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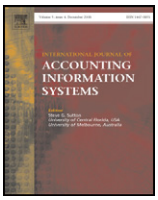

An analysis of attributes that impact information technology audit quality: A study of IT and financial audit practitioners

Dale Stoel *, Douglas Havelka, Jeffrey W. Merhout

Farmer School of Business, Miami University, 800 E. High St., Oxford, OH 45056, USA

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ABSTRACT

The importance of information technology (IT) auditing has grown with increased reliance on IT for business operations and new regulations regarding the assurance of IT for these operations. Prior work on IT and financial auditing has suggested several general frameworks that may affect IT audit quality; however, the prior work has not provided measurable constructs nor has it considered whether these proposed constructs are the same or different. Building on prior work that has proposed frameworks of IT audit quality, we identify and evaluate potential constructs suggested by these frameworks as well as financial auditing literature. We develop a survey tool and ask IT and financial accounting practitioners to assess the impact of these items on IT audit quality. A factor analysis is used to refine the set of IT audit quality factors identified, and we are able to provide insight into the prioritized impact of each factor on IT audit quality. In comparison to prior research, we find that additional factors are significant for IT audit quality and that the relative importance of the factors for IT audit quality differs for IT versus financial auditors.

Contents

* Corresponding author.
E-mail addresses: stoelmd@muohio.edu (D. Stoel), havelkdj@muohio.edu (D. Havelka), merhoutjw@muohio.edu (J.W. Merhout).

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1. Introduction

The purpose of this study is to analyze attributes identified in prior research that are thought to impact the quality of the information technology (IT) audit process. Prior research has identified several attributes that are argued to impact IT audit quality, both positively and negatively. These attributes include various characteristics of the process or system being audited, the procedures or techniques used to perform the audit, traits of the audit personnel themselves, organizational and environmental conditions, as well as many others. The natural extension of this work is to develop a structural model of IT audit quality and its antecedents; however, to date, there has not been an examination of these attributes to identify the underlying measurable components of IT audit quality. Additionally, the financial audit literature suggests other audit quality attributes which may also provide insight into *IT* audit quality. Therefore, the purpose of this research is to rationalize the potential constructs and develop potential instruments that allow for measurement of these constructs.

Recent research has identified the importance of IT audit to organizations and has called for additional research in this area (Weidenmier and Ramamoorti, 2006; Curtis et al., 2009). This attention to IT audit has been driven by two primary reasons, 1) increased spending and dependence on IT for business operations, and 2) new legislation and professional requirements related to the audit of these operations. Demand for IT services to support key business activities has driven the level of global IT spending to over $3.6 trillion for 2011 (Gartner Group, 2011). This reliance on IT and the investment it entails require an increased level of assurance that these systems deliver what they promise. IT audits are widely used *internally* to examine the operations, effectiveness, controls, and security of critical systems to identify opportunities for improvement and areas of weakness.

Discussions by the Public Company Accounting Oversight Board (PCAOB) Standing Advisory Group (SAG) regarding auditor's knowledge of information systems (IS) have emphasized the importance of information technology (IT) in general, and IT auditing specifically, to the *external* financial audits of public companies. In addition to the United States' Sarbanes–Oxley Act (SOX), a plethora of other laws, regulations, and standards have all necessitated additional IT assurance related to information security and privacy. These include, but are not limited to, the Health Insurance Portability and Accountability Act (HIPAA), Canada's Personal Information Protection and Electronic Documents Act (PIPEDA), the Payment Card Industry Data Security Standard (PCI DSS) and the European Union's Data Privacy Directive. In addition to these regulatory compliance requirements, auditors of public companies in the U.S. are bound by auditing standards that require adequate IT expertise to assess controls; for an insightful discussion of these standards please see Curtis et al. (2009).

IT audits may serve various objectives and multiple parties within an organization, and therefore there may be different definitions of IT audit quality. These definitions may include ideas such as impact or effectiveness, completeness as related to different standards, and efficiency or cost. One purpose of IT audits is to provide management with assurance that a system or automated process is meeting its objectives.

Specifically, the focus may be on managements' control responsibilities over computer-based information assets and processes. In these cases, specific standards developed by groups such as ISO, PCAOB, or AICPA may assist in defining certain IT audit quality. For internal operational audits, the focus is usually on performance, i.e. cost reduction or improvements in productivity. Therefore the focus may be on the overall impact of the audit findings and the cost of performing the audit. Regardless, to perform an IT audit efficiently and effectively, firms must make appropriate decisions regarding the scope, resources (e.g., personnel or computer-automated audit tools), tasks or activities to be performed, methods, techniques, and other "inputs" to the IT audit process. Management's decisions regarding specific resources to deploy for a specific IT audit should attempt to maximize the overall audit quality and minimize the cost as related to their specific IT audit objectives. This also requires a consideration of other attributes that might impact the performance and outcome of the IT audit, but over which they have no or little control. These attributes might include the availability of key auditee personnel, the infrastructure or architecture on which a system is running, or the organizational structure of a business unit being audited.

One objective of this research is to assist these decision-makers by providing additional information regarding the relative importance of the attributes previously identified in the research and the underlying components that these attributes comprise. We believe that these could be used to help guide audit management's planning by making tradeoffs among the attributes. We also analyze whether differences exist with regard to perceptions of these components between key constituents.

We believe that there are four primary contributions attributable to this research activity. First, we identify and rationalize specific attributes associated with the IT audit quality domain, including attributes from the general audit quality domain that are relevant to IT audit quality. Specifically, we begin with the general framework proposed by Merhout and Havelka (2008) and expand this work by integrating other attributes from the IT audit domain and then relevant items identified in the financial audit quality domain.

Second, we evaluate the relative importance of these attributes to IT audit quality. By evaluating the individual attributes, we can compare our results to the work of prior researchers that have done similar work in the general audit quality domain to determine if IT audits have different requirements or peculiarities. Our results indicate that there is a different priority in the skills and knowledge required for IT audit quality as compared to attributes identified in prior financial audit quality literature.

Third, we perform a factor analysis to determine the underlying components of the attributes identified. In general, factor analysis allows us to reduce a large set of items into a smaller set of composite components that are more easily manageable. The long-term goal of this stream of research related to IT audit quality is to develop a testable model of constructs that may impact IT audit quality. The research presented in this paper is a critical, initial step in rationalizing and developing measurable constructs related to IT audit quality. This paper is similar to Carcello et al. (1992) who focus on identifying the critical factors related to financial audit quality.

Fourth, we analyze differences in perceived importance of the IT audit quality factors generated by the factor analysis between distinct groups involved in the IT audit process. We identify differences in perceptions between IT and financial auditing participants. This may aid in developing a better understanding of expectations and perceptions of the IT audit process and quality for these groups, and, hopefully allow management to improve audit planning and execution so all parties perceive similar (higher) quality.

The remainder of this paper proceeds as follows. Section 2 provides a review of the existing IT and financial audit quality literature and identifies potential IT audit quality attributes. Section 3 describes the research method and approach for analyzing the IT audit quality attributes. In Section 4, we describe the results of the analysis including explanation and interpretation of supported factors, perceived importance of each factor, and differences in evaluation of the factors between IT audit participants. Section 5 discusses specific observations from our data, limitations of our study, and implications for future research and for practitioners.

2. Background

This work was directly motivated by the call for additional research in IT audit (Weidenmier and Ramamoorti, 2006) which suggests the need for greater understanding of IT and the related audit process. Additionally, a recent survey of more than 450 internal auditor professionals conducted by Protiviti

identified IT auditing as one of the top two areas that requires improvement (Filipek, 2007). Potential reasons for this result include: a) advances in information technology and increases in IT spending which have resulted in organizations relying on software and technical infrastructures to support most businesses processes, and b) laws, such as SOX, which require all information systems used to produce financial statements be documented and tested for compliance with management's IT control objectives. The increased demand for IT audit services emphasizes the importance of performing these services in the most efficient and effective manner. As a result, additional research is needed to understand the potential issues in performing IT audits and critical factors that may be related to the overall quality of the IT audit (Weidenmier and Ramamoorti, 2006).

Within the IT audit literature, there are a variety of resources to guide practitioners at the operational level. For example, the Information Systems Audit and Control Association's (ISACA) Control Objectives for Information and related Technology (COBIT®) provides a detailed series of potential controls and checklists. Additionally, there are many publications (e.g., Davis, 1997; Bagranoff and Vendrzyk, 2000; Petterson, 2005; Brody and Kearns, 2009) and textbooks (e.g., Hunton et al., 2004a; Hall and Singleton, 2005) which provide overviews of IT audit processes and specific direction for audit tasks. However, there has been little academic research on the IT audit process, and specifically on what factors influence IT audit quality and on the relative importance of each factor.

Previous IT audit studies have focused primarily on specific aspects or characteristics of IT audit or assurance tasks. For example, recently authors have explored the IT proficiency of auditors and the importance of IT knowledge for assurance practitioners as one critical component of IT auditing (Carnaghan, 2004; Greenstein and Mckee, 2004; Leader, 2004; Wilkinson, 2004; Brazel, 2005; Curtis et al., 2009). Additionally, researchers have explored the potential impact of group dynamics and group support systems (Bamber et al., 1998; Carnaghan, 2000; Leech, 2000; O'Donnell et al., 2000a, b) and the impact of various technologies such as EDI, ERP or XBRL on auditing (Vanecek et al., 1983; Hansen and Hill, 1989; Morris and Pushkin, 1995; O'Leary, 2002; Wright and Wright, 2002; O'Donnell and Schultz, 2003; Hunton et al., 2004b; O'Donnell, 2005, 2006; Boritz and No, 2009; Brody and Kearns, 2009; Kuhn and Sutton, 2010; Srivastava and Kogan, 2010). Researchers have also used case studies of IT audits to identify potential concerns and improvement opportunities for IT audit (Smith, 2007). The impact of this research is that a broad set of attributes that may influence IT quality has been identified.

Additional research related to IT audit has investigated the impact that IT has on financial audit, internal controls, or other projects. Examples include work that investigates the changing role of IS audit and auditors in US accounting firms (Bagranoff and Vendrzyk, 2000; Vendrzyk and Bagranoff, 2003; Omoteso et al., 2010); the IT-related activities of auditors and the use of computer-based tools (Lovata, 1990; Burton, 2000; Hermanson et al., 2000a; Jackson, 2000; Bierstaker et al., 2001; Janvrin et al., 2009); the effect of internal control reliability on IT audit hours and fees (Daigle et al., 2005); the effect of IT on auditor detection of misstatements (Messier et al., 2004); the development of metrics for information systems assurance and the identification of high risk modules (Sherer and Paul, 1993; Havelka et al., 1998; Salterio, 1998; Stockton, 1998); and the general implementation of technology for auditing (Dowling and Leech, 2007; Curtis and Payne, 2008; Dowling, 2008). Again, this research provides individual attributes that may influence audit quality; however, little has been done to consolidate and rationalize these factors into a framework of IT audit quality.

Recent work by Merhout and Havelka toward developing a theory for the IT audit process utilized group data gathering techniques with IT audit practitioners, internal and external, to create a framework of logical factors related to IT audit quality (Havelka and Merhout, 2007; Merhout and Havelka, 2008; Havelka and Merhout, 2009). They identified a large (over 260) set of attributes (referred to as factors by Merhout and Havelka) that were suggested by practitioners as "critical" to the IT audit process. While they logically categorize the attributes identified, Merhout and Havelka do not provide any empirical evidence to support their framework or to evaluate the importance of the attributes or the categories they suggest. Therefore, one purpose of this research is to empirically analyze the underlying attributes to better understand the groupings of the proposed factors. Additionally, Merhout and Havelka intentionally focus on IT auditors in their data gathering; however, there may be overlap with the concepts of financial audit quality that should be considered.

The primary approach used within the financial audit literature to identify audit quality attributes has been literature reviews and validation surveys. There are many works in the general audit literature that

consider individual audit quality attributes (Rudolph and Welker, 1998; Hun-Tong and Kao, 1999; Ghosh and Moon, 2005; Carey and Simnett, 2006; El-Masry and Hanson, 2008; Arena and Azzone, 2009); however, there are two primary works which review the literature and identify measurable attributes. First, Schroeder, Solomon and Vickrey (1986) surveyed audit committee chairs and audit partners on 15 specific "factors" of audit quality from prior research and identified eight of these as having a strong or very strong impact on audit quality, including executive involvement, planning/conduct field work, communication to management, independence, technical competence, team experience, quality control, and communication to audit committee. Second, the approach of Carcello et al. (1992) extended Schroeder et al. in that they developed a broader survey of audit quality attributes and administered the survey to a combination of external audit, internal audit, and business professionals. Using a factor analysis technique, Carcello et al. identified 12 factors overall, including four primary factors: client experience, industry experience, responsiveness to client needs, and compliance with GAAS.

An alternative approach used to identify audit quality factors is through direct solicitation from audit professionals using interviews and group-based approaches. The primary work in this area is by Sutton and Lampe (Sutton and Lampe, 1991; Sutton, 1993; Lampe and Sutton, 1994). One of the unique benefits of this approach is the potential detail and rich data set developed. These studies identified 19 specific attributes. Examples of the attributes identified by Sutton and Lampe's studies include audit team expertise, audit timing requirements, audit manager involvement, and prior notes and work papers.

Overall, our review of the literature suggests many attributes of IT audit quality. We believe that many of these attributes are semantically similar and overlap in definitions. For example, the single planning/conduct field work construct identified by Schroeder et al. may overlap with the audit methodology concepts of Merhout and Havelka and with the fieldwork concept of Carcello et al. Similarly, we believe that executive involvement is one aspect of the supervision concept. An additional example where overlap is possible and refinement of the definition may be possible is the idea of audit skills which may include components of other attributes including auditor preparation, technical competence and/or social/communication skills. We believe that rationalization of this set of potential IT audit quality attributes is required before a testable model can be developed. Based on this prior research, we prepared an initial set of attributes to analyze. A description of the general approach and method used to perform our further analysis follows.

3. Research methodology

The purpose of our research is to refine and validate attributes suggested by prior research that would impact IT audit quality. Additionally, understanding the relative perceived importance of the attributes, and the factors resulting from our analysis, provides an opportunity to focus on critical concerns. Lastly, we also explore differences in perception about the perceived importance between key IT audit groups. We believe that understanding these differences in perception may be critical to developing well constructed audit teams and identify areas of the IT audit process which require greater communication to increase understanding about the activities and outcomes of the IT audit.

Our approach to this process follows that of Carcello et al. (1992) who examine quality attributes for financial audits. We follow an informed exploratory process identifying potential attributes (survey items) based on either prior surveys or other work where attributes may be identified and developed to measure related constructs. We then asked a broad set of knowledgeable and experienced practitioners to take the survey to evaluate the relative impact of each indicator on IT audit quality. Next, we use the survey results to analyze the scores of each attribute and to perform a factor analysis to rationalize the attributes and determine the underlying components. Finally, we compare our results to prior literature for similarities and distinctions between financial audit quality research and IT audit quality. One item of note is that we do not provide a definition of IT audit quality within the research materials. This approach allows the respondents to formalize their own view of "IT audit quality" and assess the importance of individual items accordingly without potential guidance from a single definition. This approach is consistent with that of Carcello et al. (1992) in their examination of financial audit quality attributes.

To develop our survey, we initially identified attributes which have been utilized in prior literature on audit quality. Specifically, we use representative items from Schroeder et al. (1986), Carcello et al. (1992), and Behn et al. (1997). We also reviewed the attributes within the various works from Sutton and Lampe

and find some overlap with prior literature; however we do add items to our survey to represent additional concepts. From this review, we believe we capture the relevant attributes identified within the general audit quality literature. We then reviewed the IT audit quality field work results of Merhout and Havelka (Merhout and Havelka, 2008; Havelka and Merhout, 2009) to identify additional potential attributes which we added to the survey instrument. Specifically, we focused on the lower level "indicators" presented in their results to identify potential attributes that did not repeat or directly overlap items already included. Focusing on the "indicators" rather than any of their proposed higher-level constructs allowed us to include a wider set of potential attributes and thus allowed the statistical analysis to determine the specific components or factors.

We began with this set of attributes and then reviewed other existing IT auditing and financial auditing literature to rationalize this set further by paring, combining, and adding to the initial set. The survey was pre-tested for understanding, grammar, and clarity by several of our academic colleagues and practicing IT auditors. Our final set of potential attributes consisted of 54 items from various sources. These attributes and the source for each are presented in Appendix A. The resulting survey included the 54 items which were randomly distributed in the survey to prevent clustering bias. Similar to prior research, respondents were asked to assess the impact of each item on IT audit quality using a five point Likert scale ranging from no impact to extremely impactful.

Our goal for the survey sample was to identify a set of experienced practitioners involved with the management or execution of IT audits. To recruit a broad set of practitioners, our implementation of the survey focused on identifying two respondent sets: 1) IT audit professionals and 2) financial auditors and other accounting professionals involved with IT audits. We partnered with four ISACA chapters located in the U.S. Midwest to solicit potential survey respondents for the first set. ISACA chapters focus on professional development, advocacy, and education in the area of IT governance, risk management, controls and auditing. We believe that these participants provide the perspective of practitioners responsible for managing and executing IT activities and audits.

An online survey was established and the link was provided to the participating chapters who sent an e-mail to their membership identifying our request. The e-mail request indicated that we were seeking participants who were directly involved in the management and performance of IT audits. The e-mail contained a link that directed participants to an introductory page which explained the general concept of the research and asked participants to reflect on all of their experiences with IT audits in assessing the impact of individual items on IT audit quality. The participating chapters indicated a membership of approximately 1600 and we received 187 usable survey responses, a response rate of 11.7%. We believe the response rate is reasonable considering that one ISACA group reports that only 35–40% of its membership regularly opens e-mails from the group. The IT audit respondents average over 7 years in IT audit experience and common job titles include IT auditor, IT audit manager, senior audit manager, and various internal and external audit positions. These qualities seem to indicate that we have reached a pool of IT auditors with significant and wide-ranging experiences.

For our second respondent set, we used an alumni database for a Midwest university's accounting department. We believe that this set of participants provides an understanding of IT audit quality from the perspective of the financial auditor and other accounting practitioners that are involved with IT audits. Alumni were sent one email asking for their participation if they have been involved in either financial auditing which integrated IT audit activities or were a recipient of IT audits. Similar to the IT participant e-mail, participants were asked to reflect on their total sum of experiences in assessing the IT audit quality impact. The email was sent to approximately 3000 accounting alumni and generated 196 usable survey responses, a response rate of 7%. The response rate may be lower than other surveys; however, the solicited population includes many practitioners whose experiences are not applicable to our research. The financial audit respondents average over 12 years with financial audits and 3 years experience with IT audits. The common job titles for the financial audit respondents include internal financial positions such as CFO, controller, accounting manager or internal auditor and external audit positions such as audit manager, senior manager and partners. The pool of financial audit and accounting respondents appear to be able to provide informed perspectives on IT audit quality from a perspective different than the IT audit practitioner.

Overall, we believe that the combined set of respondents is a representative sample of experienced practitioners involved with the management or execution of IT audits and includes good representation

of the two respondent sets: 1) IT audit professionals and 2) financial auditors and other accounting professionals involved with IT audits.

4. Analysis

Our analysis of the survey responses includes examination of individual survey items to determine which attributes individually might be most important to IT audit quality, a factor analysis to determine if underlying components exist that might be useful for further study, and an analysis of differences in respondent groups.

4.1. Evaluation of individual IT audit quality indicators

To assess the relative importance of the attributes identified, the initial analysis of the survey results focused on analyzing the average score provided by all respondents for the individual attributes and determining the highest and lowest rated attributes. For consistency with prior research (Carcello et al., 1992), we focus on the top and bottom ten attributes based on their average ranking from the entire sample. Table 1 identifies the top ten attributes with the highest rating (with the highest listed first). We believe that each individual item in this list is important as all have a mean above 4.1, which indicates that they were generally rated as very or extremely impactful to IT audit quality.

The general focus of the highest rated attributes is on audit planning and fieldwork. By comparison, Carcello et al. (1992) found accounting and audit expertise and partner involvement as the highest rated items. This may indicate that the complexities or peculiarities of IT audits may require increased focus on planning the audit to ensure that the auditor and the auditee understand the specific objectives to be achieved and tests to be performed for the specific system or process being audited. Conversely, in a financial audit the focus is on better established standards, GAAP and GAAS, and the expertise of the team and the involvement of the audit partner who brings knowledge of these standards. A consistent finding between our results and those of Carcello is the focus on auditor attributes such as communication skills and ethics. This finding emphasizes the importance of the abilities and characteristics of the specific individuals assigned to the audit team.

Table 1 also identifies how the top ten items were ranked by the financial auditors and how they were ranked by the IT auditor populations. We notice that most of the overall top ten items are also ranked within the top ten by both the financial auditors and by the IT auditors. The primary exception is that the top two items identified by the financial auditors are not in the overall top ten. These two items (question 1 and question 54) relate to the audit teams knowledge of accounting and GAAP, which may not be

Table 1
Ten highest rated items of IT audit quality.

No.	Questionnaire item	Overall mean rating	Fin Rank	IT Rank
16.	The audit is adequately planned	4.43	3	1
22.	The audit team members have high ethical standards	4.34	4	3
50.	Audit team has good communication skills (oral and written)	4.33	8	2
52.	Sufficient resources exist to meet audit scope and timeframe	4.28	5	5
35.	Risk-based audit approach is used to develop audit plan, and risk assessment model is understandable	4.27	10	4
2.	Auditee understands the audit process and purpose of the audit	4.23	9	7
18.	Fieldwork is reviewed by a higher level audit team member	4.20	6	11
15.	The audit team members conduct the audit field work in an appropriate manner	4.17	11	8
13.	Audit team members are very knowledgeable about internal controls and business processes	4.16	19	6
5.	Audit team members are knowledgeable about unique business practices and processes in your industry	4.10	7	23

The Fin Rank and the IT Rank indicate the ranking of the specific attribute out of the 54 questions included in the survey. The ranking is based on the mean score of the item within the subgroup (financial auditor or IT auditor) compared to all other items within the same subgroup.

viewed as being as critical by the IT auditors, resulting in their lack of inclusion in the overall top ten items. The top ten items identified by the IT auditor top ten also has two differences from the overall group; however, these differences are only a few spots in the overall rankings (question 43, "Audit objectives, scope and plan are documented and agreed to by auditee and audit team", was ranked 9th by IT auditors and 14th overall; question 4, "The audit team maintains independence in appearance and in fact", was ranked 10th by IT auditors and 13th overall).

Table 2 presents the means of the lowest ten rated individual attributes (with the lowest rated attribute listed first). These attribute scores range from 2.31 to 3.46, indicating that these items were generally rated as having little to some impact. This suggests that these items are still considered important to IT audit quality, but not as important as others. The two lowest rated attributes (CPA exam and CISA exam) suggests that certification may not be as important to performing a quality IT audit. In a recent study by Abdolmohammadi and Boss, 2010, they find that internal auditors with a CISA certification spend more time on IT audits; however, that study does not consider the perceived benefit of the CISA certification. By comparison, Carcello et al. identified a knowledgeable audit team in auditing and accounting as *the highest* rated individual attribute. One explanation for this difference is that IT may be embedded throughout organizations and require more specific, unique knowledge about the organization, industry, and business processes as opposed to GAAP or GAAS. The fact that two of the highest rated attributes in our study include knowledge about internal controls and unique business processes lends additional evidence to this explanation.

Similar to Table 1, Table 2 identifies how the bottom ten items were ranked by each of the two subgroups — the financial auditor and the IT auditor populations. We notice that most of the overall bottom ten items are included in the bottom ten items of each subgroup. The few discrepancies between the subgroups and the overall bottom ten appear relatively minor as the largest difference is that questions related to accounting knowledge (questions 1 and 54) are in the bottom ten of the IT auditors and are not in the overall bottom ten based on the ratings from the financial auditors.

4.2. Factor analysis of IT audit quality attributes

We perform a factor analysis to determine the relationships between individual items within the survey instrument and identify underlying composite components (i.e., factors). One concern when performing factor analysis is sample size; however, there are few specific rules about required sample size for factor analysis and the general belief is that "bigger is better." Two methods for determining an appropriate sample size that have been proposed in the literature include: 1) the ratio between responses and items, and 2) an absolute number of responses (Guadagnoli and Velicer, 1988). The ratio approach suggests that for each item in the factor analysis that there should be a certain number of unique responses. Suggested ratios have started at two responses per item and increased, again with the belief that more is better. The "absolute number of

Table 2
Ten lowest rated items of IT audit quality.

No.	Questionnaire item	Overall mean rating	Fin Rank	IT Rank
28.	The majority of audit team personnel have passed the CPA exam	2.31	53	54
32.	The majority of audit team has passed the certified information systems auditor (CISA) exam	2.58	54	48
19.	Inclusion of geographically and culturally dispersed business units and processes in the audit	2.96	51	52
7.	The audit team makes extensive use of statistical techniques in conducting the audit	2.98	50	51
49.	The audit team is diverse (e.g., thoughts; ways of doing work; background; experiences)	3.07	52	47
36.	The use of outsourcing within the business processes or systems being audited	3.12	49	49
40.	Audit team has strict sign off procedures for completed audit steps	3.36	45	46
51.	Computer-assisted auditing tools (CATs, e.g. ACL) are used for testing and analysis	3.39	46	43
20.	Number of business units, processes, or systems involved in audit	3.44	47	40
29.	The audit team members maintained a skeptical attitude throughout the audit engagement	3.46	41	45

The Fin Rank and the IT Rank indicate the ranking of the specific attribute out of the 54 questions included in the survey. The ranking is based on the mean score of the item within the subgroup (financial auditor or IT auditor) compared to all other items within the same subgroup.

responses" approach is based on the view that the sample estimate likely represents the population when samples reach a certain size. The suggested sample sizes start at 100 responses, and it is again argued to be better when larger. Our sample size meets the requirements for both of these guidelines.

To perform the factor analysis, we utilize a principal components analysis with varimax rotation to identify more clearly identifiable and interpretable factors. We retain factors that have an eigenvalue greater than one and we require factor loadings for individual items to be greater than 0.4. Research uses a variety of cut-off points for individual factor loadings; however, our use of .4 is consistent with the prior audit quality research (Carcello et al., 1992) and is consistent with other exploratory factor analyses. We also find that there are few items with factor loadings below .6 and that there are relatively small cross-loadings. We associate individual items with the factor where they have the highest loading. Table 3A includes the factor analysis and provides the item loadings on across all retained factors. Table 3B identifies the specific factors and associated items along with information about the percentage of variance explained by each factor.

In general, factors that explain more variance are considered to be more *parsimonious*. That is, they are thought to be stronger representations of the underlying theoretical dimension or component being investigated (Frankfort-Nachmias and Nachmias, 1996). One objective of factor analysis is to identify a good set of indicators for abstract concepts. While it is never possible to be certain of the validity of a specific set of indicators for an abstract concept, it is widely accepted that factors which match concepts previously identified and that are reliable (they have high correlations among items in the factor) indicate positive evidence of validity (Simon and Burstein, 1985).

The factor analysis results in 13 factors which we label using the attributes loading on each factor as our guide (see Table 3B). We focus on the top five factors as these explain the greatest amount of variance. These five are each discussed below with regard to the prior research and in order of their parsimoniousness.

4.2.1. Independence

The most parsimonious factor identified (.1846 explained variance) is labeled *Independence*. It includes items related to the objective and proper conduct of the audit emphasizing the independence of the audit team from influence by the auditee management. Independence is usually defined as when the audit team is independent from the auditee and reports to an appropriate, responsible entity (e.g., the audit committee of the board of directors). The *Independence* concept has been recognized as important in prior research on audit quality, but almost exclusively from a financial audit perspective (Schroeder et al., 1986; Carcello et al., 1992; Behn et al., 1997; Chen et al., 2001; Samelson et al., 2006). One study with implications for IT audit addressed the issues that arise when internal auditors are involved with the design of information systems and subsequently audit these systems (Plumlee and Snowball, 1987). Petterson (2005) also emphasizes the importance of independence as a prerequisite for IT audit.

4.2.2. Accounting knowledge and audit skills

The second most parsimonious factor identified was *Accounting Knowledge and Audit Skills* (.0749 explained variance). This factor refers to the audit personnel's knowledge of accounting and auditing in general, their understanding of the accounting system being audited in specific, and their ability to perform tasks and exercise professional judgment as auditors. The impact of the knowledge and skill of audit personnel on audit quality has been addressed in prior research, again primarily in the financial audit research (Knapp, 1991; Carcello et al., 1992; Hun-Tong and Kao, 1999; Chen et al., 2001; Samelson et al., 2006; Merhout and Havelka, 2008; Havelka and Merhout, 2009). Specifically, Carcello et al. identified two factors that are similar to the factor found in our study: 1) compliance with general auditing standards and 2) individual team members' characteristics (that included knowledge of accounting and auditing). Chen et al. also found two factors that are similar to ours: 1) knowledgeable and ethical (auditors) and 2) qualification and risk control. The only IT audit-oriented research including *Accounting Knowledge and Audit Skills* was exploratory (Havelka and Merhout, 2009).

4.2.3. Business process knowledge

The third most parsimonious factor identified was *Business Process Knowledge* (.0423 explained variance). This factor refers to the audit personnel's understanding of the specific client's practices and processes, the industry's practices and processes, and business processes in general. Prior research indicates that

Table 3A
Factor analysis and item loadings. Cells in bold represent the maximum loading for the item. Rows in italics lack a loading which exceeds 0.4 and are dropped from the analysis (q18, q26, q30, q34, q49, q50, q52).

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13
q1	−0.073	**0.751**	0.186	−0.055	−0.004	0.090	−0.002	0.111	−0.293	0.038	−0.016	0.028	0.024
q2	0.109	0.001	0.080	−0.209	−0.079	0.036	0.050	0.006	0.176	0.273	0.028	**0.469**	0.250
q3	0.031	0.152	0.364	−0.157	−0.191	0.010	0.014	**0.408**	0.059	−0.070	−0.019	0.293	0.168
q4	**0.726**	0.048	−0.016	0.002	0.005	0.054	0.048	0.064	0.196	0.069	0.059	0.078	0.128
q5	0.053	0.206	**0.726**	−0.017	0.018	0.082	0.012	0.128	0.070	0.076	−0.052	0.030	−0.011
q6	0.370	0.074	0.005	−0.241	−0.110	0.159	0.126	0.088	**0.404**	0.099	−0.080	0.265	0.166
q7	0.253	**0.497**	0.031	−0.163	0.247	0.038	0.045	0.123	0.288	−0.036	0.122	0.185	0.205
q8	**0.463**	0.156	0.113	0.061	0.303	0.027	−0.094	0.135	0.156	0.286	0.005	0.011	0.072
q9	0.032	0.134	0.032	−0.176	0.102	0.009	**−0.686**	0.058	0.111	0.028	0.088	0.041	0.054
q10	**0.418**	0.018	0.125	0.055	0.119	0.073	−0.352	0.096	0.247	0.096	−0.063	0.201	0.135
q11	−0.009	**0.628**	0.121	0.040	−0.106	0.002	−0.240	0.063	0.240	0.199	0.022	0.121	0.164
q12	**0.435**	0.156	0.048	−0.034	−0.003	0.020	−0.158	0.023	0.248	0.068	0.385	0.093	−0.012
q13	0.272	0.130	0.267	0.018	0.061	0.000	−0.179	0.036	**0.457**	0.206	0.023	0.118	0.096
q14	0.135	0.177	0.220	−0.036	0.059	0.022	0.098	**0.754**	0.047	0.094	0.013	0.001	−0.054
q15	**0.446**	0.138	0.226	−0.179	0.111	0.103	−0.163	0.118	0.059	0.239	0.299	0.007	−0.121
q16	0.190	0.123	−0.054	−0.185	0.130	0.010	−0.346	0.112	0.046	**0.498**	0.238	0.004	−0.093
q17	0.364	0.012	−0.034	−0.110	0.064	0.111	**−0.456**	0.176	0.050	0.167	0.160	0.122	0.263
q18	*0.284*	*0.141*	*−0.050*	*0.088*	*0.292*	*0.048*	*−0.259*	*0.260*	*0.012*	*0.316*	*0.125*	*0.075*	*−0.105*
q19	0.104	0.205	0.086	−0.116	−0.021	**0.785**	0.000	0.069	0.088	0.047	0.101	0.012	−0.037
q20	−0.031	0.003	0.014	−0.047	0.080	**0.764**	−0.021	0.072	0.180	0.084	−0.038	0.000	0.164
q21	0.221	0.226	0.079	−0.006	0.141	0.154	−0.045	0.001	**0.723**	0.029	0.066	0.029	0.025
q22	**0.758**	0.050	0.016	−0.134	0.073	0.114	−0.084	0.002	0.094	0.109	−0.025	0.052	−0.005
q23	0.048	0.047	−0.045	−0.137	−0.054	0.089	−0.134	0.132	0.316	−0.032	**0.611**	0.053	0.065
q24	−0.058	0.147	0.134	−0.151	0.074	0.008	−0.097	**0.763**	0.076	0.073	0.056	0.007	0.177
q25	0.049	0.003	0.212	−0.013	0.030	0.123	−0.152	0.115	**0.755**	0.144	0.078	0.059	0.050
q26	*−0.077*	*0.173*	*0.039*	*−0.249*	*0.219*	*0.014*	*−0.370*	*0.335*	*0.076*	*0.043*	*0.008*	*0.236*	*0.198*
q27	0.109	0.081	0.163	**−0.587**	0.052	0.044	−0.261	0.135	0.038	0.141	−0.084	0.010	−0.076
q28	0.053	**0.657**	0.046	−0.101	0.115	0.152	−0.009	0.246	−0.051	0.079	0.165	0.025	−0.113
q29	0.072	0.266	0.023	0.173	0.170	0.123	−0.159	0.106	−0.013	0.218	**0.500**	0.164	−0.072
q30	*0.154*	*0.060*	*0.144*	*0.004*	*−0.072*	*0.291*	*−0.124*	*0.245*	*−0.056*	*0.231*	*0.074*	*0.370*	*0.378*
q31	**0.722**	0.058	0.000	−0.063	0.116	0.047	−0.006	0.069	0.121	0.060	0.099	0.013	−0.012
q32	0.227	0.130	−0.067	0.001	0.161	0.094	0.050	0.096	**0.683**	0.041	0.130	0.023	0.058
q33	0.220	0.005	0.097	−0.084	0.237	0.125	−0.025	0.087	0.079	**0.579**	0.250	0.251	0.042
q34	*0.255*	*0.144*	*0.294*	*−0.040*	*0.130*	*0.103*	*−0.069*	*0.057*	*0.185*	*0.196*	*0.368*	*0.023*	*0.134*
q35	0.171	0.022	0.227	−0.112	0.003	0.120	0.076	0.149	0.094	**0.620**	0.171	0.039	0.094
q36	0.119	0.009	−0.010	0.030	0.102	0.353	0.008	0.288	0.151	−0.067	0.017	0.151	**0.469**
q37	0.089	0.050	0.189	−0.146	0.133	0.276	−0.130	0.044	−0.105	−0.129	0.085	0.010	**0.482**
q38	−0.075	0.040	0.140	−0.189	**0.676**	0.059	−0.057	0.083	0.153	0.134	−0.016	0.040	0.183
q39	−0.025	0.105	**0.688**	−0.224	0.143	0.056	−0.066	0.111	0.127	0.063	0.001	0.071	0.166
q40	0.236	0.123	0.062	−0.020	**0.782**	0.018	−0.101	0.064	0.119	0.107	0.083	0.046	0.013
q41	0.025	0.242	**0.656**	0.006	0.113	0.006	−0.014	0.305	0.054	0.012	0.143	0.031	−0.010
q42	0.017	0.311	−0.036	−0.047	0.135	0.031	−0.031	0.232	0.111	**0.673**	−0.088	0.095	0.004
q43	0.216	0.038	−0.088	−0.353	0.008	0.092	−0.069	0.083	0.173	**0.451**	−0.120	0.085	0.150
q44	0.118	0.091	0.039	**−0.717**	0.006	0.101	−0.046	0.120	−0.013	0.137	0.116	0.019	0.071
q45	−0.015	0.064	0.033	−0.076	0.093	0.038	−0.066	0.076	0.194	0.165	0.025	0.071	**0.667**
q46	0.107	0.207	0.101	−0.295	0.109	0.036	−0.157	0.089	0.105	**0.496**	−0.163	0.121	0.165
q47	0.181	0.155	0.151	−0.136	0.169	0.015	−0.366	0.028	−0.010	0.068	0.040	0.014	**0.457**
q48	0.258	0.023	0.048	−0.298	0.177	0.122	0.051	0.009	0.214	0.253	0.029	**0.429**	0.017
q49	*0.173*	*0.140*	*−0.212*	*−0.216*	*0.305*	*0.210*	*0.208*	*0.073*	*0.398*	*0.063*	*0.169*	*0.296*	*0.117*
q50	*0.118*	*0.143*	*0.125*	*−0.394*	*0.016*	*0.008*	*−0.092*	*0.008*	*0.236*	*0.218*	*0.229*	*0.329*	*0.063*
q51	0.095	0.134	0.038	−0.021	0.282	0.075	0.190	0.137	0.276	0.019	**0.462**	0.106	0.383
q52	*0.093*	*0.159*	*0.140*	*−0.257*	*0.365*	*0.011*	*−0.030*	*0.019*	*−0.046*	*0.340*	*0.398*	*0.091*	*0.105*
q53	−0.008	0.129	0.117	**−0.615**	0.311	0.149	−0.069	0.093	−0.035	0.058	0.035	0.007	0.117
q54	0.057	**0.684**	0.207	−0.047	0.086	0.082	−0.028	0.185	−0.325	−0.034	−0.003	0.129	0.003

industry expertise is significantly, positively related to audit quality (Carcello et al., 1992) and client satisfaction (Behn et al., 1997); in fact, industry expertise was found to be one of the most important factors for audit quality (Carcello et al., 1992). Other prior research also found that understanding of client's system

was positively associated with perceived audit quality (Samelson et al., 2006). Audit team expertise was also identified by Sutton (1993) as an important factor for audit quality. The relationship between industry specialization and audit quality has been investigated with mixed results, and Watkins et al. (2004) provide a good review of these studies. Again, all of this prior work has focused on financial audit quality. We found one study with implications for IT audit related to *Business Process Knowledge*: Wright and Wright (2002) examined risk factors associated with ERP systems for IS assurance. Their results suggest that a focus on understanding business processes is critical to IT audit quality (for ERP systems).

4.2.4. Responsiveness

Responsiveness to client needs was identified as the fourth most parsimonious factor in our study (explained variance = .0394). The factor represents the audit team's responsiveness to client requests, working with the auditee organization, and completing the audit within management's timeframe. Prior research has found responsiveness to client's need to be one of the most important factors for both audit quality and client satisfaction (Carcello et al., 1992; Behn et al., 1997; Chen et al., 2001; Samelson et al., 2006). In addition, earlier research indicated that the "level of partner/manager attention given to the audit" was perceived to be the most important factor affecting audit quality by audit committee chairpersons (Schroeder et al., 1986). We did not find any studies focusing on IT audit that included the *Responsiveness* concept.

4.2.5. Fieldwork and audit procedures

The fifth most parsimonious factor found was *Fieldwork and Audit Procedures* (explained variance = .0332). This factor represents the audit team use of appropriate templates, forms, or other tools to conduct the audit and the proper documentation and sign-off procedures for each step in the audit. Again, prior research has shown that the conduct of fieldwork is positively associated with both audit quality (Carcello et al., 1992; Samelson et al., 2006) and with client satisfaction (Behn et al., 1997). In addition, O'Donnell et al. (2000a,b) found that the use of group decision making improved decision quality of the control assessment process.

4.2.6. Other factors

Beyond the five factors described above, there are eight additional factors identified by the analysis. We believe that these factors fall into three groups which are represented in prior literature. One group is a set of factors related the abilities of the auditor. Specifically, this group includes the factors *Auditor Experience* and *IT and Controls Knowledge*. These types of factors are well represented in the literature. For example, Behn et al. (1997) and Carcello et al. (1992) have examined factors related to industry experience, client experience and involvement. The second group of factors relate to the organization which is being audited. This group includes the factors *Business Scale*, *Auditability*, and *Business Environment*. We generally find the idea that factors related to the audited organization may impact the audit quality; however, we do not necessarily find this specific separation of factors identified within the existing literature. The third grouping of factors relate to the management of the specific audit. For example, the factors *Planning and Methodology*, *Resource Availability*, and *Auditee Relationship* are specific to the particular audit engagement and must be considered as part of IT audit quality.

4.2.7. Summary of factor analysis results

In general, the factors identified in our results are consistent with prior financial audit quality literature. However, some significant factors identified in prior research were not found in our analysis. By comparison with Carcello et al. (1992) we find two of their factors, industry experience and executive involvement, to be less pronounced. In both cases the items that represent these factors seem to load into areas where capability would be utilized. For example, we find industry experience items within the business process knowledge factor as well as the auditor experience factor. It appears that the general concept of industry knowledge is included in understanding how the processes may be unique and in comparing the specific systems and technologies with the industry norms. Additionally, the "Quality Control" factor found by Carcello et al. (1992) was not supported as a separate factor in our analysis; however, this may be seen as an aspect of our *Fieldwork* factor or *Planning and Methodology* factor.

Table 3B
IT audit quality factors: factors and item loadings. Numbers in parentheses for each factor are average variance explained and cumulative variance.

Factor 1: Independence (.1864, .1864)
Q4. The audit team maintains independence in appearance and in fact (0.726)
Q8. The audit team has strict quality control procedures (0.463)
Q10. A thorough study of internal controls is performed (0.418)
Q12. The audit team focuses on facts, does not act as an advocate for the auditee (0.435)
Q15. The audit team members conduct the audit field work in an appropriate manner (0.446)
Q22. The audit team members have high ethical standards (0.758)
Q31. Audit team members never engage in any actions that would compromise their independence (0.722)

Factor 2: Accounting knowledge and audit skills (.0749, .2613)
Q1. Audit team members are knowledgeable about accounting (0.751)
Q7. The audit team makes extensive use of statistical techniques in conducting the audit (0.497)
Q11. The audit team's understanding of the accounting system is adequate (0.628)
Q28. The majority of audit team personnel have passed the CPA exam (0.657)
Q54. The audit team members are competent in their knowledge/application of GAAP and GAAS (0.684)

Factor 3: Business process knowledge (.0423, .3036)
Q5. Audit team members are knowledgeable about unique business practices and processes in your industry (0.726)
Q39. Audit team members are knowledgeable about your unique business practices and processes (0.688)
Q41. The audit team has the necessary industry expertise to effectively audit your company (0.656)

Factor 4: Responsiveness (.0394, .3430)
Q27. The audit group effectively works in a team environment with the auditee organization (−0.587)
Q44. The audit team is responsive to the auditee's needs (−0.717)
Q53. The audit team is agreeable to completing the audit within management's timeframe (−0.615)

Factor 5: Fieldwork and audit procedures (.0332 , .3762)
Q38. The audit team utilizes common documentation templates and forms (0.676)
Q40. Audit team has strict sign off procedures for completed audit steps (0.782)

Factor 6: Business scale and audit scope (.0296, .4058)
Q19. Inclusion of geographically and culturally dispersed business units and processes in the audit (0.785)
Q20. Number of business units, processes, or systems involved in audit (0.764)

Factor 7: Auditability (.0277, .4335)
Q9. Auditee provides competent support to assist in data gathering (−0.686)
Q17. Well defined organizational standards and processes (of auditee) with adequate documentation (−0.456)

Factor 8: Auditor experience (with auditee) (.0259, .4593)
Q3. The audit team has an appropriate amount of prior experience in auditing your company (0.408)
Q14. Lead audit manager has worked in your industry for at least 2 years (0.754)
Q24. Lead audit personnel have been on your audit at least 2 years (0.763)

Factor 9: IT and controls knowledge (.0251, .4844)
Q6. The audit team provides valuable suggestions to management (0.404)
Q13. Audit team members are very knowledgeable about internal controls and business processes (0.457)
Q21. Audit team members are very knowledgeable about information security and data processing (0.723)
Q25. Audit team members are very knowledgeable about information technology and accounting systems (0.754)
Q32. The majority of audit team has passed the certified information systems auditor (CISA) exam (0.683)

Factor 10: Planning and methodology (.0243, .5088)
Q16. The audit is adequately planned (0.498)
Q33. The audit team utilizes a robust audit methodology to plan and manage the audit (0.579)
Q35. Risk-based audit approach is used to develop audit plan, and risk assessment model is understandable (0.620)
Q42. Audit manager is active in planning and conducting the audit (0.673)
Q43. Audit objectives, scope and plan are documented and agreed to by auditee and audit team (0.451)
Q46. Frequent communication between audit manager and management (0.496)

Factor 11: Resource availability (.0228, .5315)
Q23. Ability of audit team to gather independent data without reliance on auditee (0.611)
Q29. The audit team members maintained a skeptical attitude throughout the audit engagement (0.500)
Q51. Computer-assisted auditing tools (CATs, e.g. ACL) are used for testing and analysis (0.462)

(continued on next page)

Table 3B (*continued*)

Factor 12: Auditee relationship (.0210, .5525)
Q2. Auditee understands the audit process and purpose of the audit (0.469)
Q48. Audit team effectively utilizes issue and conflict resolution practices (0.429)
Factor 13: Business environment (.0200, .5725)
Q36. The use of outsourcing within the business processes or systems being audited (0.469)
Q37. The level of regulatory compliance required within the auditee's industry (0.482)
Q45. The level of automation within the organization, process or system being audited (0.667)
Q47. The existence of well defined audit trails within the auditee organization and systems being audited (0.457)

We also re-examine the initial model from Merhout and Havelka (2008) and find many of their general factors to be supported. Specifically, we find many factors that would be components of the general concepts that they refer to as Audit Team Factors, Audit Process and Methodology Factors, and Personnel Competency Factors. The one concept which is least represented is their factor focused on audit personnel social and interpersonal factors. It appears that most of these interpersonal considerations have been integrated into related factors in our analysis. For example, communication and relationship building skills would be traits that would be necessary to support client responsiveness and to perform the actual audit fieldwork activities such as interviews and data gathering.

4.3. Perceived importance of each factor on IT audit quality

In addition to performing the factor analysis to confirm the potential IT audit quality factors, we also evaluate the relative perceived impact of each factor on IT audit quality. We calculate a score for each factor based on the average of the raw scores for the items which load on each factor.[1] Table 4 presents the mean perceived importance for each of the 13 IT audit quality factors based on all respondents as well as ranked lists based on responses from each subgroup — financial auditors and IT auditors.

Overall, we conclude that all of these factors impact the quality of IT audits as each factor has an average score of over 3.0, the neutral point in our scale (1 = no impact, 5 = extremely impactful). Similar to the results of Table 1, we find *Planning and Methodology* and *Independence* as the most important factors for IT audit quality. We conclude that the integration and complexity of IT requires sound planning and a strong audit methodology to perform the tasks necessary for high quality IT audits. In addition, it would appear that auditor independence from the auditee is also a critical component for IT audits which is consistent to prior findings focused on financial audits. And since many IT audits are performed by internal auditors, independence, both in organizational structure *and* in actions, is critical.

In juxtaposition to those factors, *Accounting Knowledge and Audit Skills* was rated as one of the least important factors for IT audit quality, whereas it has generally been considered as one of the most important factors associated with financial audit quality. This result may be due to the integration of IT within business processes and the focus on more technical concepts such as security or system operations. Consistent with this assertion is the higher ratings of *Business Process Knowledge and Experience* and *IT and Controls Knowledge*.

The rankings by subgroups indicate that the perceived importance of each factor is generally similar. The largest exceptions based on rankings are *Business Process Knowledge and Experience*, *IT and Controls Knowledge*, and *Accounting Knowledge and Audit Skills*. Consistent with results from the individual item analysis, financial auditors rate the *Accounting Knowledge and Audit Skills* factor higher and IT auditors rate the *IT and Controls Knowledge* factor higher. Contrary to initial expectations, financial auditors rate the *Business Process Knowledge* higher than IT auditors. Our expectation is that IT auditors may have

[1] Factor scores generated by the factor analysis in Table 3A standardize each factor to a mean score of one; therefore, we use the average raw score related to each factor for this analysis.

Table 4
Overall perceived importance of IT audit factors on IT audit quality.

Factor (number)	Overall mean	Fin Rank	IT Rank
Planning and methodology (10)	4.121	2	1
Independence (1)	4.038	4	2
Business process knowledge and experience (3)	4.017	1	6
Auditability (7)	4.002	3	4
Auditee relationship (12)	3.972	6	3
Responsiveness (4)	3.893	5	7
Business environment (13)	3.694	8	8
Auditor experience with auditee (8)	3.681	7	9
IT and controls knowledge (9)	3.602	12	5
Field work and audit procedures (5)	3.457	11	10
Resource availability (11)	3.456	10	11
Accounting knowledge and audit skills (2)	3.267	9	13
Business scale and audit scope (6)	3.201	13	12

The Fin Rank and the IT Rank indicate the ranking of the specific attribute out of the 13 factors identified by the factor analysis. The ranking is based on the mean score of the factor within the subgroup (financial auditor or IT auditor) compared to all other factors within the same subgroup.

perceived business process knowledge as helpful in understanding the business activities associated with the IT system. Table 4 considers the general ratings of each factor and the rankings within each sub-group; however, the following section examines whether there are statistically different perspectives among the sub-groups.

4.4. Analysis of differences between groups

The factor analysis and the mean perceived factor importance results are based on a single pooled sample. However, there may be differences in perspectives within subgroups; therefore, Table 5 reports the results of tests for differences in factor scores between the IT and the financial respondents. We use the factor loadings generated by the factor analysis from the entire sample and create factor scores for each observation. We then separate the sample based on respondent type (IT or financial) and perform a test of difference between the factor scores.

The table indicates the difference in factor scores, the p-value related to a *t*-test between the factor scores for each group, and the group with the higher factor scores if there was a significant difference. We find that IT respondents rate the impact of *Auditor Experience with Auditee*, *IT and Controls Knowledge*,

Table 5
Evaluation of differences in factor scores between IT and financial respondents.

Factor (number)	Difference in factor scores	P-value for a *t*-test of difference	Higher impact: IT or financial
Independence (1)	.096	.347	No difference
Accounting knowledge and audit skills (2)	1.07	.001	Financial
Business process knowledge and experience(3)	.348	.001	Financial
Responsiveness (4)	.012	.906	No difference
Fieldwork and audit procedures (5)	.000	1.00	No difference
Business scale and audit scope (6)	.086	.399	No difference
Auditability (7)	.049	.632	No difference
Auditor experience with auditee (8)	.331	.001	IT
IT and controls knowledge (9)	1.033	.001	IT
Planning and methodology (10)	.172	.086	IT
Resource availability (11)	.014	.891	No difference
Auditee relationship (12)	.003	.977	No difference
Business environment (13)	.042	.681	No difference

and *Planning and Methodology* higher than the financial respondents. We interpret these results to suggest that IT audits place greater need on understanding the unique systems of the client as well as general IT knowledge to perform the audit. Additionally, as IT participants rank the importance of *Planning and Methodology* as higher than financial respondents, this may indicate the desire to define a specific scope of systems and business processes to ensure an audit that is consistent with the business expectations. By contrast, financial respondents rate *Accounting Knowledge and Audit Skills* and *Business Process Knowledge and Experience* factors as having greater impact on IT audit quality than IT participants. As audits become increasingly integrated between financial results and IT systems, these results suggest that each set of practitioners may need to be aware of the differing weights and perspectives on IT audit quality that exists.

5. Discussion

The importance of IT audit quality has increased with additional spending on IT and a variety of new legislation. The purpose of this study is to refine the factors related to IT audit quality and evaluate their relative importance. Our research supports 13 factors associated with IT audit quality, and *Independence* and *Business Process Knowledge* are among the highest rated factors for impact on IT audit quality and among the factors which explain the greatest variance in the factor analysis. We believe that the importance of independence may be crucial in IT audits as the integrated nature of IT within many aspects of the business may require greater reliance on internal IT and business personnel to assist with data collection and analysis. Similarly, the business process knowledge factor highlights the need for IT auditors to understand how IT is supporting the business and be able to isolate IT issues from the surrounding business process.

Based on the results of the factor analysis and the scores for these factors, we then compared the perspectives of respondents that have a financial orientation to those with an information technology orientation and found some significant and interesting differences. Based on our analysis, there were five factors that were rated differently by the financial respondents versus the IT respondents: Accounting Knowledge and Audit Skills, Business Process Knowledge and Experience, Auditor Experience with Auditee, IT and Controls Knowledge, and Planning and Methodology. The first two of these factors were rated significantly higher by the financial respondents and the last three significantly higher by the IT respondents.

First, Planning and Methodology was perceived to be the most important factor to IT audit quality overall and was rated most important by the IT respondents (and second most important to financial respondents) and yet there was a significant difference between the ratings (at a 0.10 p-value). The higher rating by the IT respondents may be explained by the lack of a standardized approach for IT audits when compared to financial audits. The method used and planning performed for a financial audit is well known and understood, still important, but more structured than the method and planning for IT audits. The variability in operating systems, networks, and applications used by organizations makes the method used and planning performed to audit the systems and processes based on these technologies less structured and therefore perceived to be even more important by IT auditors. Overall, as both the IT and financial respondents rated Planning and Methodology as being more important than the other factors to IT audit quality, its importance to achieve success should not be underestimated.

Second, Business Process Knowledge and Experience was rated as the third most important factor overall and most important by the financial respondents (and sixth by the IT respondents). The higher rating by the financial respondents may be explained by them having a greater appreciation for understanding the underlying business processes and the business goals and objectives associated with the processes versus the technology focus of the IT respondents. The financial respondents have training and expertise focused on identifying and analyzing risks and controls related to the "abstract" business processes regardless of the information systems and technology used to support them and thus a greater appreciation for understanding these. Based on these findings, it may be useful for organizations to ensure that the IT audit personnel understand the purpose and activities of the business processes being audited as well as the technical concerns.

Next, the IT respondents rated Auditor Experience with Auditee significantly more important for IT audit quality than the financial respondents. This finding may be explained similarly to the difference in Planning and Methodology above, i.e. due to the variation in platforms, networks, and application systems

it may be more important to the IT respondents to have had prior experience with an auditee. Certainly it makes sense that any prior experience with a specific auditee would make subsequent audits more productive (for both financial and IT audits) due to the knowledge gained about how the specific process or system operates. But as perceived by the IT respondents the time and effort expended in comprehending the IT infrastructure of a specific audit target may be considered to be more important to IT quality (than perceived by the financial respondents).

Lastly, with regard to differences between IT and financial respondents, let us consider Accounting Knowledge and Audit Skills and IT and Control Skills together. The financial respondents rated Accounting Knowledge and Audit Skills significantly higher than did the IT respondents and the IT respondents rated IT and Controls Skills significantly higher than the financial respondents. Occam's razor, or *lex parsimoniae*, would suggest the obvious explanation is that each group believes their area of expertise to be more important. More complex explanations are available, e.g. the IT respondents are not as focused on accounting issues and therefore do not value this as much as the financial respondents; but probably do not add more understanding than the parochial explanation.

To summarize the discussion related to differences between the financial and IT respondents, while there appear to be significant differences in the ratings of some of the factors overall both the IT respondents and the financial respondents rate Planning and Methodology as very important to IT audit quality. The differences in perspective may need to be addressed to avoid friction, disagreement, or conflict during the IT audit process with regard to allocation of resources or priority of tasks.

One final observation regarding our findings, the factor analysis also identified one factor, *Business Scale and Audit Scope*, where we find limited previous discussion within the literature. Prior literature refers to the potential impact of organizational size on audits; however, this construct considers the scale and variety of business activities rather than pure size. Of particular interest is the role of IT to support growth in business scale; therefore, as we continue to witness merger and acquisitions of businesses, we need to consider the potential impact on audit quality. We believe that the impact of the *Business Scale and Audit Scope* factor requires additional investigation and research.

5.1. Limitations

Several limitations of this study can be identified, primarily due to the nature of the investigation. A limitation may exist from the focus on IT audits where integration of the IT audit plan with the overall financial and operations audit plan may identify additional quality factors. We have attempted to mitigate this limitation through our comparison of the initial IT model with the financial audit model from prior research and the subsequent validation survey.

A second limitation of this study focuses on the survey respondents. Our response size meets the targets established by the literature for factor analysis; however, a larger sample may produce more robust estimates.

Additionally, our use of ISACA members to participate in the study may limit the ability to generalize the results of the study. ISACA members are assumed to be more educated about IT audits and may have a more common set of experiences and definition of IT audit quality. Other participants in the IT audit process may perceive quality from different dimensions and may add new factors for IT audit quality.

5.2. Implications for future research

This research has refined the specific factors which may affect IT audit quality. This is a critical step toward developing a testable model of IT audit quality. Therefore, one possibility for future research is to gather data on these factors for specific IT audits along with data on the overall quality of those audits. This data could be used to test the specific relationships between the individual constructs and IT audit quality.

There is also a possibility that some of the individual factors may impact each other and/or work synergistically together to affect IT audit process quality. For example, there may be an association between *Auditor Experience with Auditee* and *Auditee Relationship* that might meet the requirements of being a mediated relationship. Similarly, *Planning and Methodology* may be a moderator of other identified factors, such as *Fieldwork*. Beyond the concepts of mediation and moderation, research may also find that some

key factors are able to substitute for other factors. Additional research would be useful to explore these relationships.

One additional area for consideration is the *IT Knowledge* factor. This research considers overall IT knowledge as a general factor; however, there may be differences between security knowledge, network knowledge, application knowledge or understanding of various hardware and infrastructure platforms. We believe that these are specific representations of the *IT Knowledge* factor found within this study; however, there may be specific audit instances where certain domains of IT knowledge are more beneficial.

5.3. Implications for practitioners

Our results can be used by audit managers to identify risks and opportunities associated with the IT audit quality factors. Managers may wish to self-evaluate each factor to determine their ability to improve their IT audits. Managers may also use the results to prioritize opportunities for training and development on the differences in factors that are perceived as critical for audit success. The factors could also be used as part of a quality control program to conduct post-audit reviews and this could help determine where issues occurred or opportunities were missed for improving audit quality.

5.4. Conclusion

Many different categories and positions of auditors should benefit from this study. Although we focus our research on IT audits, we believe that, with increased integration of IT and financial audits, some of the factors we identify in our comprehensive model of audit quality should be important across many types of audits.

First, the identification of the factors that affect the quality of the IT audit process may give IT audit managers guidance in assessing the resources required for specific assurance engagements. Moreover, by identifying critical factors related to audit quality, it may be possible to better control and manage the audit process and thus improve the effectiveness and/or efficiency of the audit. Second, researchers may benefit from this work by utilizing a defined series of constructs within structural models to understand how each factor influences IT audit quality. There may be opportunities for some factors to mediate or moderate the influence of other factors on the overall level of IT audit quality.

Finally, the concepts identified may be used to quantify measurements of the level of quality of an IT audit. Considering the current global emphasis on controlling the information assets used for external financial reporting and compliance requirements, obtaining and using a set of critical factors for analyzing IT audit quality are valuable in communicating to stakeholders about the overall quality. We believe that the ability to identify the quality of an IT audit will be critical as technology evolutions, such as XBRL and cloud computing, and associated standards are introduced into the business environment.

Appendix A. IT audit quality attributes: Survey items and source

Instructions

This research is targeted at understanding the specific types of inputs and activities perceived to impact audit quality. Based on your prior experiences, please evaluate the *impact* of each item on IT audit quality. If any item is unclear or you feel you do not have enough expertise to evaluate the item, please leave that item blank.

Response format

Respondents were requested to evaluate the *impact* of each item on IT audit quality on a 1 (No Impact) to 5 (Extremely Impactful) scale.

	Attribute	Source[a]
1	Audit team members are knowledgeable about accounting	Carcello et al. (1992)
2	Auditee understands the audit process and purpose of the audit	M&H (2008)
3	The audit team has an appropriate amount of prior experience in auditing your company	Behn et al. (1997)
4	The audit team maintains independence in appearance and in fact	Samelson et al. (2006)
5	Audit team members are knowledgeable about unique business practices and processes in your industry	M&H (2008)
6	The audit team provides valuable suggestions to management	Lowensohn et al. (2007)
7	The audit team makes extensive use of statistical techniques in conducting the audit	Carcello et al. (1992)
8	The audit team has strict quality control procedures	Schroeder et al. (1986)
9	Auditee provides competent support to assist in data gathering	Lampe (1994)
10	A thorough study of internal controls is performed	Carcello et al. (1992)
11	The audit team's understanding of the accounting system is adequate	Samelson et al. (2006)
12	The audit team focuses on facts, does not act as an advocate for the auditee	Carcello et al. (1992)
13	Audit team members are very knowledgeable about internal controls and business processes	Carcello et al. (1992)
14	Lead audit manager has worked in your industry for at least 2 years	Carcello et al. (1992)
15	The audit team members conduct the audit field work in an appropriate manner	Behn et al. (1997)
16	The audit is adequately planned	Lowensohn et al. (2007)
17	Well defined organizational standards and processes (of auditee) with adequate documentation	M&H (2008)
18	Fieldwork is reviewed by a higher level audit team member	M&H (2008)
19	Inclusion of geographically and culturally dispersed business units and processes in the audit	M&H (2008)
20	Number of business units, processes, or systems involved in audit	M&H (2008)
21	Audit team members are very knowledgeable about information security and data processing	Carcello et al. (1992)
22	The audit team members have high ethical standards	Behn et al. (1997)
23	Ability of audit team to gather independent data without reliance on auditee	M&H (2008)

	Attribute	Source[b]
24	Lead audit personnel have been on your audit at least 2 years	Carcello et al. (1992)
25	Audit team members are very knowledgeable about information technology and accounting systems	Carcello et al. (1992)
26	Prior audit notes and results are available for review	M&H (2008)
27	The audit group effectively works in a team environment with the auditee organization	M&H (2008)
28	The majority of audit team personnel have passed the CPA exam	Carcello et al. (1992)
29	The audit team members maintained a skeptical attitude throughout the audit engagement	Behn et al. (1997)
30	The amount of organizational change occurring within the auditee's organization	M&H (2008)
31	Audit team members never engage in any actions that would compromise their independence	Behn et al. (1997)
32	The majority of audit team has passed the certified information systems auditor (CISA) exam	Carcello et al. (1992)
33	The audit team utilizes a robust audit methodology to plan and manage the audit	M&H (2008)
34	The audit team has access to unique resources (people, databases, tools) for specialized audit requirements	M&H (2008)
35	Risk-based audit approach is used to develop audit plan, and risk assessment model is understandable	M&H (2008)
36	The use of outsourcing within the business processes or systems being audited	M&H (2008)
37	The level of regulatory compliance required within the auditee's industry	M&H (2008)
38	The audit team utilizes common documentation templates and forms	M&H (2008)
39	Audit team members are knowledgeable about your unique business practices and processes	M&H (2008)
40	Audit team has strict sign off procedures for completed audit steps	Carcello et al. (1992)
41	The audit team has the necessary industry expertise to effectively audit your company	Behn et al. (1997)
42	Audit manager is active in planning and conducting the audit	Samelson et al. (2006)
43	Audit objectives, scope and plan are documented and agreed to by auditee and audit team	M&H (2008)
44	The audit team is responsive to the auditee's needs	Behn et al. (1997)
45	The level of automation within the organization, process or system being audited	M&H (2008)
46	Frequent communication between audit manager and management	Carcello et al. (1992)
47	The existence of well defined audit trails within the auditee organization and systems being audited	M&H (2008)
48	Audit team effectively utilizes issue and conflict resolution practices	M&H (2008)
49	The audit team is diverse (e.g., thoughts; ways of doing work; background; experiences)	M&H (2008)
50	Audit team has good communication skills (oral and written)	M&H (2008)
51	Computer-assisted auditing tools (CATs, e.g. ACL) are used for testing and analysis	M&H (2008)
52	Sufficient resources exist to meet audit scope and timeframe	M&H (2008)
53	The audit team is agreeable to completing the audit within management's timeframe	Carcello et al. (1992)
54	The audit team members are competent in their knowledge/application of GAAP and GAAS	Behn et al. (1997)

[a]Where possible items are used identically from the prior work, and where necessary they were modified to fit an IT audit context. Items from Merhout and Havelka (2008) and Havelka and Merhout (2009) are listed as M&H (2008) and were presented as given in that work and are based on a theory building approach. Lampe and Sutton (1994) is listed as Lampe (1994).

[b]Where possible items are used identically from the prior work, and where necessary they were modified to fit an IT audit context. Items from Merhout and Havelka (2008) and Havelka and Merhout (2009) are listed as M&H (2008) and were presented as given in that work and are based on a theory building approach.

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