the likelihood of under-auditing may increase in cases where both the CAS and auditor are of lesser ability, firms should consider the combined capabilities of these individuals when assigning them to audit engagements with advanced AIS. Given that auditor AIS expertise may play a significant role in determining audit quality in complex AIS environments, firms might also want to stress AIS training and experience during the initial years of auditors' careers. In this way, as staff auditors transition to the role of senior, they may be better equipped with the AIS expertise required in today's audit environment. The results also validate the importance of AIS-related courses in accounting curricula. Lastly, policy-makers should consider whether additional guidance, beyond that provided by SAS No. 22 (1978), is needed to assist auditors when using CAS on their engagements (e.g., see above implication concerning the combined assessment of CAS/auditor capabilities).

Future research could explore ways in which to improve the CAS/auditor relationship (e.g., through combined trainings and on-going dialogues). In addition, the impact of advanced AIS on audit quality should be further examined. For example, future research could investigate the relationship between the complexity level of corporations' AIS and an observable measure of audit quality (e.g., restatements, earnings

management). Also, auditor AIS expertise appears to be a distinct domain of expertise and not simply a by-product of general audit experience. Therefore, this study's auditor AIS expertise measure could be used to evaluate the effects of auditor AIS expertise on other audit activities such as the performance of substantive tests. Lastly, this study examined auditors' reactions to the implementation of an ERP module and the numerous increased risks that often accompany such implementations. Future research could evaluate if, and how, auditors react to specific ERP-related risks (e.g., lack of employee training, password/system access issues). Such research will advance our understanding of the role CAS, advanced AIS, and auditor AIS expertise play in determining the quality of contemporary audit services.

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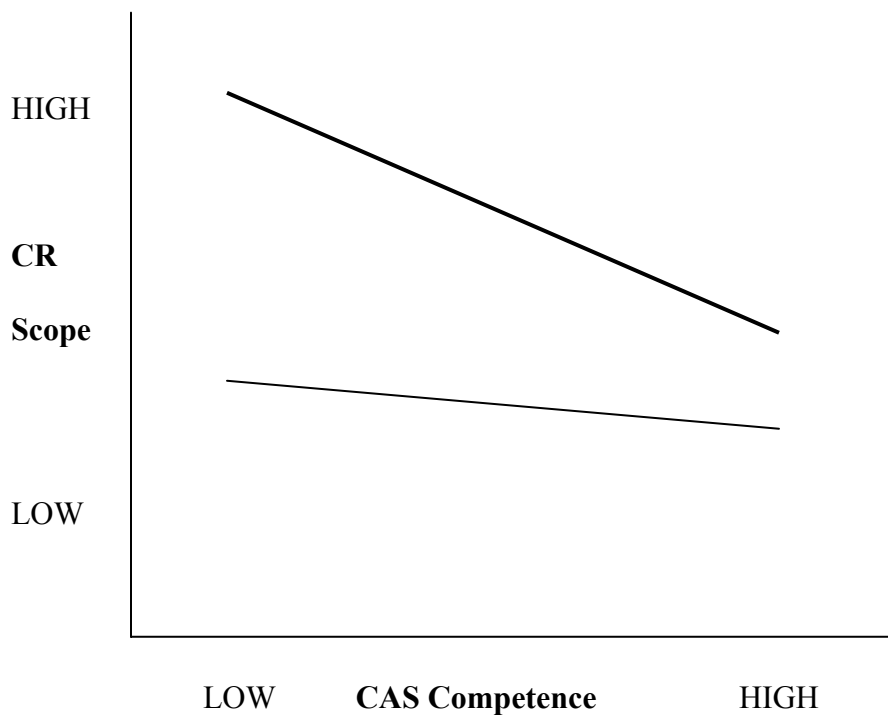
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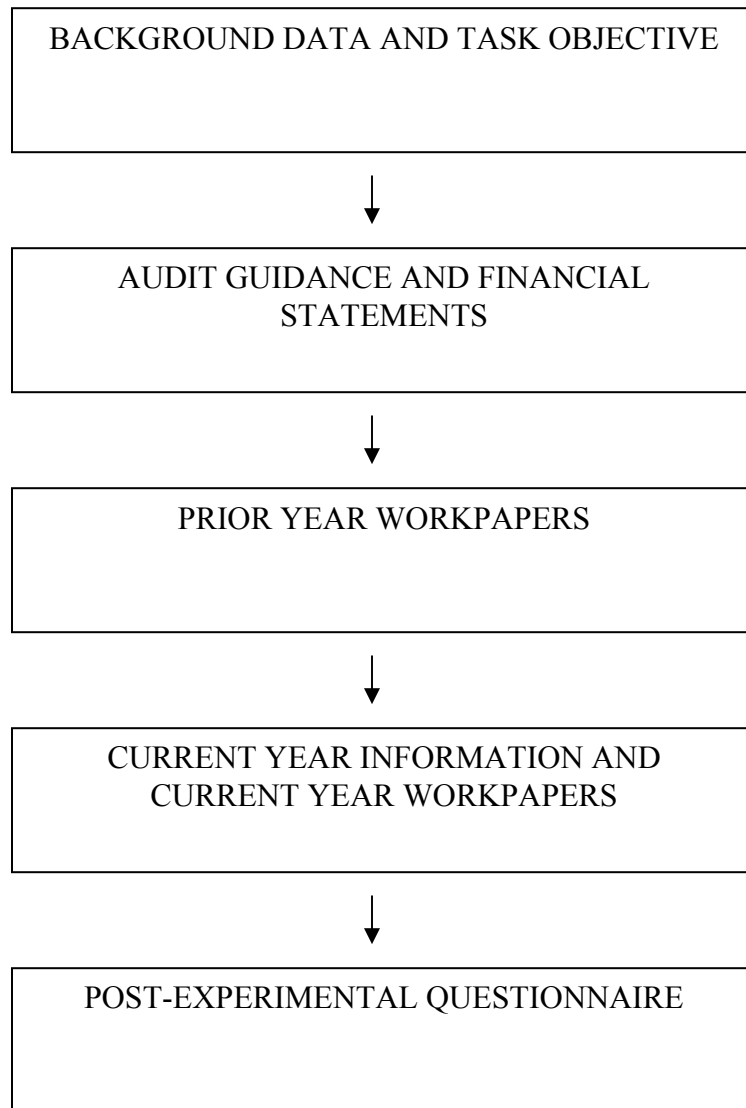


Note: **—————** indicates high auditor AIS expertise.  
**—————** indicates low auditor AIS expertise.

CR: Control risk assessment level

Scope: Scope of substantive tests (i.e., nature, timing, and extent).

**Figure 1 – Graph Depicting Computer Assurance Specialist (CAS) and Auditor Accounting Information System (AIS) Expertise Interaction**



**Figure 2 – Diagram of the Quasi-Experimental Task**

	Low CAS Competence	High CAS Competence
High Auditor AIS Expertise	Group 1	Group 2
Low Auditor AIS Expertise	Group 3	Group 4

**Figure 3 – Experimental Groups**

Hypothesis Number	Independent Variable	Dependent Variable
H1a	Auditor AIS Expertise	Inherent Risk Level
H1b	Auditor AIS Expertise	Control Risk Level
H1c	Auditor AIS Expertise	Scope of Substantive Testing
H2	CAS Competence	Reliability Judgment
H3a	CAS Competence	Control Risk Level
H3b	CAS Competence	Scope of Substantive Testing
H4a	Auditor AIS Expertise * CAS Competence	Control Risk Level
H4b	Auditor AIS Expertise * CAS Competence	Scope of Substantive Testing
H5a	Auditor AIS Expertise	Quality of Inherent Risk Assessment
H5b	Auditor AIS Expertise	Quality of Control Risk Assessment
H5c	Auditor AIS Expertise	Effectiveness of Scope of Substantive Testing

**Figure 4 – Summary of Testing**

**APPENDIX A: COMPUTER ASSURANCE SPECIALIST (CAS)  
COMPETENCE/AUDITOR RELATIONSHIP SURVEY**

Year of experience (in years):

Level in firm (senior or manager):

Do you have experience dealing with CAS personnel (the CAS staff that perform system control testing procedures) on your engagements? (yes or no):

Has the competence / ability of CAS personnel assigned to your engagements, at times, been an issue on your audit engagements? (yes or no):

Do you, for some CAS personnel, feel they could be more experienced / more competent at their job? (yes or no):

Indicators of CAS competence / ability: Please read the statements below and answer the question at the end regarding which items most influence your perceptions of CAS competence / ability on your engagements.

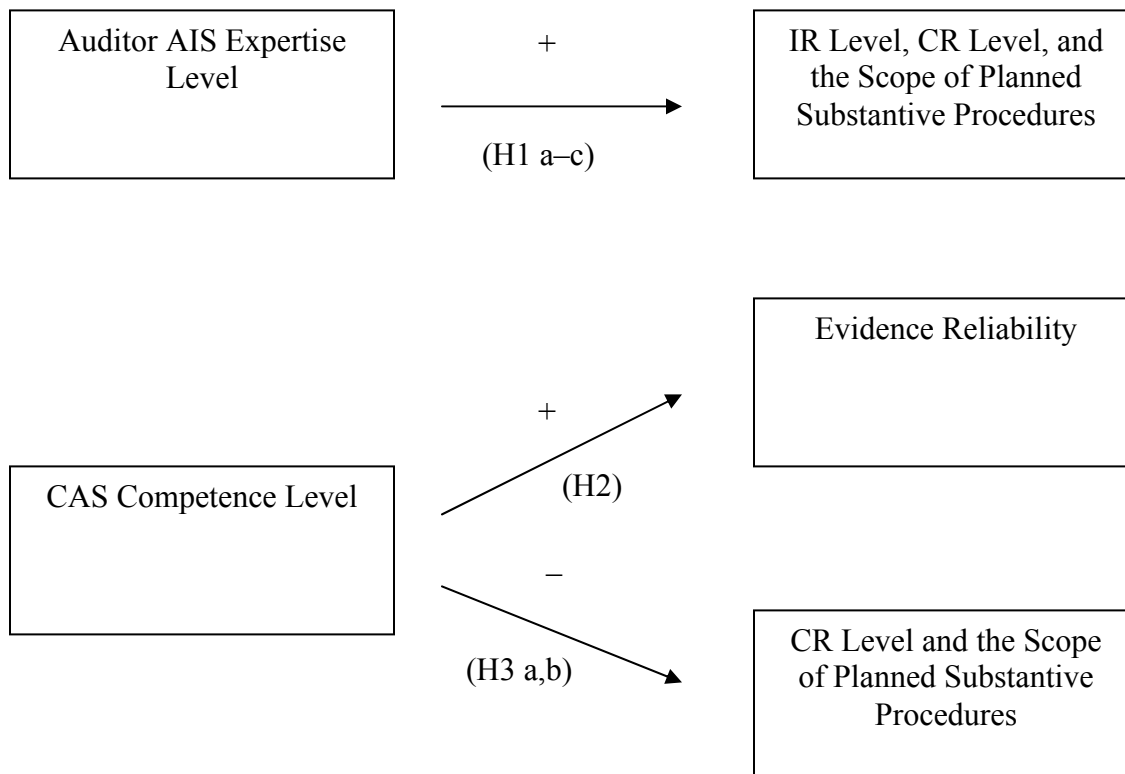
1. The technical ability of the CAS.
2. Your manager's opinion of the CAS.
3. How much training the CAS has received.
4. The number of years of experience of the CAS.
5. How well the CAS knows your client / amount of interaction of the CAS with the engagement team.
6. How quickly or late you receive the CAS internal control testing workpapers.

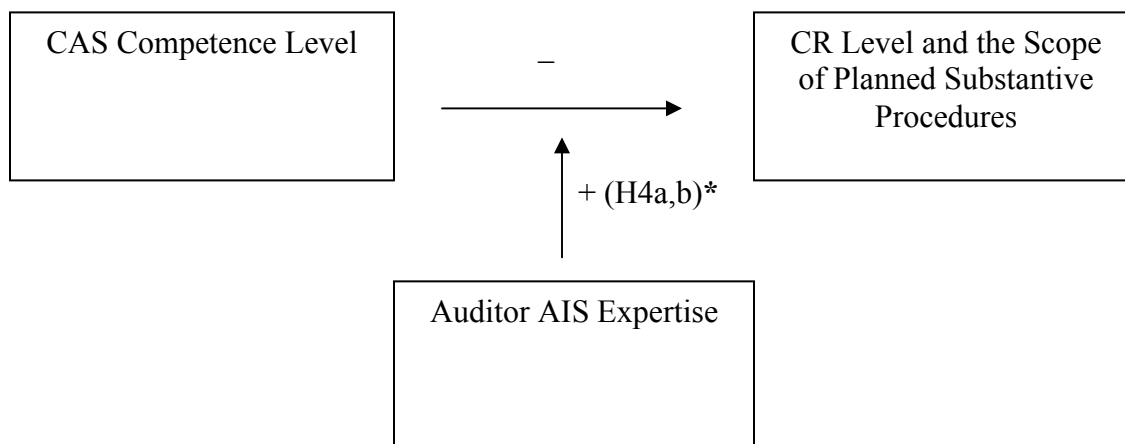
Question: Of the items identified above, pick the three items that affect your perceptions of CAS competence / ability on your engagements. Simply input the numbers below. If less than three affect you perceptions of the CAS or none at all, simply list the ones that are relevant below or input "none."

Input numbers from above that are relevant here:

Do any other factors affect your perception of CAS competence more than the items you listed above?

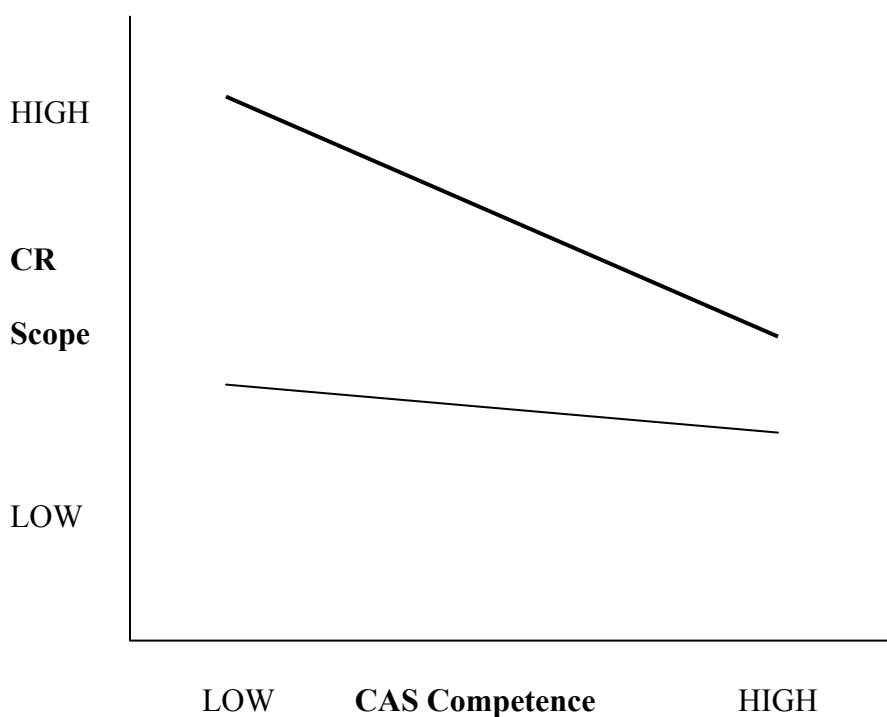
## APPENDIX B: HYPOTHESES



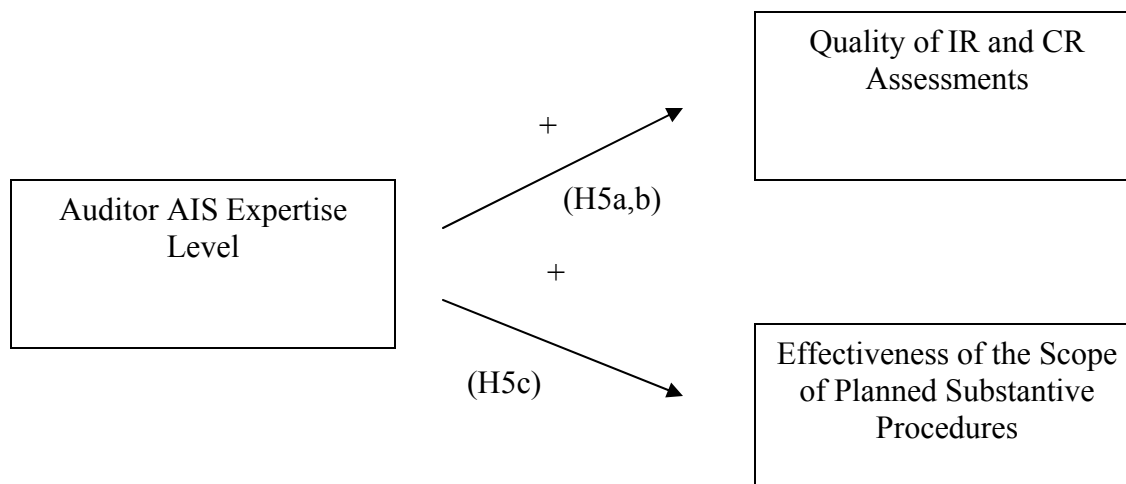


\* As described in H4a,b, the positive relationship between auditor AIS expertise and their planning judgments is expected to be stronger in the low CAS competence condition and weaker in the high CAS competence condition (see graph below).

H4a,b: CAS competence and auditor AIS expertise are expected to interact to affect auditor planning judgments as follows:



Note: **—————** indicates high auditor AIS expertise.  
**—————** indicates low auditor AIS expertise.



**APPENDIX C: QUASI-EXPERIMENTAL INSTRUMENT**

[The following letter was provided to all participants in hardcopy form along with the case study.]

Dear Participant,

Thank you for participating in this research project by completing this case study. I am a former Deloitte and Touche auditor who is currently completing the requirements for a Ph.D. in Accounting at Drexel University. By completing this case study, you will be assisting me in satisfying these requirements and helping me finish my degree. Please be assured that all of your responses are for academic purposes, will remain **completely confidential**, and will not be shared with any member of your firm or any other party. For each auditor who completes this case study I will be making a monetary donation to the United Way. This research project has been approved by your firm and they also request your participation and thank you for your time spent on the project.

The case study materials should take you approximately 20 to 30 minutes to complete. Since you will be asked to record the time spent on the case study, please attempt to work all the way through it in one sitting. Once you have completed the case study, please place all materials in the pre-addressed and stamped envelope provided and mail it back to me. **If you have any questions about the case study, do not hesitate to call me at 215-895-2883 or e-mail me at [jfb24@drexel.edu](mailto:jfb24@drexel.edu).**

Again, thank you for offering your time to complete this research project and assisting me in obtaining my Ph.D. degree.

Sincerely,

Joe Brazel  
Ph.D. Candidate  
Drexel University

**MADISON INC.**

**CASE STUDY**

## BACKGROUND

Assume that you are the senior (in-charge) auditor assigned to the 12/31/03 fiscal year-end audit of Madison Inc. The audit team consists of you (the senior auditor), four assistants, a manager, and a partner. Madison Inc. is a publicly held, mid-sized manufacturer of sporting goods equipment headquartered in Philadelphia, PA. It makes a variety of products for baseball, football, hockey, basketball, hunting, and fishing. Its products are sold across the U.S. to retailers of sporting goods equipment and also directly to customers via its internet website. Your firm has audited Madison Inc. for the last five years and past audits have always resulted in unqualified audit opinions. As in the prior year, the partner in-charge of the Madison Inc. audit has set audit risk at a low level of 5%. The financial statements and materiality calculations for Madison Inc. are contained in the appendix of this case study. Feel free to refer to these items at any time.

It is now October of 2003 and you are currently in the planning/internal control phase of the 12/31/03 fiscal year-end audit.

## TASK OBJECTIVE

Based on the information provided in this case, you will be asked to provide *preliminary* assessments of the current year (12/31/03) risks associated with the Sales and Accounts Receivable cycle of Madison Inc. Also, you will be asked to prepare audit programs and budgets for the current year's substantive tests of that cycle. It is important that you respond to questions in this case study as you normally would during your day-to-activities. **Prior year workpapers are provided in this case study.** You may consult these workpapers at any time. The format of some information presented in the case was chosen to accommodate any firm's audit approach and, thus, may differ from the format used by your firm. However, the format used in the case is designed to be straight-forward and should be easy to follow. Be especially attentive to items in **YELLOW**, as these items require you to provide a response.

**PLEASE INPUT THE EXACT CURRENT TIME: \_\_\_\_\_ : \_\_\_\_\_ (e.g., 6:37 pm).**

**After you have input the current time, please turn the page and begin the case study.**

**AUDIT GUIDANCE: SAS No. 47**

**INSTRUCTION:** *Please review the following guidance for assessing risks and planning substantive procedures adapted from SAS No. 47 (AICPA 1983).*

SAS No. 47 provides the conceptual underpinning for the audit risk model. The auditor applies the audit risk model during the planning/internal control phase of the audit. Audit risk (AR) is the risk that the auditor may unknowingly fail to appropriately modify his or her opinion on financial statements that are materially misstated. Audit risk is the product of the following interrelated factors:

Inherent Risk (IR) = the risk that a financial statement assertion is susceptible to a material misstatement, assuming there are no related controls

Control Risk (CR) = the risk that the entity's internal control structure or procedures will not prevent or detect, in a timely manner, a material misstatement which could occur in a financial statement assertion

Detection Risk (DR) = the risk that the auditor will not detect a material misstatement that exists in a financial statement assertion

Thus, the mathematical depiction of the model is  $AR = IR \times CR \times DR$ , with each risk level assessed by the auditor as a percentage of 1.0 (e.g., IR = 40% or .40). In theory, the model is intended to be applied as follows: AR is first set by the partner in-charge of the audit engagement at an acceptably low level (e.g., 5%). Next, IR and CR are assessed via the auditor's knowledge of client operations, testing of internal controls, prior history with the client, etc. Lastly, given the assessed levels of IR and CR, the scope of planned substantive procedures (i.e., the nature, timing, and extent of substantive testing procedures), or DR, is adjusted by the auditor to obtain the desired level of AR ( $DR = AR / (IR \times CR)$ ).

**PRIOR YEAR WORKPAPERS: Inherent Risk Assessment**

**INSTRUCTION:** *Please review the following prior year workpaper.*

**Madison Inc.: FYE 12/31/02**

Preparer: HSD 10/10/02

Reviewer: LDM 10/17/02

JSP 10/23/02

**12/31/02 Inherent Risk Assessment Workpaper: Sales and Accounts Receivable Cycle**

Audit Risk = 5%

Monetary Precision/Tolerable Error = \$261,000

Inherent Risk Assessment: Sales and Accounts Receivable Cycle (percentages)

0	10	20	30	40	50	60	70	80	90	100
Low					Moderate					High
Risk					Risk					Risk

**12/31/02 Inherent Risk Assessment (in percentage form): 35%**Inherent Risk Factors: Sales and Accounts Receivable Cycle

In the prior year (12/31/01), one material audit adjustment was identified and recorded by the client for the cycle. No material misstatements were identified for the cycle for the fiscal year-ended 12/31/00.

The majority of transactions in this cycle are routine transactions, but there is a considerable amount of management judgment required for the allowance for doubtful accounts valuation. From a review of the 9/30/02 accounts receivable aging schedule, it appears that 75% of the accounts receivable balance is current (<30 days old). No prior year audit adjustment was required for the allowance for doubtful accounts.

Experience with the client indicates that top management of Madison Inc. is fairly conservative in terms of reporting financial results. No factors appear to exist that might motivate them to circumvent or override existing control procedures.

Madison Inc. is a manufacturer and distributor of sporting goods to mainly large sporting goods retailers. Prior years audits have shown that these customers are generally good credit risks because they have a low risk of default. Approximately 10% of sales are on a consignment basis.

There do not appear to be any material revenue transactions with related parties in the current year.

**PRIOR YEAR WORKPAPERS: Control Risk Assessment**

**INSTRUCTION:** *Please review the following prior year workpaper.*

**Madison Inc.: FYE 12/31/02**

Preparer: HSD 10/15/02

Reviewer: LDM 10/22/02

JSP 10/25/02

**12/31/02 Control Risk Assessment Workpaper: Sales and Accounts Receivable Cycle**

Audit Risk = 5%

Inherent Risk = 35%

Monetary Precision/Tolerable Error = \$261,000

Control Risk Assessment: Sales and Accounts Receivable Cycle (percentages)

0	10	20	30	40	50	60	70	80	90	100
Low					Moderate					High
Risk					Risk					Risk

**12/31/02 Control Risk Assessment (in percentage form): 40%**Control Risk Factors: Sales and Accounts Receivable Cycle

The results of tests: manual and programmed controls were adequate except for the following results:

1. Statements are not prepared and mailed to customers on a monthly basis.
2. The credit-granting control procedures were not operating at an acceptable level. Additional audit work indicated that the average number of days' sales outstanding has only risen from 20 to 21 days in the current year. Write-offs of accounts as uncollectable have not increased.

Current year testing of internal controls indicates that the client largely relies on adequate separation of duties and proper authorization of transactions to meet its control objectives. The internal control structure consists of both manual and programmed controls.

Prior year's (12/31/01) tests of controls indicated adequate controls over the sales/accounts receivable cycle.

Sales representatives have the authority to grant their customers price discounts without approval. The amount of revenue lost is not determinable at this time, but it is unlikely to be material. A letter has been provided to management proposing that discount terms be in writing and approved by a company official.

**Madison Inc.**  
**Current Year Workpapers**

**The following pages contain the current year workpapers for Madison Inc. You may consult the Prior Year Workpapers presented on pages 3 and 4 at any time.**

**CURRENT YEAR WORKPAPER: The Effects of ERP Implementation**

**INSTRUCTION:** *Please review the following CURRENT YEAR workpaper.*

**Madison Inc.: FYE 12/31/03**

Preparer: LDM 9/4/03  
Reviewer: JSP 9/10/03

**12/31/03 Planning Workpaper Documenting the Effects of Madison Inc.'s Current Year ERP System Module Implementation on the Sales and Accounts Receivable Cycle**

During the fiscal year-ended 12/31/03, Madison Inc. implemented the Sales and Distribution (SD) module of Automated Processing Systems (APS) Version 3: an enterprise resource planning (ERP) system. The client started the SD implementation on 1/12/03 and completed the implementation 6/18/03. In the prior year, the client implemented the Financial Accounting and Materials Management modules of APS Version 3. Over the next two fiscal years, the client intends to implement several other modules of the system.

From discussions with client personnel involved with the implementation of the SD module, it appears that the Sales and Accounts Receivable cycle will be the transaction cycle most affected by the current year SD module implementation. As documented in prior year workpapers, prior to the SD implementation, the system that accounted for Sales and Accounts Receivable transactions was a non-complex, spreadsheet-based, off-the-shelf computer package. That system was not integrated with other systems, the majority of internal controls were manually performed, and the majority of audit evidence used to test Sales and Accounts Receivable was produced by client personnel with the assistance of the system.

**Workpaper continued on next page.**

**CURRENT YEAR WORKPAPER: The Effects of ERP Implementation (cont.)**

**INSTRUCTION:** *Please continue reviewing the following CURRENT YEAR workpaper.*

**Madison Inc.: FYE 12/31/03**

The implementation of the Sales and Distribution (SD) module has made the Sales and Accounts Receivable cycle **computer dominant and complex** for the current year-ended 12/31/03. From our observations of the SD module in use and discussions with the SD module implementation team, the following specific items were noted:

1. Madison Inc. has followed the same procedures as in the prior year's module implementations when (a) transferring data from the old system to the SD module and (b) integrating the SD module with the other modules implemented in the prior year.
2. Madison, Inc. will be integrating an internal control application with the SD module in the current year. This internal control application is a non-APS version 3 product (i.e., the application is produced by another software company).
3. The majority of data input for the Sales and Accounts Receivable cycle has been moved to transaction sources (e.g., shipping department).
4. On 6/18/03, the date of the completion of the SD module implementation, Madison Inc. stopped accounting for Sales and Accounts Receivable transactions with the prior system and used only the SD module.
5. The SD module implementation team consisted of external consultants and Madison Inc. IT personnel.

**Conclusion:** Engagement management concludes that, for the 12/31/03 audit of Madison Inc., the Sales and Accounts Receivable cycle is **computer dominant and complex**. Therefore, a computer assurance specialist (CAS) from our firm will be assigned to the engagement team to test the reliability of the cycle's system-related internal controls. As in the prior year, an audit staff assistant will test the remaining few manual controls of the cycle.

**CURRENT YEAR WORKPAPER: Inherent Risk Assessment**

**INSTRUCTION:** *Please review the following CURRENT YEAR workpaper. FIRST input your risk assessment and THEN provide documentation for your assessment.*

**Madison Inc.: FYE 12/31/03**

**12/31/03 Preliminary Inherent Risk Assessment Workpaper: Sales and Accounts Receivable Cycle**

Current Year Audit Risk = 5%

Current Year Monetary Precision/Tolerable Error = \$264,000

**Prior Year Inherent Risk = 35%**

Preliminary Inherent Risk Assessment: Sales and Accounts Receivable Cycle (percentages)

0	10	20	30	40	50	60	70	80	90	100
Low					Moderate					High
Risk					Risk					Risk

**12/31/03 Preliminary Inherent Risk Assessment (Please input any whole number between 0 and 100) → %**

Inherent Risk Factors: Sales and Accounts Receivable Cycle

**Based on the information provided to you previously, please DOCUMENT inherent risk factors that support your PRELIMINARY inherent risk ASSESSMENT BELOW. Also, please list any additional factors you would consider before making a final inherent risk assessment or changing your preliminary assessment.**

## CAS INFORMATION

[The following is the manipulation provided to the Low CAS competence group.]

**INSTRUCTION:** *Please review the following information about the computer assurance specialist assigned to test SYSTEM-RELATED internal controls.*

As noted in the planning workpaper documenting the current year Sales and Distribution module implementation, the **Sales and Accounts Receivable cycle** has been deemed computer dominant and complex for the current year (12/31/03). Thus, the majority of controls related to the Sales and Accounts Receivable cycle are system-related in the current year. A competent and qualified staff assistant tested the relatively few remaining manual controls of the cycle in the current year. The results of those tests indicate that manual controls for the Sales and Accounts Receivable cycle appear reliable.

**Chris Smith**, a computer assurance specialist (CAS) from your firm, has been assigned to the 12/31/03 Madison Inc. audit engagement to test system-related controls for the **Sales and Accounts Receivable cycle**.

Chris has eight months of experience testing system-related controls for your firm. He has yet to receive training in relation to the Automated Processing Systems (APS) Version 3 implemented by Madison Inc. Conversations with fellow audit seniors who have used Chris indicate that he has a tendency to perform weak (i.e., less than effective) tests of controls. In fact, one of your fellow audit seniors has informed you that Chris did not uncover a material weakness in her client's system-related controls. During the course of that audit, it became apparent to that senior's audit team that the system did not allow for a proper segregation of duties in relation to the payroll cycle. Chris' system control testing workpaper for that audit did not identify that control weakness and therefore the scope of planned substantive testing failed to reflect this weakness.

You have just received Chris's workpaper documenting his system-related control testing. It is provided on the following page.

## CAS INFORMATION

[The following is the manipulation provided to the High CAS competence group.]

**INSTRUCTION:** *Please review the following information about the computer assurance specialist assigned to test SYSTEM-RELATED internal controls.*

As noted in the planning workpaper documenting the current year Sales and Distribution module implementation, the **Sales and Accounts Receivable cycle** has been deemed computer dominant and complex for the current year (12/31/03). Thus, the majority of controls related to the Sales and Accounts Receivable cycle are system-related in the current year. A competent and qualified staff assistant tested the relatively few remaining manual controls of the cycle in the current year. The results of those tests indicate that manual controls for the Sales and Accounts Receivable cycle appear reliable.

**Chris Smith**, a computer assurance specialist (CAS) from your firm, has been assigned to the 12/31/03 Madison Inc. audit engagement to test system-related controls for the **Sales and Accounts Receivable cycle**.

Chris has approximately four years of experience testing system-related controls for your firm. He has also received an extensive amount of training in relation to the Automated Processing Systems (APS) Version 3 implemented by Madison Inc. Conversations with fellow audit seniors who have used Chris indicate that he has the ability to perform strong (i.e., very effective) tests of controls. In fact, one of your fellow audit seniors has informed you that Chris uncovered a material weakness in her client's system-related controls. During the course of that audit, Chris appropriately concluded that the system for that client did not allow for a proper segregation of duties in relation to the payroll cycle. Chris' system control testing workpaper properly identified that control weakness and therefore the scope of planned substantive testing was increased by the audit senior.

You have just received Chris's workpaper documenting his system-related control testing. It is provided on the following page.

**CURRENT YEAR WORKPAPER: System Control Testing**

**INSTRUCTION:** *Please review the following CURRENT YEAR workpaper.*

**Madison Inc.: FYE 12/31/03**

**12/31/03 System Control Testing: Sales and Accounts Receivable Cycle**

**System-Related Controls – tested by Chris Smith, computer assurance specialist**

<u>Control Tested</u>	<u>Testing Result</u>
1. Proper transferal of data from legacy operating system to Sales and Distribution (SD) module and integration of the SD module with the rest of the ERP system modules.	<b>(a)</b>
2. External control application successfully integrated with SD Module.	<b>(a)</b>
3. Access controls – password used to ensure only authorized user access.	<b>(b)</b>
4. System requires an approved sales order to produce a shipping document and compares totals of quantities shipped to quantities billed.	<b>(c)</b>
5. System automatically posts sales transactions to the accounts receivable subsidiary ledger and general ledger.	<b>(c)</b>
6. System compares customer order with customer's authorized credit limit and current account balance.	<b>(c)</b>

**(a)** Implementation process appears to be properly controlled.

**(b)** Tests revealed that access to the system was achieved without the use of a password; further testing indicated that the problem was isolated and was properly addressed by the client.

**(c)** Control appears to be in place.

**Conclusion:** The system-related controls for the Sales and Accounts Receivable cycle appear reliable, taking into account the exception noted above.



**CURRENT YEAR WORKPAPER: Control Risk Assessment**

**INSTRUCTION:** *Please review the following CURRENT YEAR workpaper. FIRST input your risk assessment and THEN provide documentation for your assessment.*

**Madison Inc.: FYE 12/31/03**

**12/31/03 Preliminary Control Risk Assessment Workpaper: Sales and Accounts Receivable Cycle**

Current Year Audit Risk = 5%

Current Year Monetary Precision/Tolerable Error = \$264,000

**Prior Year Inherent Risk = 35%**

Preliminary Control Risk Assessment: Sales and Accounts Receivable Cycle (percentages)

0	10	20	30	40	50	60	70	80	90	100
Low					Moderate					High
Risk					Risk					Risk

**12/31/03 Preliminary Control Risk Assessment (Please input any whole number between 0 and 100) → %**

Control Risk Factors: Sales and Accounts Receivable Cycle

**Based on the information provided to you previously, please DOCUMENT control risk factors that support your PRELIMINARY control risk ASSESSMENT BELOW. Also, please list any additional factors you would consider before making a final control risk assessment or changing your preliminary assessment.**

**SAS No. 47 EXAMPLES**

**INSTRUCTION:** *Please review these examples illustrating the application of the audit risk model.*

**EXAMPLES:**

1. If control risk associated with the sales/accounts receivable cycle is assessed at a higher level in the current year in comparison to the prior year, all other things held constant, the auditor may consider increasing the number of accounts receivable confirmations tested in the current year over that of the prior year. As IR and CR increase, the auditor is expected to compensate with substantive procedures that are greater in scope to reduce DR.
2. If AR, IR, and CR are assessed at 5%, 35%, and 60%, respectively, then the scope of planned substantive procedures should be designed to allow for a DR of 24% ( $.24 = .05 / (.35 \times .60)$ ).

**CURRENT YEAR WORKPAPER: Sales Audit Program and Budget**

**INSTRUCTION:** Given the current year ERP system implementation, your IR and CR assessments, and the CAS information provided, please complete the workpaper that follows. You have been provided with prior year audit procedures and budgets. For each procedure, respond as to whether you would like to REPEAT (repeat procedure, performer, timing, and budget for the current year), DELETE, or CHANGE (change the performer, timing, or budgeted hours) the procedure. Indicate your response by circling one of the three options for each procedure. If you decide to REPEAT or DELETE a procedure, please continue to the next procedure. If you decide to CHANGE a procedure (e.g., increase the budgeted hours), please input changes in the yellow boxes provided. You will also have the opportunity to input any customized procedures that you would like performed.

**Madison Inc.: FYE 12/31/03**  
**12/31/03 Audit Program and Budget: Sales**  
**Account**

12/31/03 Audit Risk = 5%

12/31/03 Inherent Risk = \_\_\_\_\_  
 (input from p. 8)

12/31/03 Control Risk = \_\_\_\_\_  
 (input from p.12)

12/31/03 Monetary Precision / Tolerable Error =  
 \$264,000

	Staff Assistant, Senior or Manager	Interim: 9/30/03 or Final: 12/31/03	Budgeted Hours	CIRCLE one for each procedure
	<u>Performed By</u>	<u>Timing</u>	<u>Budgeted Hours</u>	
<b>EXAMPLE:</b>				
A. Sample audit procedure	PY: Staff Assistant	Final	10	<b>Repeat Delete Change*</b>
	CY: <input type="text"/>	<input type="text"/>	<input type="text"/>	* If change, input changes <-----in boxes to the left
1. Compare sales to an expectation of sales (by product line). Roll-forward interim account balance to fiscal year-end.	PY: Staff Assistant	Interim	16	<b>Repeat Delete Change*</b>
	CY: <input type="text"/>	<input type="text"/>	<input type="text"/>	* If change, input changes <-----in boxes to the left

Audit Procedure

2. Compare sales returns and allowances as a percentage of gross sales with previous years (by product line). Roll-forward interim account balance to fiscal year-end.

	<b>Staff Assistant, Senior or Manager</b>	<b>Interim: 9/30/03 or Final: 12/31/03</b>	
	<u>Performed By</u>	<u>Timing</u>	<u>Budgeted Hours</u>
PY:	Staff Assistant	Interim	5
CY:	<input type="text"/>	<input type="text"/>	<input type="text"/>

**CIRCLE** one for each procedure

**Repeat Delete Change\***  
\* If change, input changes  
<-----in boxes to the left

3. Compare bad debts expense as a percentage of gross sales with previous years. Roll-forward interim account balance to fiscal year-end.

PY:	Staff Assistant	Interim	5
CY:	<input type="text"/>	<input type="text"/>	<input type="text"/>

**Repeat Delete Change\***  
\* If change, input changes  
<-----in boxes to the left

Audit Procedure

4. Review sales journal and master file for unusual transactions and amounts.

	<b>Staff Assistant, Senior or Manager</b>	<b>Interim: 9/30/03 or Final: 12/31/03</b>	<b>Budgeted Hours</b>
	<u>Performed By</u>	<u>Timing</u>	
PY:	Staff Assistant	Final	4

**CIRCLE** one for each procedure

**Repeat Delete Change\***

\* If change, input changes  
<-----in boxes to the left

CY:	<input type="text"/>	<input type="text"/>	<input type="text"/>
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5. Select a sample of shipping documents and trace transactions to the sales journal.

PY:	Staff Assistant	Interim	6
-----	-----------------	---------	---

**Repeat Delete Change\***

\* If change, input changes  
<-----in boxes to the left

CY:	<input type="text"/>	<input type="text"/>	<input type="text"/>
-----	----------------------	----------------------	----------------------

6. Perform sales cut-off testing by sampling sales transactions from the sales journals before and after fiscal year-end and tracing to sales invoice and bill of lading.

PY:	Staff Assistant	Final	5
-----	-----------------	-------	---

**Repeat Delete Change\***

\* If change, input changes  
<-----in boxes to the left

CY:	<input type="text"/>	<input type="text"/>	<input type="text"/>
-----	----------------------	----------------------	----------------------

7. Select a sample of transactions from the sales journal, tracetransaction to invoice, recompute extensions on sales invoices, and trace details on sales invoices to shipping documents and customer order.

PY:	Staff Assistant	Interim	6
-----	-----------------	---------	---

**Repeat Delete Change\***

\* If change, input changes  
<-----in boxes to the left

CY:	<input type="text"/>	<input type="text"/>	<input type="text"/>
-----	----------------------	----------------------	----------------------

8. Select a sample of transactions from the sales journal and trace transactions to the accounts receivable subsidiary ledger.

PY:	Staff Assistant	Interim	6
-----	-----------------	---------	---

**Repeat Delete Change\***

\* If change, input changes  
<-----in boxes to the left

CY:	<input type="text"/>	<input type="text"/>	<input type="text"/>
-----	----------------------	----------------------	----------------------

**Any additional procedures for the current year?  
If YES, please input procedures below along with  
the performer, timing, and budgeted hours for  
each additional procedure. If NO, please go to the  
Accounts Receivable Audit Program.**

<u>Additional Audit Procedures (if any)</u>	<b>Staff Assistant, Senior or Manager</b> <u>Performed By</u>	<b>Interim: 9/30/03 or Final: 12/31/03</b> <u>Timing</u>	<u>Budgeted Hours</u>
9. <hr/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
10. <hr/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
11. <hr/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
12. <hr/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
13. <hr/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
14. <hr/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
15. <hr/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

**CURRENT YEAR WORKPAPER: Accounts Receivable Audit Program and Budget**

**INSTRUCTION:** Given the current year ERP system implementation, your IR and CR assessments, and the CAS information provided, please complete the workpaper that follows. You have been provided with prior year audit procedures and budgets. For each procedure, respond as to whether you would like to REPEAT (repeat procedure, performer, timing, and budget for the current year), DELETE, or CHANGE (change the performer, timing, or budgeted hours) the procedure. Indicate your response by circling one of the three options for each procedure. If you decide to REPEAT or DELETE a procedure, please continue to the next procedure. If you decide to CHANGE a procedure (e.g., increase the budgeted hours), please input changes in the yellow boxes provided. You will also have the opportunity to input any customized procedures that you would like performed.

**12/31/03 Audit Program and Budget: Accounts Receivable**

12/31/03 Audit Risk = 5%

12/31/03 Inherent Risk = \_\_\_\_\_  
 (input from p. 8)  
 12/31/03 Control Risk = \_\_\_\_\_  
 (input from p.12)

12/31/03 Monetary Precision / Tolerable Error = \$264,000

	Staff Assistant, Senior or Manager	Interim: 9/30/03 or Final: 12/31/03	Budgeted Hours	CIRCLE one for each procedure
	<u>Performed By</u>	<u>Timing</u>		
<b>EXAMPLE:</b>				
A. Sample audit procedure	PY: Senior	Interim	10	<b>Repeat Delete Change*</b>
	CY: <input type="text"/>	<input type="text"/>	<input type="text"/>	* If change, input changes <-----in boxes to the left
1. Select a sample of accounts from the accounts receivable subsidiary ledger, trace accounts to the accounts receivable trial balance, and obtain positive confirmation. Perform alternative procedures for nonresponses. Roll-forward interim account balance to fiscal year-end.	PY: Staff Assistant	Interim	18	<b>Repeat Delete Change*</b>
	CY: <input type="text"/>	<input type="text"/>	<input type="text"/>	* If change, input changes <-----in boxes to the left

Audit Procedure

2. Obtain an aged list of receivables: select a sample of accounts and trace to the accounts receivable trial balance, foot trial balance, and trace to the general ledger. Investigate the collectability of account balances on aged list of receivables.

	<b>Staff Assistant, Senior or Manager</b>	<b>Interim: 9/30/03 or Final: 12/31/03</b>	<b>Budgeted Hours</b>	<b>CIRCLE one for each procedure</b>
	<u>Performed By</u>	<u>Timing</u>		
PY:	Staff Assistant	Interim	10	<b>Repeat Delete Change*</b>
CY:	<input type="text"/>	<input type="text"/>	<input type="text"/>	* If change, input changes <-----in boxes to the left

3. Obtain an analysis for the allowance for doubtful accounts and bad debt expense: test accuracy, examine authorization for write-offs, and trace to general ledger.

PY:	Staff Assistant	Interim	6	<b>Repeat Delete Change*</b>
CY:	<input type="text"/>	<input type="text"/>	<input type="text"/>	* If change, input changes <-----in boxes to the left

4. Review lists of balances for amounts due from related parties or employees, credit balances, unusual items, and notes receivable due after one year.

PY:	Staff Assistant	Final	6	<b>Repeat Delete Change*</b>
CY:	<input type="text"/>	<input type="text"/>	<input type="text"/>	* If change, input changes <-----in boxes to the left

**Any additional procedures for the current year?  
If YES, please input procedures below along with the performer, timing, and budgeted hours for each additional procedure. If NO, please skip the next page and turn to the following page.**

<u>Additional Audit Procedures (if any)</u>	<b>Staff Assistant, Senior or Manager</b> <u>Performed By</u>	<b>Interim: 9/30/03 or Final: 12/31/03</b> <u>Timing</u>	Budgeted <u>Hours</u>
5. _____			
6. _____			
7. _____			
8. _____			
9. _____			
10. _____			
11. _____			

**STOP**

- 1) Please take a moment now to check and make sure that you have provided responses in all the **YELLOW** areas in the current year workpapers on pages **8, 12, 14, 15, 17, and 18**.
- 2) Please also make sure that you have responded properly to the two scales on page **11**.
- 3) After checking your responses, please **input the current time below** and complete the questionnaire that follows.

PLEASE INPUT THE EXACT CURRENT TIME: \_\_\_\_\_ : \_\_\_\_\_ (e.g., 7:08 pm).



6. Relative to other in-charge auditors at my firm, I have received *more* combined informal and formal *training* in relation to complex and pervasive accounting information systems (e.g., ERP systems) during my career.

1	2	3	4	5	6	7	8
Strongly Disagree	Mostly Disagree	Moderately Disagree	Mildly Disagree	Mildly Agree	Moderately Agree	Mostly Agree	Strongly Agree

7. Relative to other in-charge auditors at my firm, I have *more experience* auditing complex and pervasive accounting information systems (e.g., ERP systems).

1	2	3	4	5	6	7	8
Strongly Disagree	Mostly Disagree	Moderately Disagree	Mildly Disagree	Mildly Agree	Moderately Agree	Mostly Agree	Strongly Agree

8. Relative to other in-charge auditors at my firm, I feel *more comfortable* auditing complex and pervasive accounting information systems (e.g., ERP systems).

1	2	3	4	5	6	7	8
Strongly Disagree	Mostly Disagree	Moderately Disagree	Mildly Disagree	Mildly Agree	Moderately Agree	Mostly Agree	Strongly Agree

9. Relative to other in-charge auditors at my firm, I receive *more enjoyment* from auditing complex and pervasive accounting information systems (e.g., ERP systems).

1	2	3	4	5	6	7	8
Strongly Disagree	Mostly Disagree	Moderately Disagree	Mildly Disagree	Mildly Agree	Moderately Agree	Mostly Agree	Strongly Agree

10. Relative to other in-charge auditors at my firm, a *larger* portion of my *time* is assigned to auditing complex and pervasive accounting information systems (e.g., ERP systems).

1	2	3	4	5	6	7	8
Strongly Disagree	Mostly Disagree	Moderately Disagree	Mildly Disagree	Mildly Agree	Moderately Agree	Mostly Agree	Strongly Agree

11. Relative to other in-charge auditors at my firm, I *began* auditing complex and pervasive accounting information systems (e.g., ERP systems) at an *earlier* point in my career.

1	2	3	4	5	6	7	8
Strongly Disagree	Mostly Disagree	Moderately Disagree	Mildly Disagree	Mildly Agree	Moderately Agree	Mostly Agree	Strongly Agree







34. My experience with clients that have intentionally or unintentionally materially misstated their financial statements is:

1	2	3	4	5	6	7	8	9	10
Very Low									Very High

35. On average, I would classify the computerized accounting information system expertise of the *managers and partners* I work for as typically:

1	2	3	4	5	6	7	8	9	10
Very Low									Very High

36. The amount of *experience* I have with *auditing manufacturing clients* is:

1	2	3	4	5	6	7	8	9	10
Very Low									Very High

**INSTRUCTIONS: Please indicate your response to the following statement by *INPUTTING* the appropriate numbers.**

37. The amount of audit experience I have is: \_\_\_\_\_ years and \_\_\_\_\_ months.

**INSTRUCTIONS: Please indicate your response to the following statements by *CIRCLING* Yes or No.**

38. I had a *system-related* major or minor in college (e.g., MIS major):      Yes      No

39. I generally perform *separate* assessments of inherent and control risk:      Yes      No

40. I generally assess inherent and control risk at the *transaction cycle level*:      Yes      No

**Thank you very much for completing the case study.**

Please place all materials in the pre-addressed and stamped envelope provided and mail it back to me. **If you have any questions about the case study, do not hesitate to call me at 215-895-2883 or e-mail me at [jfb24@drexel.edu](mailto:jfb24@drexel.edu).**

Thank you for offering your time to complete this research project and assisting me in obtaining my Ph.D. degree.

**APPENDIX**

**MADISON INC.  
BALANCE SHEETS, INCOME STATEMENTS, AND  
MATERIALITY CALCULATIONS**

**APPENDIX: BALANCE SHEETS****INSTRUCTION: *Feel free to review the following background information.*****Madison Inc.  
Balance Sheets**

(in thousands)	<b>9/30/2003</b>	<b>12/31/2002</b>	<b>12/31/2001</b>
<b>Assets</b>	<b>(Unaudited)</b>	<b>(Audited)</b>	<b>(Audited)</b>
<b>Current assets:</b>			
Cash and cash equivalents	\$2,599	\$2,499	\$2,380
Accounts receivable, net of allowances for doubtful accounts of 305; 294; and 280, respectively	2,219	2,114	1,994
Inventory	81,097	76,507	73,564
Prepaid advertising	3,592	3,453	3,289
Other prepaid expenses	1,782	1,697	1,601
Deferred income tax benefits	4,055	3,825	3,678
Total current assets	\$95,343	\$90,095	\$86,506
<b>Property, plant, and equipment, at cost:</b>			
Land and buildings	33,267	31,987	30,464
Fixtures and equipment	36,122	34,402	32,455
Leasehold improvements	906	855	822
Total property, plant, and equipment	\$70,295	\$67,244	\$63,741
Less - accumulated depreciation	23,627	22,718	21,636
Property, plant, and equipment, net	\$46,669	\$44,527	\$42,105
Intangibles, net	1,204	1,147	1,082
Total assets	\$143,216	\$135,768	\$129,693
<b>Liabilities and shareholders' equity</b>			
<b>Current liabilities</b>			
Accounts payable	\$27,441	\$25,769	\$24,370
Accrued liabilities	14,872	13,556	12,888
Short-term notes payable	4,076	3,554	3,289
Income taxes payable	5,205	4,596	4,241
Total current liabilities	\$51,594	\$47,476	\$44,788
Deferred income taxes	2,667	2,516	2,337
Long-term liabilities	190	182	173
<b>Shareholders' equity:</b>			
Common Stock, 17,773,000 shares issued	177	177	177
Additional paid-in capital	15,146	15,146	15,146
Retained earnings	109,818	104,588	99,527
Treasury stock (at cost)	(36,376)	(34,317)	(32,455)
Total shareholders' equity	88,764	85,594	82,395
Total liabilities and shareholders' equity	\$143,216	\$135,768	\$129,693

## APPENDIX: INCOME STATEMENTS AND MATERIALITY CALCULATIONS

**INSTRUCTION:** *Feel free to review the following background information.*

### Madison Inc. Income Statements

(in thousands)

**Note:** 9/30/03 Income Statement for 9 months ended 9/30/03; 12/31/02 and 12/31/01 Income Statements for 12 months ended 12/31/02 and 12/31/01, respectively.

	<u>9/30/2003</u>	<u>12/31/2002</u>	<u>12/31/2001</u>
	<u>(Unaudited)</u>	<u>(Audited)</u>	<u>(Audited)</u>
Net Sales	\$357,812	\$454,364	\$432,728
Cost of sales	210,044	264,206	249,251
Gross profit	147,768	190,158	183,477
Selling, general, and administration expenses	131,987	169,214	162,706
Income from operations	15,781	20,944	20,771
Other income (expense):			
Interest expense	(632)	(818)	(779)
Interest income	113	142	134
Other	465	586	563
Total other income (expense), net	(53)	(90)	(82)
Income before income taxes	15,728	20,854	20,689
Income tax provision	6,291	8,341	8,276
Net income	<u>\$9,437</u>	<u>\$12,512</u>	<u>\$12,413</u>

### Madison Inc. Materiality Calculations

<u>Materiality Calculations</u>	<u>CURRENT YEAR</u>		
(in thousands)	<u>12/31/03 Audit</u>	<u>12/31/02 Audit</u>	<u>12/31/01 Audit</u>
Income Before Income Taxes	20,971(a)	20,854	20,689
Multiply by 5%	X 0.05	X 0.05	X 0.05
Result: Planning Materiality	1,055	1,043	1,034
Multiply by 25%	X 0.25	X 0.25	X 0.25
Result: Monetary Precision or Tolerable Error	264	261	259

Note: Planning Materiality is the preliminary estimate of materiality made during initial planning. Monetary Precision/Tolerable Error is the application of Planning Materiality at the individual account balance level.

(a) Estimate of 12/31/03 amount represents the 9/30/03 Income Before Income Taxes amount annualized (15,728/.75 = 20,971).

**APPENDIX D: AUDITOR ACCOUNTING INFORMATION SYSTEM (AIS)  
EXPERTISE MEASURE**

The following questions will be used to measure self-assessments of participants' AIS expertise levels:

1. Relative to other in-charge auditors at my firm, I have received *more* combined informal and formal *training* in relation to complex and pervasive accounting information systems (e.g., ERP systems) during my career.
2. Relative to other in-charge auditors at my firm, I have *more experience* auditing complex and pervasive accounting information systems (e.g., ERP systems).
3. Relative to other in-charge auditors at my firm, I feel *more comfortable* auditing complex and pervasive accounting information systems (e.g., ERP systems).
4. Relative to other in-charge auditors at my firm, I receive *more enjoyment* from auditing complex and pervasive accounting information systems (e.g., ERP systems).
5. Relative to other in-charge auditors at my firm, a *larger* portion of my *time* is assigned to auditing complex and pervasive accounting information systems (e.g., ERP systems).
6. Relative to other in-charge auditors at my firm, I *began* auditing complex and pervasive accounting information systems (e.g., ERP systems) at an *earlier* point in my career.
7. Relative to other in-charge auditors at my firm, auditing complex and pervasive accounting information systems (e.g., ERP systems) is *more important* in my day-to-day audit activities.
8. Relative to other in-charge auditors at my firm, auditing complex and pervasive accounting information systems (e.g., ERP systems) will play a *more important role* in my career in the future.
9. Relative to other in-charge auditors at my firm, I have a *higher* level of complex and pervasive accounting information systems (e.g., ERP systems) *expertise*.

**Participants will respond to each of the above questions via the following eight-point Likert scale:**

1	2	3	4	5	6	7	8
Strongly Disagree	Mostly Disagree	Somewhat Disagree	Mildly Disagree	Mildly Agree	Somewhat Agree	Mostly Agree	Strongly Agree

**APPENDIX E: FACTOR ANALYSIS RESULTS FOR PRE-TEST OF AUDITOR AIS  
EXPERTISE MEASURE**

**Panel 1:**

**Spearman Correlation Matrix:**

		<u>AIS</u>	<u>AIS</u>	<u>AIS</u>	<u>AIS</u>	<u>AIS</u>	<u>AIS</u>	<u>AIS</u>	<u>AIS</u>	<u>AIS</u>	<u>AUDIT</u>	<u>YEAR</u>
	<u>Item<sup>b</sup></u>	<u>TRAIN</u>	<u>EXP</u>	<u>COMFO</u>	<u>ENJOY</u>	<u>TIME</u>	<u>BEGAN</u>	<u>IMPOR</u>	<u>ROLE</u>	<u>EXPER</u>	<u>EXP</u>	<u>INFI</u>
Correlation	AISTRAIN	1.00	0.76	0.72	0.57	0.52	0.55	0.44	0.44	0.63	-0.07	-0.11
	AISEXP	0.76	1.00	0.81	0.57	0.64	0.63	0.55	0.45	0.73	0.08	0.08
	AISCOMFO	0.72	0.81	1.00	0.70	0.77	0.63	0.66	0.59	0.78	-0.08	-0.05
	AISENJOY	0.57	0.57	0.70	1.00	0.70	0.60	0.59	0.53	0.66	-0.19	-0.07
	AISTIME	0.52	0.64	0.77	0.70	1.00	0.71	0.66	0.57	0.78	-0.16	-0.15
	AISBEGAN	0.55	0.63	0.63	0.60	0.71	1.00	0.64	0.64	0.84	-0.12	-0.03
	AISIMPOR	0.44	0.55	0.66	0.59	0.66	0.64	1.00	0.70	0.78	-0.23	-0.12
	AISROLE	0.44	0.45	0.59	0.53	0.57	0.64	0.70	1.00	0.65	-0.38	-0.24
	AISEXPER	0.63	0.73	0.78	0.66	0.78	0.84	0.78	0.65	1.00	-0.13	-0.04
	AUDITEXP	-0.07	0.08	-0.08	-0.19	-0.16	-0.12	-0.23	-0.38	-0.13	1.00	0.88
	YEARINFI	-0.11	0.08	-0.05	-0.07	-0.15	-0.03	-0.12	-0.24	-0.04	0.88	1.00
Sig. (2-tailed) <sup>a</sup>	AISTRAIN		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.66	0.48
	AISEXP	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.62	0.60
	AISCOMFO	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.60	0.74
	AISENJOY	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.20	0.67
	AISTIME	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.28	0.33
	AISBEGAN	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.43	0.83
	AISIMPOR	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.12	0.42
	AISROLE	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.01	0.11
	AISEXPER	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.41	0.81
	AUDITEXP	0.66	0.62	0.60	0.20	0.28	0.43	0.12	0.01	0.41		0.00
	YEARINFI	0.48	0.60	0.74	0.67	0.33	0.83	0.42	0.11	0.81	0.00	

**a** p-values associated with two-tailed t tests for Spearman correlations.

**b** AISTRAIN = Relative to other in-charge auditors, I have received more combined informal and formal accounting information systems training during my career.

AISEXP = Relative to other in-charge auditors, I have more experience auditing accounting information systems.

AISCOMFO = Relative to other in-charge auditors, I feel more comfortable auditing accounting information systems.

AISENJOY = Relative to other in-charge auditors, I feel more enjoyment when auditing accounting information systems.

AISTIME = Relative to other in-charge auditors, I spend more time auditing accounting information systems.

**b** AISBEGAN = Relative to other in-charge auditors, I began auditing accounting information systems at an earlier point in my career.

AISIMPOR = Relative to other in-charge auditors, auditing accounting information systems is more important in my day-to-day audit activities.

AISROLE = Relative to other in-charge auditors, auditing accounting information systems will play a more important role in my career in the future.

AISEXPER = Relative to other in-charge auditors, I have a higher level of accounting information system expertise.

AUDITEXP = Number of audit experience in months.

YEARINFI = Level / year in firm.

### **Panel 2:**

Communalities:

<u>Item<sup>a</sup></u>	<u>Initial</u>	<u>Extraction</u>
AISTRAIN	1.000	.576
AISEXP	1.000	.756
AISCOMFO	1.000	.811
AISENJOY	1.000	.631
AISTIME	1.000	.736
AISBEGAN	1.000	.706
AISIMPOR	1.000	.666
AISROLE	1.000	.644
AISEXPER	1.000	.854
AUDITEXP	1.000	.943
YEARINFI	1.000	.884

Extraction Method: Principal Component Analysis.

**a** As defined in Panel 1.

**Panel 3:**

Total Variance Explained:

Comp.	Initial Eigen-values			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	6.231	56.648	56.648	6.231	56.648	56.648	6.137	55.789	55.789
2	1.975	17.957	74.605	1.975	17.957	74.605	2.070	18.816	74.605
3	.784	7.123	81.728						
4	.484	4.398	86.126						
5	.398	3.622	89.748						
6	.362	3.290	93.038						
7	.267	2.428	95.467						
8	.189	1.717	97.184						
9	.141	1.284	98.467						
10	.100	.909	99.377						
11	.000	.623	100.000						

Extraction Method: Principal Component Analysis.

**Panel 4:**

Component Matrix:

Item <sup>a</sup>	Component	Component
	1	2
AISTRAIN	.749	.123
AISEXP	.812	.311
AISCOMFO	.890	.136
AISENJOY	.794	1.382E-02
AISTIME	.858	2.889E-04
AISBEGAN	.837	7.106E-02
AISIMPOR	.812	-8.369E-02
AISROLE	.757	-.266
AISEXPER	.919	9.327E-02
AUDITEXP	-.226	.944
YEARINFI	-.150	.928

Extraction Method: Principal Component Analysis.

2 components extracted.

<sup>a</sup> As defined in Panel 1.

**Table 1: Participants by Group**

	Low CAS Competence	High CAS Competence
High Auditor AIS Expertise	n = 18 (Group 1)	n = 18 (Group 2)
Low Auditor AIS Expertise	n = 21 (Group 3)	n = 16 (Group 4)

**Table 2: Sample Demographic Data**

Demographic Variable <sup>a</sup>	Sample Mean	Standard Deviation
Audit experience	44.21	17.38
Experience with CAS	5.19	2.15
Experience assessing risks	6.84	1.70
Experience planning substantive procedures	7.23	1.71
Experience with ERP systems	4.86	2.30
Likelihood of assignment to a similar engagement	6.29	2.59
Manufacturing industry experience	6.10	2.86
<p><b>a</b> Audit experience is measured in months. For all other variables, participants responded on ten-point response scales (1 = “very low;” 10 = “very high”).</p>		

**Table 3: Demographic Data by Group**

Demographic Variable <sup>a</sup>		High AIS/Low CAS (Group 1)	High AIS/High CAS (Group 2)	Low AIS/Low CAS (Group 3)	Low AIS/High CAS (Group 4)	F Value	p-value
Audit experience	Mean (SD)	43.22 14.43	45.78 23.92	43.86 17.75	44.00 11.86	0.07	0.98
Experience with CAS	Mean (SD)	4.56 2.06	5.19 2.15	4.76 2.00	5.94 1.88	1.81	0.15
Experience assessing risks	Mean (SD)	7.17 1.62	7.06 1.63	6.52 1.99	6.63 1.50	0.64	0.60
Experience planning substantive procedures	Mean (SD)	7.44 1.89	7.78 1.35	6.71 1.88	7.06 1.57	1.42	0.25
Experience with ERP systems	Mean (SD)	5.00 2.22	5.22 2.53	4.19 2.32	5.19 2.11	0.87	0.46
Likelihood of assignment to a similar engagement	Mean (SD)	5.28 2.72	6.78 2.71	6.48 2.36	6.63 2.53	1.27	0.29
Manufacturing industry experience	Mean (SD)	5.78 3.08	6.00 2.97	6.10 2.95	6.56 2.56	0.22	0.89
<p><sup>a</sup> Audit experience is measured in months. For all other variables, participants responded on ten-point response scales (1 = “very low;” 10 = “very high”).</p>							

**Table 4: Manipulation Check**

Variable <sup>a</sup>		Low CAS Competence Group	High CAS Competence Group	t statistic	p- value
Perceived CAS Competence Level	Mean (SD)	3.77 1.66	7.91 1.28	-11.774	< .001
<b>a</b> (1 = “very low;” 10 = “very high”).					

**Table 5: Spearman Correlation Matrix for AIS Expertise Measures and Audit Experience**

Spearman Correlation Matrix										
Item <sup>a</sup>	AIS TR AIN	AIS EXP	AIS COMF	AIS ENJOY	AIS TIME	AIS BEGAN	AIS IMPORT	AIS ROLE	AIS EXPERT	AU EX
AIS TRAIN	<b>1</b>	<b>0.874</b>	<b>0.770</b>	<b>0.699</b>	<b>0.799</b>	<b>0.753</b>	<b>0.751</b>	<b>0.643</b>	<b>0.850</b>	0.019
AIS EXP		<b>1</b>	<b>0.861</b>	<b>0.716</b>	<b>0.751</b>	<b>0.708</b>	<b>0.7441</b>	<b>0.7531</b>	<b>0.891</b>	0.020
AIS COMF			<b>1</b>	<b>0.783</b>	<b>0.722</b>	<b>0.653</b>	<b>0.716</b>	<b>0.706</b>	<b>0.830</b>	0.031
AIS ENJOY				<b>1</b>	<b>0.779</b>	<b>0.755</b>	<b>0.7130</b>	<b>0.748</b>	<b>0.697</b>	0.012
AIS TIME					<b>1</b>	<b>0.822</b>	<b>0.850</b>	<b>0.631</b>	<b>0.845</b>	0.004
AIS BEGAN						<b>1</b>	<b>0.758</b>	<b>0.691</b>	<b>0.802</b>	0.019
AIS IMPORT							<b>1</b>	<b>0.757</b>	<b>0.843</b>	0.017
AIS ROLE								<b>1</b>	<b>0.725</b>	0.073
AIS EXPERT									<b>1</b>	-0.011
AU EX										<b>1</b>

**Bold** = significant correlations at the  $p < .001$  level (two-tailed test).

**a** The nine items related to auditing complex and pervasive accounting information systems (e.g., ERP systems) and asked participants to respond on eight-point scales (1 = “strongly disagree”; 8 = “strongly agree”). All nine items began with the same prompt (“Relative to other in-charge auditors at my firm,”), before diverging. The prompts related to each of the individual items: “I have received *more* combined informal and formal *training* during my career” (AISTRAIN) “I have *more experience*” (AISEXP) “I feel *more comfortable*” (AISCOMF) “I receive *more enjoyment*” (AISENJOY) “a *larger* portion of my *time* is assigned” (AISTIME) “I *began* at an earlier point in my career” (AISBEGAN) “is *more important* in my day-to-day audit activities” (AISIMPORT) “will play a *more important* role in my career in the future” (AISROLE) “I have a *higher* level of *expertise*” (AISEXPERT). Participants were also asked to provide their audit experience in months (AUEX).

**Table 6: Communalities for AIS Expertise Measures and Audit Experience**

Communalities		
Item <sup>a</sup>	Initial	Extraction
AISTRAIN	1	0.8040227
AISEXP	1	0.8385413
AISCOMF	1	0.7800911
AISENJOY	1	0.7405476
AISTIME	1	0.8150119
AISBEGAN	1	0.7552177
AISIMPORT	1	0.7991858
AISROLE	1	0.7026042
AISEXPERT	1	0.8821781
AUDEXP	1	0.9931621

Extraction Method: Principal Component Analysis.

**a** The nine items related to auditing complex and pervasive accounting information systems (e.g., ERP systems) and asked participants to respond on eight-point scales (1 = “strongly disagree”; 8 = “strongly agree”). All nine items began with the same prompt (“Relative to other in-charge auditors at my firm,”), before diverging. The prompts related to each of the individual items: “I have received *more* combined informal and formal *training* during my career” (AISTRAIN) “I have *more experience*” (AISEXP) “I feel *more comfortable*” (AISCOMF) “I receive *more enjoyment*” (AISENJOY) “a *larger* portion of my *time* is assigned” (AISTIME) “I *began* at an earlier point in my career” (AISBEGAN) “is *more important* in my day-to-day audit activities” (AISIMPORT) “will play a *more important role* in my career in the future” (AISROLE) “I have a *higher* level of *expertise*” (AISEXPERT). Participants were also asked to provide their audit experience in months (AUDEXP).

**Table 7: Factor Components for AIS Expertise Measures and Audit Experience**

Factor Components: Total Variance Explained						
Component	<u>Initial Eigenvalues</u>			<u>Extraction Sums of Squared Loadings</u>		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	7.098	70.98164446	70.98164446	7.098	70.98164446	70.98164446
2	1.012	10.12398203	81.10562649	1.012	10.12398203	81.10562649
3	0.473	4.728820142	85.83444663			
4	0.457	4.573227683	90.40767432			
5	0.322	3.223934984	93.6316093			
6	0.247	2.472086572	96.10369587			
7	0.167	1.673470619	97.77716649			
8	0.1	0.996378626	98.77354512			
9	0.066	0.656767449	99.43031257			
10	0.057	0.569687434	100.00			

Extraction Method: Principal Component Analysis.

**Table 8: Component Matrix for AIS Expertise Measures and Audit Experience**

Component Matrix <sup>a</sup>		
Item <sup>b</sup>	Component 1	Component 2
AISTRAIN	0.89587379	0.03785278
AISEXP	0.91529445	0.02788212
AISCOMF	0.88221541	0.04227413
AISENJOY	0.86050838	0.00854074
AISTIME	0.90268603	0.01303113
AISBEGAN	0.86883325	0.0186136
AISIMPORT	0.89330969	0.03440384
AISROLE	0.83017153	0.11584237
AISEXPERT	0.93921758	0.00696224
AUDEXP	0.00143523	0.99657417

Extraction Method: Principal Component Analysis.

**a** Two components extracted.

**b** The nine items related to auditing complex and pervasive accounting information systems (e.g., ERP systems) and asked participants to respond on eight-point scales (1 = “strongly disagree”; 8 = “strongly agree”). All nine items began with the same prompt (“Relative to other in-charge auditors at my firm,”), before diverging. The prompts related to each of the individual items: “I have received *more* combined informal and formal *training* during my career” (AISTRAIN) “I have *more experience*” (AISEXP) “I feel *more comfortable*” (AISCOMF) “I receive *more enjoyment*” (AISENJOY) “a *larger* portion of my *time* is assigned” (AISTIME) “I *began* at an earlier point in my career” (AISBEGAN) “is *more important* in my day-to-day audit activities” (AISIMPORT) “will play a *more important role* in my career in the future” (AISROLE) “I have a *higher* level of *expertise*” (AISEXPERT). Participants were also asked to provide their audit experience in months (AUDEXP).

**Table 9: Frequency Distribution and Descriptive Statistics for Mean AIS Expertise Measure**

Mean AIS Score <sup>a</sup>	Frequency	Percent	Cumulative Percent
1.000	1	1.37%	1.37%
1.222	2	2.74%	4.11%
1.333	3	4.11%	8.22%
1.444	1	1.37%	9.59%
1.556	2	2.74%	12.33%
1.667	4	5.48%	17.81%
1.778	5	6.85%	24.66%
1.889	1	1.37%	26.03%
2.000	2	2.74%	28.77%
2.111	3	4.11%	32.88%
2.222	2	2.74%	35.62%
2.333	2	2.74%	38.36%
2.556	2	2.74%	41.10%
2.778	3	4.11%	45.21%
2.889	1	1.37%	46.58%
3.000	1	1.37%	47.95%
3.111	1	1.37%	49.32%
3.222	2	2.74%	52.05%
3.333	2	2.74%	54.79%
3.444	2	2.74%	57.53%
3.667	1	1.37%	58.90%
3.778	1	1.37%	60.27%
3.889	1	1.37%	61.64%
4.000	1	1.37%	63.01%
4.111	3	4.11%	67.12%
4.222	1	1.37%	68.49%
4.333	1	1.37%	69.86%
4.444	1	1.37%	71.23%
4.556	1	1.37%	72.60%
4.667	1	1.37%	73.97%
4.889	1	1.37%	75.34%
5.000	1	1.37%	76.71%
5.111	1	1.37%	78.08%
5.222	1	1.37%	79.45%
5.667	2	2.74%	82.19%
5.778	2	2.74%	84.93%
5.889	2	2.74%	87.67%
6.222	1	1.37%	89.04%
6.444	2	2.74%	91.78%
6.556	2	2.74%	94.52%
6.667	1	1.37%	95.89%
6.889	1	1.37%	97.26%
7.222	1	1.37%	98.63%
7.333	<u>1</u>	<u>1.37%</u>	100.00%
Total	73	100.00%	
Mean		3.5129376	
Median		3.2222222	
Std. Deviation		1.8050218	
<p><b>a</b> Participants' mean AIS expertise scores were measured as their average response to the nine, eight-point scales listed in Appendix D.</p>			

**Table 10: Testing of Hypothesis Set One**

## Descriptive Statistics and Statistical Results

Dependent Variable <sup>a</sup>		Low AIS Expertise Group	High AIS Expertise Group	Test Statistic <sup>b</sup>	p-value
Inherent Risk Assessment	Mean	39.86	54.17	-4.207	<.001
	(SD)	13.15	15.74		
Control Risk Assessment	Mean	46.70	60.14	12.266	<.001
	(SD)	16.81	19.25		
Procedures	Mean	12.00	12.97	5.211	0.013
	(SD)	1.78	1.83		
Labor	Mean	2.32	3.31	4.058	0.024
	(SD)	1.75	2.46		
Timing	Mean	4.89	5.67	1.351	0.125
	(SD)	3.10	2.86		
Extent	Mean	100.77	107.33	1.296	0.130
	(SD)	22.49	25.85		

**a** *Inherent and Control Risk Assessments* were measured on scales ranging from 0 (“low risk”) to 100 (“high risk”) percent. *Procedures* was determined by the total number of procedures planned. *Labor* was computed as the total number of procedures assigned to a more senior level auditor than staff assistant. *Timing* was measured as the total number of procedures to be tested at fiscal year-end. *Extent* was determined by the total number of budgeted audit hours.

**b** For *Inherent Risk Assessment*, the test statistic is the t statistic from the independent-samples t test. For all other variables, the test statistic is the F statistic for the main effect of Auditor AIS Expertise from the overall 2X2 ANOVA.

**Table 11: Testing of Hypothesis Set Two**

Descriptive Statistics and Independent-Samples t Test

Dependent Variable <sup>a</sup>		Low CAS Competence Group	High CAS Competence Group	t Statistic	p-value
Evidence Reliability Judgment	Mean (SD)	3.69 1.58	7.15 2.09	-7.880	<.001
<p><b>a</b> <i>Evidence Reliability Judgment</i> was measured on a scale ranging from 1 (“not reliable”) to 10 (“very reliable”).</p>					

**Table 12: Testing of Hypothesis Set Three**

Descriptive Statistics and ANOVA results

Dependent Variable <sup>a</sup>		Low CAS Competence Group	High CAS Competence Group	F Statistic <sup>b</sup>	p- value
Control Risk Assessment	Mean	58.21	47.21	7.851	0.004
	(SD)	17.53	19.68		
Procedures	Mean	12.64	12.29	.974	0.164
	(SD)	1.97	1.73		
Labor	Mean	3.15	2.41	2.753	0.051
	(SD)	2.08	2.23		
Timing	Mean	5.56	4.94	.922	0.170
	(SD)	2.62	3.37		
Extent	Mean	107.33	100.19	1.932	0.085
	(SD)	25.30	22.79		

**a** *Control Risk Assessment* was measured on scale ranging from 0 (“low risk”) to 100 (“high risk”) percent. *Procedures* was determined by the total number of procedures planned. *Labor* was computed as the total number of procedures assigned to a more senior level auditor than staff assistant. *Timing* was measured as the total number of procedures to be tested at fiscal year-end. *Extent* was determined by the total number of budgeted audit hours.

**b**The F statistic is for the main effect of CAS competence from the overall 2X2 ANOVA.

**Table 13: Testing of Hypothesis Set Four**

## Panel A - Descriptive Statistics

Dependent Variable <sup>a</sup>		High AIS/Low CAS (Group 1)	High AIS/High CAS (Group 2)	Low AIS/Low CAS (Group 3)	Low AIS/High CAS (Group 4)
Control Risk Assessment	Mean	65.28	55.00	52.14	39.56
	(SD)	15.58	21.58	17.14	13.80
Procedures	Mean	13.44	12.50	11.95	12.06
	(SD)	2.01	1.54	1.69	1.95
Labor	Mean	4.06	2.56	2.38	2.25
	(SD)	2.29	2.46	1.56	2.02
Timing	Mean	6.00	5.33	5.19	4.50
	(SD)	2.61	3.13	2.64	3.67
Extent	Mean	117.06	97.61	99.00	103.09
	(SD)	29.12	18.09	18.36	27.47

## Panel B - Planned Contrasts

Dependent Variable <sup>a</sup>	Contrast Tested <sup>b</sup>	Value of Contrast	t Statistic	p-value
Control Risk Assessment	(65.28 - 52.14) - (55.00 - 39.56)	-2.30	-0.282	0.780
Procedures	(13.44 - 11.95) - (12.50 - 12.06)	1.05	1.248	0.108
Labor	(4.06 - 2.38) - (2.56 - 2.25)	1.37	1.393	0.084
Timing	(6.00 - 5.19) - (5.33 - 4.50)	-0.02	-0.016	0.988
Extent	(117.06 - 99.00) - (97.61 - 103.09)	23.54	2.131	0.019

<sup>a</sup> *Control Risk Assessment* was measured on scale ranging from 0 (“low risk”) to 100 (“high risk”) percent. *Procedures* was determined by the total number of procedures planned. *Labor* was computed as the total number of procedures assigned to a more senior level auditor than staff assistant. *Timing* was measured as the total number of procedures to be tested at fiscal year-end. *Extent* was determined by the total number of budgeted audit hours.

<sup>b</sup> Planned contrast tested = (Group 1 Mean – Group 3 Mean) > (Group 2 Mean – Group 4 Mean).

**Table 14: Testing of Hypothesis Set Five**

## Descriptive Statistics and Statistical Results

Dependent Variable <sup>a</sup>		Low AIS Expertise Group	High AIS Expertise Group	F Statistic <sup>b</sup>	p-value
Inherent Risk Assessment Quality	Mean	18.96	13.80	6.266	.008
	(SD)	9.67	7.65		
Control Risk Assessment Quality	Mean	19.69	15.60	2.840	.048
	(SD)	12.97	11.44		
Effectiveness of Planned Substantive Procedures	Mean	5.15	5.71	1.809	.092
	(SD)	.92	1.03		

**a** *Inherent Risk Assessment Quality* was calculated as the absolute difference between participants' inherent risk assessments and the overall mean expert inherent risk assessment. *Control Risk Assessment Quality* was computed as the absolute difference between participants' control risk assessments and the mean expert control risk assessment for their CAS competence condition. *Effectiveness of Planned Substantive Procedures* was measured on a scale ranging from 1 ("very low") to 10 ("very high").

**b** For *Inherent Risk Assessment Quality* and *Control Risk Assessment Quality*, the F statistic is for the main effect of auditor AIS Expertise from the overall 2X2 ANOVA. For *Effectiveness of Planned Substantive Procedures*, the F statistic is for the main effect of auditor AIS expertise from a 2X2 ANCOVA that included participants' inherent and control risk assessments as covariates.

## VITA

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### PROFESSIONAL APPOINTMENTS

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### RESEARCH

#### Working Papers:

“Electronic vs. Face-to-Face Review: The Effects of Alternative Forms of Review on Auditors’ Performance,” with Christopher P. Agoglia and Richard C. Hatfield. Currently submitted for the third time to *The Accounting Review*.

“CEO Compensation and the Seasoned Equity Offering Decision,” with Elizabeth Webb. Currently submitted to *Managerial and Decision Economics*.

#### Presentations:

“The Effects of Computer Assurance Specialist Competence and Auditor Accounting Information System Expertise on Auditor Planning Judgments,” Ph.D. dissertation proposal presented to workshop participants at Drexel University, University of Montana, Kansas State University, Boise State University, North Carolina State University, University of Vermont, University of Manitoba, University of Mississippi, and Mississippi State University; fall 2002 and spring 2003.

“Electronic vs. Face-to-Face Review: The Effects of Alternative Forms of Review on Auditors’ Performance,” with Christopher P. Agoglia and Richard C. Hatfield. Presented at the 2002 International Symposium on Audit Research, 2002 AAA Annual Meeting, and the 2002 AAA Western Regional Meeting.

