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ABSTRACT

Information systems auditing is a growing profession. In order for information technology educators to help keep up with the demand for information systems audit professionals, more understanding is needed about the knowledge, skills and abilities required for entry-level IT auditors. In our ongoing research, we have analyzed several sources to identify such skills. In the process we noted that there are gaps between what academics, practitioners, and professional associations see as the key skills required for success in this lucrative profession. We suggest reasons for such gaps and discuss potential future research opportunities.

Keywords

Knowledge, skills and abilities (KSAs), IS auditors, Model Curriculum, ISACA, COBIT, CISA.

INTRODUCTION

Information systems (IS) auditing is a profession in high-demand (Merhout & Buchman, 2007; Hoffman, 2004). This condition is due to a number of factors, but primarily because of extensive compliance requirements for organizations, such as the Sarbanes-Oxley Act (SOX) in the United States. In order for information technology (IT) educators to help keep up with this demand, more understanding is needed about the knowledge, skills and abilities (KSAs) required for entry-level IT auditors. In our ongoing research, we have analyzed several sources to identify such KSAs, and in the process noted that there are gaps between what academics, practitioners, and professional associations see as the key skills required for success in this lucrative profession. New compliance standards, technologies and an ever changing business environment have only widened these expectation gaps for entry-level IS auditors, and it appears these gaps are rooted in the misalignment of focus among academia, professional organizations and future employers. Our study utilizes extensive research from several sources to highlight and assess these inconsistencies. These sources include an IS Audit Model Curriculum, a popular professional certification examination taken by many IT auditors early on in their careers, a commonly adopted IT governance and controls framework, online job advertisements, and focus group research with the IT audit department of a large financial services company.

Questions addressed in this research-in-progress paper include:
- What knowledge, skills, and abilities are suggested by academic-oriented resources, e.g., ISACA's Model Curriculum?
- What are common KSAs required by employer job postings on Monster.com?
- What KSAs have IT audit practitioners identified as critical and how do they relate to the Monster research?
- What have Big Four Accounting Firms (e.g., KPMG, Deloitte) outlined as essential skills for IT auditors?
- How are identified KSAs from different sources similar? Dissimilar?
- What are the causes of these expectation gaps?

The remainder of this paper will proceed as follows: professional associations concerned with IT governance, IS auditing and internal audit (this is the function where most corporate IT auditors practice their profession) will be discussed. Thereafter, we review data from online job advertisements and from our focus group research. We follow with a review of what two of the Big Four accounting firms expect from early-career IT audit professionals, and then do a comparison across these various

sources of relevant KSAs. Finally we discuss some of the key observations we make from this comparison, conjecture about the source of the expectations gaps, and discuss possible future research.

PROFESSIONAL ASSOCIATIONS CONCERNED WITH IT GOVERNANCE

Publications by the Information Systems Audit and Control Association (ISACA), The Institute of Internal Auditors (IIA), and The Information Technology Governance Institute (ITGI) have been examined for our research. ISACA is the top IT governance, assurance, security and control organization. Representing individuals worldwide, it hopes to synchronize IT control practice standards across the globe. In order to facilitate this harmonization, ISACA developed a Model Curriculum (ISACA, 2004). The Model Curriculum was created as an educational resource for academics, assurance, and control practitioners. Its intention is to focus on formal education by identifying essential course concepts for IS audit and control to provide graduates with the necessary KSAs to better meet the needs of the profession. The Model Curriculum offers a framework in developing and revitalizing courses in universities as well as professional organizations and is an effort to keep academia up to date as the IS audit profession continually evolves by aligning course components with the needs and expectations of practitioners.

ISACA's Model Curriculum categorizes KSAs as either technical or general. The framework suggests that a total of 244 hours of study be spent on knowledge of technical topics. Identified *technical* topics include: IS audit function; fundamental auditing concepts, standards and guidelines for IS auditing; internal control concepts; audit planning, management, evidence, and reporting process; IS/IT management and strategic planning and management issues; support tools; frameworks (e.g., *Control Objectives for Information and related Technology* (COBIT®)) and techniques; technical infrastructure; service center management; information assets security management; logical and applied IT security; physical and environmental security; disaster recovery planning; insurance; IS planning; information management and usage; development, acquisition and maintenance of IS; IT related to business processes and solutions; and software development application controls. Note that many of these technical topics are part of the foundation of most MIS curriculums, making MIS majors an excellent candidate for IT auditing careers.

The Model Curriculum also suggests some general or "soft" skills necessary for IS audit professionals. Those *general* skills are: managerial communications and/or public speaking; interviewing skills; negotiation skills and/or personal selling; business writing; industrial psychology and/or behavioral science; project management/time budgeting; team building; and team leading.

ISACA also offers certifications to help practitioners identify competent personnel and assists entry-level professionals in differentiating themselves from their competition. One certification is Certified Information System Auditor (CISA) (ISACA, 2006). The program was developed as a testing instrument in assessing IS auditor competency and as a tool to encourage professionals to remain competent and practice continued learning. ISACA hopes this CISA certification will help management build a sound IS audit function. The exam covers content areas identified as fundamental in the IS audit function. Content areas and their related coverage percentage include:
- The IS Audit Process (10%);
- IT Governance (15%);
- Systems and Infrastructure Life Cycle Management (16%);
- IT Service Delivery and Support (14%);
- Protection of Information Assets (31%); and
- Business Continuity and Disaster Recovery (14%).

The CISA certification is a functional tool for both employers and graduates. It can facilitate bridging the knowledge gap between expectations upon graduation and within the first couple of years of employment.

The Institute of Internal Auditors (IIA) is a professional association recognized as the profession's authority, educator, and leader. The IIA has identified essential IT knowledge considerations for three categories of internal auditors (IIA, 2005). The first category encompasses all auditors, regardless of level of experience. The focus of this category applicable to our research is knowledge of basic IT. Fundamental IT topics include an understanding of basic IT concepts, such as networks; IT security and control components, such as authentication; and business control and assurance operations and their vulnerability in business operations and related support systems.

IIA's second category focuses on Audit Supervisors. Additional knowledge for this group includes a comprehensive understanding of IT issues and elements related to planning, testing, analyzing, reporting, following up, and assigning tasks on audit engagements. More specifically, included are: knowledge of threats and vulnerabilities related to automated business

processes; business controls and risk mitigation in IT; the effectiveness of IT in providing controls for business applications and environment; audit team competence; IT tools to be used in audit assessment and testing; as well as IT vulnerabilities and control weaknesses and the source of these risks. The third category addresses Technical IT Audit Specialists. The IIA suggests this group should additionally have knowledge of underlying technologies supporting business components and related threats and vulnerabilities of these technologies.

It is evident that the IIA is on a quest to help corporate internal auditors (of which IS auditors can be a subset) keep up with the changing IT environment and new compliance requirements. To facilitate this changing environment, the IIA offers specialized training and targeted resources related to information technology management, control and security.

The ITGI is an international professional association whose aim is to direct and control information technology governance in enterprises. The organization hopes to advance international discussions and standardization in this area, and COBIT® was developed (ITGI, 2007a) in order to assist enterprises in this advancement. COBIT is a comprehensive framework for IT controls. Its purpose is to help enterprises achieve effective IT governance. Although this is a useful resource for enterprises and academia in teaching the criticality of IT controls, it fails to identify many skill requirements needed by users for management control or assurance services, perhaps because its focus is on IT professionals (such as database administrators) and IT management rather than on IT auditors.

ONLINE JOB ADVERTISEMENTS

A compilation of job skills collected from the well known Monster.com career database was examined to discern KSAs desired by employers when they seek new IT audit professionals (Merhout and Buchman, 2007). Data were collected on several hundred jobs listings for IS Auditors in the United States between October 18, 2005 and April 12, 2006. Required skills listed for the keyword "Information Systems Auditor" were captured, categorized and analyzed. While close to 95% of job postings collected required experience, it seems reasonable that IS auditors at any level, including entry, possess these key skills (Merhout and Buchman, 2007). Data collected from Monster.com suggest there are four main categories of required KSAs that are vital for any level of IS auditor: technical skills; organizational skills/business knowledge; audit and technical skills; and certification. KSAs and skill subsets were broken down from these four categories.

Suggested knowledge competencies for category 1 (technical skills) are hardware/ telecommunications and software. Within hardware/telecommunications, the suggested KSAs (that appeared in multiple advertisements) include networking, Internet and security. Within the software subset, the required skills desired are operating systems, databases, CAATs (computer assisted audit tools)/ACL (audit control language), SQL (standard query language), Windows/Office applications, programming, and ERP (Enterprise Risk Planning).

The second category from this study is *organizational skills/business knowledge*. Skills and knowledge recommended in this category are work experience, general management (e.g., leadership, project management), communications, problem solving, and social skills. Within the social skills subset, specific KSAs include general social skills (e.g., ability to carry on an appropriate conversation with personnel at all levels), willingness to travel and work long hours, and foreign language skills.

The third category focuses on technical skills related to audit. Audit knowledge expertise and systems knowledge are recommended in this group. Audit knowledge expertise requires KSAs related to control frameworks (e.g., COBIT, COSO), audit processes, and general audit knowledge. SOX, risk, and Big Four experience is also suggested under audit knowledge expertise. Recommended KSAs within systems knowledge include development methodologies, computer operations, and IT controls experience.

Lastly, the fourth category is simply certification. Certifications, including certified public accountant (CPA), CISA, and certified internal auditor (CIA) are advantageous to securing a job and often help employers differentiate among candidates. Certifications are also an indicator of specific skills and competencies as suggested by the specific title of the certification.

It is notable that this list is quite comprehensive. Employers expect entry level and experienced candidates to have considerable technical skills, well-rounded personal skills, general business knowledge, systems and audit specific knowledge and expertise, as well as certifications. However, the question that continues to drive our ongoing research follows from such expectations: is it reasonable to assume recent graduates possess a majority of the skills included on this extensive list, especially since IT auditors come from a variety of academic backgrounds?

FOCUS GROUP RESEARCH

In a related stream of research, focus groups were used to generate data, some of which is applicable to the current study. Specifically, a nominal group technique was used at a large mid-western financial services company to identify critical success factors related to the IS audit function. Current IT audit practitioners, ranging from staff to management, were asked to generate factors based on the following question: What factors do you believe influence the efficiency, effectiveness, and quality of the IT audit process? The group discussed these factors and a comprehensive list was compiled. Lastly, participants were asked to individually select and rank factors they identified as critical. These data were further compiled and categorized and then compared to the Monster.com research for this current study. Common KSAs were broken down into two groups. Group one is technical competency, which was broken down into auditors' understanding and judgment of risk and business processes; experience; controls identification; ability to identify control weaknesses; project management; and knowledge and ability to use audit tools. Group two is social and interpersonal skills, which was broken down into communication skills; willingness/ability to change; and motivation/enthusiasm.

BIG FOUR ACCOUNTING FIRMS

Lastly, analyses of the Big Four Accounting firms' expectations are relevant because a majority of IT audit professionals will begin their careers with one of these major firms. KPMG, Ernst and Young, Deloitte, and PricewaterhouseCoopers have the dominant international market share in all types of audits (IT, internal control, financial statement, internal, etc.). Accordingly, publicly accessible publications from KPMG and Deloitte were used to identify skill requirements for auditors.

KPMG identifies fundamental KSAs for the internal auditor in its publication "The Evolving Role of the Internal Auditor" (KPMG, 2007). This additional skill set has been developed because the internal audit function has shifted from being a training program for future executives to a value creation function. New skills that should help internal auditors facilitate this shift of focus include: industry knowledge and functional expertise; cross-culture training for global internal audit functions; improved interpersonal skills to allow for effective communication with all levels of auditee personnel; risk management and evaluation under the paradigm of enterprise risk management (ERM); continuous auditing capabilities; fraud detection skills; and specific certifications (Six Sigma, CIA, certified fraud examiner (CFE), etc.) that represent KSA competencies.

Deloitte's Enterprise Risk Services practice area describes courses outlined in its specialist audit and risk management "Aid to Industry" training division's publications (Deloitte, 2007) that enhance personal and professional development. The firm urges internal audit employees of all levels to be proficient in the skill sets taught in these courses (usually covering 1-2 days of class time). Table 1 below (adapted from Deloitte, 2007) outlines the various courses aims and target audiences.

Deloitte Aid to Industry Job Skill Recommendations (adapted)											
	Course Title				**Course Aim**				**Target Audience**		
					Technical Skills	Personal ("soft") Skills	Other		Audit Managers	General Managers	IT Auditors
Core Internal Audit Skills											
	Getting started on internal auditing				X					X	X
	Introduction to IT audit				X					X	X
Internal Audit - Moving Beyond the Basics											

	Internal audit and risk management			X			X	X	
	Corporate governance audit				X		X	X	
	Auditing outsourced arrangements			X			X	X	
	Program and project assurance			X			X	X	
	IT audit and IS security (auditing SAP)			X			X	X	X
	Auditing Oracle			X			X	X	X
	Auditing projects and project risk			X			X	X	X
	Business continuity management			X			X	X	X
	Auditing data protection			X			X	X	X
	Delivering security change			X			X		X
	Scoping and managing IT vulnerability assessments and attacks & penetration testing				X		X	X	X
Other									
	Effective reporting				X		X	X	X
	Presenting yourself effectively				X		X	X	X
	Facilitation skills				X		X		
	Interview techniques				X		X	X	X
	Managing audit projects			X			X	X	X
	Fraud awareness			X		X	X	X	X
	Influencing and negotiation skills			X		X	X	X	X
	Handling difficult situations and people				X		X	X	X

Table 1: Adapted from *Training and Support for Audit, Risk Management, and Information Security Specialists*, Deloitte and Touche

COMPARISONS ACROSS VARIOUS SOURCES OF RELEVANT KSAS

Now that key KSAs from academia, professional associations, and practitioners have been identified, it may be enlightening to analyze similarities and differences across sources. The following table should facilitate this analysis. KSAs mentioned throughout the various discussions from above have been grouped into four categories: technical, audit, general and other. Duplicate skills have been eliminated.

IS Auditor Job Skills Comparison		
	BOLD = Skills identified by 4 sources ITALICS = Skills identified by 3 sources	X = academic; O = practitioner

Skills Category	Skill	ISACA Model Curriculum	CISA Exam	Institute of Internal Auditors	Monster.com	Focus Group (Fifth Third Bank)	KPMG (Evolving Internal Auditor)	Deloitte (Aid to Industry)
Technical Skills								
	Support Tools Knowledge and Use (ACL, CAATs)	X		X	O	O		
	Technical Infrastructure	X						
	IT Security and Control Components	X		X	O			O
	IS Planning	X						
	Information Management and Usage	X						
	Development Acquisition and Maintenance of IS	X						
	IT Related to Business Process and Solutions	X				O		
	Software Development Application Controls	X						
	IT Service Delivery and Support		X					
	Fundamental IT Concepts		X	X				
	Networks			X	O			
	Automated Business Process/Control Vulnerabilities			X		O		
	Business Controls and IT Risk Mitigation							
	IT Control Identification/Effectiveness			X		O		
	Internet				O			
	Computer Applications (Windows/Office)				O			
	Programming (SQL)				O			O
	Development Methodology				O			
	IT Controls Experience				O			
Audit Skills								
	IS Audit Function/Process	*X*	*X*		*O*			
	Fundamental auditing concepts	X						

	Standards and Guidelines for IS Auditing	X					
	Audit Planning, Management, Evidence, Reporting	X					O
	Audit Team Competence			X			
	General Audit Knowledge				O		
	SOX Experience				O		
	Big 4 Experience				O		
	Auditing Outsourced Arrangements						O
	Auditing Projects and Project Risk						O
	Auditing Oracle						O
	Scoping and Managing IT Vulnerability						O
General "Soft" Skills							
	Communication (written and oral)	**X**			**O**	**O**	**O**	
	Public Speaking	X					
	Interviewing Skills	X					O
	Negotiation Skills	X					O
	Personal Selling Skills	X					
	Business Writing	X					
	Industrial Psychology/Behavioral Science	X					
	Project Management	X				O	
	Time Budgeting	X					
	Team Building	X					
	Team Leading	X					
	Work Experience				O		
	General Management Knowledge				O		O
	Problem Solving				O		
	General Social Skills				O	O	
	Willingness to Travel				O		
	Willingness to Work Long Hours				O		
	Foreign Language				O		
	Willingness/Ability to Change					O	
	Motivation/Enthusiasm					O	
	Presenting Yourself Effectively						O
	Facilitation Skills						O
	Ability to Handle Difficult Situations						O
Other							

	Internal Control Concepts	X						
	IT Governance (IS/IT Management, Strategic Planning and Management Issues)	X	X					O
	Framework (COBIT, COSO) and Techniques	X		O				
	Service Center Management	X						
	Information Assets Security Management	X	X					O
	Physical and Environmental Security	X						
	Disaster Recovery/Business Continuity Plan	X	X					O
	Insurance	X						
	Systems and Infrastructure Life Cycle Management		X					
	Business Component Technologies			X				
	ERP			O				
	Risk Experience/Understanding (ERM)			**O**	**O**	**O**	**O**	
	Competency (Certification (CPA, CISA, CFA etc.))			O		O		
	Industry Knowledge and Functional Experience					O		
	Cross-Culture Training for Global IA Functions					O		
	Fraud Skills					O	O	

Table 2: Comparison of Various Sources of Relevant KSAs

DISCUSSION

A comparison of compiled skills shows there are a limited number of skills identified by three and four sources. Also observed is that there are a number of skills identified by practitioners that were not identified by academia. Even more intriguing is the abundant amount of skills identified by academia and not practitioners. This poses a very important question: Do practitioners have false expectations or is academia focusing on too many and the wrong topics? (Based on our experiences, we tend to believe the real answer is more of the latter rather than the former.)

Summary points from this analysis include:
- KSAs identified by four of any source (academia or practitioner) include: support tools knowledge; IT security and control components; communication; and risk experience/understanding (ERM).
- KSAs identified by three of any source (academia or practitioner) include: IS audit function/process; IT governance (IS/IT management, strategic planning, and management issues); information assets security management; and disaster recovery/business continuity plan.
- KSAs identified by two or more practitioner sources, but zero academia sources include: programming (SQL); general management knowledge; general social skills; competency (certification); and fraud skills.
- KSAs identified by at least one academia source, but zero practitioner sources: technical infrastructure; IS planning; information management and usage; development acquisition and maintenance of IS; software development application controls; IT service delivery and support; fundamental IT concepts; fundamental auditing concepts; standards and guidelines for IS auditing; audit team competence; public speaking; personal selling; business writing; industrial psychology/behavioral science; time management; team building; team leading; internal control concepts; service center management; physical and environmental security; insurance; systems/infrastructure life cycle management; and business component technologies.

The apparent disconnect between the various stakeholders analyzed in this paper that lead to these gaps is most likely centered on a lack of awareness and communications. These groups all have a stake in developing the KSAs of future IT

audit professionals, but they do not always share the same goals and objectives. Practitioners, such as those represented by the Monster.com research and the Big Four firms, want bright minds that they can mold to meet the requirements of their respective organizations. Professional associations may earnestly attempt to represent a various group of stakeholders (as exemplified by the diverse group of contributors to the ISACA Model Curriculum, such as universities, governmental agencies and large commercial firms); however, their efforts apparently do not always trickle down to educators and practitioners. This is a shame because professional associations tend to be less biased and focus on what is best for as many of the stakeholder groups as possible. Ironically, academics (specifically at the individual university level) probably have the least voice in this discussion, which is where this paper and conference presentation will hopefully make a contribution.

FUTURE RESEARCH AND CONCLUSION

In the future we would like to identify additional credible sources of key KSAs for entry-level IT auditors to continue to develop our comparison model. We also plan to do a comparison to IT/IS Model Curricula (e.g., from AIS) to determine if, as we suggest, a compliant general MIS curriculum at a university would also develop the key skills necessary for success as an IT audit professional. Similarly, it might be interesting to see if these Model Curricula would develop IT graduates with the KSAs necessary to provide controls over key IT processes (within the IT function) as suggested by COBIT for its high level objective entitled "ME 2 - Monitor and Evaluate Internal [IT] Control." In the Maturity Model for this objective, ITGI argues that an organization where "[s]killed IT staff members are routinely participating in internal control assessments" (ITGI, 2007b, p. 84) is a key component of a well-managed IT internal controls process. This suggests that (non-audit) IT personnel need to have knowledge of risks and controls, something that all university curricula may not necessarily provide.

One other area perhaps worthy of further investigation includes more research on the gaps of KSAs identified by academics, but not by practitioners. Are the practitioners just ignoring them because they assume these skills are present, given the expectations of what a university education provides? In such cases, there may not be a gap after all.

We call on other IT educators and researchers to address the skills expectation gaps we identify in this paper in creative ways to ensure that we are providing full support for IT/IS students' IT audit career opportunities.

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