Factors associated with IT audits by the internal audit function

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Abstract

Responses from a large sample of 1,029 chief audit executives (CAEs) from Australia, Canada, New Zealand, the U.K./Ireland, and the U.S. are used to estimate the proportion of time spent by internal audit functions (IAF) on information technology (IT) audits. The sample is also used to investigate explanatory and control variables that are associated with the extent of IT audits by IAFs. The results show that the proportion of IAF time spent on IT audits was only 7.97 percent in 2003, 10.61 percent in 2006, and was projected to be 13.40 percent in 2009, indicating an approximately one percent increase per year. Multivariate regression indicates that four variables; Certified Information System Auditor (CISA) certification, IAF age, training, and the number of organizational employees are significantly and positively associated with IT audits by IAFs. Other common certifications such as CIA, CPA, and CMA are not positively associated with the proportion of IT audits. Also, while CAE experience, education level, and the country of residence did not affect the results, an IS/CS (information system/computer science) was significant and positive in two of the four models tested. Implications for additional research and practice are discussed.

Key words: Internal auditing, chief audit executives, IT audits, professional certification.

Data Availability: The data base used in this study is the CBOK (2006) database from the Institute of Internal Auditors Research Foundation.
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Introduction

The first objective of this study is to estimate the proportion of time that Internal Audit Functions (IAFs) spend on information technology (IT) audits of their organizations. The Sarbanes-Oxley Act of 2002 (SOX 2002) has put an enormous strain on the resources of the internal audit function (IAF) within the organization (SmartPros, 2009). Prior to the SOX (2002) it was common for organizations to utilize their external audit firms to facilitate the design, implementation and audits of systems controls, including IT audits. However, SOX (2002) has changed this situation in two important ways: First, incumbent auditors are no longer allowed to provide certain services such as financial information systems design and implementation, or internal audit outsourcing services (SOX 2002, Section 201). Second, SOX (2002, Section 404) specifically places the burden of documenting and evaluating internal control systems on management who, in turn, have delegated much of the burden to the IAF at a significant cost. Thus the primary responsibility for SOX compliance has fallen to the IAF (Aguilar, 2006)

The substantial IAF cost also has become unavoidable in many organizations because IAFs have become increasingly important as an effective corporate governance mechanism. The SOX (2002) regulations and the requirement by important stock exchanges (e.g., the New York Stock Exchange) for the listed companies to have an IAF leave little room for companies to avoid IAF costs in the U.S., and laws in many other countries (e.g., Australia, the U.K.) encourage the existence of IAFs for all public companies. Our data indicate that while there is variation by country, overall 56.4 of respondents report that internal auditing was required by

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1 Krishnan et al. (2008) estimate the average cost to be approximately $2.2 million per company.
either some law or regulation in 2006, and it was anticipated that this would increase significantly by 2009 to 66.1 percent.

The significant IAF cost to organizations is related to the complexity of today’s information technology, where companies have increased their investments in IT at a significant rate over the past decade (Seddon et al, 1999, Petter et al., 2008). However, while we know that the IAF is involved in audits, particularly that there is increased activity in IT audits, we know very little about the extent of IAFs’ involvement with those IT audits. For example, we do not know the extent of IT audits by IAFs currently as compared with the past or the future. The current study provides estimates of the extent of IT audits by IAFs at the time of data collection (2006) as compared with three years earlier (2003) and the predication of three years later (2009).

The second, and perhaps more important objective of this paper is to investigate variables that are potentially associated with IT audits by IAFs. IT audits involve computer-based aspects of information systems, including but not limited to, the assessment of the proper implementation, operation, and control of computer resources (Hall and Singleton 2005). IT audits also involve evaluations of information systems by reviewing documents, interviewing personnel, and reviewing large data sets using computer programs (Hunton, et al. 2004). Audit standards (AICPA 2007, AU 319.30) require that an IT audit must be performed when:

- the client utilizes complex business systems and relies extensively on IT controls
- the client has replaced or made any significant changes to its IT systems
- the client extensively shares data between systems internal organizational systems
- the client is involved in electronic commerce
- the client uses emerging technology
significant amounts of required audit evidence is electronic.

The complex nature of IT audits suggests that IT auditors must possess specialized knowledge (Janvrin, et al., 2008, Merhout and Cothran, 2006). We therefore investigate a number of explanatory variables such as professional certification (CIA, CISA, CPA, CMA) and IT training as proxies for technical knowledge and use the age of the IAF as a proxy for organizational knowledge. We control for variables related to the Chief Audit Executive (CAE), such as years of experience, college degree (graduate vs. undergraduate), and academic major (information systems/computer science vs. other majors). We also include organization size (proxied by the natural logarithm of the number of full time equivalent employees of the whole organization), and a dummy variable for the difference between countries, where the U.S. as a non-commonwealth country is compared with other countries (Australia, Canada, New Zealand, and Ireland/U.K.) in the sample as members of the old commonwealth countries.  

The data used in the study is from the CBOK (2006) database that was developed by the IIA Research Foundation in 2006 with one of the authors being a member of the research team that developed the database. Since our research is concerned with the organizations’ IAF and IT auditing function, we limited our data to those of CAEs because they are arguably the most knowledgeable about various aspects of their IAF. CBOK contains data from approximately 100 countries with diverse cultures. Since culture has been found to affect professions in various countries (Hofstede 1983, Gray 1988, House et al. 2004), we focus our study on the Anglo-culture countries, where there is a long tradition of internal audit activity. This focus should mitigate the potential effects of culture on our results.

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2 This classification may not be entirely accurate because Ireland has never been a Commonwealth country. However, it has had significant influence from the UK. In addition, the CBOK (2006) data base provides only combined data for UK/Ireland. Another issue relates to Canada, where minority responses from provinces with strong French influence (e.g., Quebec) are included with in the sample along with the majority responses that
Next section provides a brief review of the literature leading to the study’s research questions. The study’s research method and results are presented in the following sections, and the final section presents a summary and the implications of this study.

**Background and Research Questions**

Section 404 of the US Sarbanes-Oxley Act of 2002 (SOX 2002) requires that management of public companies assess the effectiveness of their systems of internal controls over financial statement reporting. Section 404 also requires that external auditors attest to the effectiveness of the system of internal controls. Given the increasing use of complex information technology, such as enterprise resource management (ERM) systems by companies, the assessment of the effectiveness of internal controls requires increasing use of IT audit techniques. Gelinas et al. (2008, 152) assert that SOX (2002) “has increased the importance of AIS-related knowledge for auditors.” Similar legislation in other countries (e.g., Company acts in Australia and the UK) also has increased management and auditor responsibility with respect to the systems of internal controls.

While Gelinas et al. (2008) primarily refer to the importance of AIS-related knowledge for external auditors, a similar argument can be made for internal auditors, whose knowledge and expertise of systems can be brought to bear to help the management of their organization to comply with Section 404 of SOX (2002). However, to date, no research has investigated the extent of time that IAFs spend on IT audits. We present the following research question to investigate in the current study:

**RQ1:** What proportion of IAFs’ time is spent on IT audits?

were from English-speaking provinces.
We answer this question at three different points in time: three years before the conduct of CBOK (2006) survey, the year of survey (2006), and projections for three years later (2009). In addition to understanding the amount of time spent on IT audits, we also identify a number of explanatory and control variables to be regressed against the proportion of time spent on IT audits.

**Explanatory Variables**

The literature has identified an extensive list of knowledge and skills for IT auditors. For example, Merhout and Buchman (2007) analyzed the trade and academic literatures, online advertisements for IT audit jobs (e.g., monster.com), and interviews/discussions with professionals from firms that hire IT auditors to compile a set of technical skills (e.g., networking, systems knowledge) and organizational knowledge skills (e.g., work experience) for IT auditors. The resulting set of skills presented by Merhout and Buchman (2007) is quite extensive and although the authors present them as required for entry-level IT auditors, they nevertheless acknowledge that at least 95 percent of the advertised positions require some experience (Merhout and Buchman 2007, 471). This finding suggests that IT skills and knowledge identified by the authors may apply to IT auditors of varying professional rank and experience levels.

IT audit skills are extensive because IT auditors must be both auditors and IT professionals. The Information Systems Audit and Control Association (ISACA) requires five years of work experience in addition to a rigorous certification test to certify one as an information systems auditor (CISA). From an audit perspective, internal auditors who traditionally perform financial, operational, and compliance audits of their organizations, may

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3 The changes in the proportion of time spent on IT audits over the years 2003, 2006, and 2009 provides a
also need to be IT professionals who must be “skilled in the implementation, operation, and maintenance of IT systems in an organization” (Merhout and Buchman 2007, 470). If the IAF does possess these skills, then it is also likely to perform IT audits. If it does not then the IT audit may be performed by other departments (e.g., Management Information Systems), or may be co-sourced, or completely outsourced.

The discussion above suggests that specialized technical knowledge and skills are required to perform IT audits (cf., Tubbs, 1992, Janvrin, et al., 2008). One proxy for technical knowledge is professional certification such as a CISA, CIA, or CPA issued by professional or regulatory organizations (cf., Congemi 2000, Gallegos et al. 2004). For example, evidence in the literature suggests that individuals with either a CPA or CISA designation will gain IT auditors promotion over those without certification (Wier et al. 2000). Eighty-five percent of the posted jobs for IT auditors preferred or required professional certification, or they required actively working toward attaining certification (Merhout and Buchman, 2007). This evidence suggests that any relevant professional certification (e.g., CIA, CISA, CPA, or CMA) will be positively associated with IT audits.

However, as argued earlier, IT auditors additionally need IT-specific specialized knowledge above and beyond the skill set required for financial audits. The additional knowledge and skills are tested by the ISACA, which is responsible for the CISA certification. Consequently, we expect CISA certification to be positively and significantly associated with the proportion of time spent on IT audits by IAFs. However, since CIA, CMA and CPA are generic in nature (i.e., less IT-oriented than the specialized CISA), they may not systematically be a reasonable measure of the potential impact SOX (2002) on IT audits.
associated with IT audits. However, in the absence of strong theory, we present the following research questions:

RQ2a: Is a CISA certification positively and significantly related to IT audits by IAFs?
RQ2b: Is a CIA certification positively and significantly related to IT audits by IAFs?
RQ2c: Is a CPA certification positively and significantly related to IT audits by IAFs?
RQ2d: Is a CMA certification positively and significantly related to IT audits by IAFs?

A related issue to professional certification is continuing professional education (CPE) as an important factor for preparing IAFs for contemporary audits, such as IT audits. CPE is a requirement of many professional organizations (e.g., AICPA, the IIA) for retaining professional certification (e.g., CPA, CIA). For example, the IIA (2008) *Standards* require that CIAs must complete 80 hours of training every 24 months. However, only the portion of the CPE that is focused on IT is likely to be beneficial to prepare IAs for IT audits. CBOK (2006) has data on specialized IT training, where CAEs were asked to use a 1-5 Likert-type scale (never, as needed, less frequently than annually, annually, and more frequently than annually) to capture data regarding the training of the IAF professional staff on basic and/or advanced technology. We use these data as a proxy for the training of the IAF on IT-audit related issues and to test whether it has a positive relationship with the proportion of time spent on IT audits. Therefore:

RQ3: Is basic and/or advanced technology training positively related to IT audits by IAFs?

Finally, organizational knowledge can be drawn from IT auditors’ experience in the organization (Tubbs, 1992; Merhout and Buchman, 2007). We use the age of the IAF as a proxy for organizational experience attained by the IAF as a whole and expect IAF age to be positively related to IT audits, thus:
RQ4: Is the IAF age positively related to IT audits by IAF?

Control Variables

In addition to the explanatory variables specified above, we also investigate the effects of a number of control variables on the percentage of IAF time spent on IT audits. As directors of internal audits, CAEs are in influential positions to determine the proportion of time assigned to various types of audit, including the IT audit. More experienced CAEs may favor spending time on more traditional audits (with which they have familiarity and experience, and comfort level) than the IT audit. Thus, we use CAE experience as a control variable and expect a negative association with IT audits. Other CAE personal demographic variables, such as academic degree (graduate vs. undergraduate) and major (information systems or computer science vs. other majors) are also used as control variables. Merhout and Buchman’s (2007) data shows that 88 percent of jobs posted required IT audit candidates to hold a bachelor’s degree. In the current study, overall 62.9 percent of the CAEs held an undergraduate degree, and the remaining 37.1 percent held at least one graduate degree. We use a binary dummy variable for graduate/undergraduate degree to investigate the effect, if any, that CAE education level has on IT audits performed by IAFs.

The preponderance of IT audit job postings listed accounting, finance, information systems, computer science or other related degrees as requirements, although some recruiters indicated that they looked for any business degree with an aptitude for technology (Merhout and Buchman, 2007). Consequently, we classify IAs’ academic majors into a binary variable showing information systems/computer science vs. all other degrees (e.g., accounting, economics) and expect this control variable to have a positive effect on the IT audit.
The next control variable is a categorical variable called “Group” representing U.S. vs.
other countries in the sample (i.e., Australia, Canada, New Zealand, and UK/Ireland). The
literature suggests that Anglo-culture countries are generally under the same regulatory and legal
regimes, and thus are expected to have similar responses (c.f., Hofstede, 1983; House et al.,
2004). Similarly, IAs practicing in Anglo-culture countries that have strong regulatory
environments for systems of internal controls are expected to understand the pertinent
requirements and support their organizations to comply with the requirements, including the use
of IT audit techniques to assess the effectiveness of organizational information systems (Janvrin,
et al., 2008). Thus, group is used as a control variable comparing the non-Commonwealth
country of the U.S. with the other countries (Australia, Canada, New Zealand, as UK/Ireland) as
members of the old Commonwealth countries.

Finally, we use the natural logarithm of the full-time equivalent number of employees in
organizations that have IAFs as a proxy for organizational size. IAF size also could be used to
control for size. However, this number is used as a denominator to calculate the proportion of
various professional certifications in the organization, and as such, is significantly and
negatively correlated with the ratios of IAs with professional certification.\(^4\)

**Model Specification**

The explanatory and control variables identified above are codified into an Ordinary
Least Squares (OLS) regression model with the dependent variable being the proportion of IAF
time spent on IT audits and the independent variables as specified below:

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\text{ITAudit} = \alpha + \beta_1\text{CISA} + \beta_2\text{CIA} + \beta_3\text{CPA} + \beta_4\text{CMA} + \beta_5\text{Training} + \beta_6\text{IAFage} + \beta_7\text{CAExp} + \\
\beta_8\text{CAEDegree} + \beta_9\text{CAEMajor} + \beta_{10}\text{Group} + \beta_{11}\text{LnEmploy} + \epsilon
\]  

\(^4\) CBOK (2006) also provides data for sales and assets. However, these data are not reliable due to currency
translations. Also, assets and revenues may not be appropriate as proxies for size for not-for-profit and
governmental organizations.
Where:

- ITAudit = the proportion of IAF time spent on IT audits
- CISA = the proportion of IAF that is certified as CISA
- CIA = the proportion of IAF that is certified as CA
- CPA = the proportion of IAF that is certified as CPA
- CMA = the proportion of IAF that is certified as CMA
- Training = training of the IAF professional staff on basic/advanced technology. Likert scale: 1-5 (never, as needed, less frequently than annually, annually, and more frequently than annually)
- IAFage = Number of years that IAF has been in existence in the organization
- CAEexp = Years of experience as CAE
- CAEDegree = graduate degree = 1, undergraduate degree = 0
- CAEMajor = information systems or computer science = 1, 0 otherwise
- Group = 1 if Australia/Canada/New Zealand/UK&Ireland, 0 if US
- LnEmploy = natural logarithm of total number of employees (full-time equivalent)
- \( \varepsilon \) = Error term

The research method to estimate this model and results are presented in the next two sections.

**Research Method**

**The CBOK Database**

CBOK (2006) contains data on a long list of issues of concern to the practice of internal auditing (Abdolmohammadi, et al., 2006), and is the most comprehensive database on the current state of the internal auditing profession world-wide (Burnaby, et al., 2007). The database is populated with data collected electronically by the IIA from its chapters and affiliates worldwide. It has data on a variety of issues from internal auditors and their organizations’ characteristics to the type of skills needed for the practice of internal auditing. We use responses from CAEs that are needed for the purpose of the current study. The choice of CAEs was important to our study because they arguably have the knowledge and experience to judge certain questions, such as the proportion of IAF staff that is certified as CISA.

Overall, 1,029 observations were obtained on CAE respondents from Australia (n = 72), Canada (n = 116), New Zealand (n = 13), UK/Ireland (n = 68), and the U.S. (n = 760). The data
used from CBOK (2006) database were the percentage of time spent by the IAF on IT audits, the proportion of IAF staff that is certified as CISA, CIA, CPA, CMA, or others, the level of basic/advanced technology training of the IAF staff, the IAF age (as a proxy for knowledge base), and a number of control variables (e.g., CAE experience, graduate/undergraduate degree, major, country, and the number of employees as a proxy for organization size). Analysis of the data pertaining to the study’s research questions is presented in the next section.

Data Analysis

Descriptive Statistics and RQ₁

Table 1 presents descriptive statistics on the variables specified in Model (1). Depending on the variable, either the F-test of the means (i.e., ANOVA) or the $\chi^2$ test of observed vs. expected is performed to compare the responses by country, where significant statistical results are highlighted. The first variable in Table 1 presents the means and standard deviations of the proportion of IT audits performed in 2003 (i.e., three years before the 2006 survey), 2006 (the year of survey) and projected 2009 (three years after the year of survey). The F-statistic is not significant for any of these results, indicating no significant difference between the countries represented. An interesting observation from these data is that the proportion of time spent by IAFs on IT audits has increased from 2003 to 2006 and was expected to show increase from 2006 to 2009 for every country. For example, the Australian CAEs reported to have spent only 7.93 percent of their IAF time on IT audits in 2003. This number increased to 10.68 percent in 2006 and was expected to increase to 12.46 percent by 2009. This pattern is typical of other countries in Table 1 and provides data to answer RQ₁. It indicates that over a six year period from 2003-2009, the estimates of the proportion of time spent on IT audits has increased by approximately one percent per year.
For all countries the data shows that on average only 10.61 percent of the IAF time was spent on IT audits in 2006, and that from 2003 to 2009 this proportion increased by approximately one percent per year. These numbers seem to establish a benchmark for future comparison. A noteworthy observation is that given the prevalence of IT in contemporary organizations in the developed countries represented in this study one can conclude that there is a great opportunity for IAFs to more actively engage in IT audits so as to free their organizations from relying on other departments or for cosourcing/outsourcing of IT audits. The multivariate analysis in the next section addresses this question.

The next statistic in Table 1 is IAF size. The data indicates that on average IAFs have 12.33 members, with a large standard deviation of 36.40, thus a very high variation between companies (low mean years of 6.22 for Australia to high mean years of 16.99 for UK/Ireland), resulting in statistically not significant differences by country (F-stat = 0.79, p=0.53).

The next descriptive items in Table 1 provide the proportions of IAs that possess various professional certifications. To calculate these proportions, the number of IAs possessing these professional certifications was scaled by the total number of full-time equivalents of professionals in the IAF. The data shows that overall 26 percent of the IAs had CISA certification, with no significant difference between various countries. In contrast, other three certifications (CIA, CPA, CMA or equivalents) show significant differences by country. For example, on average 43 percent of the IAs possess the CIA certification, with Australia having the largest (69 percent) and New Zealand having the lowest proportion (31 percent) with the differences between countries being highly significant (F-stat = 6.40, p<0.01). The results for the
CPA and CMA are similar to the CIA, where on average 54 percent (23 percent) of IAs possess CPA or equivalent (CMA or equivalent) certification with high variation between the countries.

The data on training for basic and advanced technology is summarized next. These data were measured on a Likert-type scale of 1-5 (1=never, 3= less frequently than annually, 5=more frequently than annually). Table 1 shows that the overall mean for basic and/or advanced technology training is 3.07, indicating that training takes place “less frequently than annually.” With an average of 2.80, Canada had the lowest mean training, while the U.S. had the highest average training of 3.15. The country differences were statistically significant (F-stat = 4.25, p=0.02).

The final explanatory variable in Table 1 is the IAF age. This variable indicates high variation between countries, resulting in high standard deviations. Overall, the mean IAF age is 15.30 years, with a low of 12.88 for Australia and a high of 17.06 for Canada. However, due to the high variation, these averages are not statistically different.

Turning to control variables, Table 1 shows that the CAEs in the study had an average experience on the job of 6.87 years with little differences by country. However, analysis of the academic degrees indicates that overall 62.9 percent of the CAEs possess an undergraduate degree, while the remaining 37.1 percent have at least one graduate degree, but there is a significant difference by country ($\chi^2= 10.57, p = 0.03$), where the U.S. has the lowest percentage of undergraduates (60.7 percent), and New Zealand has the highest percentage of undergraduates (84.6 percent). The next variable, major, indicates that overall, only 6.9 percent of CAEs had a major in information systems or computer science, and there is no statistically significant difference by country ($\chi^2= 6.82, p = 0.15$). Finally, Table 1 shows no significant differences between the countries for the size of their organizations as measured by the natural logarithm of
the number of full time equivalent employees in the organization. Specifically, the LnEmployees was 7.47 with a standard deviation of 2.07 for all countries.

**Correlation Matrix**

Table 2 presents a correlation matrix between independent variables, where statistically significant double digit correlation coefficients of 0.30 or higher are highlighted. The results indicate that the proportions of professional certifications of various types (CISA, CIA, CPA, and CMA) to the IAF size are highly correlated with each other. Particularly noteworthy is the Pearson correlation coefficient of 0.66 between CISA and CIA that causes concern for the possibility of multicollinearity if the two measures are included in the same regression model. This high correlation indicates that many IAs possessing the CISA certification also have the CIA certification. Other inter-certification correlations are also quite high and statistically significant. For this reason, the regression model described earlier is tested multiple times, each including only one type of the professional certification.

[Insert Table 2 Here]

The next highly significant correlation is between the group variable and the CMA certification (Pearson = 0.45). This result indicates that the old-Commonwealth countries are associated with more IAs with the CMA certification than the U.S. Nevertheless, this correlation is below the critical level of 0.50 to cause concern for the possibility of multicollinearity, and thus it is included in all regression models. Finally, as expected, the correlations between the size of IAF (LnIAF) and professional certifications are negative and highly significant. This expected result indicates that, *ceteris paribus*, the larger the IAF size, the smaller the proportion of professional certification to the IAF size. Thus, these two variables are not independent of each other and therefore, IAF size is excluded from the following regression models.
Regression Analysis and RQ2-RQ4.

Table 3 presents the results of OLS regression analysis performed under four conditions (models 1-4). All models are statistically significant and the R-squares explain reasonable amounts of variation in the dependant variable. Model 1 provides evidence to answer RQ2a, RQ3 and RQ4, where CISA, training and IAF age are significant at conventional levels. Of the control variables, the IS/CS major and size (LnEmploy) are statistically associated with IT audits. However, the control variables of CAE experience, CAE degree and the country group are not statistically significant.

[Insert Table 3 Here]

Replacing CISA certification with CIA certification, Model 2 presents results that are consistent with Model 1 for training, IAF age and all control variables. Also, Model 2 shows that CIA certification is not significantly associated with IT audits (RQ2b). The results of Model 3, which tests RQ3c, RQ3 and RQ4 are also generally consistent with models 1&2, with two exceptions. The first is that the CPA certification is negatively and significantly associated with IT audits. This is an interesting finding as it indicates that the more CPAs an IAF has the less proportion of its time is spent on IT audits. This may not be completely unexpected because typically as professionals with experience in public accounting, CPAs may be primarily concerned with financial audits. The second exception is that in this model academic degree is statistically significant, indicating that CAEs with graduate degrees are significantly more associated with IT audits than those with only an undergraduate degree.

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5 IT audits in external auditing are typically performed by IT audit specialists.
Finally, in Model 4, the statistics in Table 3 address RQ_{2d}, indicating no effect on IT audits for the CMA certification. Other results are similar to those of models 1-3 with one exception. Training (RQ_{3}) which is significant in models 1-3 is not significant in Model 4.

**Summary and Implications**

This study used data from a large sample of 1,029 CAEs in Australia, Canada, New Zealand, UK/Ireland, and the U.S. to provide evidence on the proportion of IAF time spent on IT audits. The study also identified a number of variables that are significantly associated with the extent of IT audits within an organization. The results show that overall the proportion of IT audits performed in 2003 (i.e., three years before the 2006 survey) was 7.97 percent, and increased to 10.61 percent in 2006 (the year of survey) and was projected to increase further to 13.40 percent in 2009, a trend indicating an increase of approximately one percent per year regardless of country. While these numbers appear to be low, they nevertheless establish a benchmark for future comparison. Increases in IT audits by IAFs should decrease the dependence of organizations on their MIS departments or cosourcing/outsourcing of the IT audit function to consultants. However, the results of the study imply that significant increase in IT audits requires investment in recruiting, training, and CISA certification of new recruits because these variables are positively and significantly associated with IT audits. The study also shows that the current IAF size is on average 12.33 professionals, with no significant difference between countries. To engage in more IT audits, either the IAF’s size must increase, or the IT audits may have to be traded with other types of IAF activities such as operational audits. The exact nature of these changes requires further research.

The findings of the study also show that while only 26 percent of IAF professionals have CISA certification, 43 percent possess CIA, 54 percent possess CPA, and 23 percent possess
CMA certifications. Since the study finds the CISA certification to be positively and significantly associated with IT audits, it would be reasonable to conclude that an increase in the number of professionals with CISA certification within IAFs would also result in a corresponding increase in IT audits. The CIA and CMA certifications are not significantly associated with IT audits, and unexpectedly, the CPA certification is negatively associated with IT audits. This latter result may indicate that as experienced financial auditors, CPAs may not have IT audit knowledge to perform IT audits because usually this audit is delegated to IT audit specialists. However, we are not certain as to the exact reason for this finding and thus, propose future research to ascertain its implications. Since many organizations hire their IAF professionals from a pool of candidates with CPA and other certifications, does the negative association of CPA and IT audits suggest that less CPAs should be hired in favor of more CISA and other certifications? Further research is needed to answer this question.

A related issue is that for the current IAs, the study implies a need for more IT training. Specifically, basic/advanced training in technology is found to be significantly and positively associated with the extent of IT audits in three of the four models tested. The results also indicate that additional investigation is needed to identify the most effective training material to adequately prepare technology-oriented IAs to become more familiar with technology and comfortable with IT audits. For example, CIAs, CPAs and CMAs can be trained to participate in IT audits giving them the necessary skills and knowledge to prepare for the CISA exam. Related to this point is that models 1 and 2 show significant positive effects on IT audits for CAEs who majored in either information systems (IS) or computer science (CS). This result suggests that IS/CS training may be useful for CAEs that did not major in IS/CS, a point awaiting further investigation.
All four regression models indicated significance for the positive effects of the IAF age on IT audits. The older the IAF the higher the proportion of the time spent on IT audits. This finding makes sense in that practice of various types of internal auditing, and thus older IAFs have had more chances of developing IA practice, including IT audits. A related finding is that the size of the organization (proxied by the natural logarithm of full-time equivalent employees) is positively associated with IT audits. This finding suggests that while bigger companies may have the incremental resources for IT audits smaller companies may lack these resources. However, the results of the study do not indicate significance for CAE experience, which averaged 6.87 years. Additionally, the results did not show any significant difference between countries in this sample. These results suggest a need for investigation of the variables that are associated with the “optimal” size of the IAF for various companies and/or industries.

Overall, this study suggests that the current involvement of an IAF in IT audits is modest, but increasing at an average rate of approximately one percent per year. If it is important that IAFs provide more value added services to their organizations, IAFs should plan to increase the proportion of IT audits, and facilitate these plans by both hiring more technology-savvy professionals (such as CISAs) and providing them with continuing professional education related to IT audits.

As discussed earlier, the CAEs studied in the current study represent IAFs that are located in Anglo-culture countries. The control variable used to test differences by group membership (the U.S. vs. old-Commonwealth countries of Australia, Canada, New Zealand, and UK/Ireland), was not found to be statistically significant. This evidence provides comfort with respect to the lack of effects of culture on the results for the countries studied. However, caution should be exercised in generalizing these results to other countries that belong to other cultural
classifications. Hofstede (1983) and House et al. (2004) provide classifications of various countries into cultural clusters that should be used in future research to extend the results of the current study.

A similar issue for future study might be the investigation of differences in IT audits by industry. For example, one could expect that IT audits may be more extensive by IAFs in technology companies than by government entities. While industry may have an effect on the extent of IT audits by IAFs, further research is required to confirm this expectation and also investigate if the variables associated with IT audits are also different by industry.

Limitations of the CBOK database resulted in using a number of simple proxies for some of our variables. For example, we use IAF age as a proxy for organizational knowledge. Organizational knowledge can be affected by turnover as well as other variables. This limitation of our study signals a potential for future studies in which more direct measures of organizational knowledge can be identified and used in the study.

Finally, the current study’s focus was on CAE responses because CAEs have the knowledge to respond to questions such as the number of internal auditors in IAF who have professional certifications. Future studies may benefit from extending the study to other influential respondents such as audit managers. This investigation may be insightful because as in-charge auditors, internal audit managers may be more trained in technical matters than CAEs whose focus may be more of an overall management of the IAF than managing the audit.
References


CBOK, Common body of knowledge in internal auditing data base (Altamonte Springs, FL: The Institute of Internal Auditors Research Foundation), 2006.


<table>
<thead>
<tr>
<th>Variable</th>
<th>Australia</th>
<th>Canada</th>
<th>New Zealand</th>
<th>UK/Ireland</th>
<th>USA</th>
<th>Total</th>
<th>F-stat.(Sig.)</th>
<th>Or** for χ² (Sig.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proportion of IT Audits in:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2003 (3 years ago)</td>
<td>7.93(8.51)</td>
<td>9.76(7.81)</td>
<td>8.00(10.06)</td>
<td>9.76(7.81)</td>
<td>7.50(9.03)</td>
<td>7.97(9.26)</td>
<td>1.65 (0.16)</td>
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<tr>
<td>2006 (year of data)</td>
<td>10.68(8.75)</td>
<td>11.26(10.21)</td>
<td>9.00(8.54)</td>
<td>11.97(8.25)</td>
<td>10.42(9.26)</td>
<td>10.61(9.26)</td>
<td>0.60(0.67)</td>
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</tr>
<tr>
<td>2009 (in 3 years)</td>
<td>12.46(8.53)</td>
<td>13.96(9.54)</td>
<td>11.82(9.82)</td>
<td>13.76(9.04)</td>
<td>13.40(9.48)</td>
<td>13.40(9.38)</td>
<td>0.33(0.86)</td>
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</tr>
<tr>
<td>IAF size</td>
<td>6.22(8.72)</td>
<td>12.09(32.10)</td>
<td>9.62(14.16)</td>
<td>16.99(42.07)</td>
<td>12.56(38.24)</td>
<td>12.33(36.40)</td>
<td>0.79(0.53)</td>
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</tr>
<tr>
<td>Proportion of IAF having certifications:</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>CISA or equivalent</td>
<td>0.34(0.42)</td>
<td>0.29(0.21)</td>
<td>0.17(0.18)</td>
<td>0.21(0.18)</td>
<td>0.25(0.26)</td>
<td>0.26(0.26)</td>
<td>1.29 (0.27)</td>
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<tr>
<td>CIA or equivalent</td>
<td>0.69(0.55)</td>
<td>0.41(0.30)</td>
<td>0.31(0.38)</td>
<td>0.41(0.28)</td>
<td>0.41(0.41)</td>
<td>0.43(0.41)</td>
<td>6.40 (&lt;0.01)</td>
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<tr>
<td>CPA or equivalent</td>
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<td>0.55(0.54)</td>
<td>0.80(1.10)</td>
<td>0.42(0.28)</td>
<td>0.53(0.54)</td>
<td>0.54(0.54)</td>
<td>3.02(0.02)</td>
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</tr>
<tr>
<td>CMA or equivalent</td>
<td>0.30(0.33)</td>
<td>0.45(0.37)</td>
<td>0.41(0.43)</td>
<td>0.20(0.17)</td>
<td>0.10(0.21)</td>
<td>0.23(0.31)</td>
<td>17.01(&lt;0.01)</td>
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</tr>
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<td>Training*</td>
<td>2.82(1.10)</td>
<td>2.80(1.11)</td>
<td>3.08(1.19)</td>
<td>2.80(1.17)</td>
<td>3.15(1.18)</td>
<td>3.07(1.17)</td>
<td>4.25(0.02)</td>
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</tr>
<tr>
<td>IAF age in years</td>
<td>12.88(9.31)</td>
<td>17.06(13.56)</td>
<td>15.09(13.84)</td>
<td>14.74(12.90)</td>
<td>15.32(14.89)</td>
<td>15.30(14.28)</td>
<td>0.93(0.45)</td>
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</tr>
<tr>
<td>CAE experience</td>
<td>7.75(5.95)</td>
<td>6.31(6.10)</td>
<td>6.62(6.60)</td>
<td>7.10(5.70)</td>
<td>6.86(6.57)</td>
<td>6.87(6.42)</td>
<td>0.57(0.68)</td>
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<tr>
<td>CAE degree: (% undergraduate)</td>
<td>63.9%</td>
<td>74.1%</td>
<td>84.6%</td>
<td>63.2%</td>
<td>60.7%</td>
<td>62.9%</td>
<td>10.57(0.03)**</td>
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</tr>
<tr>
<td>Major: (% IS/CS)</td>
<td>13.9%</td>
<td>5.2%</td>
<td>7.7%</td>
<td>8.8%</td>
<td>6.3%</td>
<td>6.9%</td>
<td>6.82(0.15)**</td>
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</tr>
<tr>
<td>LnEmployees</td>
<td>7.20(1.64)</td>
<td>7.69(1.94)</td>
<td>7.67(1.45)</td>
<td>7.91(2.07)</td>
<td>7.43(2.12)</td>
<td>7.47(2.07)</td>
<td>1.48(0.21)</td>
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</tr>
</tbody>
</table>

*Scale is 1-5 (never to more frequently than annually)
### Table 2
Correlation Matrix
Between Independent variables

<table>
<thead>
<tr>
<th></th>
<th>CISA</th>
<th>CIA</th>
<th>CPA</th>
<th>CMA</th>
<th>CPE</th>
<th>IAFage</th>
<th>CAEage</th>
<th>Degree</th>
<th>Major</th>
<th>Group</th>
<th>LnIAF</th>
<th>LnEmp</th>
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<tbody>
<tr>
<td>CISA</td>
<td>1.00</td>
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<td></td>
</tr>
<tr>
<td>CIA</td>
<td>0.66**</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>CPA</td>
<td>0.36**</td>
<td>0.47**</td>
<td>1.00</td>
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<tr>
<td>CMA</td>
<td>0.35**</td>
<td>0.32**</td>
<td>0.07</td>
<td>1.00</td>
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<td>CPE</td>
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<td>-0.02</td>
<td>-0.06</td>
<td>-0.07</td>
<td>1.00</td>
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<td>IAFage</td>
<td>-0.09</td>
<td>-0.07</td>
<td>-0.18**</td>
<td>-0.08</td>
<td>0.04</td>
<td>1.00</td>
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<td>CAEexp</td>
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<td>-0.07*</td>
<td>0.08</td>
<td>0.06</td>
<td>0.22**</td>
<td>1.00</td>
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<td>CAEDegree</td>
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<td>0.00</td>
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<td>-0.04</td>
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<td>0.02</td>
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<tr>
<td>CAEMajor</td>
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<td>-0.02</td>
<td>0.04</td>
<td>0.03</td>
<td>0.02</td>
<td>-0.01</td>
<td>0.08**</td>
<td>1.00</td>
<td></td>
<td></td>
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<td>Group</td>
<td>0.03</td>
<td>0.09</td>
<td>0.05</td>
<td>0.45**</td>
<td>-0.13**</td>
<td>0.00</td>
<td>0.00</td>
<td>-0.08*</td>
<td>0.04</td>
<td>1.00</td>
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<tr>
<td>LnIAF</td>
<td>-0.45**</td>
<td>-0.52**</td>
<td>-0.45**</td>
<td>-0.39**</td>
<td>0.09**</td>
<td>0.37**</td>
<td>0.08**</td>
<td>0.07*</td>
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<td>LnEmp</td>
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<td>-0.19**</td>
<td>-0.19**</td>
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<td>0.00</td>
<td>0.23**</td>
<td>0.02</td>
<td>0.13**</td>
<td>-0.02</td>
<td>0.04</td>
<td>0.49**</td>
<td>1.00</td>
</tr>
</tbody>
</table>

* Correlation is significant at the 0.05 level (2-tailed)
** Correlation is significant at the 0.01 level (2-tailed).
Table 3
OLS Regression for IT Audits by Internal Auditors
Proportion of time spent on IT audits as dependent variable
*Current year (2006)*

\[
\text{ITAudit} = \alpha + \beta_1 \text{CISA} + \beta_2 \text{CIA} + \beta_3 \text{CPA} + \beta_4 \text{CMA} + \beta_5 \text{Training} + \beta_6 \text{IAFage} + \beta_7 \text{CAEexp} + \beta_8 \text{Degree} + \beta_9 \text{Major} + \beta_{10} \text{Group} + \beta_{11} \text{LnEmploy} + \epsilon
\]

<table>
<thead>
<tr>
<th>Variable</th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
<th>Model 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>1.67*</td>
<td>2.11**</td>
<td>2.20**</td>
<td>0.45</td>
</tr>
<tr>
<td>1 RQ2a CISA</td>
<td>+0.11</td>
<td>1.99**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 RQ2b CIA</td>
<td>-0.04</td>
<td>-0.98</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 RQ2c CPA</td>
<td>-0.09</td>
<td>-2.10**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 RQ2d CMA</td>
<td></td>
<td></td>
<td>-0.06</td>
<td>-0.73</td>
</tr>
<tr>
<td>5 RQ3 Training</td>
<td>+0.09</td>
<td>1.73*</td>
<td>+0.09</td>
<td>2.00**</td>
</tr>
<tr>
<td>6 RQ4 IAFage</td>
<td>+0.11</td>
<td>2.14**</td>
<td>+0.10</td>
<td>2.24**</td>
</tr>
<tr>
<td>7 CAEexp</td>
<td>-0.02</td>
<td>-0.41</td>
<td>-0.05</td>
<td>-1.16</td>
</tr>
<tr>
<td>8 CAEDegree</td>
<td>-0.05</td>
<td>-0.85</td>
<td>-0.01</td>
<td>-0.32</td>
</tr>
<tr>
<td>9 CAEMajor (IS/CS)</td>
<td>0.13</td>
<td>2.53***</td>
<td>+0.08</td>
<td>1.76*</td>
</tr>
<tr>
<td>10 Group</td>
<td>+0.05</td>
<td>0.97</td>
<td>+0.02</td>
<td>0.38</td>
</tr>
<tr>
<td>11 LnEmploy</td>
<td>+0.10</td>
<td>1.92*</td>
<td>+0.11</td>
<td>2.57***</td>
</tr>
</tbody>
</table>

F-stat | 3.099 | 3.255 | 4.929 | 2.069 |
\(\text{(Sig.)}\) | (0.002) | (<0.001) | (<0.001) | (0.042) |
\(R^2\) | 6.3% | 4.6% | 6.6% | 9.8% |
\(\text{Adj. } R^2\) | 4.3% | 3.2% | 5.2% | 5.1% |

* significant at the 0.10
** significant at the 0.05
*** significant at the 0.01

Where:
ITAudit = the proportion of IAF time spent on IT audits
CISA = the proportion of IAF that is certified as CISA
CIA = the proportion of IAF that is certified as CA
CPA = the proportion of IAF that is certified as CPA
CMA = the proportion of IAF that is certified as CMA
Training = training of the IAF professional staff on basic/advanced technology. It uses a 1-5 Likert scale (never, as needed, less frequently than annually, annually, and more frequently than annually)
IAFage = Number of years that IAF has been in existence in the organization
CAEexp = Years of experience as CAE
CAEDegree = graduate degree =1, undergraduate degree = 0
CAEMajor = major: information systems or computer science= 1, 0 otherwise
Group = 1 if Australia/Canada/New Zealand/UK&Ireland, 0 if US
LnEmploy = natural logarithm of total number of employees (full-time equivalent)
\(\epsilon\) = Error term