Remote Audit: A Review of Audit-Enhancing Information and Communication Technology Literature

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Abstract:

As internal audit management seeks to control costs, improve quality, and take full advantage of emerging business technology within their organization' the remote audit becomes increasingly sensible. The integrated audit of the future, with real-time evidence feeds and both remote and in loco components, will be very different from the current internal audit work and will eventually be also embraced by external auditors. During a remote audit, internal auditors would interact with different departments and functions of the firm and third parties over long distances using remote communication technology, such as web conferencing and remote access to information system clouds. This paper is designed to 1) synthesize information and literature found in areas from distance learning to operations management, and 2) present a framework for applying this technology to the remote audit. The literature includes items from remote audit, continuous audit, virtual organization theory, distance technology, and value proposition. Our focus is primarily on the technology that enables audit teams to work effectively and efficiently from a remote location.

I. Introduction

The use of technology to enable remote communication and execution of business processes is not new. Since the beginning of networked computing, researchers have identified characteristics of virtual organizations, observed the use of web conferencing and other information and communication technologies (ICT), and sought to understand better how organizations can reap the benefits of streamlined remote monitoring and control systems. With respect to the financial audit, researchers and companies have developed advanced analytics and computer assisted auditing techniques (CAATs). These techniques enable auditors to evaluate data found within complex information systems and provide assurance that the numbers these systems produce are an accurate reflection of the business. In this paper, we discuss some of the remote technology and auditing techniques that exist and apply them to an enhanced, remote-enabled internal audit.

We define *remote auditing as the process by which auditors couple information and communication technology with data analytics to assess the accuracy of financial data and internal controls, gather electronic evidence, and interact with clients, all without the need to be physically present*. The remote audit can be utilized to aid a traditional periodic audit, and many of these components can be executed independently of one another. We envision the future of internal audit as a continuous process owned by management and implemented with three components: traditional, on-demand remote, and agent-based continuous.

While ICT can certainly enhance the traditional in loco audit, the remote audit has the advantage of assessing risk and reliability on a real-time or on-demand basis. One key benefit is the change in attention span of the auditee. With a traditional audit, business processes experience an intense audit ramp-up where documentation and evidence are hastily compiled and systems “cleaned” immediately before the audit begins. Once the auditor

leaves, the systems, processes, and deterrence atrophy until the next scheduled audit. With a remote-enabled audit, the auditor becomes a perpetual proctor, monitoring to ensure that systems and procedures are in good condition and maintained. This was one of the primary goals of the continuous process auditing system developed at AT&T Bell Labs in the late 1980s (Vasarhelyi & Halper, 1991; Jans, 2010)

The nature of audit evidence is changing as well. In the real-time economy, auditors are made aware of smooth operation, data problems, unusual events, changes in risk profile, or controls breakdown through a series of computer-based mechanisms. In a continuously audited system, individual transactions that fail a set of statistical tests send alerts to the auditors for immediate follow-up (audit by exception, Vasarhelyi & Halper, 1991). Changes in documentation pass through a workflow in an electronic document management system. Internal controls settings in enterprise resource planning systems are set a baseline and monitored for deviation via continuous controls monitoring (Teeter & Brennan, 2010). The level of risk for different business processes is dynamically adjusted, based on algorithms inside a continuous risk measurement assessment. These systems can be designed to sift through vast amounts of data and automatically extract relevant information. Trained auditors then verify this information alongside their own manual extractions, copies of documentation, and interview notes. Audit support systems develop forensic models of detected anomaly patterns (fraud and error). These filters are installed at the entry of processes to detect potential anomalies and for auditors / system managers to act on them.

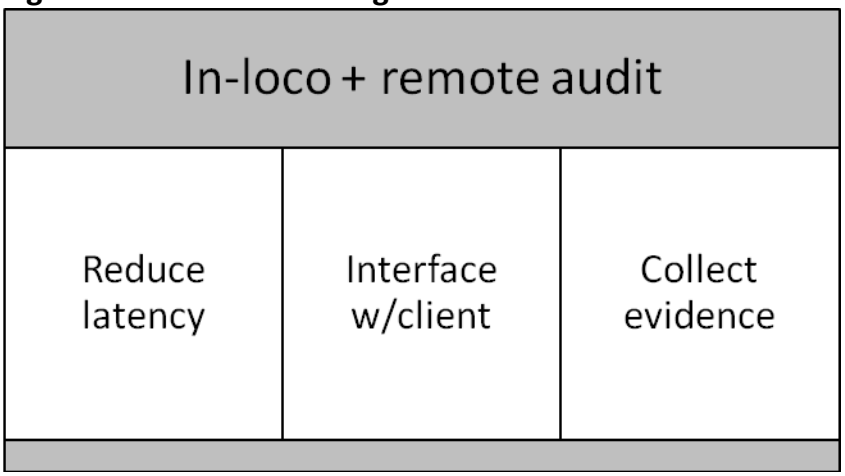
For the purposes of this paper, we limit our scope to the internal audit, which provides "a systematic, disciplined approach to evaluate and improve the effectiveness of risk management, control, and governance processes." (IIA, 2010). This includes the monitoring of internal controls and the audit of IT systems.

After a brief discussion of our vision of the future integrated remote audit in the next section, our review of the literature follows this order: section III discusses virtual organization theory, section IV evaluates current distance technology, section V describes analytics and continuous evidence, section VI presents a framework for a remote audit, section VII identifies impacts of the remote audit, and section VIII presents our concluding observations and suggestions for extensions of this work.

II. The Integrated Audit

The role of internal audit has changed in the past decade. Aside from heightened expectations from management to provide assurance on internal controls and help the firm run more efficiently, internal auditors are increasingly being called upon to foot the evidence for the external audit, due in part to Auditing Standard 5 (PCAOB, 2005; Protiviti, 2008). At the same time, internal audit organizations are pressured to downsize operations and trim expenses, requiring greater efficiency on their part. There is a great need for a truly integrated audit.

Figure 1: Goals of the Integrated Audit



The integrated audit meets the needs of management and external auditors while reducing latency, balancing in loco and remote communication, and utilizing tools appropriate for collecting physical and electronic audit evidence, as shown in Figure 1. We discuss these three attributes in this section.

In loco and remote audit

The traditional audit is at odds with the real time economy's dynamic of change. While much of current business work is now team based and remote, much of the current auditor interface is in loco (local) and face-to-face. Cost, method, and culture is pressing to change by creating an audit that uses both physical and virtual presence in the performance of assurance activities. We describe in Table 1 a set of activities and their potential method of execution divided into in loco and remote audit. However, there are many forms of virtual presence facilitated by technology that are further discussed later in this paper.

Table 1: In loco vs. Remote Audit Activities

Activity	In loco	Remote audit	Observations
Client interface			
Initial kick-off meeting	Experienced auditors meet with process managers	Meeting via video conferencing	Experienced auditors meet with process managers to get "feeling" and understanding of audit in person
Interviews	Auditor meets with specific parties in person	Meeting conducted by phone, or video conferencing	Lack of visual communication removes bias, non-verbal feedback
Process mapping	Auditor reviews documentation, tours facility	Auditor evaluates flowcharts, verifies data flow in ERP system	Depending on application, both are essential
Knowledge engineering	Offline documentation reviewed and updated	Online documentation reviewed and updated	Offline documentation would be digitized and kept in an EDMS
Evidence collection			
Dashboard	n/a	Auditor alerted via web interface or e-mail when	Audits can be performed around exceptions

		analytics find a positive match	
Audit management	Audit manager assesses risk based on interaction with processes managers, preliminary analysis	Continuous risk monitoring provides automatic risk profiles for specific areas	Automatic assessment aids audit planning
Work papers	Evidence gathered/stored offline	Evidence gathered from/stored in online systems	Online systems are centralized and accessible by any member of the team
Latency Reduction			
Continuous monitoring	n/a	ERP systems run through analytical tests	Auditors are alerted when controls failure occurs
Continuous data assurance	n/a	Databases are checked for validity consistency	Auditors are alerted when consistency checks fail
Document versioning	Paper documents are updated and old versions removed based on retention policy	Digital documents are updated and purged in online systems based on retention policy	

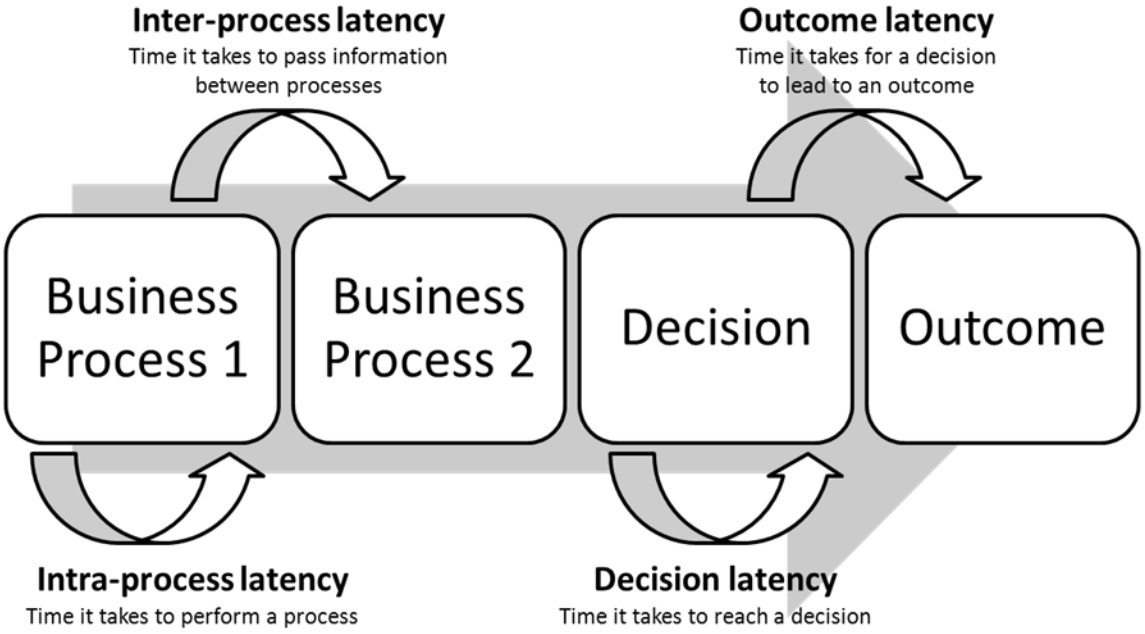
The remote audit relies on a combination of the elements discussed up to this point. While it may appear trivial to combine ICT tools with a traditional internal audit engagement, our vision of a true remote audit is that of an on-demand audit or audit by exception (Vasarhelyi & Halper, 1991). The on-demand audit is triggered by output from continuous risk monitoring and assessment (CRMA), a system which evaluates changes in a business' risk environment and directs auditors to areas of increased risk.

The remote audit is built on a three-function Monitor-Evidence-Interface approach. Beginning with analytics, a continuous monitoring platform routinely passes transactional data through a series of rule-based tests and statistical models and alerts the auditor when an abnormal event, high-risk transaction, or control failure occurs. Once an alert is made, the auditor begins the evidence collection process, extracting data from the ERP system and gathering additional evidence into an electronic working papers system based on an EDMS. This system is ideally located in a private cloud so that other members of the audit team can access and contribute results from their coordinated audit. For better understanding of the alert, the auditor then uses web conferencing (with archiving capability) to interface with the process owner and other audit team members to determine the cause and scope of the issue.

III. Latency Reduction

The real time economy (Economist, 2002; Vasarhelyi and Alles, 2008) has substantially changed the nature of business processes. Its main purpose is the reduction of latency (Srivatava et al. 2006), which occupies labor and capital. The reduction of latencies (Vasarhelyi, Alles and Williams, 2010) described in Figure 2 applies to all business processes. Clearly, automation can reduce latency. While human processes are measured in minutes and hours, automated processes are measured in thousandths of seconds.

Figure 2: Business Process Latencies[1]



The audit / assurance process implies in all these experiences each of these four latency types of latency under different circumstances to varying degrees. It may be desirable to break the assurance process into sub-processes. We consider the following seven audit / assurance sub-processes: 1) engagement procurement, 2) audit planning, 3) internal control evaluation, 4) internal control compliance, 5) substantive testing, 6) audit decisions, and 7) audit reporting. The first five sub-processes experience significant intra- and inter-process latencies. The last two face decision and outcome latency. In Table 2, we identify specific process electronization, which may be used to reduce latency throughout the audit process (Vasarhelyi & Greenstein, 2003). We complement this electronization with examples of ICTs, where appropriate.

Table 2: Audit processes, latency and electronization

STEP / PROCESS LATENCY	**Intra-process latency**	**Inter-process latency**	**Decision latency**	**Outcome latency**
Engagement procurement	• Engagement procurement analytics & investigations *(e.g. Ratio and financial statement analysis, Firms hire private investigators to observe CEOs)*Remote audit	• Electronic communication *(e.g. preliminary e-mail notification, phone/web interviews)*	• Contingent on external factors such as client investigation and client decision plans	• Contingent on contractual preparation and in some cases regulatory/ legal review
Audit planning	• Remote audit	• Automated		

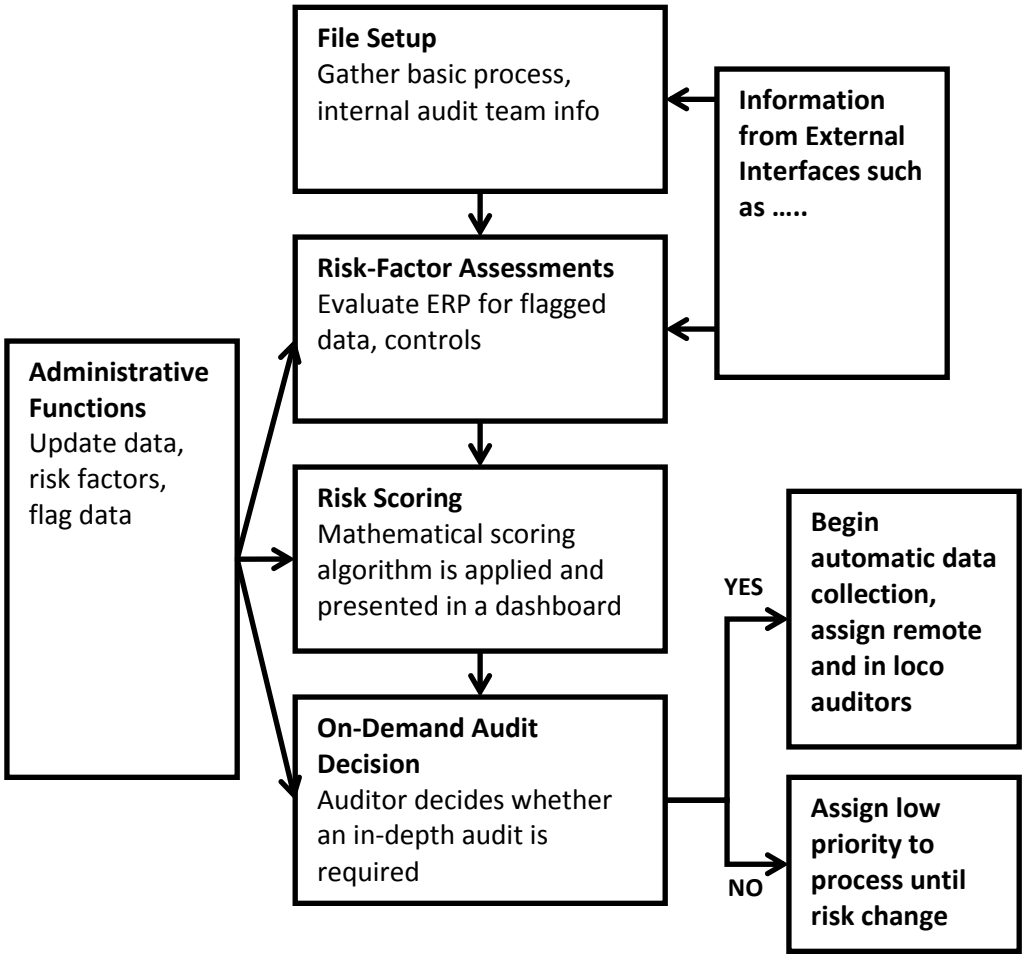
[1] From Vasarhelyi, Alles and Williams (2010b)

	• Risk analysis *(e.g. CRMA, ratios)*	working papers • Adoption of XML technology to fully interlink processes		
Internal control evaluation	• Remote audit • Real time feeds of evidence *(e.g. dashboard monitoring, baseline comparison)*		• Partial decision automation is possible	NA
Control compliance testing	• Remote audit • Continuos control monitoring (Alles et al, 2006, Teeter & Brennan, 2010) • Real time feeds of evidence • Automation of audit steps • Generation of alarms (alerts)			
Substantive testing	• Automatic confirmations	• Automated working papers • Adoption of XML technology to fully interlink processes		
Evidence evaluation / decision making	• Remote audit		• Automation of certain decision models • Decision support system • Judgment support algorithms	
Reporting				• Automated reporting through a mutating "seal" • Automatic information on details • Feedback mechanisms

Continuous risk monitoring assessment

Audit plans, whether periodic or on-demand, are built around risk, risk of operations, risk of the environment, or the risk that the auditor will find controls failure or material errors. The foundation of the on-demand remote audit is a continuous risk monitoring assessment (CRMA), which provides a more focused outline of risk based on an automatic scoring of individual business processes and transactions. This continuously updated risk profile is used to determine functions with high control and audit risk. The internal auditors would use this profile to develop and update an audit plan. Processes whose risk profile changes suddenly would trigger automatic evidence collection and the formation of an on-demand audit, shown in Figure 3.

Figure 3: Risk Monitoring Workflow[2]



External auditors have employed decision aids to determine client risk. Bell et al (2002) present a formalized procedure for evaluating potential clients and seeing whether they are low-risk or high-risk based on a number of factors, including firm information, independence issues, due diligence, financial information, qualitative observation, the entity's operations, and financial results. Through their decision aid, auditors can choose to accept or reject potential clients.

Internal auditors would narrow the scope to determine risk factors for specific business processes, regions, or functions. These factors would include process information, transaction information, tagged data, qualitative observation, the function's operations, and an analysis of micro-level financial data. Most of this data can be pulled directly from the ERP systems and supplemented with periodic manual updates (e.g. process owner information). Some reengineering of the system would allow greater automatic processing. Initial implementation of the system would assess data and define "normal" ranges of operational activity and establish baselines for risk monitoring. Afterward, the CRMA will alert auditors to changes in risk via a web-enabled dashboard.

[2] Adapted from Bell et al, 2002

Table 3: Risk monitoring
Bedard et al 2008: Risk monitoring and control audit firms: a research synthesis
Bell et al 2002: KRisk: a computerized decision aid for client acceptance and continuous risk assessments
Dowling and Leech, 2007: Audit support systems and decision aids
Srivastava and Shafer 1992: Belief-function formulas for audit risk

Bedard et al (2008) note that decision aids are designed to improve audit quality and efficiency. However, this may lead to over-reliance on recommendations provided the system, mechanistic behavior, and limitations due to perceived complexity (Dowling and Leech, 2007). These issues are also applicable to the remote audit and may be areas of resistance by internal auditors.

Audit firm quality control (AFQC) has also been used as an indicator of audit risk for external auditors. Bedard et al (2008) note that evidence suggests that auditors engage in quality-threatening behaviors, such as "the collection of insufficient audit evidence, inadequate workpaper (i.e. audit documentation) review,… truncating sample size, insufficient risk adjustment in audit planning…", etc. CRMA may help overcome these issues with automatic evidence collection, population testing, and indicators of changing risk.

CRMA would also build on the belief function formulas identified by Srivasta and Shafer (1992). Their mathematical formulas for determining financial statement audit risk identify evidence and weighting based on audit objectives.

A continuous audit with CRMA would entail a reasonable number of KPIs / RPSs (Risk Performance Indicators / Models) that would be constantly or frequently recalculated with clearly defined action thresholds and pre-defined action procedures (APs). These actions could take many potential paths including informational flows only, feeds to risk dashboard, ad hoc on demand audits, system closure alarms, and evidence rebalancing parameterization.

Continuous controls monitoring

One of the key developments in modern audit analytics is the concept of continuous controls monitoring (CCM). CCM is a derivative of the formalization of audit procedures and automation of CAATs and other items from the audit plan. A remote audit would rely a great deal on the existence of a monitoring platform that would alert the auditor to high-risk transactions and controls failures on a real-time basis.

Table 4: Controls monitoring
Brown et al. 2007: Survey of continuous auditing and continuous monitoring research
Alles et al. 2006: CCM pilot at Siemens Corporation
Murthy 2004: Implementation for CCM in e-commerce
Nelson 2004: CCM at Hospital Corporation of America
Rose and Hirte 1996: Carolina Power and Light
Turoff et al. 2004: Homeland Security
Vasarhelyi & Halper 1991: Continuous online auditing at Bell Laboratories
Hunton et al. 2008: Managers' perception of CCM

Brown et al (2007) provide a review of literature related to CCM implementation. From their survey, they identify the trends of auditors to increasingly utilize monitoring and other audit automation technologies (Glover et al. 2000; Rezaee et al. 2002). They also identify key implementations of CCM at a global corporation (Alles et al, 2006), in an e-commerce setting (Murthy, 2004), at a large hospital chain (Nelson, 2004), at a utility company (Rose and Hirte, 1996), in government (Turoff et al, 2004), and at AT&T Bell Laboratories (Vasarhelyi & Halper,

1991). Each of these papers builds on specific processes within these organizations, such as accounts receivable and separation of duties. Additionally, Alles et al (2008) identify generalizable observations about CCM implementation from two separate cases.

In addition to enabling auditors to audit by exception, CCM has the potential to deter management from taking unnecessary risks. Hunton et al (2008) examine CCM from the manager's perspective and find that where monitoring is in place, incentives to smooth income or make high-risk investments are decreased.

IV. Remote Interface

In current practice, the internal audit team visits the audit site and runs through a checklist of audit tasks and procedures in an effort to validate the accuracy of data and the efficient and effective function of internal controls and business processes. The team is already using various information and communication technologies (ICTs) to enhance the audit. Whether it is a spreadsheet for visually checking a sample, a macro for running an analysis, e-mail to receive information from the auditee, or a laptop for storing evidence to support their audit, these technologies increase access to information to aid the audit.

In order to transition to a remote audit, existing ICTs will need to be enhanced with additional technology that facilitates remote communication, centralized evidence gathering, and coordination within the audit team. Here we review some of these remote interfacing technologies, including web conferencing and telework, and electronic document management systems. The current trend is toward cloud computing, where collaboration and communication tools are run remotely on distributed systems over the Internet (Armbrust et al., 2009)

Table 5: Remote Interface
Web conferencing & telework
Ellis et al. 1991: Groupware: some issues and experiences Overview of web conferencing,
Hunton & Harmon 2004: A model for investigating telework in accounting Model for addressing antecedents and outcomes of telecommuting.
Campbell and McDonald (2009): Defining a conceptual framework for telework Overview of and issues with telework application in accounting
Electronic working papers
DeYoung 1989: Hypertext challenges in the auditing domain. Workpapers mimicking the Web
Bierstaker et al. 2001: The impact of information technology on the audit process Adoption of EWP by audit firms
Jans et al 2010: Process mining of event logs in auditing: opportunities and challenges Discussion of process mining for auditing
Cloud computing
Armbrust et al. 2010: Above the clouds: a Berkeley view of cloud computing Description of cloud computing with challenges and possible solutions

Web conferencing & telework

The concepts of web conferencing and telework have been around since the creation of the first networks. These technologies are designed to "assist groups in communicating, in collaborating, and in coordinating their activities." (Ellis et al, 1991). Ellis et al (1991) identify the basic philosophy of groupware and how it can aid group communication over the spread of time and space. Starting with message systems, they expand to discuss

computer conferencing, intelligent agents, and coordination systems that were precursors to our modern view of e-mail, video conferencing, artificial intelligence, and planning applications.

Many organizations' IT departments have implemented some form of web conferencing or telework tool to help managers and process owners communicate with vendors and customers. Depending on the security policy of the organization, many of these services are now accessed directly from a Web browser. These services provide computer-mediated communication, enhancing voice with visual cues (via live multi-directional video streams) and co-browsing of information (via screen and application sharing). Some additional Web-based services feature real-time collaboration on documents and spreadsheets (such as Google Docs), which allow multiple parties to contribute to a dynamic document.

Hunton and Harmon (2004) observe that the presence of telework in the accounting profession is increasing dramatically. They extend beyond the technical requirements of telework and provide a theoretical model called the Telework Behavior Model, which looks at psychology, consequences, and outcomes of adopting this type of technology. This model is expanded by Campbell and McDonald (2009), who identify specific research and practical issues of adoption in accounting. Many of these same issues apply to the remote interaction with auditor and managers of the different business processes.

Electronic working papers

Electronic document management systems (EDMS) are designed for business process owners to store and maintain procedural documentation. Based on a similar principle, electronic working papers (EWP) are designed around the audit. In a continuous setting, the EWPs include evidence collected on demand by the auditor along with transaction-relevant data extracted and posted by the automated system.

EWP systems were designed to follow the Internet model, creating links between information from various domains (DeYoung, 1989). Many accounting firms have adopted more complicated database-oriented systems (Bierstaker et al, 2001). But the current state of systems is designed to mimic the history-oriented audit, rather than creating a real-time snapshot of how internal controls are working. Where information is increasingly linked to create context, incorporating technology such as process mining (Jans et al, 2010) will not only provide context for data found in EWPs, but also help auditors drill down into the systems themselves and gain better insight into failures.

Cloud computing

Cloud computing has recently risen in popularity and is based on well-established ideas. Essentially, it allows users to access private or public services and databases hosted on a network through a Web browser. Armburst et al (2009) define three aspects of cloud computing: "the illusion of infinite computing resources available on demand, the elimination of up-front commitment by cloud users, [and] the ability to pay for use of computing resources on a short-term basis as needed." These features make cloud computing attractive to companies that wish to enable greater access to their data. This also allows internal audit departments to access and store their own audit evidence, likely in a private cloud hosted by their own company.

V. Continuous Evidence

The promulgation of massive information systems and enterprise resource planning architectures allows members of an organization to run data analytics and report everything from key performance indicators to the behavior of their customers. O'Leary et al. (1997) discuss the role of autonomous or semiautonomous online agents to carry out specific tasks established by virtual organizations. Similarly, automation of analytical procedures, process monitoring, and evidence gathering facilitate the ability of a remote audit team to conduct a thorough and efficient audit.

While the previous sections of this paper have discussed elements the remote audit shares with organization management and IT in general, here we discuss literature related directly to the internal audit. These include procedures from transactional data analytics and computer assisted audit techniques to more robust continuous controls monitoring. As we discuss later in this paper, continuous application of analytics allows for testing of the entire population of data and transitions the periodic internal audit to an on-demand audit.

Table 6: Continuous Evidence
Evolution of analytics
Deakin 1978: Statistical analysis of financial accounting ratios
Stringer & Stewart 1986: Use of analytical techniques in auditing
Tabor & Willis 1985: Increased use of analytical procedures by auditors
Hirst and Koonce 1996: Use of analytical procedures in the planning, execution, and review stages of the external audit
Nigrini and Mittermeier 1997: Inclusion of Benford's Law to detect anomalies and fraud
Vasarhelyi et al. 2004: Principles of Analytic Monitoring for Continuous Assurance Continuity equations, transaction tagging, time-series and cross-sectional statistical analyses, automatic confirmation, and control tags
CAAT tools
Debreceny et al. 2005: Employing Generalized Audit Software in the Financial Services Sector CAAT acceptance low, varied in highly-technical bank setting
Zhao et al. 2004: Auditing in the e-commerce era Identify CAATs as a necessary step for continuous auditing
Javrin et al. 2008: Auditor Acceptance of Computer-Assisted Audit Techniques Auditor use of CAAT requires training and accessibility
Continuous controls monitoring
Brown et al. 2007: Research Streams in Continuous Audit: A Review and Analysis of the Existing Literature. Compilation of papers on CCM design and implementation
Hunton et al 2006: Effect of monitoring on management behavior
Zhao et al. 2004: Auditing in the e-commerce era Technical hurdles and lack of standards make CCM adoption difficult

Change in the nature of evidence

SAS 106 defines audit evidence as "all the information used by the auditor in arriving at the conclusions on which the audit opinion is based." (AICPA, 2006). The types of evidence auditors collect range from inspection of documents to analytical review (see Table 7). As a result of the audit rebalancing effort, internal auditors are collecting more of this evidence for the external audit team while also meeting requests from management. Audit evidence has traditionally been static, providing a snapshot of a sample set of financial data. Conclusions drawn from the sample are generally applied to the population from which the sample was extracted. Continuous evidence enhances the audit by decreasing the time needed to collect supporting evidence for controls failure or to assure business is running smoothly. Furthermore continuous evidence gathering creates a new type of

evidence for the audit which encompasses alarms (Vasarhelyi & Halper, 1991) and the resulting reactions by management and auditors. As continuous data and control monitoring is done automatically it requires the formalization of algorithms based on analytics and heuristics gathered from experts. Continuous evidence is by essence much more formal and algorithm based.

Table 7: Audit Procedures for Obtaining Audit Evidence (SAS 106)

Procedure	Static Method	Continuous Method
Inspection of Records or Documents (e.g. authorization)	Pull a sample of purchase orders and verify authorized signature exists and matches authority list	Evaluate entire purchase order population in ERP and verify POs passed through approval workflow and possess authorized user stamp
Inspection of Tangible Assets (e.g. physical inventory count)	Print a list of inventory, walk through warehouse, open boxes, etc.	RFID tagging
Observation (e.g. watching someone complete a process)	Sit with a worker and observe procedure	Use process mining to determine transactions that deviate from standard
Inquiry (e.g. written or oral interviews)	Communicate electronically or in loco as part of traditional audit	Monitor processes/controls. Automatically identify process owner when exceptions occur
Confirmation (e.g. verify account balances)	Electronic communication	Linked data streams from financial institutions, other businesses through IDE, etc.
Recalculation (e.g. using CAAT to recalculate figures)	Manually extract data, run CAATs	Monitor transactions, run calculations automatically at standard intervals
Reperformance (e.g. aging of accounts receivable)	Manually extract data, run CAATs	Monitor accounts, run calculations, automatically replicated transactions.
Analytical Procedures (e.g. scanning and statistics)	Extract data, scan for anomalies based on auditor judgment	Filter real-time data through continuity equations, ratio analysis,

While the scope and scale of evidence varies from firm to firm, the static methods are fairly standard. Inspecting documents, for example, requires someone to physically pull a sample of authorized forms and verify that signatures are present and match authority lists. Moving this evidence to a continuous setting may require reengineering not only of the audit function, but also of the business process itself. The electronic versions of those forms may be required to pass through a required ERP workflow or include special tags within the ERP system itself.

Siemens worked with the Rutgers Carlab (Alles et al, 2006; Teeter et al, 2010) to develop a methodology of continuous control monitoring as a means for gathering evidence of IT controls operation. This project converted the existing Siemens audit methodology that was typically applied to their SAP systems once every 18 to 24 months and supplemented it with a stream of control assurances drawn daily.

AT&T (Vasarhelyi & Halper, 1991) monitored a large billing system creating data alarms based on over 200 rules. The key principle for this system was to take the "pulse" of each process within the system and alert the audit team. Alerts of perceived anomalous conditions are reported if occurring in an audit by exception mode.

External validation, though confirmations, is progressively being performed by e-mail. Although this reduces inter-process latency, it is a relatively antiquated method. Future systems will be closed and coupled to transaction partners (firms and their banks, sellers and clients, firms and localities) through database cooperation (Dull and Tegarden, 2004) and automatic confirmation at the transaction and account level. This will substantively change the population integrity concerns that persist in today's audit environment.

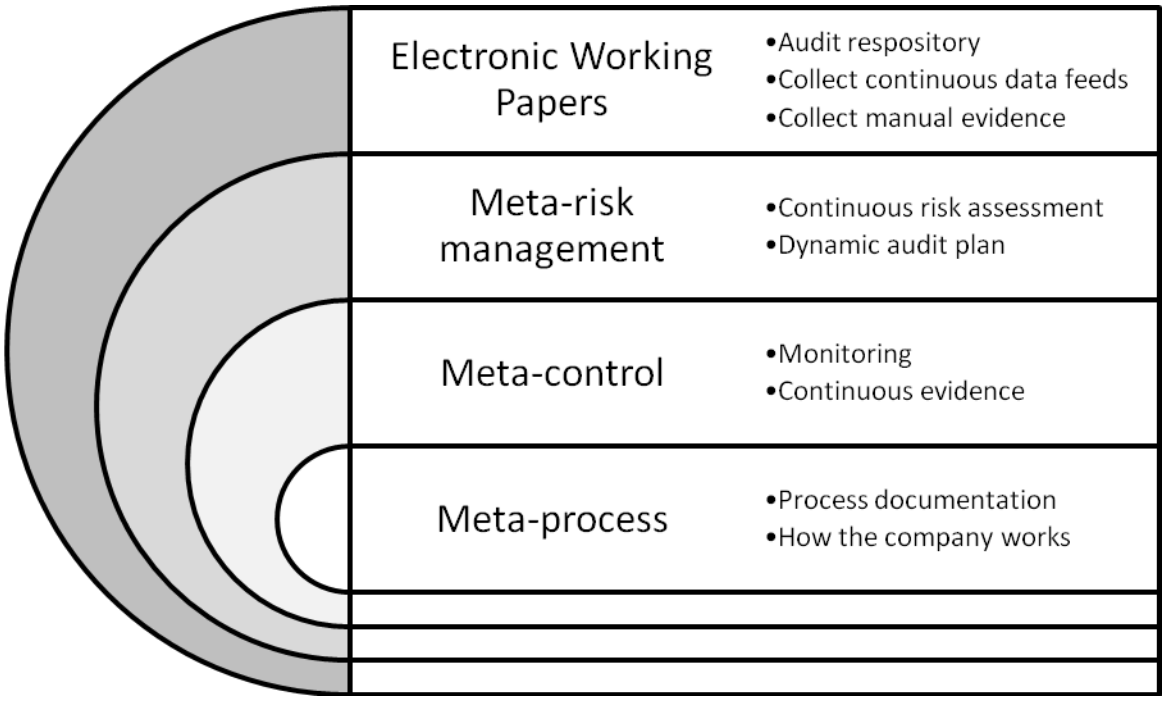
Although rhythms of data processing are different, and their utilization varies, continuous audit is progressively changing the nature and frequency of audit evidence. Consequently, its usage and method of automation and models for decision support must change.

Documentation and electronic document management systems

A document is a unit of "recorded information structured for human consumption" (Levien, 1989) that is recorded and stored (Sprague, 1995). For an auditor, a document can be a set of audit procedures, a spreadsheet of extracted information, a transcript from an interview, or a combination of these and other elements. For a process owner, documentation details the standard operating procedure that workers should follow to complete their process objective. From the line worker to the auditor, documentation ensures that all parties know their precise tasks, have a reference to train new employees, and possess a "paper trail" of economic transactions.

We identify four main areas of meta-documentation, or documentation that defines procedures, shown in Figure 4. At the lowest level, a meta-process system describes how the organization operates, demonstrated by process documentation. This can include flow-charts, workflow structures, and step-by-step instructions. Above that, a meta-control system defines the parameters and metrics used for monitoring accounting information systems. Next, a meta-risk management system prescribes the scope of the audit based on risk analysis. Finally, all of these are encompassed by an electronic working papers system, which serves as a repository for any documentation that may serve as an aid to the auditor.

Figure 4: The Role of Documentation Within an Organization



Reliable and secure documentation is essential to the validity of the audit. Auditors rely on work papers consisting of audit procedures, a repository of extracted evidence, and their notes and observations. Electronic document management systems (EDMS) provide the infrastructure to centrally store and access relevant information. The decrease in storage cost and increase in availability of online data help overcome two of the challenges of implementation discussed by Sprague (1995).

Sprague (1995) identifies the value of documents as a way to "manage, control, and operate the organization." The author identifies technology that makes EDMS feasible, such as the low cost of storage, and ease of network access. Issues such as ownership, document versioning, and retention management are also discussed. Contrasting EWP systems, EDMS provides the process documentation

Dourish et al. (2000) suggest that the file cabinet structure for EDMS is not necessarily ideal for easily locating and associating relevant documents. They suggest that the addition of metadata, in particular keyword tagging, provide a more logical storage and retrieval method.

Cho (2010) discusses the importance of organizational learning to the adoption of EDMS. In particular, the author finds organizations that focus on organizational learning, or the ability of workers to contribute to the existing collective knowledge of the organization, are more likely to be successful in using EDMS. Additionally, users who feel they are contributing to the organization's base of knowledge are more satisfied with these systems. Extending this to audit work papers, there is potential for higher adoption success of EDMS if auditors feel that their contribution is valued by the organization.

Finally, Luoma (2006) discusses the importance of electronic document retention for legal purposes. Failure to retain electronic documents and produce them on-demand can have a serious negative effect on organizations. Whether producing evidence of compliance or evidence for a fraud investigation, document policies are essential to limiting risk exposure. Barker et al (2008) expands the discussion to address the changing media on which these documents are stored and used. They suggest updating document retention policies to address the use of mobile phones, flash drives, online sources, and large database systems. A similar evaluation is necessary when considering a move to the remote audit.

Evolution of Analytics

As SOX restricts the ability of external auditors to provide consulting services to their audit clients, internal auditors will need to assume a very different role in the near future. Whereas external auditors previously provided their analytic bags of tricks along with an engagement, now those same analytics will require greater in-house understanding and development. Vasarhelyi and Kuenkaikaew (2009c) indicate that most likely in large organizations internal audit will take much increased role in assurance functions associated with a decrease of scope in external audits. The inclusion of real time monitoring and analytic exception harvesting will tend to make internal auditors deeper into systems and processes while external auditor will tend to focus on the big issues and substantive exceptions.

The evolution of audit analytics has been rather disappointing. While academic and professional practice has for over two decades advocated improvement in assurance analytics practice has not followed (Tabor & Willis, 1985). The realignment of internal and external audit roles and the emergence of improved information, communication and analytic technologies will probably finally allow the prognosticated evolution of analytic usage, now however often incorporated in automatic devices.

Financial accounting ratios have long been a simplistic indicator of firm performance measures, including liquidity and profitability. The application of statistical techniques and probability measures to these ratios provides additional insight into the relationships in financial information and appropriateness to outside sources (Deakin, 1978). The application of regression analysis and other techniques has expanded to the realm of auditor expertise, allowed auditors to identify mistakes (Stringer and Stewart, 1986) and help uncover potential fraud (Nigrini and Mittermaier, 1997).

The Auditing Standards Board recommended the use of analytical procedures in 1978, which were subsequently mandated by SAS No. 56 (Hirst and Koonce, 1996). In their study, Hirst and Koonce (1996) evaluate the use of analytical procedures in the planning, execution, and review stages of the financial statement audit.

They build on the observations of Tabor and Willis (1985), which saw an increase in the use and scope of analytical review procedures.

Stringer & Stewart (1996) outline numerous analytical review tools, including Deloitte and Touche's sophisticated Statistical Technique for Analytical Review (STAR) technique. Many of these tools can be tailored to the specific needs of the internal auditor and management. They also require the internal auditor to possess a deep understanding of the statistics underpinning these analytics.

Nigrini and Mittermaier (1997) introduce Benford's Law as a measure for testing the authenticity of numbers within a financial system. This technique evaluates the frequency distribution of digits to test the validity of the numbers and aids auditors in detecting fraudulent transactions. This paper demonstrates the progressive development of analytical procedures through the use of external statistics.

An evaluation of the various techniques that can be used for analytical review led Vasarhelyi et al (2004) to enumerate those that are most appropriate for the auditing of continuous data. They suggest that data tagging, for instance, allows more targeted evaluation of interesting data. Several of the techniques, including a continuous application of cross-sectional analysis, are adapted to uncover relationships within the data and alert auditors to changes in the underlying assumptions. In an online environment, auditors face a trade-off between highly complex, more accurate algorithms and simplistic, readily run and available ratios. Depending on the desired audit objectives, a healthy mix of analytical procedures will aid the auditor in an on-demand audit.

Computer assisted auditing techniques (CAATs)

Most internal audit organizations employ numerous CAATs to facilitate evidence collection. These techniques range from simple extractions of data from ERP systems to sophisticated macros that model transactions within normal ranges of acceptability. There are four main categories for CAATs: data analysis software, network security evaluation software, OS and DBMS security evaluation software/utilities, and software and code testing tools (Sayana, 2003). For the purposes of our discussion, we limit our focus on data analysis software, such as generalized audit software (GAS). GAS can be used to interrogate databases and other data sources and perform analyses and other audit tests in real-time systems.

Debreceny et al (2005) evaluate the use of CAATs within a banking environment. In this setting, the authors discover some insight into the use of GAS for evidence collection. While internal auditors use audit software, they appear to be inconsistent in their application of these tools. In some cases, auditors perceive these audit tools as necessary for fraud investigation or special instances, but not for mainstream substantive testing procedures.

While Zhao et al (2004) identify CAATs as necessary tools for building a real-time auditing environment, Javrin et al (2008) relate that auditors need more specialized training if they are to use these tools more often and more effectively. These tools also need to be made more accessible so that auditors understand the underlying processes and can use them more effectively. Furthermore, CAATS will incorporate advanced analytics integrating these two technologies.

VI. Characteristics of virtual organizations

In our conceptualization of the remote audit, we observe numerous characteristics of an audit team that are shown in broader virtual organizations, prevalent in the organization management literature. Desanctis and Monge (1999) define a virtual organization as "a collection of geographically distributed, functionally and/or culturally diverse entities that are linked by electronic forms of communication and rely on lateral, dynamic relationships for coordination." In many ways, internal audit departments already operate as virtual organizations. Auditors collaborate and coordinate with team members across long distances to complete a common goal: the internal audit. In cases where the internal audit function is outsourced, this type of dynamic communication is more of the norm in an effort to reduce transaction costs and increase efficiency (Widener and Selto, 1999).

Two primary areas of research exist under the umbrella of virtual organization theory and provide similar challenges to internal auditors. This research covers electronic communication and trust within the virtual organizations.

Table 8: Virtual Organizations
Communication
Desanctis & Monge 1999: Communication processes for virtual organizations Overview and areas of research for VOs.
Wiesenfeld et al. 1999: Communication patterns as determinants of organizational identification in a virtual organization Organizational identity key to overcoming weakened ties caused by distance
Trust
Handy 1995: Trust and the virtual organization Workers aren't trusted, self-fulfilling prophecy
Meyerson et al. 1996: Swift trust in temporary groups Team members develop trust based on stereotype, maintain trust
Jarvenpaa et al. 1998: Is anybody out there? Research model for explaining trust in virtual teams
Javenpaa & Leidner 1999: Communication and trust in global virtual teams Case studies on trust among high-trust and low-trust teams
Kasper-Fuehrera & Ashkanasy 2001: Communicating trustworthiness and building trust in interorganizational virtual organizations Reliable technology, communication of emotion, and strong ethics promote trust in virtual teams
Ridings et al. 2002: Some antecedents and effects of trust in virtual communities Precursors to trust, users who trust participate more in virtual environtments

Communication

Audit teams, like virtual organizations rely on electronic communication to coordinate activity and receive feedback for remote-enabled processes. As virtual organizations embrace varied methods of communication, from e-mail and phone calls to full web conferencing, the substance and volume of the communication between members of a virtual team is affected. In many cases, team dynamics must be better defined to counteract the decentralized, informal nature of remote communication.

Desancis and Monge (1999) summarize research on the effect of electronic communication within virtual organizations. From their review, they generalize six elements that have implications for organizations moving to a virtual existence. First, electronic communication increases the volume of communication while decreasing message efficiency. This is more the case with written communication (e.g. e-mail or instant messaging) than voice- or video-enabled communication. In other words, more instruction is needed to effectively and clearly communicate expectations and verify understanding. At the same time, they gather that message bias decreases, but the time it takes to form an impression of the speaker/topic increases, citing an example from Straus and Miles (1998) where job interviewers are less stereotyped and more valid when visual observation is not present. For an auditor decreased bias may lead to increased skepticism of the interviewee. Third, while remote communication is effective for divergent thinking, there is consensus in the literature that convergent thinking, conflict resolution, and reaching consensus are more effectively done face-to-face. Fourth, electronic communication promotes broader, diverse participation among users and reduces hierarchy and conversation domination. This network effect promotes faster information flow and a greater quality of participation. Fifth, communication norms are established more by social cues and reflect more of each individual's personal values, which may cause conflict

among participants. Finally, electronic communication is likely to evolve and develop as more users participate and establish their own values within the organization.

Wiesenfeld et al. (1999) also discuss the challenge of operating and organization in a virtual environment. They suggest that temporal and spatial dispersion enabled by information technology weakens relationships between team members. Electronic communication lends itself to weaker social context cues and higher informality. E-mail, for example, facilitates communication more readily in environments where there is an established interpretive context. Their findings suggest that mangers should establish a formalized organizational identity and routine, as well as a culture that "encourages the use of on-line media to share task and nontask related information."

Regarding the audit, effective communication is essential for the auditor to draw an accurate opinion and fully test the nature of the audit. For some aspects of the audit, the lack of visual bias may cause the auditor to be more skeptical and therefore more thorough. On the other hand, they may miss important visual cues that indicate someone is being dishonest. In loco communication may be more effective at projecting the urgency and importance of an audit, while the threat of on-demand remote communication may motivate employees to maintain proper procedures and controls.

Trust

Audit teams also rely on a certain degree of trust and skepticism within their teams and with process owners. Trust is essential to building a case for effective internal controls and understanding of the business functions. Likewise, the volume and intensity of communication within a virtual organization is dependent on the level of trust between members of the organization. Handy (1995) suggests that both volume and intensity of remote communication increases because managers don't trust workers. At that same time, workers are less inclined to be trustworthy. The lack of physical presence thus induces a self-fulfilling prophecy. Conversely, Meyerson et al. (1996) identifies the ability of temporary teams to develop "swift" trust. In the case of these temporary teams, trust is established based on preliminary, stereotypical impressions of other team members. Trust is maintained when members of the team work actively to complete tasks and maintain the confidence of other team members.

Javenpaa et al. (1998) conducted a survey of virtual teams to better understand the development of trust between team members. They find that members' initial perceptions of integrity and benevolence have a positive and negative association with trust, respectively. Javenpaa & Leidner (1999) present a series of case studies that enhance this understanding, citing that "teams that reported high levels of trust in the beginning and at the end appeared to be more capable of managing uncertainty, complexity and expectations of the virtual environment." Ridings et al (2002) test the association of trust from Javenpaa et al (1998) with members' desire to participate in virtual communities. They find that trust is a strong precursor to participation and that elements of communication, such as the disclosure of personal information, tend to enhance trust.

Kasper-Fuehrera & Ashkanasy (2001) mentions three obstacles that must be overcome in order to establish trust in interorganizational virtual environments. The first, communication of trustworthiness, depends on reliable and effective information and communication technology. Breakdowns in the technology or non-standardized, incompatible systems increase uncertainty. Additionally, the ability to transmit emotional and nonverbal messages enhances communication. Second, they identify the prior establishment of common business understanding as a necessary element to establish and maintain trust. Finally, they highlight business ethics as a key component to trust and the existence of a recognized policy on business ethics.

In the remote audit environment, the level of trust or skepticism is crucial to fully understanding the extent of investigation and analysis. Here, the literature reveals interesting ideas that trust is difficult to establish via electronic communication. Relationships are difficult to develop as well as a result of the increased uncertainty prevalent it this environment. If this is the case, a lack of trust via remote communication may require auditors to conduct a more in-depth analysis.

VII. Impacts of the remote audit

As the cost of technology and broadband access continues to decline and budgetary pressure increases, more internal audit teams may be in a position to incorporate some or all of the technologies needed to add a remote element to their audit. Benefits of technology adoption have discussed the increased efficiency that can be achieved after an initial investment and learning cost, a reduction of transportation expenses achievable through telecommuting or telework, the ability to more effectively utilize areas of knowledge concentration, and finally an increase in audit quality.

While ICT enhances the interaction between auditors and managers, a more formalized approach allows the audit organization to take advantage of features of a virtual organization, including a reduction of travel costs, increased efficiency, and the benefit of knowledge concentration.

From the organization's perspective, the primary motivator for organizations to embrace a remote audit is the reduction of travel and entertainment expenses. Furthermore as auditees are progressively parts of virtual distributed organizations potentially a remote audit may only be the only feasible approach to distributed virtual assurance. However, for practical purposes audit managers may be prone to cite cost savings and return on investment to convince management to adapt the integrated audit. For example, the audit department in a large consumer goods firm faced with budget cutbacks simply reduced the number of on-site auditors by half, leaving some auditors at the home location to conduct data analytics while the others conducted interviews of the business process owners. One of the objectives of the continuous monitoring project presented in Teeter et al (2010) was the reduced frequency of in loco visits by the IT audit team. This effort resulted in the reduction of nearly 500 man hours of direct testing of the system, including travel and entertainment expenses.

However, the motivation for adopting a remote audit should be directed more toward innovating the audit process. This allows organizations to take advantage of advances in technology and reengineered business processes, rather than imitating their existing information systems in a computer-based environment. The fundamental components of the audit are based on a fundamental change in the view of financial and non-financial data and finding linkages within those.

VIII. Conclusions and Direction for Future Work

The literature relating to information and communication technologies is large and varied, but the specific application of these technologies, including the radical change represented by an on-demand remote audit, is missing. There is a significant amount of work left to be done, particularly where the challenges and dynamics of interaction between auditors and clients is concerned. Moreover the role of internal auditors in the current regulatory and business environment is still not very well established. Additional research into this dynamic is necessary to make the case for the remote audit.

As information technology improves and becomes the underlying driver for the internal audit and business monitoring, the remote audit will become a more viable and necessary option to help organizations streamline and optimize the utilization of their internal audit departments. The shift of audit responsibility to the internal audit will also drive the requirement of analytical skills and conceptual knowledge needed by auditors (Vasarhelyi et al, 2010b). Questions remain as to the extent of responsibility of the internal audit, organizational factors such as decentralization, costs of implementing technology into the audit, and responsibility for implementing, training, and maintaining these systems.

Technology adoption literature is well established (Katz and Shapiro, 1986) and has been investigated in the auditing field (Curtis and Payne, 2008), and provides a good basis for developing this issue further. However, more research is needed in specific technology implementation, the internal audit framework, and auditor skills needed for the remote audit. Details of this specific application are generally absent.

A discussion into the future direction of research in the remote audit would aid development of this area. Demand is clearly present, although it is provided anecdotally and remains untested. The technology exists, but it has not yet been synthesized and coordinated. Finally, the vision is there, but it needs support from academics as well as practitioners to become a more formalized reality.

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