The Effects of Computer Assurance Specialist Competence and Auditor AIS Expertise on Auditor Planning Judgments

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ABSTRACT: In complex accounting information system (AIS) environments, the exchange of audit evidence between computer assurance specialists (CAS) and auditors plays a critical role in determining audit quality. This study investigates the effects of CAS competence and auditor AIS expertise on auditor planning judgments in a complex AIS environment. The source competence literature in auditing 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. This study utilizes a quasi-experiment, where CAS competence was manipulated as high and low between auditors and auditor AIS expertise was measured. Consistent with hypotheses, both auditor AIS expertise and CAS competence significantly affected auditor risk assessments in a complex AIS setting. Interestingly, with respect to the planning of substantive procedures, auditors’ reactions to CAS competence variation was moderated by their own level of AIS expertise. Under conditions of low CAS competence, auditors with higher AIS expertise expanded the scope of their audit testing 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. These results suggest that auditors’ AIS expertise can play a significant role in complex AIS environments and in their ability to compensate for CAS competence deficiencies.

Keywords: accounting information systems; audit risk model; computer assurance specialist; ERP systems; expertise; source competence

Data Availability: Data is available upon request.
I. INTRODUCTION

This study investigates the effects of computer assurance specialist (CAS) competence and auditor accounting information system (AIS) expertise on auditor planning judgments in a complex AIS environment. Recent professional standards have stated that auditors need to change their audit strategies in reaction to the all-encompassing changes in information technology (IT) at their clients (AICPA 2001; 2002). IT applications, such as Enterprise Resource Planning (ERP) systems, are significantly changing the ways in which companies operate their businesses (e.g., business process reengineering) and 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). 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; AICPA 2002). Expertise in the AIS domain may make auditors more cognizant of AIS-specific risks and provide them with the sophisticated audit skills required in such settings (Lilly 1997; Hunton et al. 2001).

Statement on Auditing Standards (SAS) No. 94 (AICPA 2001) suggests that a CAS be assigned to assist in the audit of computer-intensive environments.1 Although CAS are becoming an increasing source of evidence for auditors in complex AIS environments (POB 2000; AICPA 2001), prior research has not examined the CAS/auditor relationship. Further, while prior studies have typically investigated scenarios where the source of audit evidence maintained a similar expertise structure to the auditor’s (e.g., a subordinate auditor (Bamber 1983)), auditors and CAS generally have different expertise structures (Curtis and Viator 2000; Hunton et al. 2001). These differences could make judgments related to CAS evidence difficult for auditors. As CAS are

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typically within-firm specialists, audit guidance requires auditors to supervise and review CAS as they would any other engagement team member (AICPA 1978; AICPA 2001; Hunton et al. 2001). But while auditors are typically able to compensate for subordinate auditor competence deficiencies by employing additional procedures themselves, auditors with limited AIS expertise may not have the knowledge structure to compensate for CAS of low competence. This study builds on prior auditor expertise, ERP, and source competence literature by investigating the effects of, and interactions between, auditor AIS expertise and CAS competence on auditor planning judgments in a complex AIS environment.

In this study, 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 via a post-experimental questionnaire. The case required auditors to evaluate evidence related to the audit of a complex AIS client to which a CAS had been assigned. After examining the evidence, the auditors were asked to assess current year inherent and control risks and to plan the nature, timing, and extent of substantive procedures for a transaction cycle. The quality of the auditors’ risk assessments and the effectiveness of their substantive procedures were measured with the aid of audit experts.

Results indicate that auditors with higher AIS expertise, relative to those with lower 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 (versus high) competence. More importantly, 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 auditor AIS expertise effect occurred when auditors received evidence from a highly competent CAS. These results suggest that auditor AIS expertise can play a significant role in advanced AIS environments and in their ability to compensate for CAS competence deficiencies by increasing the scope of substantive tests.

The remainder of this paper is organized as follows. The next section discusses the background and related research and develops the hypotheses. Sections III and IV present the method and results, respectively. Section V offers conclusions and implications.

II. BACKGROUND AND HYPOTHESIS DEVELOPMENT

ERP Systems and Auditor AIS Expertise

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. SAS No. 80 (AICPA 1996) suggests that, in complex AIS environments, 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 settings such as ERP system environments, auditors should assign one or more 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. Thus, while the positive aspects of ERP systems (e.g., real time data, shortened cycle times, compliance with the Sarbanes-Oxley Act of 2002) have made them the computing environment of choice among many corporations (Brown 1997; O’Leary 2000; Hunton et al. 2001; Winters 2004), the profession has acknowledged that there are significant risks associated with their implementation (POB 2000).
Specifically, with ERP implementations, inherent risks are heightened in the periods immediately following implementation as issues such as inadequately trained personnel, improper data input, and interdependencies among business processes can lead to an increased potential for financial statement misstatements, misclassifications, and defalcations (e.g., O’Leary 2000; Soh et al. 2000; Wah 2000; Hunton et al. 2001). Control risk also increases as the focus shifts from segregation of duties to greater access to information. Additionally, supervisory review is typically minimal and supplemental internal control applications are often not properly integrated with the ERP system (Turner 1999; Wright and Wright 2002). The 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 react to increased inherent and control risks by increasing risk assessments and the scope of planned substantive procedures in non-complex AIS environments (AICPA 1983; Houston 1999; Wright and Bedard 2000). However, in complex AIS environments, the levels at which the auditor assesses risks and the resulting scope of substantive testing 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 prior year assessment serving as a starting point, or “anchor.” This anchor is then revised, often insufficiently, given new 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). Given their knowledge base/abilities, auditors with low AIS expertise may be less able to fully consider the potential effects of risks associated with an ERP implementation. Therefore, these auditors may be more likely to anchor on prior year assessments (Low 2004).
Auditors with high expertise, on the other hand, may be more aware of the possible risks associated with a current year ERP system implementation (Hunton et al. 2001). This increased awareness of risks among high AIS expertise auditors could lead to higher assessed risk levels, as professional skepticism should be exercised to achieve reasonable assurance that material misstatements are detected (AICPA 1988).

To mitigate their higher risk assessments (and consistent with the audit risk model), auditors with higher AIS expertise will likely increase the scope of planned audit procedures beyond that of low AIS expertise auditors in complex AIS environments (AICPA 1983). In addition to following the model’s guidance, auditors with greater AIS expertise should have the knowledge to plan and competently perform expanded audit procedures to effectively mitigate such risks. The findings of Low (2004), for example, suggest that greater industry expertise can cause auditors to make more current year changes to planned substantive procedures when customizing prior year audit programs. In contrast, given the difficulty of the task and their inferior ability to recognize the impact of an ERP implementation on their risk assessments, low AIS expertise auditors may be more prone to rely on prior year testing as an anchor. Even in scenarios where low AIS expertise auditors are aware of increased risks, they may not be confident in their ability to select tests which will appropriately decrease detection risk (Ajzen 1991). Thus, they may perceive that expanding substantive tests will only decrease audit efficiency. For example, increasing the budget of a particular substantive test, which does not increase the audit’s effectiveness in a complex AIS setting, would lead to a decrease in audit efficiency.

The above discussion suggests that, in complex AIS environments, auditors with greater AIS expertise will assess both inherent and control risks at higher levels than auditors with lower AIS expertise. In addition, auditors with higher AIS expertise should also increase the scope of
planned substantive audit procedures beyond that of low AIS expertise auditors. Thus, we test the following hypotheses:

**H1a:** Auditors with high AIS expertise will assess inherent risk as higher than auditors with low AIS expertise.

**H1b:** Auditors with high AIS expertise will assess control risk as higher 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.

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; Low 2004). Given the significant risks and complexities associated with ERP systems, AIS expertise should be an important factor in planning effective and efficient audits in such settings (Wright and Wright 2002). For example, Hunton et al. (2001) found that auditors with greater AIS expertise were more likely to recognize a seeded control risk in the study’s experimental case. The findings of Low (2004) suggest that higher levels of AIS expertise should also provide auditors with an understanding of the mix of audit tests and resources needed to address the risks associated with a complex AIS environment. As a result, it is expected that auditor AIS expertise should positively affect the quality of their risk assessments and the effectiveness of their scope decisions. Risk assessments and effectiveness ratings from audit experts, given the audit engagement’s underlying circumstances and risks, will serve as the basis for evaluating auditor risk assessment quality and the effectiveness of their substantive procedures for this study (Tan 1995; Low 2004). We therefore investigate the following hypotheses:

**H2a:** The quality of inherent risk assessments will be greater for auditors with high AIS expertise than auditors with low AIS expertise.
**H2b:** The quality of control risk assessments will be greater for auditors with high AIS expertise than auditors with low AIS expertise.

**H2c:** Auditors with high AIS expertise will plan more effective substantive audit procedures than auditors with low AIS expertise.

**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 obtained and audited by CAS (i.e., system control testing).

There are some indications that auditors have concerns about CAS competence in practice. For example, Hunton et al. (2001) noted considerable intra-firm tension surrounding the engagement of CAS and that auditors were unlikely to engage CAS in ERP environments, reflecting perhaps a perceived lack of value added to the audit. Additionally, participants in our study expressed in a post-experimental questionnaire that they have experienced a fairly large degree of variation in CAS competence on their engagements that, at times, limits their reliance on CAS evidence.4

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). 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. Therefore, we examine the following hypothesis:

H3: Auditors using positive evidence from a CAS of higher competence will assess control risk at a lower level than auditors using positive evidence from a CAS of lower competence.

The Moderating Role of Auditor AIS Expertise

While it is expected that auditors will be sensitive and react to variation in CAS competence when assessing control risk, auditors’ reactions with respect to substantive testing decisions may not be as homogeneous. Considerable professional judgment is required when planning substantive tests (Arens et al. 2003). Indeed, prior research and a recent evaluation of the auditing profession suggest that task complexity increases as auditors move from risk assessment to planning-related substantive tests (e.g., Hackenbrack and Kneckel 1997; POB 2000). Further, CAS and auditors maintain different expertise structures (Curtis and Viator 2000; Hunton et al. 2001) and, under conditions of low CAS competence, auditors’ AIS expertise levels may determine their ability to compensate for CAS competence deficiencies by increasing the scope of substantive tests.
Under conditions of low CAS competence (and evidence indicating system controls are reliable), auditors with high AIS expertise may be more likely to expand substantive testing because they have the ability and confidence to plan and perform additional substantive procedures to compensate for CAS competence deficiencies (Ajzen 1991). Under the same conditions, auditors with low AIS expertise may be more apt to rely on CAS evidence and not appreciably change substantive procedures from those of the prior year, since compensating for CAS competence deficiencies through additional testing represents a significantly more difficult task for them. The anchoring and adjustment literature suggests that these auditors will likely rely more on prior year planned substantive tests rather than increasing their testing (e.g., Joyce and Biddle 1981). In contrast, the effect of auditor AIS expertise on the scope of their substantive tests is 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. Thus, we investigate the following hypothesis:

**H4:** 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.

### III. METHOD

**Participants**

Seventy-three practicing auditors from four international and two national public accounting firms participated in this study. Participants were audit seniors with, on average, 3.68 years of experience. 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. Prior research and discussions with practitioners revealed that audit seniors would be familiar
with evaluating the evidence provided by CAS and performing planning judgments (e.g.,
Houston 1999; Messier and Austen 2000).

**Research Instrument**

Participants were provided with a case that contained background information for a hypothetical client, relevant authoritative audit guidance, and prior year workpapers. These workpapers included prior year inherent and control risk assessments and substantive testing for the sales and accounts receivable cycle (hereafter, cycle). They were then provided with a current year workpaper documenting the client’s implementation of an ERP system module for the cycle and the need for a CAS to be assigned to the engagement to test system controls. Participants then assessed inherent risk for the cycle. Next, participants were provided with information about the CAS (the CAS competence manipulation) and the CAS’s control tests which concluded that “system-related controls … appear reliable.” After examining this evidence, participants assessed control risk and planned the nature, timing, and extent of substantive procedures for the cycle. Lastly, participants completed a post-experimental questionnaire that included a manipulation check and an auditor AIS expertise measure.

**CAS Competence Manipulation**

Participants were randomly assigned to one of two CAS competence conditions. Based on prior source competence literature and discussions with practitioners, three factors that substantially influenced auditor perceptions of CAS competence were identified. The three factors were: amount of CAS experience, amount of training, and past job performances (Bamber 1983; Brown 1983; Margheim 1986; Schneider 1984; Rebele et al. 1988; Anderson et al. 1994). Practitioners considered all three indicators to be important determinants of CAS competence in practice. As suggested by Kadous and Magro (2001), the manipulation of CAS
competence in this study made use of all three important facets of the construct. The three indicators were manipulated concurrently, and in a manner similar to prior source competence manipulations and congruous with practitioner experience (e.g., Bamber 1983; Schneider 1984; Anderson et al. 1994; Wright and Wright 2002).

In the high (low) CAS competence condition, participants were informed that: a) the CAS had four years (eight months) of experience, b) the CAS had (had not yet) received training in the specific AIS implemented by the client, and c) a colleague had received strong (weak) tests of controls from the CAS on a previous audit. A post-experimental manipulation check indicated participants attended to and understood the intended manipulation.7

**Measurement of Auditor AIS Expertise**

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. Since one cannot readily manipulate factors such as forms of intelligence (Peecher and Solomon 2001), and an observable measure of AIS expertise would be infeasible to obtain (Abdolmohammadi and Shanteau 1992), participants’ self-assessments of AIS expertise were collected via a post-experimental questionnaire. Given that no measure of auditor AIS expertise exists in the literature, one was constructed. Based on a review of prior research examining the constructs of expertise and self-efficacy and the results of a survey, a nine-item measurement was developed to measure auditor AIS expertise (see Appendix).8 Through the nine-item measure, participants evaluated their AIS expertise relative to their peers and recorded their responses on eight-point scales, with higher scores indicative of greater perceived expertise. A pilot study utilizing 45 audit seniors confirmed the reliability and construct validity of the measure. Additionally, the general audit experience of the pilot study participants was not found to be significantly correlated with the
nine AIS expertise items. Thus, auditor AIS expertise appears to be a distinct domain of auditor expertise and not simply a by-product of general audit experience.

An AIS expertise score was calculated for each participant in this study as the mean of their responses to the nine items. Participants scoring below and above the median expertise score of 3.222 were post-experimentally dichotomized as being of low and high AIS expertise, respectively. Means for the low and high AIS expertise groups were 2.015 and 5.052, respectively. Based on scale labels for the nine items, responses of 2 and 5 indicate that participants “mostly disagreed” and “mildly agreed,” respectively, that their AIS expertise exceeded their peers. This difference between the high and low AIS expertise groups indicates that participants in the two groups maintained significantly different perceptions of their own AIS expertise levels (p < .001). After randomly assigning participants to the two CAS competence conditions and post-experimentally dichotomizing participants into AIS expertise groups, the study consisted of four cells (see Figure 1).

**Dependent Variables**

Consistent with prior research, inherent and control risk assessments for the sales and accounts receivable cycle were measured via separate scales (e.g., Anderson and Maletta 1994; Dusenbury et al. 2000; Messier and Austen 2000). Similar to Messier and Austen (2000), scales used in this study 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 completing their risk assessments, participants were asked to prepare two separate audit programs for the substantive testing of sales and accounts receivable 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, timing, and extent of substantive procedures related to the two 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 (1994). 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, and more budgeted hours indicate audit procedures that are greater in scope (e.g., AICPA 1983; Mock and Wright 1993).11

Consistent with practice, participants had prior year workpapers available when providing both their risk assessments and substantive testing decisions. Prior year workpapers were constructed with the assistance of two audit senior managers and a partner from an international accounting firm. Inherent and control risks for the sales and accounts receivable cycle were assessed at moderate-to-low levels in the prior year (35% and 40%, respectively). Prior year audit testing for the two accounts indicated 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.

The quality of participants’ risk assessments and the effectiveness of their planned substantive procedures were determined with the assistance of experts. 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. 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). 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 (and similar to Low (2004)), the experts individually evaluated the effectiveness of the planned substantive procedures 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 their condition was used as an effectiveness measure for the participants.

IV. RESULTS

Auditor AIS Expertise

Hypothesis Set 1 predicts that auditors with high AIS expertise will assess inherent and control risks higher and will plan substantive audit procedures that are greater in scope than auditors with low AIS expertise in complex AIS environments. Table 1 presents the results of Hypothesis Set 1 testing. Mean inherent risk assessments for the low and high AIS expertise
groups were 40.00 and 54.29, respectively. These means are in the hypothesized direction and indicate a significant AIS expertise effect (t = -4.091, p < .001), providing support for H1a. Means of the control risk assessments for the two conditions were also significant and in the expected direction, with the mean assessments for the low and high AIS groups being 46.61 and 59.86, respectively (F = 10.952, p = .002). Thus, there is support for H1b. Further, in documenting their risk assessments, auditors with higher AIS expertise supplied a greater number of evidence items to support their assessments than lower expertise auditors (non-tabulated means = 8.63 and 6.89 items, respectively; t = 2.507, two-tailed p = .015). This is consistent with the notion that high AIS expertise auditors are more aware of the risks associated with ERP implementation.

Table 1 also presents results relating to the four scope measures: Procedures, Labor, Timing, and Extent. For the Procedures measure, auditors with high expertise planned significantly more procedures than auditors with low AIS expertise (12.86 and 11.94, respectively; F = 4.437, p = .020), providing support for H1c. Similarly, with respect to the Labor variable, auditors with higher AIS expertise also assigned more senior-level auditors to perform the procedures (3.34 and 2.36, respectively; F = 3.757, p = .029). Though not significantly different, means for the high and low AIS expertise groups on the Timing (5.69 and 5.08, respectively; F = 0.684, p = .206) and Extent (106.80 and 101.14, respectively; F = .845, p = .181) of planned audit procedures were also in the expected direction.

Hypothesis Set 2 indicates that auditors with high AIS expertise will provide higher quality inherent and control risk assessments and more effective substantive procedures than auditors with low AIS expertise. The results of Hypothesis Set 2 testing are presented in Table 2. [Insert Table 2] Mean absolute deviations from the experts’ mean inherent risk assessment for the low and high
AIS expertise groups were 18.89 and 14.00, respectively. These means were in the hypothesized direction (i.e., lower absolute deviation for the high AIS expertise group), and independent-samples t test results indicate a significant AIS expertise effect ($t = 2.340, p = .011$). Mean absolute control risk assessment deviations for the two groups were in the expected direction (low and high AIS expertise group means = 19.87 and 15.86, respectively) and significant at $p = .087$, providing support for Hypothesis 2b. Mean expert effectiveness ratings for the planned substantive tests of the low and high AIS expertise groups were 5.14 and 5.72, respectively. These means were in the hypothesized direction and significant ($t = -2.491, p = .008$). Thus, Hypothesis 2c is supported by the sample data.15

**CAS Competence and Control Risk Assessments**

Hypothesis 3 suggests that auditors obtaining positive evidence from a CAS with high competence will assess control risk at a lower level than auditors using similar evidence from a CAS with low competence. Auditors who receive evidence from a more competent CAS, which indicates system controls are operating effectively, should perceive the evidence as more reliable than auditors receiving the same evidence from a less competent CAS. That appeared to be the case here, with participants in the high CAS competence condition evaluating the reliability of CAS evidence as higher, on average, than those in the low competence condition (non-tabulated means = 7.21 and 3.71, respectively, on a scale where 1 = “not reliable” and 10 = “very reliable”; $t = 7.853$, two-tailed $p < .001$). In turn, this ability to place greater reliance on the favorable systems control evidence led auditors in the high CAS competence condition to assess control risk as lower, on average, than their counterparts (47.06 and 58.42, respectively; $F = 8.314$, $p = .003$), providing support for H3 (see Table 3).

[Insert Table 3]
The Interactive Effect of Auditor AIS Expertise and CAS Competence

Hypothesis 4 specifies the form of the interactive effect of auditor AIS expertise and CAS competence on the scope of planned substantive audit procedures. Specifically, the form of the interaction specified by H4 stipulates that the difference between high and low AIS expertise auditors’ scope of planned substantive procedures will be greater when CAS competence is low than when it is high (see Figure 2). This hypothesis was tested for all four scope measures using the following planned contrast:

\[(\text{Cell 2 Mean} - \text{Cell 4 Mean}) > (\text{Cell 1 Mean} - \text{Cell 3 Mean})\]

where:
- Cell 1 = high AIS expertise/high CAS competence group
- Cell 2 = high AIS expertise/low CAS competence group
- Cell 3 = low AIS expertise/high CAS competence group
- Cell 4 = low AIS expertise/low CAS competence group.

Results relating to H4 are presented in Table 4. With respect to the Procedures measure, the value of the contrast is 1.20, significant at \(p = .082\), and in the hypothesized direction (i.e., positive). Similarly, for Labor, the value of the contrast is 1.27 and significant at \(p = .109\). For Timing, the contrast value is .28 and not significant (\(p = .428\)). The value of the contrast for Extent (25.13), on the other hand, is significant (\(p = .016\)) and in the expected direction. Thus, there is support for the interactive effect posited in H4.16

V. CONCLUSIONS AND IMPLICATIONS

In complex AIS environments, both auditor AIS expertise and their evaluations of CAS evidence play a critical role in determining audit quality (POB 2000). Prior research 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 affect auditor planning judgments in advanced AIS settings. More importantly, auditors’ AIS expertise levels appear to determine their ability to compensate for potential CAS competence deficiencies.

The results of this study indicate that 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. 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 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.

With respect to the planning of substantive tests, auditors’ AIS expertise levels moderated their reaction to CAS competence variation. 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 is 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.

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 courses in accounting curricula.

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, this study’s auditor AIS expertise measure could be used to evaluate the effect of auditor AIS expertise on other audit activities such as the performance of substantive tests. 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.
## TABLE 1

**Testing of Hypothesis Set 1**

<table>
<thead>
<tr>
<th>Dependent Variable*</th>
<th>Low AIS Expertise Group ([n = 36])</th>
<th>High AIS Expertise Group ([n = 35])</th>
<th>Test Statistic* (b)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Risk Assessments</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inherent Risk Assessment</td>
<td>Mean 40.00 (SD 13.31)</td>
<td>Mean 54.29 (SD 15.96)</td>
<td>-4.091</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Control Risk Assessment</td>
<td>Mean 46.61 (SD 17.04)</td>
<td>Mean 59.86 (SD 19.46)</td>
<td>10.952</td>
<td>0.002</td>
</tr>
<tr>
<td><strong>Scope Measures</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Procedures</td>
<td>Mean 11.94 (SD 1.84)</td>
<td>Mean 12.86 (SD 1.75)</td>
<td>4.437</td>
<td>0.020</td>
</tr>
<tr>
<td>Labor</td>
<td>Mean 2.36 (SD 1.76)</td>
<td>Mean 3.34 (SD 2.47)</td>
<td>3.757</td>
<td>0.029</td>
</tr>
<tr>
<td>Timing</td>
<td>Mean 5.08 (SD 3.26)</td>
<td>Mean 5.69 (SD 2.89)</td>
<td>0.684</td>
<td>0.206</td>
</tr>
<tr>
<td>Extent</td>
<td>Mean 101.14 (SD 22.82)</td>
<td>Mean 106.80 (SD 25.72)</td>
<td>0.845</td>
<td>0.181</td>
</tr>
</tbody>
</table>

*a Inherent and Control Risk Assessments were measured on scales ranging from 0 (“low risk”) to 100 (“high risk”) percent. Procedures refers to 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 refers to 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>
<thead>
<tr>
<th>Dependent Variable*</th>
<th>Low AIS Expertise Group [n = 36]</th>
<th>High AIS Expertise Group [n = 35]</th>
<th>t Statistic</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inherent Risk Assessment Quality</td>
<td>Mean 18.89 (SD 9.79)</td>
<td>Mean 14.00 (SD 7.66)</td>
<td>2.340</td>
<td>.011</td>
</tr>
<tr>
<td>Control Risk Assessment Quality</td>
<td>Mean 19.87 (SD 13.11)</td>
<td>Mean 15.86 (SD 11.50)</td>
<td>1.372</td>
<td>.087</td>
</tr>
<tr>
<td>Effectiveness of Planned Substantive Procedures</td>
<td>Mean 5.14 (SD .93)</td>
<td>Mean 5.72 (SD 1.05)</td>
<td>-2.491</td>
<td>.008</td>
</tr>
</tbody>
</table>

*a Inherent (Control) Risk Assessment Quality was calculated as the absolute deviation of participants’ assessments from experts’ mean inherent (control) risk assessment. Effectiveness of Planned Substantive Procedures was measured as participants’ mean effectiveness rating provided by experts assigned to their CAS competence condition. Experts individually assessed effectiveness on a scale ranging from 1 (“very low”) to 10 (“very high”).
TABLE 3
Testing of Hypothesis 3

<table>
<thead>
<tr>
<th>Dependent Variable&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Low CAS Competence Group&lt;sup&gt; &lt;/sup&gt;[n = 38]</th>
<th>High CAS Competence Group&lt;sup&gt; &lt;/sup&gt;[n = 33]</th>
<th>F Statistic&lt;sup&gt;b&lt;/sup&gt;</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Risk Assessment</td>
<td>Mean 58.42 (SD 17.71)</td>
<td>Mean 47.06 (SD 19.58)</td>
<td>8.314</td>
<td>0.003</td>
</tr>
</tbody>
</table>

<sup>a</sup> *Control Risk Assessment* was measured on scale ranging from 0 (“low risk”) to 100 (“high risk”) percent.

<sup>b</sup> The F statistic is for the main effect of CAS competence from the overall 2X2 ANOVA.
## TABLE 4
### Testing of Hypothesis 4

**Panel A - Descriptive Statistics**

<table>
<thead>
<tr>
<th>Dependent Variable&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Cell 1</th>
<th>Cell 2</th>
<th>Cell 3</th>
<th>Cell 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>High AIS/High CAS (Cell 1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>12.29</td>
<td>13.39</td>
<td>12.00</td>
<td>11.90</td>
</tr>
<tr>
<td>(SD)</td>
<td>1.31</td>
<td>1.96</td>
<td>2.00</td>
<td>1.74</td>
</tr>
<tr>
<td>High AIS/Low CAS (Cell 2)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>2.59</td>
<td>4.06</td>
<td>2.25</td>
<td>2.45</td>
</tr>
<tr>
<td>(SD)</td>
<td>2.50</td>
<td>2.29</td>
<td>2.02</td>
<td>1.57</td>
</tr>
<tr>
<td>Low AIS/High CAS (Cell 3)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>5.35</td>
<td>6.00</td>
<td>4.88</td>
<td>5.25</td>
</tr>
<tr>
<td>(SD)</td>
<td>3.22</td>
<td>2.59</td>
<td>3.76</td>
<td>2.88</td>
</tr>
<tr>
<td>Low AIS/Low CAS (Cell 4)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>96.06</td>
<td>116.94</td>
<td>103.50</td>
<td>99.25</td>
</tr>
<tr>
<td>(SD)</td>
<td>17.48</td>
<td>28.49</td>
<td>27.50</td>
<td>18.82</td>
</tr>
</tbody>
</table>

**Panel B - Planned Contrasts**

<table>
<thead>
<tr>
<th>Dependent Variable&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Contrast Tested&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Value of Contrast</th>
<th>t Statistic</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Procedures</td>
<td>(13.39 - 11.90) - (12.29 - 12.00)</td>
<td>1.20</td>
<td>1.411</td>
<td>0.082</td>
</tr>
<tr>
<td>Labor</td>
<td>(4.06 - 2.45) - (2.59 - 2.25)</td>
<td>1.27</td>
<td>1.264</td>
<td>0.109</td>
</tr>
<tr>
<td>Timing</td>
<td>(6.00 - 5.25) - (5.35 - 4.88)</td>
<td>0.28</td>
<td>0.183</td>
<td>0.428</td>
</tr>
<tr>
<td>Extent</td>
<td>(116.94 – 99.25) - (96.06 - 103.50)</td>
<td>25.13</td>
<td>2.222</td>
<td>0.016</td>
</tr>
</tbody>
</table>

<sup>a</sup> Procedures refers to 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 refers to the total number of budgeted audit hours.

<sup>b</sup> Planned contrast tested = (Cell 2 Mean – Cell 4 Mean) > (Cell 1 Mean – Cell 3 Mean).
<table>
<thead>
<tr>
<th>Cell Description</th>
<th>High CAS Competence</th>
<th>Low CAS Competence</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Auditor AIS Expertise</td>
<td>Cell 1, n = 17</td>
<td>Cell 2, n = 18</td>
</tr>
<tr>
<td>Low Auditor AIS Expertise</td>
<td>Cell 3, n = 16</td>
<td>Cell 4, n = 20</td>
</tr>
</tbody>
</table>

**FIGURE 1**
Cell Labels with Number of Participants
FIGURE 2
Graph Depicting Computer Assurance Specialist (CAS) Competence and Auditor Accounting Information System (AIS) Expertise Interaction

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

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


FOOTNOTES

1. Also referred to as computer auditors and information systems audit specialists, CAS provide the auditor with control testing evidence related to the client’s AIS (Curtis and Viator 2000; AICPA 2001; Hunton et al. 2001).

2. Inherent risk is the risk that the financial statements are susceptible to a material misstatement, assuming there are no related controls. Control risk is the risk that the entity’s internal control structure will not prevent or detect a material misstatement (AICPA 1983).

3. The audit risk model states that audit risk (i.e., the risk that the auditor fails to appropriately modify his or her opinion on financial statements that are materially misstated) can be expressed as the multiplicative combination of inherent risk, control risk, and detection risk (i.e., the risk that the auditor will not detect a material misstatement that exists in the financial statements). Thus, to compensate for increases in inherent and control risks, the auditor reduces detection risk by planning substantive procedures that are greater in scope (AICPA 1983).

4. Participants were asked, on a scale from 1 (Disagree) to 10 (Agree), whether they had experienced variation in CAS competence. The mean response was 7.23. They were also asked, on a scale from 1 (Small) to 10 (Large), the amount of CAS competence variation they had experienced in practice. Participants’ mean response was 6.93.

5. Client control strength (i.e., internal controls tested) and CAS test results (i.e., AIS controls appear reliable) were kept constant between auditors. Therefore, H3 and H4 are developed given that the positive results of CAS tests of controls support an assessment of control risk below the maximum level (i.e., below 100 percent).

6. There were no significant differences in mean months of audit experience between the cells
(means = 45.76, 43.22, 44.00, and 44.80, F = .07, p = .98, for the high AIS expertise/high CAS competence, high AIS expertise/low CAS competence, low AIS expertise/high CAS competence, and low AIS expertise/low CAS competence cells, respectively). Also, there were no significant differences (all p’s > .15) between cells on other demographic variables (e.g., experience with: CAS, assessing risks, planning substantive procedures, and ERP systems).

7. After completing the case, participants were asked to assess the “competence (ability) level of the computer assurance specialist (CAS)” assigned to audit engagement on a ten-point scale (where 1 = “very low” and 10 = “very high”). For the low and high competence conditions, the mean responses were significantly different and in the expected direction (3.77 and 7.91, respectively; t = -11.774, p < .001). In addition, measurements of participant perceptions with respect to the importance of each of the three factors and the realism of the manipulation were relatively high and insignificant between conditions.

8. Prior audit research has established a link between domain-specific experience/training and expertise (e.g., Bonner 1990; Bonner and Lewis 1990; Bedard and Chi 1993). Thus, several experience and training-related items were included in the measure (e.g., experience auditing AIS, AIS training). Four other items were included based on a survey of accounting students (e.g., importance of AIS in their future careers). A final item directly measured auditor perceptions of their AIS expertise as suggested by Ajzen (1991).

9. Factor analysis of the pilot study data provided a Cronbach’s alpha = 0.9404, well above the generally accepted threshold of 0.70, and all nine items satisfactorily loaded on one factor (all factor loadings in excess of .70) (Nunnally 1978). General audit experience for the pilot study participants loaded on a separate factor. The Cronbach’s alpha (0.9649) and factor loadings for this study were consistent with the pilot study.
10. Two participants had mean scores of 3.222 and were removed from the original sample of 73 auditors for analyses performed in Section IV.

11. A researcher and a research assistant who was blind to experimental conditions coded the four scope measures (e.g., number of procedures). Cohen’s (1960) kappa measure of agreement between coders was greater than .80 for all four measures (all p’s >.001). The small number of differences were subsequently reconciled.

12. To reduce the complexity of the experts’ task and their time required, expert auditors were randomly assigned to cases with either low or high CAS competence conditions similar to Low (2004). Thus, for the dependent variables provided by the experts, CAS competence is confounded with expert groups and no hypotheses are offered which predict the effect of CAS competence on these dependent variables.

13. 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).

14. For dependent variables for which relationships with both independent variables are hypothesized (control risk and scope measures), results are analyzed within a 2X2 ANOVA framework. For other dependent variables (inherent risk, inherent and control risk quality, and scope effectiveness), independent-samples t tests were utilized, as the only independent variable of interest is auditor AIS expertise. Due to the directional nature of the hypotheses, all tests of hypotheses are one-tailed. Additionally, linear regressions using auditor AIS expertise as a continuous variable (i.e., auditors’ mean AIS expertise scores) were
conducted and were consistent with the results reported in the text.

15. 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 Two. Such tests were performed and non-tabulated results were consistent with the results presented in the text for Hypothesis Set Two.

16. Although not hypothesized, planned contrasts used to test H4 were performed on the effectiveness measure of participants’ substantive tests (i.e., dependent variable in H2c). Non-tabulated results indicate a similar interactive effect of auditor AIS expertise and CAS competence on the effectiveness of participants’ tests (value of contrast = .74, two-tailed p = .085). These results suggest that experts perceived as effective: (a) high AIS expertise auditors’ decision to expand the scope of testing beyond that of low AIS expertise auditors in light of low CAS competence, and (b) both high and low AIS expertise auditors planning tests of lesser scope when assigned to the high CAS competence condition. These conclusions are limited by the confounding of CAS competence and expert group for the effectiveness measure as discussed in footnote 11.
APPENDIX

Auditor Accounting Information System (AIS) Expertise Measure

The following questions were used to measure 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 Strongly Disagree 2 Mostly Disagree 3 Somewhat Disagree 4 Mildly Disagree 5 Mildly Agree 6 Somewhat Agree 7 Mostly Agree 8 Strongly Agree