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Auditing Symposium XIII: Proceedings of the 1996 Deloitte & Touche/University of Kansas Symposium on Auditing Problems

University of Kansas, School of Business

Michael L. Ettredge

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Opportunities for Assurance Services in the 21st Century: A Progress Report of the Special Committee on Assurance Services

Richard Lea
California State University, Chico, and Member of SCAS

BACKGROUND AND FOCUS OF THE PAPER

The Special Committee on Assurance Services (SCAS) was established in 1994 to develop new opportunities for the accounting profession to provide value-added assurance services. The Committee is composed of 14 members: six partners from the Big 6, one partner from a regional firm and two from local firms, a corporate financial executive, a representative from the GAO, two academics, and one communications consultant. In addition, SCAS has an Executive Director and other support staff provided by the AICPA. The Committee is scheduled to complete its deliberations and issue its final report at the end of 1996.

The stimuli leading to the formation of SCAS included the following:[1]

- Flat revenues earned for accounting and auditing services for the six years 1989 to 1994.
- Loss in market share of decision useful information covered by an audit.
- Ongoing concerns regarding the "tough problems" (for example, detection of fraud and illegal acts, financial distress and business failure, choice of generally accepted accounting principles).
- Dramatic developments in information technology that are leading to profound changes in how decision-makers deal with information (for example, format, content, timing, sources).
- Jenkins Committee findings and recommendations involving a new business reporting model and possible auditor involvement.[2]
- Increasingly contentious litigation problems.

The charge given to SCAS by the Board of Directors of the AICPA is to:

- Assess the current and future (i.e., 5-10 years out) needs of users of decision- making information and related needs for audit/assurance services.
- Examine the trends shaping the audit/assurance environment.
- Consider the definition of the audit/assurance function and the need for additional concepts.
- Identify opportunities for new or improved assurance services.
- Consider implications for potential changes in independence, professional skills, and professional education.

SCAS's plan for addressing this charge involves three phases containing the following major tasks:

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[1] See: Elliott, R. K., 1994, Confronting the Future: Choices for the Attest Function, *Accounting Horizons* 8 (3): 106-124; Elliott, R. K., 1994, The Future of Audits, *The Journal of Accountancy* (September): 74-82.

[2] See: Special Committee on Financial Reporting, 1994, *Improving Business Reporting - A Customer Focus*, American Institute of Certified Public Accountants.

Phase I (completed):

- Identification of customer needs (44 interviews were conducted by an outside consulting firm with senior management and boards of directors of corporations, institutional investors, banks, educational institutions, governmental agencies, etc.).
- Identification of current competencies (sources included human resource representatives of selected CPA firms as well as research by the AICPA and a recent New Zealand study).
- Identification of significant developments in the political, social, economic and technological environments (SCAS was assisted by experts in trend assessment, economic forecasting, and information technology).
- Establishment of a communication and change management function, which began the process of making contacts with all interested audiences, stakeholders, and constituencies (for example, CPA firms, regulatory agencies, financial executives, state CPA societies, etc.).

Phase II (in process):

- Consideration of the future of the current audit. This involves a scenario building exercise that looks at various prototype audits such as: i) a large, publicly held, multinational, financially sophisticated client; ii) a small, privately held, domestic, financially less sophisticated client; and iii) a small governmental unit.
- Identification of additional assurance services representing "close-in" extensions of the current audit. This involves, among other things, a survey of firms to assess the types of "close-in" extensions presently being conducted in today's market.
- Identification of new assurance services. This involves both the development of an institutional process for the ongoing identification and development of new assurance services and the development of illustrative business plans for introducing new assurance services.
- Identification of alternative approaches for dealing with legal liability issues.

Phase III (not yet started):

- Identification of new competencies required for new types of assurance services that may be offered in the next ten years.
- Development of an appropriate conceptual framework for new assurance services. This task began in Phase I with the development of a working definition of "assurance services" - see further below.
- Testing of proposed assurance services with customer and business panels.
- Identification of barriers to the introduction of additional assurance services and ways to deal with them.

The remainder of this paper will focus on four areas of SCAS's work: i) a proposed definition of assurance services; ii) an outline of a proposed scenario for the future of the current audit; iii) a brief overview of a proposed process for the ongoing identification and development of new assurance services; and iv) an example of an identified opportunity for extending assurance services to a new area. In reviewing the remainder of this paper, the reader should keep in mind that the next four sections represent "work in process." All of these proposals are presently in the process of

development. Accordingly, SCAS is very eager to receive feedback from participants at this symposium as it completes Phase II and moves on to Phase III.[3]

I - PROPOSED DEFINITION OF ASSURANCE SERVICES

The committee is proposing the following definition of assurance services:

> **Assurance services are independent professional services that improve the quality of information, or its context, for decision-makers.**

Several aspects of this definition are worthy of comment. First, and most importantly, the definition adopts a ***customer focus*** by explicitly identifying the decision-maker as the intended beneficiary of assurance services. A customer focus is introduced for three reasons:

1- Over the past 15 years, virtually all industries have seen a dramatic shift in power from producers (suppliers, preparers) to customers (consumers, users). This shift is due to advances in technology, which have created the means for efficient and effective delivery of highly customized (demassified) products and services.

2- The explosive growth in networking of organizations and individuals is providing customers with increasingly rapid communications regarding customization possibilities. This connectivity fuels the power shift from producers to consumers.

3- Just as customers elsewhere have gained power, the customers for "decision-useful" information can be expected to do the same. Information technology is quickly providing opportunities for information users to receive the information they need any time, any place, and in any format.

In short, information is rapidly becoming a "buyers' market," and the proposed definition of assurance services explicitly recognizes this trend.

A second element of the proposed definition deals with the nature of the benefit that an assurance service provides to decision-makers, namely, ***improvement in the quality of (decision-making) information, or its context***. Relevance and reliability are the two primary qualities that make information useful for decision making.[4] To date, the audit function has focused almost exclusively on enhancement of reliability for the benefit of users. In contrast, relevance enhancement has remained within the domain of the Financial Accounting Standards Board and its predecessor organizations (GASB is also charged with relevance enhancement).

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[3] Written comments may be sent to SCAS's Executive Director, Don Pallais: 14 Dahlgren Road, Richmond VA 23233 (fax: 804/784-0885; e-mail: 75471.162@compuserve.com).

[4] See: Financial Accounting Standards Board, 1980, Statement of Financial Accounting Concepts No. 2: *Qualitative Characteristics of Accounting Information.*

SCAS predicts that assurance services will experience a dramatic shift in the next ten years in the relative emphasis given to reliability versus relevance. Relevance will become the primary benefit offered to users of assurance services. This shift in benefits to users is expected to occur for the following reasons:

1. Information systems are becoming increasingly reliable as designs exploit developments in software technology (object programming, extensive beta testing, code generators, etc.)

2. Information system reliability is further enhanced by the development of: i) electronic sensors and software agents that are capable of identifying unusual events or relationships; ii) fail-safe measures that exploit the rapid decrease in cost to performance ratios by building in massive redundancies.

3. The explosive growth in on-line information sources places a premium on the ability of decision makers to identify what is relevant. In short, on-line information has the capacity to: "drown them [decision makers] in data.... CPAs have a natural advantage in helping business decision makers navigate these seas of data and gather what will best support their decision needs."[5]

A Closer Look at Relevance

One way in which relevance is likely to be established will be through information technology. Users (individuals and groups) will explicitly state their information needs by their inquiries of preparer data bases and by their direct feedback addressed to preparers (and/or assurers). In short, the test for relevance under this scenario will become: ***If the user asks for the data, the data are relevant.***

A more penetrating analysis of relevance for a particular user will involve an exploration of various facets of the user's decision modeling activities and the role of information in those activities. SCAS predicts that assurance regarding relevance will quickly move in this direction, in which case various modeling activities, such as those shown in Figure 1, will need to be explored.

[5] Elliott, R. K. 1994, The Future of Audits, *Journal of Accountancy* (September), 78.

Figure 1

User Decision-Modeling Activities

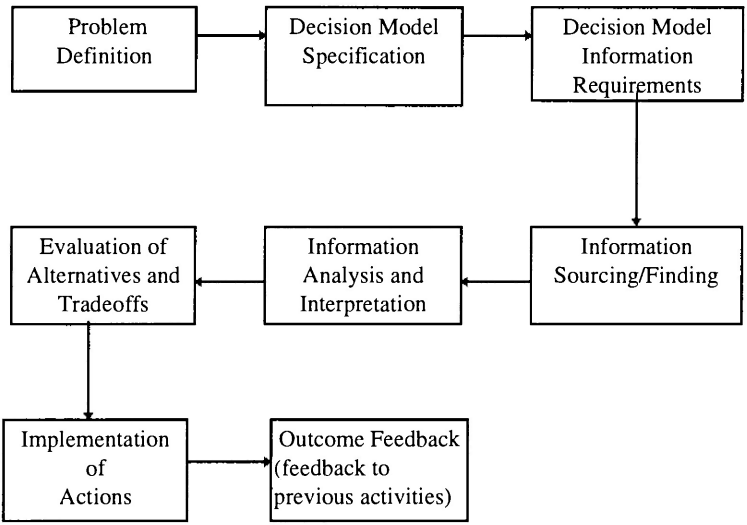


Table 1 presents a brief description of the types of assurance that might be provided to a particular user with respect to each of the decision-making activities identified in Figure 1. The table also identifies information technology developments that will have an impact on the various types of assurance.

Several points about the content of the Table 1 should be emphasized. First, many of the "assurances" identified in the middle column represent services that, in today's market, would involve adding an assurance component to present consulting services. (See the Appendix for additional comments on the boundaries of assurance services vs. consulting services). In short, a very broad perspective is being taken regarding assurance services, namely, assurance services are any services that assist information users in improving the quality of their decision-making information, including their decision model.[6]

[6] When viewed broadly, "decision-making information" includes a user's decision model, which is simply a set of information organized in a particular way for the purpose of making a decision. In this sense, issues regarding the quality of information extend naturally to the quality of decision models.

Table 1

User Decision-Modeling Assurance

Decision Activity	**Nature of Assurance Provided**	**Information Technology Considerations**
Overview of assurers' involvement with specific users:	Extensive involvement with specific users will become the norm.	Users will need much more assistance from assurers because of: -Vast amounts of available information -Increased electronic access -Rapid degradation in value -Widespread availability and use of computer decision models.
1 - Problem definition	-Problems will involve a broad range of economic and social issues faced by information users/decision makers; assurance may be given regarding the appropriateness of problem definition.	A broader range of issues may be identified and monitored through efficient and effective electronic sensors.
2 - Decision model specification	-Specific decision models tailored to specific user needs will become the norm; assurance may be given regarding the appropriateness of the model, given the problem definition.	Computer decision models used to model a broad range of economic and social decision problems will become widely available.

Table 1 - Cont. User Decision-Modeling Assurance		
Decision Activity	**Nature of Assurance Provided**	**Information Technology Considerations**
3 - Decision model information requirements	Information requirements will be identified in the context of the specific decision model that has been selected by the user. Assurance may be given regarding relevance of proposed information.	Complexity of computer decision models may require specialized skills in determining appropriate information required to run the models.
4 - Information sourcing/finding	-Users may need assistance in searching through vast quantities of information; assurance may be given regarding completeness of search.	Search processes will be influenced by: -Vast volume of available data -Increased electronic access -Development of efficient and effective software agents (perhaps controlled by assurers).
5 - Information analysis and interpretation	-Users will continue to seek assistance in analysis and interpretation from "information intermediaries," which may include assurers.	Even in contexts of formal computer decision models, users will need assistance in analysis/interpretation because: -Data may be in multimedia format, much of which will not fit neatly into formal decision models -Much data will not be "controlled" by standards enforced on preparers -Vast quantities of data will be available.

Table 1 - Cont. User Decision-Modeling Assurance		
Decision Activity	**Nature of Assurance Provided**	**Information Technology Considerations**
6 - Evaluation of alternatives and tradeoffs	- Users will continue to seek assistance in weighing alternatives and tradeoffs from "information intermediaries," which may include assurers.	Computerized decision models may do much of this, but significant judgments may be still be left to the decision-maker.
7 - Implementation of actions	-Users may seek greater assistance in implementation, including assurance regarding appropriateness of implementation reporting activities.	Expertise will be needed in the design of electronic sensors to monitor implementation activities, which may be provided by assurers.
8 - Outcome feedback: -Feedback to preparers -Feedback to assurers	-Users will provide increasing feedback directly to preparers because of extensive user-preparer linkages and to assurers because of greater assurer involvement in user decision-making activities.	Emergence/proliferation of user "chat groups" will enhance communication links among users and between users, preparers, and assurers.

Second, other parties besides members of the profession are (or may become) involved in the delivery of assurance services identified Table 1. The profession will not have a monopoly on any of these services and must compete with others on the basis of perceived independence and competence. Third, many of the "assurances" involve issues for which standards are unlikely to provide detailed guidance; consequently, delivery of these types of assurances will involve high degrees of professional judgment. Fourth, even though many of the decision activities identified in Table 1 are assumed to take place within the context of a formal, well-defined computerized decision model (a rapid increase in the availability of such models is expected), considerable "expert judgment" outside of formal model boundaries will continue to be required.

Independence and Professional Judgment

Returning to the above proposed definition of assurance services, the third and final element of the definition that deserves comment involves the two adjectives in the phrase *"**independent professional services**."* Both adjectives were briefly mentioned in the above discussion of relevance.

Historically, ***independence*** has been the foundation stone upon which the audit function has been erected: "Independence is the cornerstone of the accounting profession and one of its most precious

assets."[7] SCAS believes that independence should remain a "bedrock" concept for all assurance services. In their roles as decision makers, information users must draw upon a wide range of information prepared by others, which immediately introduces the possibility that preparer and user interests are not congruent. Recognizing this possibility, users may want to seek the assistance of an assurer, who is recognized as independent of the preparer. Indeed, users will turn to assurers only if they believe that assurers have no stake in the outcome, other than to assist users in improving the quality of information (and decision models) entering into the user's decision-making process.

SCAS's purpose in including the second adjective, "***professional***," is to underscore a major element involved in the delivery of virtually all assurance services, namely the high level of professional judgment involved. As indicated above, providing "assurance" involves numerous judgment calls for which standards are unlikely to provide detailed guidance. Even in those cases in which the user's decision has been captured in a formal computerized decision model, considerable "expert judgment" is generally required outside of formal model boundaries. Hence, professional judgment is now, and will continue to be, an essential ingredient of assurance services.

[7] Mednick, Robert, 1991, "Reinventing the Audit," *Journal of Accountancy*, August, 75.

II - A SCENARIO FOR THE FUTURE OF THE CURRENT AUDIT

SCAS is presently (Phase II) developing scenarios regarding the future of the current audit for various types of reporting entities. The scenarios reflect a SWOT (strengths, weaknesses, opportunities, threats) analysis of the current audit process. The intention of the scenario-building exercise is to develop a coherent picture of the future of the current audit that reflects expected developments in the audit environment identified in Phase I. These scenarios will then be the basis for making recommendations regarding changes in professional skills, education, etc..

To illustrate ideas, this section will present an outline of a proposed scenario (currently in development) involving a large, publicly-held, multinational, financially sophisticated company operating in the year 2006. SCAS also is in the process of developing other scenarios involving other types of entities.

Large, Publicly-held Company

The large, publicly-held company scenario provides "views" of users, preparers and audits (and auditors) in the year 2006. Two basic assumptions underlie this scenario:

1. Historical financial information (GAAP) will continue to be reported. In addition, significant "enrichment" of the information set encompassed by GAAP will occur along the lines of the Jenkins Committee recommendations. The scenario presented below deals only with GAAP information. Extensions to this information set and the resulting impacts on the scenario are presently under consideration by SCAS.

2. The SEC will continue to require audits of public companies. SCAS is presently addressing the question of how this scenario would be altered if this assumption is dropped.

Given these basic assumptions, SCAS has developed "2006 views" of users, prepares, and audits (and auditors) which are presented in detail in Table 2 and briefly summarized below.

Table 2

Large, Publicly-held Entities
2006 Views of Users, Preparers, Audits and Auditors

Elements of the 2006 Views	Commentary on the Element
View of Users (large creditors and individual and institutional investors):	
• Users will want and need audits	User need is clearly established by work of Jenkins Committee and the SCAS customer needs interviews. Users recognize that auditor involvement enhances the integrity of financial information made available in capital markets. In short, users believe that audits fulfill a "watchdog" role.
• Users will continue to look to audited financial statements as the key test of integrity of all published financial information	See previous comment. Although the annual period for audits will probably not change, the critical notion is that a "true-up" will occur regularly, which adds integrity to all financial information reported between successive "true-ups."
• Users will continue to accept the "yes/no" audit report as a "seal of approval" regarding financial information	The messages contained in the auditor's report involving "reasonable assurance (confidence) " and "materiality (precision)" may undergo refinement. Users are believed to have more of a need for understanding the imprecision in information, perhaps through the communication of ranges (see below), than they have for understanding different levels of assurance. Reporting on "systems quality" may go beyond a "pass/fail" message and report on specific risk exposures - see further below under **Preparer.**
• Power will shift from preparers to users, who will favor entities that provide more timely and complete disclosure	Connectivity provides for communication among users via chat groups, which will create the opportunity for users to speak with one voice. The recent Intel chip problem is indicative of how fast users can organize themselves on a public network to exert considerable power.
• Users will become electronically "connected" with each other and with preparers and auditors	See the above comment on connectivity of users. Connectivity of users with preparers and auditors provides the necessary feedback loops for user views to become more clearly articulated.

Table 2 - Cont.

Large, Publicly-held Entities
2006 Views of Users, Preparers, Audits and Auditors

Elements of the 2006 Views	Commentary on the Element
View of Users (large creditors and individual and institutional investors) - cont.:	

• Connectivity will provide an ongoing "negotiation forum" for users vs. preparers. Points of negotiation will include:
  • Levels of disaggregation
  • Treatment of soft information
  • Choice of multimedia formats
	See above comments on connectivity. The negotiation forum provides users with the essential feedback communication loop necessary to make their needs known regarding "precision" and also "level of assurance."

• Users will demand more:
  • Disaggregation
  • Qualitative commentary (e.g., expanded MD&A)
	These needs were clearly identified by the Jenkins Committee. Although users have expressed interest in auditors providing qualitative commentary (See Jenkins Committee report, Ch. 7), preparers will strongly resist this idea - see further below under **Preparers.**

• Users will expect timely, on-line financial information (GAAP) that provides "drill-down" options	Developments in information technology will sweep away barriers inhibiting timely reporting, and users quickly will become aware of these developments and make their demands known for timely information.
• Users will become adept at "mining" on-line information	Users may well need the help of "financial intermediaries" in attempting to search through the "sea of data" that will be available on public networks, but user capabilities will also dramatically increase here.

Table 2 - Cont.

Large, Publicly-held Entities
2006 Views of Users, Preparers, Audits and Auditors

Elements of the 2006 Views	Commentary on the Element
View of Users (large creditors and individual and institutional investors) - cont.:	

• Users will expect auditor involvement to lead to significant improvements in dealing with the **tough problems**:
  • Detection of fraud and illegal acts
  • Early warning of financial distress
  • Early reporting on deviations from "expected"
  • Reporting on risks, uncertainties, estimates
  • Appropriateness of preparer's choice of GAAP
	Users will expect auditors to improve their detection capabilities. Users will also expect auditors, who they will view as working in the users' interests, to push for better disclosures in the listed areas.

• Users will have the power to invoke "severe penalties" on entities that:
  • Reveal prior misstatements
  • Report unpleasant surprises
  • Fail to report "negatives" on a timely basis
	The Wall Street Journal regularly reports cases where "surprises" have led to dramatic declines in share prices. Connectivity will speed up user reaction and probably make it more severe, since users will be speaking with one voice. Users will demand that the reporting of "negatives" encompass lots of issues less extreme than potential business failure and also encompass a much longer time frame than the current one-year period associated with the "going concern" issue.

Table 2 - Cont.

Large, Publicly-held Entities
2006 Views of Users, Preparers, Audits and Auditors

View of Preparers (large, publicly-held, multinational, financially sophisticated):	

• Preparers will become increasingly responsive to users:
  • Power shift to users
  • Self interests of preparers will lead to adoption of a "customer focus"
	Users will seize power (see above), and preparers will give up power regarding disclosure in order to achieve lower costs of capital.

• Preparers will face increasingly complex GAAP reporting:
  • More countries
  • More currencies
  • More tax laws and regulations
  • More complex financial instruments
	The "multi" dimension will continue to make reporting increasingly complex. Opening markets in the former Soviet Union, Eastern Europe, and China are current examples.

• Preparers will seek timely auditor involvement on the complex, nonroutine transactions	Preparers will want to avoid being "burned" by financial reporting errors or reporting of unpleasant surprises. Developments in information technology enables preparers to seek timely, in-depth auditor involvement.
• Preparers will provide timely, on-line multimedia presentations of GAAP financial information (e.g., via WWW home pages)	Network presentations will become the most efficient and effective means for communicating financial information.

Table 2 - Cont.

Large, Publicly-held Entities
2006 Views of Users, Preparers, Audits and Auditors

Elements of the 2006 Views	Commentary on the Element
View of Preparers (large, publicly-held, multinational, financially sophisticated) - cont.:	
• Connectivity with users will provide preparers with feedback on user needs	See previous comments on connectivity and feedback communication loops between users, preparers, and auditors.
• Preparers will be pressured to disclose more and more "competitively sensitive" information	The tension between the user's right to know vs. the preparer's need for confidentiality of competitively sensitive information is not new and will continue. However, the power of the user is a new development, which will alter the balance towards greater disclosure. Also, as the pace of change quickens, the length of the period needed for protection of sensitive information is reduced (i.e., sensitive information becomes stale very quickly).
• Preparers will resist user demands for auditor qualitative commentary	Preparers will aggressively move to maintain control of the interface with users. Qualitative commentary will be seen as the preparer's legitimate domain. Also, auditor commentary will be seen as undermining the free flow of information in an audit. The audit process must allow for auditors to know more than they say; otherwise, the process would become adversarial. If auditors announce to preparers that they intend to add qualitative commentary, the preparer's likely response will be that they will provide the commentary and the auditors can review it for reasonableness. Hence, auditor commentary would become redundant.
• Preparer financial systems will move towards highly integrated data bases with powerful query capabilities	This movement is swiftly becoming a reality as systems, such as SAP, become implemented.
• Preparers will experiment with providing users with "defined views" of their data bases	In short, lots of different disclosure possibilities will be enabled by technology, ranging from providing defined views of data bases to highly structured, multimedia presentations developed by the preparer.
• Preparers will continue to increase their connectivity with other preparers (e.g., EDI linkages) in their value chain	This connectivity will continue to take place to improve the efficiency and effectiveness of preparer operating processes. As described further below under **Audits**, this connectivity will open up significant opportunities for new types of audit evidence involving triangulation (i.e., looking at the same transactions from different entity perspectives).

Table 2 - Cont.

Large, Publicly-held Entities
2006 Views of Users, Preparers, Audits and Auditors

Elements of the 2006 Views	Commentary on the Element
View of Preparers (large, publicly-held, multinational, financially sophisticated) - cont.:	
• Systems reliability will increase with respect to routine transaction processing	Reliability enhancements will reflect improvements in software reliability (preventive controls), use of electronic sensors and software agents for monitoring and detection, and use of massive redundancy to insure fail-safe operation. Note that these reliability enhancement possibilities will also be available to the auditor in assessing system quality and searching for exceptions - see further below.
• Systems will move from paper-based to an electronic-based environment	New types of risks will arise involving authentication, trustholding, and privacy.
• BofD's and senior management will want assurance on the quality of their complex, integrated, multinational financial systems	The "multi" dimension of financial reporting systems will be of particular concern to Bof Ds and senior management because of the uneven skills/expertise resident in various domiciles.
View of Audits and Auditors:	
• Audits will continue as a "core competence" service and will involve annual audit reports on yearly GAAP financial information	"Clean" audit reports across the range of publicly-held entities will continue to be the primary test of financial market integrity and the stamp of approval on all financial information that flows from public companies during the year.
• MD&A type information will increasingly become part of the audited financial statements	Auditor reviews of MD&A will be the preparer's solution for dealing with user demands for auditor qualitative commentary. These reviews will be performed for the purpose of detecting misstatements, inconsistencies, and/or ommissions in management's analytical commentary.

Table 2 - Cont.

Large, Publicly-held Entities
2006 Views of Users, Preparers, Audits and Auditors

Elements of the 2006 Views	Commentary on the Element
View of Audits and Auditors - cont.:	
• Auditors will be requested by preparers to give assurance in real time on significant, nonroutine transactions: • Continuous auditing will become the norm, leading to much faster issuance of the year-end audit report	Continuous auditing of routine transactions will involve auditor monitoring of the preparer's **process**, using new techniques enabled by technology - see below. Continuous auditing of nonroutine transactions will involve auditor examination of **outputs** of the preparer's system. In short, the audit will become process oriented for the routine and output oriented for the nonroutine.
• Worldwide audit networks will focus on timely responses to the "nonroutine," which will often involve multinational dimensions • Multi country, multi currency, etc.	Timely responses worldwide is recognized as an extremely important "value-added" dimension of the audit process involving large companies.

• As preparer systems become increasingly reliable in processing routine transactions, audit effort will shift away from getting the "bookkeeping correct:"
  • Detailed substantive tests for accuracy will be drastically reduced
  • Work on detailed "transaction error" controls will be rotated over several years
	Work on controls will shift focus to prevention controls for fraud and illegal acts.

• Audit emphasis will focus on solving the **tough problems** (see above list under **Users**)	Users will expect increased detection capability with respect to fraud, illegal acts, and financial disruption. Current audit performance in these areas is below user expectations.

Table 2 - Cont.

Large, Publicly-held Entities
2006 Views of Users, Preparers, Audits and Auditors

Elements of the 2006 Views	Commentary on the Element
View of Audits and Auditors - cont.:	

• The **tough problems** will be attacked with new weapons enabled by technology:
  • Triangulation that exploits connectivity of preparers
  • Electronic sensors
  • Software agents
  • Computer modeling of industry/company relationships
	Many of the information technology innovations that preparers will use to strengthen the reliability of their systems may also be exploited by auditors in identifying unusual transactions or events. Also, EDI linkages among preparers provides auditors with the opportunity to look at specific transactions from different entity perspectives.

• The **tough problems** will also be attacked by "sharpening" existing weapons:
  • Better understanding of industries
  • Better understanding of business and key processes in the value chain
  • Better understanding of risks
	The "better understanding" will be reflected in new makeups of audit teams - see below.

• GAAS will continue to evolve towards a more flexible, output-oriented framework, which will accommodate a variety of audit process reengineering initiatives by individual firms	Firm by firm innovation regarding audit processes will not be constrained by GAAS.

Table 2 - Cont.

Large, Publicly-held Entities
2006 Views of Users, Preparers, Audits and Auditors

Elements of the 2006 Views	Commentary on the Element
View of Audits and Auditors - cont.:	

• Auditor training will need to focus on:
  • Better understanding of the "multi" issues
  • Better understanding of industries
  • Better understanding of business processes
  • Better understanding of information technology
	Although this list contains no surprises, the Committee feels strongly that the **tough problems** will only be solved by bringing new knowledge and skill sets to the audit team.

• Audit teams will need to dramatically expand their knowledge and skill sets:
  • Fraud specialists
  • Legal, regulatory knowledge
  • Industry expertise
  • Business process expertise
  • Information technology skills
	See above comments on training .

Large, Publicly- held Company - 2006 Views

Based on the detailed analysis presented in Table 2, SCAS expects the following:

Users will ...

- Continue to want and need audits
- Exert increasing power vis-à-vis preparers
- Demand real time access to financial information
- Increase their competence in information technology
- Have rising expectations regarding audits

Preparers will ...

- Adopt a customer (user) focus
- Face increasing complexity
- Seek timely auditor involvement
- Develop highly reliable systems for the "routine"
- Experiment with a range of disclosure options enabled by information technology

Audits will ...

- Continue as the primary "check and balance" on the integrity of financial reporting in public markets
- Provide preparers with timely assurance for the "non-routine"
- Redirect resources away from bookkeeping to the "tough problems"
- Attack the tough problems with new information technology weapons and sharpened existing weapons
- Be conducted by teams with more varied skill sets
- Remain the "bedrock" upon which other assurance services will be built.

III - OVERVIEW OF A "NEW LINES" DEVELOPMENT PROCESS

SCAS and its various subcommittees are in the process of identifying new opportunities for the accounting profession involving extensions of existing assurance services and new assurance services. We hope that many of these identified opportunities will lead to the implementation of new services that will add value to users in their various decision-making activities. SCAS recognizes, however, that the real solution for the profession in the long run is not simply to identify a list of today's opportunities. Such a list will inevitably have a very limited useful life. Instead a ***process*** is needed that will: i) continuously monitor long-term trends affecting assurance services; ii) assess new market needs; and iii) convert those needs into new assurance services.

SCAS believes that such a process should reside within the AICPA. The AICPA has considerable strengths that can be used to identify and validate new assurance service opportunities. The Institute has standard-setting power, and it can play an important role in positioning new assurance services as "CPA services" in the marketplace. The AICPA benefits from a diverse and involved membership that has daily contact with the marketplace. The Institute also has a large membership that buys CPA assurance services (CPAs in industry and government). Finally, as an organization that represents many financial executives in the aforementioned groups, the AICPA has access to governmental agencies, regulators, other associations of professionals, and a variety of resources that are not generally accessible to individual CPA firms.

SCAS recognizes, however, that the AICPA presently has certain inherent limitations that makes it less than an ideal organization for identifying new market opportunities and quickly developing responsive assurance services.. Table 3 identifies some of the limitations in the AICPA that must be set aside or changed in order to adopt a more aggressive role in service development activities.

Table 3
Limitations in Present AICPA Process

AICPA Process	Desired Process
· Generally reacts to practice problems	· Early identification of customer needs
· Consensus is good for standards development but not for innovation	· Early release of business development information without standards development or consensus
· Limited access to capital for product development	· Ability to bring necessary effort to bear to create new services
· New opportunities do not benefit all members equally	· Ability to target markets
· Slow, open process avails information to competitors	· Timely development of standards, training, and practice guides
· Multiple review and approval processes limit innovation and delay product introduction	· Partnering with CPA and non-CPA enterprises for service development and delivery

Associations like the AICPA, by their nature, are intended to be inclusive, consensus-driven organizations. The professional staff, especially those responsible for standards setting operations, are encouraged to seek consensus from the membership and prevent unauthorized members from making statements or pronouncements that appear to be linked to the AICPA. The association staff must please all of the members, control the members, and protect the association infrastructure from criticism. This is not a particularly nurturing environment for fast-track development of new services that might, for example, benefit some firms more than others.

The AICPA also has very limited capital with which to develop new service opportunities. It is also not likely to be the principal beneficiary of revenues from new service opportunities. Individual firms that develop markets for the new services will be the primary beneficiaries and so will be willing to invest talent and capital to develop and bring them to market.

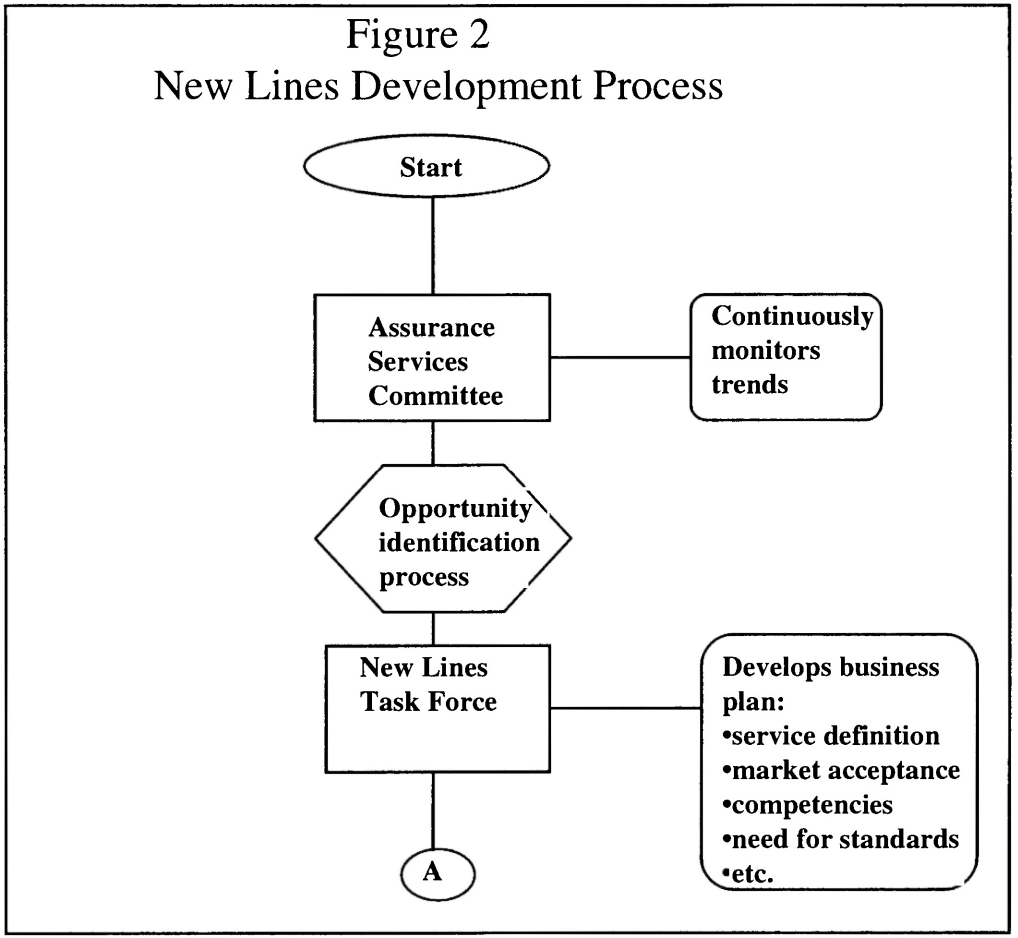
Some prospective new assurance lines can only be developed by the largest CPA firms. Others offer opportunities to small and medium-sized firms. There may also be new assurances services that benefit the entire spectrum of AICPA members in practice. While it might be in the profession's interest for all such opportunities to be developed under the AICPA's umbrella, it probably will not happen if they are subjected to a multi-level review and approval process.

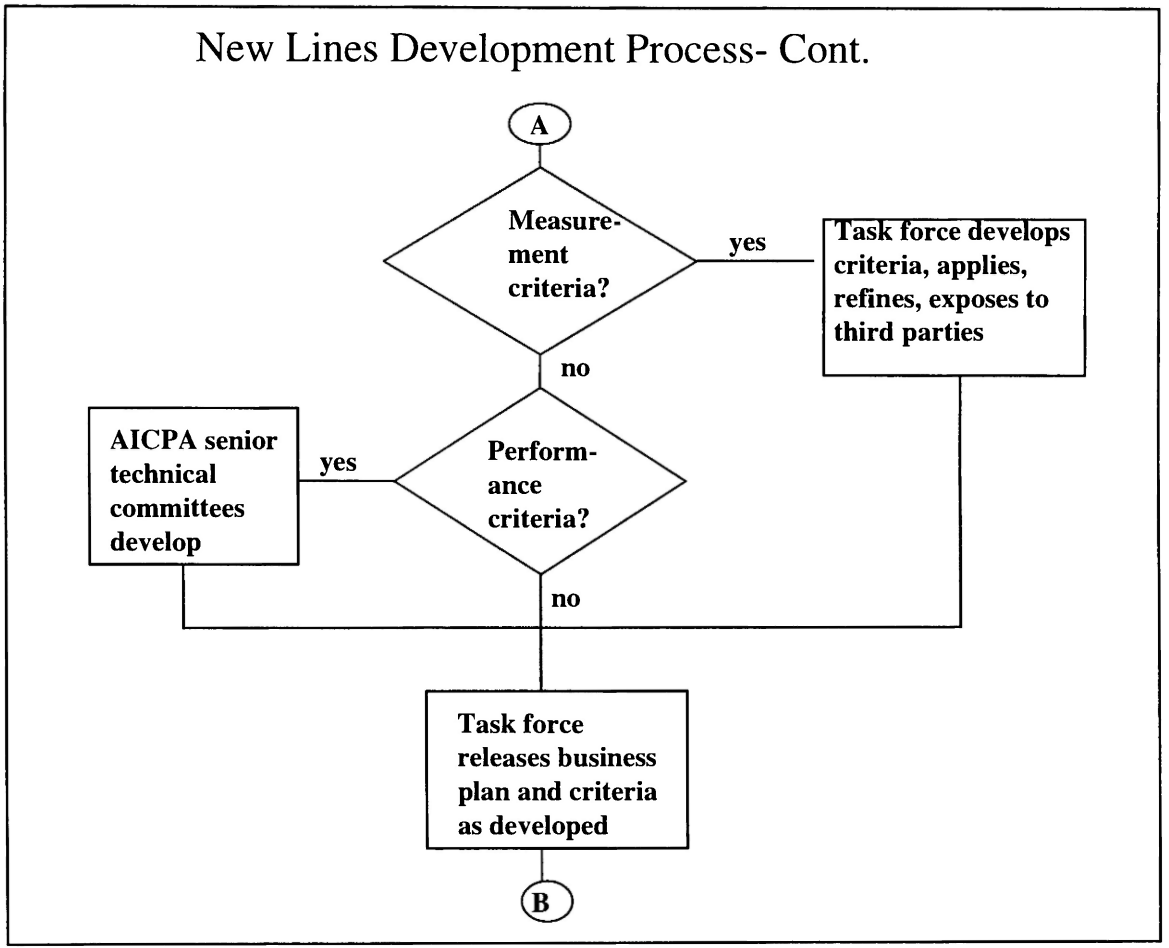
In sum, if the AICPA is to be successful in pursuing assurance services development on behalf of its membership, then it must introduce some changes in its own organization and approaches.

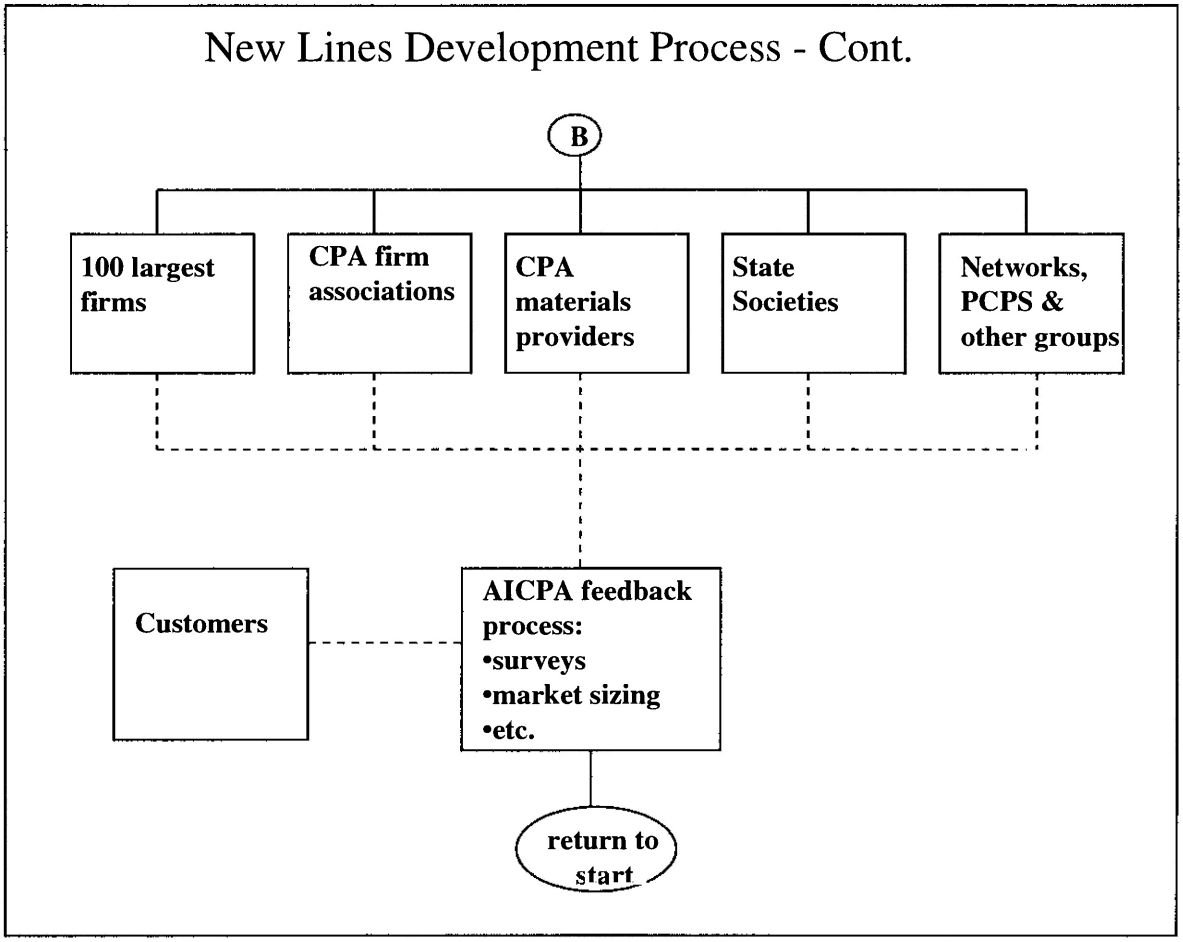
SCAS Proposal for a New Lines Development Process

SCAS believes that the AICPA should appoint a standing committee - the Assurance Services Development Committee (see Figure 2) - comprised of a mix of market-oriented senior partners of local, regional, and national firms that are actively involved in providing assurance

Figure 2
New Lines Development Process




New Lines Development Process- Cont.
A
Measure-ment criteria?
yes
Task force develops criteria, applies, refines, exposes to third parties
no
AICPA senior technical committees develop
yes
Perform-ance criteria?
no
Task force releases business plan and criteria as developed
B


New Lines Development Process - Cont.
B
100 largest firms
CPA firm associations
CPA materials providers
State Societies
Networks, PCPS & other groups
Customers
AICPA feedback process:
•surveys
•market sizing
•etc.
return to start

services. In addition, the Committee should include others within the profession who are known for their vision and future orientation. The Committee's charge would be to continuously collect and sift through information from a variety of sources to identify new or growing needs for assurance services.

As it seeks to monitor trends, the Committee would monitor the activities of the AICPA Washington office, the Strategic Planning Committee, Private Companies Practice Section (PCPS), senior technical committees, the Management of an Accounting Practice Committee (MAP), industry committees, the Accountants Forum, professional associations, such as those serving internal auditors and chief financial officers, and trends monitoring services. The Committee might also monitor developments in technology, government regulation, demographics, world trade, public policy, and a variety of other factors that could have long-term effects on assurance needs. The Committee would sift through massive and seemingly disconnected information in attempts to find meaningful and significant trends that show promise of giving rise to assurance needs. The Committee would make a preliminary assessment of which possibilities show the greatest potential for near-term development. Considerations would include market size, market attractiveness, the CPA's competitive advantages, the need for AICPA developed standards, and a variety of other issues.

For service areas that show great promise, the AICPA would create task forces to develop those services. A particular task force would bring together firms or individual CPAs who want to develop the identified service for their own practices. The task force might also create strategic alliances with industry or other specialized groups to create standards or market access.

Each task force would be charged with the development of a ***business plan*** for refining the identified service opportunity into a delivery mode. A business plan would address the various items listed in Figure 2 (see the **Health Care** example, below).

Members of a task force would be entitled to use the information developed by the task force in formulating new service strategies for their own practice units. Task forces would be obligated to develop business plans to a sufficient level where they can be shared with other practitioners who may wish to implement the new assurance services. If members of a task force decide to pilot the proposed new service in their own firms, they would be obligated to share the results of their efforts with the task force and other interested practitioners.

While individual CPAs or firms could develop new services on their own, task forces have the following advantages:

- Costs of development can be shared
- The Institute provides a forum for standards development
- A coordinated effort can help create a market through development of a critical mass of service providers
- The new service can be institutionalized under the CPA brand name.

If standards are required, a task force would communicate with and cooperate with appropriate senior technical committees or other working task forces to assist in their formulation. Also, a task force would develop the procedures and any reporting guidance in sufficient detail for practitioners to be able to understand and implement the services on their own. In addition, the AICPA would offer education, practice guides, and practice aids as appropriate.

Distribution to small firms would be accomplished through a variety of already established channels. Many smaller firms and sole practitioners might have limited ability to acquire the

competencies necessary to provide the new services. The AICPA would encourage development of appropriate training materials and practice aids through CPA associations (such as TAG, AAFI, and CPA Associates), state societies, CPA-oriented publishing houses, and franchisers. Wherever appropriate, the AICPA would follow along with standards and practice guides to assist practitioners and institutionalize the service as a "CPA service."

As with the development of any new products or services in any industry, it is probable that many proposed assurance services will fail. We hope that some will soar. The AICPA should establish measurement systems to assess how broadly new service opportunities are disseminated through its membership and the size of markets developed through the new assurance services model. The Institute may also wish to monitor public acceptance of new assurance services developed through this process. This will provide further information as to how market permission is obtained for new services.

IV - AN EXAMPLE OF AN OPPORTUNITY FOR EXTENDING ASSURANCE SERVICES

As a result of the research performed in phase I, particularly the 44 customer needs interviews that covered a broad spectrum of decision makers, SCAS has been able to identify a long list of potential unmet needs for assurance services. Some of the most promising possibilities are listed in Table 4. In addition, selected possibilities are briefly analyzed in Table 5.

If the "New Lines Development Process" was presently in place (see Figure 2, above), each of the opportunities described in Tables 4 and 5 (and possibly others identified by SCAS) would immediately be passed off to various New Lines Task Forces that would begin the development of appropriate business plans. To assist such future task forces in getting started, SCAS is in the process of developing a series of "first-cut" business plans for several of the opportunities identified in Tables 4 and 5. An example of one of those proposed "first cut" business plans (work in process) is described in the following paragraphs.

Table 4 Promising Customer Needs	
The Information/Assurance Need	**Potential Customers**
• Better information about business risk	• Boards of directors • Senior management
• Information about product quality	• Individuals
• Nonfinancial measures of performance	• Senior management • Individuals
• Quality of information reported to the board	• Board of directors • Institutional investors
• Quality of processes and controls	• Board of directors • Senior management • Investors
• Information about strategic plan execution	• Board of directors • Institutional investors
• Information about government performance	• Public (individuals and groups)

Table 5

Identified Customer Needs
Triangulation of Findings of Phase I

		The Customer's Need		Substantiation of Customer's Need		
Need ID	**Customer****	**Statement of primary customer's decision problem**	**Desired information set**	**Customer needs interviews**	**External factors analysis**	**Info. tech. analysis**
#1	**Primary:** -Boards of Directors of publicly held co's **Secondary:** -Senior mgmt. **(P)** -Institutional investors	**Corporate governance** - Is top mgmt. effectively managing the co's portfolio of risks? Ultimately, the board's decision is whether to keep the current slate of officers.	Information about various risks, the controls in place to address those risks, and the effectiveness of those controls	-Various board members -Former FASB member -K-Mart -3M Corp -Conference Board -Calpers	-Increasing public demands for accountability -Increased concentration of capital in institutional investors who will hold boards accountable -Increasing pace of change in global economy leads to rapid changes in risk profiles and need for continuous monitoring	--Rapid development and deployment of computerized risk assessment models
#2	**Primary:** -Individual consumers of health care services **Secondary:** -corp's and unions representing consumers -service providers **(P)** -third party payors (insurers, gov't)	**Quality of health care** - What is the relative quality of care being provided by various (competing) service providers? Ultimately, the consumer's decision involves the selection of a particular service provider.	Comparative provider information about various medical conditions and a provider's success in dealing with those conditions in terms of improving patients' quality of life	-GAO -OMB -Personal life needs identified by various interviewees	-Increasing public demands for accountability -Aging of the U.S. population -Cost capitation in health-maintenance organizations	- Shift in power from producers to consumers who now have easy access to vast amounts of data

** The likely payor for the "service" that would be involved in meeting the primary customer's information/decision-making need is identified with a **(P)**.

Table 5 - Cont.

Identified Customer Needs
Triangulation of Findings of Phase I

		The Customer's Need		Substantiation of Customer's Need		
Need ID	Customer**	Statement of primary customer's decision problem	Desired information set	Customer needs interviews	External factors analysis	Info. tech. analysis
#3	**Primary:** -Individual consumers (including parents) of primary, secondary, pos.-s:condary education (including life long learning - re ooling- programs) **Secondary:** -gov't (national, state, local) -educational institutions **(P)** -corp's and unions representing consumers	**Quality of education** - What is the relative quality of education being provided by various (competing) educational institutions? Ultimately, the consumer's decision involves the selection of particular institutions at all three levels of education.	Comparative information about various program offerings and the success of those programs in building knowledge, skills, and values, and for adult programs the success of programs in achieving employment.	-SUNY -Personal life needs identified by various interviewees	-Increasing public demands for accountability -Cuts in funding of education places a premium on program effectiveness -Movement towards alternative forms of education -Increasing pace of change leads to a need for frequent retooling	- Shift in power from producers to consumers who now have easy access to enormously more data -emergence of electronic distance education- anytime, anywhere, self-paced
#4	**Primary:** -Senior mgmt. **(P)** **Secondary:** -Boards of directors -Customers -Suppliers -Investors -Creditors	**Quality of internal processes and controls** - Are internal processes [i.e., sets of activities that produce results of value to "customers"] and controls designed and operating effectively in terms of specified objectives regarding customers, suppliers, employees, and other stakeholders? (An overview of various activities/processes that might be the focus of this decision are presented in the COSO activity model -Exhibit 2 - attached.) Ultimately, management's decision is whether to make significant changes in processes (reengineer) and/or controls, or possibly to outsource the process.	Information about the design and operating performance characteristics of key internal processes (e.g., cost, quality, service, cycle time, customer satisfaction, percent of on -time deliveries, etc.) and related comparative (benchmark) data reflecting best practices.	-Cenith -Norwest Bank -Harris Bank -Ultrak -Alcoa -Eastman Kodak -U.S. Home Corp. -CBI Industries	-Competition intensifying -Increasing pace of change (significant reductions in product and service life cycles)	-Shift in power from producers to consumers who now have easy access to enormously more data -Need for integrity of processing and controls -User needs for a much broader range of information for decision-making, including operational information

Table 5 - Cont.

Identified Customer Needs
Triangulation of Findings of Phase I

		The Customer's Need		Substantiation of Customer's Need		
Need ID	**Customer****	**Statement of primary customer's decision problem**	**Desired information set**	**Customer needs interviews**	**External factors analysis**	**Info tech. analysis**
#5	**Primary:** -U.S. Gov't **(P)**	**Outcomes of gov't programs** - Are individual government programs effective in achieving desired outcomes?	Information/measurements about program costs (including aggregations across agencies related to a particular program) and related impacts/outcomes	-GAO -OMB	-Government Performance and Resp. Act (1997 budget process) --Increasing public demands for accountability in gov't programs	
#6	**Primary:** -Individual consumers of products/services **Secondary:** -Producers of the products/services	**Product/service quality** - What is the relative quality of a product/service being provided by various (competing) producers? Ultimately, the consumer's decision involves the selection of a particular product/service from among a range of possibilities.	Comparative information about various dimensions of quality (reliability, durability, serviceability, operating performance characteristics, esthetics, etc.)	-Personal life needs identified by various interviewees	-Increasing public demands for accountability -Aging of the population: more emphasis on frugality, thriftiness, leading to more comparison shopping	-Shift in power from producers to consumers who now have easy access to enormously more data

Other primary customer decision problems that have surfaced in customer needs interviews but have not yet analysed include the following:

7. Senior management - quality of **supplier** processes/products
8. Various levels of management - quality of **lower level management**, e.g., BofD==>senior mgmt.; senior mgmt. ==> lower level mgmt.
9. Senior management - quality/reliability of potential or engaged **outsource**
10. Boards of directors - quality of company's **strategic planning processes**
11. Senior management - progress/outcomes of **alliances**

"First-cut" Business Plan for Non-financial Performance Measures - Health Care

Presently, the health care industry accounts for one-seventh of the US economy; total expenditures exceed one trillion dollars per year. The industry is in a state of transition. In the past, a large portion of individuals' health services were provided through fee-for-service arrangements involving employer-paid health insurance companies or government-sponsored programs (Medicare and Medicaid). Presently, a dramatic shift towards managed care networks is taking place. In this new "model," networks negotiate on behalf of consumers with health care providers to establish cost and terms of coverage. Since "cost" (i.e., revenue to the health care provider) becomes fixed in advance, the incentive for health care providers becomes one of reducing their service expenses, which may lead to reductions in quality of service.

Assurance Service Definition

CPAs would report on a set (yet to be established - see below) of "quality measures" deemed to be important to consumers of health care services. Measures might include global outcomes, such as mortality statistics, length of stay, patient satisfaction scores, and specific outcomes related to specific diseases (see further below). The health care provider might accumulate and present the data on which the CPA reports (as in current audits and attestation services). Alternatively, the CPA might accumulate relevant data on an entity's performance and report directly.

Who Pays

Although CPAs might be paid by individual consumers, it is more likely that the health care provider would pay for assurance services. Since an obvious conflict of interest arises when providers make claims about the quality of their services, users may demand that providers obtain outside assurance with respect to those claims. Even if not forced to offer outside assurance, providers may find it in their best interests to obtain assurance on their "quality of care" reports because it gives them a competitive advantage in the market place.

Market Size

SCAS is in the process of developing estimates of the revenue potential for assurance services in this market.

Measurement Standards

Measurement standards for the quality of health care are being developed by various organizations. For example, a group of major purchasers of health services recently formed an alliance to evaluate the quality of services provided by health-maintenance organizations (HMOs). Participants include the Health Care Financing Administration, which oversees Medicare and Medicaid, the Federal Employees Health Benefits Plan, the California Public Employees Retirement System, and several large private corporations. Altogether, the alliance represents 80 million Americans. The participants have formed an organization called the Foundation for Accountability that will develop a new generation of measures for evaluating the performance of health plans. The new measures will move away from existing input or process measures (e.g., frequency of emergency room visits, mammography-screening rates) and towards outcome measures that will track the impact of a disease on a person's productivity and quality of life. In short, the new measures will attempt to identify whether HMO services are having a positive impact on the health of people. The first few medical conditions for which outcome measures will be developed include breast cancer, asthma, diabetes, cardiovascular disease, low-back pain, and depression.

The National Committee on Quality Assurance has also developed some rudimentary criteria for measuring the quality of care provided by HMOs. This committee reviews the data provided by HMOs through location visits and examination of patient records.

Market Permission and Market Access

CPAs would appear to face serious permission problems. On the positive side, CPAs may be recognized as having integrity and objectivity as well as being competent in testing and reporting results, On the negative side, CPAs will certainly be viewed as lacking subject matter expertise. As the above discussion of measurement standards indicates, performance measures in health care are beginning to focus on specific diseases and will attempt to measure a health care provider's impact in treating those diseases.

CPAs might attack the "permission" problem and gain access to the market by: i) leveraging their present expertise in the health care consulting area; ii) getting involved in the health care performance standard-setting process and thereby become recognized as a "player" in this arena; iii) outright hiring of MDs to work on health care assurance engagements; and iv) forming alliances with health care entities that would bring the necessary subject matter expertise to the assurance function. Another entry point for individual CPA firms might be based on current audit services and other services presently provided to hospitals and other health care entities

Competition

Other players besides the Foundation for Accountability and The National Committee on Quality Assurance (see above) have recognized this market and are moving quickly to fill demand. The Joint Commission for Accreditation of Health Care Organizations, which was established by the American Medical Association and various hospital groups, performs a similar function for hospitals and reports on more than 11,000 organizations in a three-year cycle. In some areas, local providers have also emerged. For example, in Cleveland, hospitals have joined together in providing an annual report: *Cleveland Health Quality Choice, the Cleveland Area Hospital Quality Outcome Measurements and Patient Satisfaction Report.* In sum, competition appears to be substantial. However, the range of proposed solutions and the infancy of proposed outcome measurements suggests that the market is fluid and that no organization has yet established a dominant position.

Competencies

CPA competencies in business processes, model building, measurement, analysis, and reporting would be helpful in entering the health care performance market. As indicated above, the primary new requirement would be to add subject matter expertise, either by outright hiring or by forming alliances.

V - Summary of Paper

SCAS is approximately two-thirds of its way towards completion of its charge. This paper provides brief overviews of several items that represent "work in process" of the committee. Although much work remains, this paper highlights some of the major ideas that are beginning to take shape:

- The future demand for assurance regarding the quality of information used in decision-making appears to be very strong.

- Information technology will provide decision makers with ready access to vast amounts of information (much of it derived from systems of high reliability), which will create major user needs for assurance regarding relevance.

- The current audit is expected to change significantly and, at the same time, will provide the foundation upon which a range of new assurance services will be built.

- The profession needs to put in place a process for the orderly identification and development of new assurance services.

- The health care industry appears to be a very promising arena for the introduction of new assurance services.

Appendix
Assurance vs. Consulting Services

Professional standards define consulting services as:[8]

> Professional services that employ the practitioner's technical skills, education, observations, experiences, and knowledge of the analytical approach and procedures used in a consulting engagement. [Those procedures may involve determining client objectives, fact-finding, definition of problems or opportunities, evaluation of alternatives, formulation of proposed action, communication of results, implementation, and follow-up.]

A comparison of the procedures involved in consulting with the types of assurance shown in the middle column of Table 1, above, indicates considerable potential overlap. Indeed, there are many similarities between consulting and assurance services since both are delivered using similar knowledge and skills. However, the two services may be distinguished as follows:

- **Parties involved** - Consulting services typically involve two parties, the consultant and client. An assurance service involves three parties, the preparer, the user, and the assurer (the preparer and user may be members of the same entity, e.g., top management vs. middle management). Moreover, the need for the assurer arises because of the user's perception that user and preparer interests are in direct conflict, or are not completely congruent.

- **Engagement focus** - Consulting services focus on outcomes. Assurance services focus on the quality of information (including decision models) used in decision making.

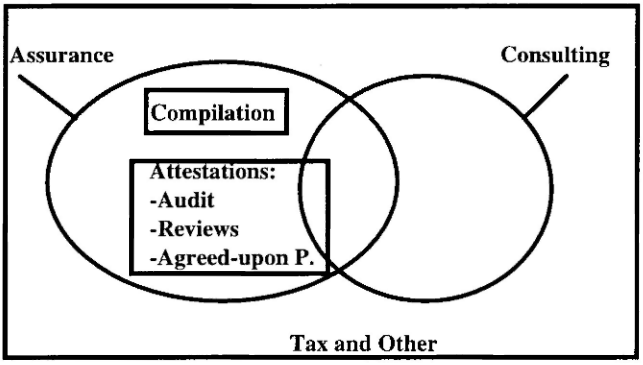
- **Primary output** - A consulting engagement generally leads to a set of recommendations. An assurance engagement results in the assurer providing some level of assurance regarding the quality of information used by the decision maker.

The "universe" of CPA services, involving assurance, consulting, tax and other services may be graphically represented as shown in Figure 3, below. In this figure, the largest rectangle represents the "universe of CPA services." The left and right circles represent the totality of assurance and consulting services, respectively. The rectangles within the assurance circle explicitly identify currently offered assurance services. The areas of overlap between the assurance and consulting circles, as well as the overlap between the attestation rectangle and the consulting circle represent service possibilities that, if structured one way, represent assurance, and, if structured differently, represent consulting.

[8] AICPA Professional Standards, CS Section 100.

Figure 3

The Universe of CPA Services



Discussion of "Opportunities for Assurance Services in the 21st Century: A Progress Report of the Special Committee on Assurance Services"

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INTRODUCTION

Conventionally, a discussant's task is to comment on a research paper which typically contains a statement of the research question and its importance, a design for answering that question, a description of methods used and approaches taken, and a presentation and interpretation of results. The progress report which I have been asked to discuss does not fit this pattern; instead of being a research paper, it is a description of an ongoing process or a set of as-yet uncompleted activities. Therefore, a conventional discussion would not be appropriate, and my discussion will take the unorthodox approach of commenting on the processes and preliminary recommendations of the AICPA Special Committee on Assurance Services (the Special Committee) as they are laid out in Richard Lea's paper.

As I interpret the assignment of the Special Committee, it is to provide answers to two questions:

(1) What *new* lines of business should CPA firms enter?

(2) What threats and opportunities are likely to be encountered in doing so?

It is noteworthy that these questions are being addressed at the level of the accounting profession--it is not easy to imagine similar activities occurring in most industries. Would we, for example, expect to see the major U.S. airlines or the major U.S. auto manufacturers jointly sponsoring research into how they could extend their current lines of business? Attempting to carry out this inquiry at the level of the profession (as opposed to the level of the individual firm) clearly has advantages and disadvantages, which are commented on in Professor Lea's report and which I will address in section 3 of this discussion. Sections 1 and 2 contain my comments on the Special Committee's proposals for answering the two questions posed in this paragraph as those proposals are reported in Professor Lea's paper.

WHAT NEW LINES OF BUSINESS SHOULD CPA'S ENTER?

What is the appropriate definition of "assurance services"?

In answer to the first question--what new lines of business should CPA firms enter--it would appear that the Special Committee will recommend that CPA firms become providers of "assurance services." Under the proposed definition provided by Professor Lea in section I of his report, "Assurance services are independent professional services that improve the quality of information or its context for decision-makers." In the text discussion accompanying table 1 in his report, however, Professor Lea broadens this definition to include "any services that assist information users in improving the quality of their decision-making information, including their decision model." Relative to the first definition, the second drops the notion of professionalism/independence and adds the idea of improving users' decision models.

Both definitions of assurance services provided in Professor Lea's report are expansive relative to that provided by a group whose 1993 conference was the impetus for the formation of the

Special Committee;[1] the definition provided by the conference participants is: "An assurance service involves the expression of a written or oral conclusion on the reliability and/or relevance of information and/or information systems" (*The CPA Journal* (1996)). Relative to the definitions in Professor Lea's report, this definition is restrictive in that it confines assurance to opining on information (or an information system), without taking actions to alter either one.

While in all cases the purpose of the definition is to guide CPAs in expanding their professional services beyond the provision of traditional audits, the form of the guidance and the kinds of activities implied differs considerably across the three definitions. The two definitions in Professor Lea's report focus on quality of information; the 1993 conference definition focuses on relevance and reliability of information. Do these have the same implications for the expansion of CPA firms' lines of business?

Professor Lea's report gives relevance and reliability as the two primary characteristics that make information useful for decision making, so it would appear that quality is measured by some combination of these two characteristics. This does not mean, however, that all would agree that these two characteristics exhaustively measure the quality of information, given the implications of other portions of Professor Lea's report. That is, if the assurance services which CPA firms might offer would focus on a variety of financial and nonfinancial information (and it appears from the report that they would), it is by no means clear that quality would be appropriately measured by just these two attributes.

Other quality measures that in my view are implied by Professor Lea's discussion of specific forms assurance services might assume include conformity to rules and procedures; if it is assumed that a system is set up to maximize some objective (which might but need not involve a combination of relevance and reliability) then quality might increase with the degree of conformity to the specifications of that system (for example, ISO9000 guidelines). A second example is fineness; if aggregation destroys information, then quality might be increasing the fineness of the information (as is alleged, for example, in the case of activity-based-costing systems). A third example is timeliness; some of those who believe that accounting information is losing market share in the competition for investors' attention would focus on timeliness--perhaps even if it meant some sacrifice in reliability--as a quality attribute.

The point of these examples is that if CPA firms are to offer assurance services which improve on the quality of financial and nonfinancial information it may be necessary to take an expansive (relative to the conventional accounting view which measures quality in terms of relevance and reliability) view of the attributes which measure quality.[2] Defining quality metrics has implications for choosing which types of assurance services activities would be likely to improve quality. Since it is these activities which will define the new lines of business for CPA firms, the choice of measures of quality will have an important influence on this definition.

Is there any internal inconsistency about which lines of business are appropriate?

This is another way of asking: Can a person who improves information quality also attest to the resulting quality? This question arises because the 1993 conference definition implies the expression of an opinion about information quality while the two definitions in Professor Lea's

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1. In May of 1993 the AICPA sponsored a conference whose participants included representatives of the practicing profession (including small and medium-sized CPA firms), regulators and academic accountants. The purpose of the conference was to consider the future of the attest function. Among other things, the conference participants proposed that the phrase "assurance" be used to describe the collection of activities envisaged for CPA firms in the future.

2. A more expansive attribute list of high quality information is found in Elliott (1994), who lists reliability, relevance, credibility and timeliness. This list is of interest because Robert Elliott is the chairman of the Special Committee.

report imply taking actions which are intended to alter (improve) information quality. (The question can also be viewed as raising the issue of auditor independence, a matter which is not the subject of this discussion.[3])

My objective in raising this question is to comment on the distinction between consulting (which might very often involve the improvement of information quality) and assurance. In making these comments, I am focusing primarily on the first of three distinctions between consulting and assurance drawn by Professor Lea in the Appendix ("Assurance vs. Consulting Services") to his report. In a consulting arrangement, there is a consultant and a recipient of his report (the client)--no other party is involved and there is no assumption of a conflict of interest. In contrast, assurance services are intended to solve or at least mitigate an agency problem--three parties are involved (preparer, user and attestor); because the user perceives that his interests and those of the preparer are not congruent he is concerned about the information provided by the preparer; the attestor reduces this conflict by providing assurances about the information developed by the preparer. If the attestor gathers the information or is substantially involved in improving its quality, then the agency relationship no longer involves three distinct parties; partially or wholly merging the attestor role with the preparer role undermines the ability of the attestation function to solve the agency problem. It appears to me that such a merger is contemplated by the Special Committee; in the text discussion accompanying table 1 of his report, Professor Lea emphasizes that many of the assurance services considered by the Special Committee "would involve adding an assurance component to present consulting services."

The potential for confusion of roles is visible in the presentation of a "first cut" business plan for nonfinancial performance measures in the health care industry; the plan appears in section IV of Professor Lea's report. The definition of assurance services for this business plan notes that the health care provider might accumulate and present the data and the CPA might report on the data *or* the CPA might perform both tasks. This definition does not sharply distinguish the preparer from the attestor role as (I argue) is required to distinguish attestation from consulting--how then can sharp distinctions be expected in practice?

While some may argue that sharp distinctions between preparation (involvement in developing the information) and attestation (opining on some attributes of the information) are unnecessary as a practical matter, I believe those arguments have to rest on a view of the attestation function which differs in fundamental ways from the traditional view, in which attestation exists to solve an agency problem. Absent a full exploration of that alternative view and its implications for the accounting profession, I think it would be premature to dismiss the practical implications of mixing the preparer role with the attestation role.

Are some assurance service lines of business less attractive or less suitable for CPA firms than others?

There are numerous forms of assurance services and the definitions provided in Professor Lea's report do not provide guidance as to which are most suitable for CPA firms. I believe there is some possibility that the Special Committee has not in fact been able to distinguish assurance services where CPAs have a comparative advantage from certain other types of assurance services. Specifically, table 4 of Professor Lea's report lists "Promising Consumer Needs" for assurance services which include better information about business risk, information about product quality, and information about quality of processes and controls (among other things). To provide some idea of how existing service providers--who are usually not CPAs-- meet these customer needs, in a way that fits the expanded definition of assurance services given in Professor Lea's report, I will provide four examples.

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3. For two quite different perspectives on auditor independence, see Sutton (forthcoming) and Wallman (1996).

Example 1 is bond rating agencies, whose objective is to provide independent judgments about one component of bond valuation models, namely, default risk. Example 2 is sell-side equity analysts, whose objectives include (among other things) providing information about the business risk of public companies. Example 3 is accreditation services (e.g., the AACSB) whose objectives include attesting to the extent to which accredited institutions meet specific benchmarks which are intended to capture product quality. Example 4 is consumer rating agencies which provide direct assessments of product quality (e.g., Consumers Union, Bests Insurance Ratings). In all these cases, external parties take actions to improve the quality of information on which resource allocation decisions are based; thus, they are providing assurance services.

The point of these examples is *not* to argue whether CPAs should or should not offer certain types of assurance services. The point is to note that since there are already providers of some assurance-like services, it is essential to consider very carefully what are the opportunities in a given line of business, what is the comparative advantage of the CPA relative to other service providers in this line of business, and what are the threats to entry (of which existing service providers is just one example).

WHAT THREATS AND OPPORTUNITIES ARE CPA'S LIKELY TO FACE?

In a 1994 article in the *Journal of Accountancy*, Robert Elliott, the chairman of the Special Committee, provided a short sketch of his vision of the future for assurance services. In speaking of the desirability of extending lines of business, Elliott pointed to the notion that dealing with all kinds of information is the CPA's natural domain: "CPA's have a natural advantage in helping business decision makers navigate these seas of data [created by on-line information sources] and gather what will best support their decision needs" (Elliott (1994), p. 78). The question arises as to what precisely are the determinants of this natural advantage, relative to existing providers of services that increase information quality, such as investment bankers and consultants? Absent a full consideration of just where the CPA's competitive advantage lies, it is not clear that entry into certain assurance lines of business would be successful.

In my view, the most important advantage of the CPA in extending into assurance services is not expertise; it is the existence of substantial amounts of "brand capital" associated with the CPA certification--integrity, objectivity, high professional standards of conduct. I argue that a substantial portion of this brand capital arises from the existence and enforcement of tight regulations (e.g., licensing requirements, CPE requirements, GAAS). Some might argue that a portion of the capital also arises from a careful demarcation between preparing financial statements and attesting to them, with CPA brand capital supported by the ability of CPAs to demonstrate the independence of their attestation activities from preparation; I do not consider this source of brand capital in these comments, except insofar as independence from preparation is caused by regulation.

The question arises: does it make sense to extend the notion of regulation--which gives rise to brand capital--to the provision of assurance services that may already exist in some wholly or largely unregulated form? The answer is not clear. It may be that regulation will only hamper CPAs in competing with less-regulated providers of assurances (e.g., analysts, investment bankers, consultants). It may also be that the value of the CPA's brand capital could be damaged by combining regulated and unregulated assurance activities in the same firm; the severity of whatever damage could ensue is of course an empirical question.[4] The question facing the profession as it considers expansion into assurance services is whether and how the brand capital developed in large part from the provision of mandatory audits of financial statements--viewed by some as a low-growth, price-sensitive business--can be extended profitably into assurance services without

4. This again raises the notion of auditor independence; operational measures of auditor independence have been debated for years in the context of CPA firms providing management advisory (consulting) services separate from their audit services.

destroying the capital.[5]

THE AICPA'S ROLE IN DEVELOPING NEW ASSURANCE SERVICES

Professor Lea's report contains a proposal that new product development should occur at the level of the profession (i.e., it should be undertaken by the AICPA). This proposal raises three questions. First, will the largest firms (those with the internal capability of generating new products) participate? Second, given the AICPA's role as a *professional* association, is it useful and appropriate to add to this role a set of activities which are in some sense directly in conflict with the Institute's traditional core activities? In other words, would it be more useful to have the AICPA develop standards for products developed by individual firms? Third, does the fact that financial statements are standardized and regulated at the level of the profession imply that product development should take place at the same level?

In answer to the first question, it is no secret to anyone familiar with the activities of Big 6 accounting firms that they are already extending their lines of business. In some instances, the activity is described as "re-engineering the audit" or "adding value to the audit"; a common element, however, is the introduction of activities that are close to if not completely within the scope of the definition of assurance services provided in Professor Lea's report.[6] Given their own within-firm activities, it then becomes an economic decision within each large CPA firm whether to devote resources (in the form of financial support, ideas and expertise) to the AICPA's efforts *as well.* Clearly, there is an economic incentive for large-firm defections from any profession-wide new product development process, and it is not clear that the AICPA can develop a practicable organizational structure for developing new products that would neutralize this incentive.[7]

The second question concerns the perils and advantages of combining professional association activities with new product development activities. I believe that table 3 of Professor Lea's report lays out the conflict clearly. In particular, professional associations with self-regulatory functions must be characterized by consensus development, open processes, and multiple review and approval processes if they are to develop effective standards. These three features in particular are in direct conflict with the desired specifications (also in table 3) of a new product development process. While Professor Lea's report seems to be quite firm on the suggestion that the AICPA modify itself as necessary to accommodate the new product development process, the report does not seem to me to make a compelling case that the accounting profession as a whole is sure to be better off in the long run if some aspects of the self-regulatory function were sacrificed to put a new product development process in place. In the discussion of this issue in Professor Lea's report, I found insufficient weight placed on the role of the self-regulatory function in developing CPA brand capital and relatively too much weight placed on the value of having new product development occur within a professional association; others might have different views, but the point is that making this choice will have profound effects on the future of the profession.

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5. The point that providing mandatory audits is a low-growth, price-sensitive line of business has been made in many places; for one such example, see Elliott (1995).

6. For a summary of selected activities among Big 6 firms, see *Emerson's Professional Services Review* (May-June, 1996), "Coopers &Lybrand: Creating a "Whole New Ball Game" for Business Assurance Services." While the focus of the article is on Coopers &Lybrand, certain activities of Arthur Andersen, Price Waterhouse, Deloitte & Touche, and KPMG PeatMarwick are also touched upon.

7. Section III of Professor Lea's report ("Overview of a 'New Lines' Development Process") lays out the basis for the committee's recommendation that the AICPA undertake new product development for the profession, discusses certain strengths and weaknesses of the AICPA in this role, and notes that the AICPA must change some of its approaches and structures if the development efforts are to succeed.

The third question draws an analogy between financial statements (an "industry-level" product) and new assurance services--if the former is regulated at the industry level then new product developments should occur there too. This analogy appears in Robert Elliott's comments at *The CPA Journal* Symposium on the Future of Assurance Services (*The CPA Journal* (1996)):

> The accounting profession and typical market-driven business activity are different. Our product design takes place at the industry level. For example, my firm cannot design its own financial statement presentation using its own GAAP....We have a standardized product...and our research and development takes place at the industry level, not the company one.

In my view, this analogy depends on the assumption that whatever new assurance services are provided by CPA firms will be regulated and standardized along the same lines as financial reports. It is not clear to me, given the diverse ways that Big 6 firms have begun to extend into business assurances, whether such standardization and regulation are currently in place. However, the extensions so far have been relatively modest compared to those apparently envisaged by the Special Committee and the possibility remains that the most appropriate approach might be to fold assurance services into the same type of regulatory framework that is currently provided by GAAS.

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The CPAS / CCM[1] experiences: Prospectives for AI/ES research in Accounting

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INTRODUCTION

This paper discusses the findings from the Continuous Process Audit System[2] (**CPAS**) and Continuous Control Monitoring (**CCM**) efforts and extrapolates into areas of potential research in AI & ES in Accounting. First we describe the motivation and key factors in the CPAS efforts, then we show how an effort a la CCM[3] can be applied onto the basic framework. In the next section we discuss some technological features and problems. Then the prospective approaches for the problems found are discussed. Finally the conclusions section summarizes the discussion and proposes some additional routes for future research.

ELEMENTS OF THE CPAS EFFORT

The CPAS project was motivated by a survey of an Internal Audit organization that identified large corporate systems as potentially a very large exposure for the corporation. The CPAS methodology was developed to measure and detect any major problems that may be occurring during the day-to-day operation of large corporate computer systems. The methodology initially focused on very large main-framed corporate legacy systems where more than one copies of a system ran in multiple data-centers around the country. Later developments allowed for the conceptualization of the process in distributed and client-server environments.

Basic concepts

The placement of software probes into large operational systems for monitoring purposes may be an intrusion on the system and can result in performance deterioration. The installation of these monitoring devices must be planned to coincide with natural life-cycle changes of major software systems. Interim measures should be implemented to prepare for online monitoring.

The CPAS effort consisted of a data provisioning system and an advanced decision support system. Data can be gathered from tailored reports (files) from the application, reports from the application, and direct monitoring data. The approach used in CPAS is dual, evolving from a **measurement phase** without intrusion and minor system overhead, to a **monitoring phase** where intrusion is necessary[4] but audit capability is substantially expanded.

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[1] CPAS stands for Continuous Process Auditing, CCM stands for Continuous Control Monitoring

[2] Vasarhelyi, M. A. & Halper, F. B., "The Continuous Audit on Online Systems," **Auditing: A Journal of Practice & Theory**, Vol. 10, No. 1, Spring 1991, pp. 11-125.

[3] Vasarhelyi, M. A. & Halper, F. B., "**Continous Control Monitoring**," a monograph submitted to the Institute of Internal Auditors, forthcoming, 1996.

[4] Intrusion and system overhead may be limited by utilizing database backup and recovery traces as the main source of transaction data, dumping a copy of these traces onto a local workstation, loading the workstation with some expert software and having it as a local interchange device.

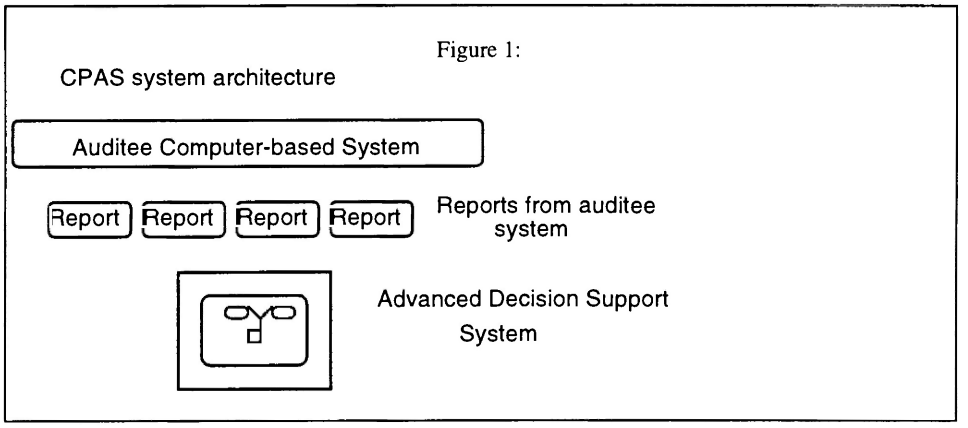
Measurement

Copies of key management reports are issued and transported through a data network to an independent audit workstation at a central location. These reports are stored in raw form and data are extracted from these reports and placed in a database. The fields in the database, map with a symbolic algebraic representation of the system that is used to define the analysis. The database is placed on a workstation and analysis is performed at the workstation using the information obtained from the database.

Monitoring

In the monitoring phase, audit modules will be impounded into the auditee system. This will allow the auditor to continuously monitor the system and provide sufficient control and monitoring points for management retracing of transactions. The level of aggregation and difficulties of balance and transaction tracing that are prevalent in current systems will decrease in the future as processing economies that dictated the limited trace-ability of transactions will not be needed as systems become more powerful.

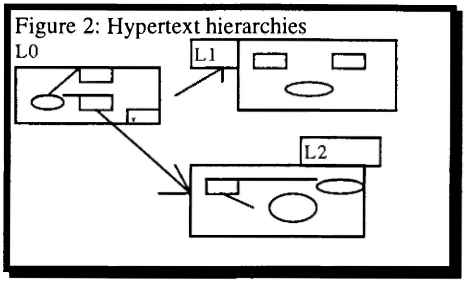
The Continuous Process Audit System (CPAS) used the "measurement" strategy of data procurement. This is illustrated in Figure 1. The auditor logs into CPAS and selects the system to be audited. The front end of CPAS allows the auditor to look at copies of actual reports used as the source of data for the analysis.



From here the auditor can move into the actual analysis portion of CPAS. In CPAS, the system being audited is represented as flowcharts on the workstation monitor. A high level view of the system (called data flow 0- DF level 0 in Figure 2) is linked hierarchically to other flowcharts representing more detail about the system modules being audited. This tree oriented view-of-the-world which allows the user to drill down into the details of a graphical representation is conceptually similar to the **Hypertext** approach [Gessner, 1990][5] [6] The analysis is structured along these flowcharts leading the auditor to think hierarchically.

[5] Gessner, R., "Building A Hypertext System," **Dr. Dobb's Journal**, (June 1990), pp.22-33.

[6] The Hypertext approach is not new being traceable to the 1960s work of Ted Nelson. It is currently quite popular due to its implementation in personal computers, the World Wide Web, its affinity to object-oriented thinking and many implementations both in commercial and public domains.



An integrated view of the system is available at DF level 0. This logical view of the system can be associated to diagnostic analytics that count the number of exceptions and/or alarms current in the system. Detailed information about each main module is available at the lower levels. This type of thinking is similar to "hypertext" conceptualization where symbolic and relational links can be specified across levels.

This information is presented primarily as **metrics** and **analytics.**

Metrics

Metrics are defined as direct measurements of the system, drawn from reports, in the measurement stage. These metrics are compared against system standards. If a standard is exceeded, an alarm appears on the screen. For example, in the auditing of a billing system, the number of bills to be invoiced is extracted from a user report. The number of bills not issued due to a high severity error in the data is captured as well as the total dollar amount of bills issued. These three numbers are metrics that relate to the overall billing process.

Analytics and Alarms

Analytics are defined as functional (natural flow), logical (key interaction), and empirical (e.g. it has been observed that ....) **relationships** among metrics. Specific analytics, related to a particular system module, can be derived from the auditor, management, user experience, or historical data from the system. Each analytic may have a minimum of three dimensions:

- its algebraic structure,
- the relationships and contingencies that determine its numeric value at different times and situations and
- rules-of-thumb or optimal rules on the magnitude and nature of variance that may be deemed as "real variance" to the extreme of alarms.

For example, a billing analytic would state that dollars billed should be equal to invoices received, minus values of failed edits plus (or minus) the change of the number of dollars in retained invoices. The threshold number of expected invoices for that particular day or week (allowing for seasonality) must be established to determine whether an alarm should be fired.

Actual experience with these issues indicates that several levels of alarms are desirable:

1. minor alarms dealing with the functioning of the auditing system,
2. low level operational alarms to call to the attention of operating management,

3. higher level alarms to call the attention of the auditor and trigger "exception audits" and

4. high level alarms to warn auditing and top management of serious crisis.

Establishing these alarm thresholds is a second harmonic development. The data and experience needed to understand the phenomena being measured to the level of specification of alarm standards are probably not available in most organizations. Experience with a CPAS-like system will aid in their development.

In Continuous Process Auditing, data flowing through the system are monitored and analyzed continuously (i.e., daily) using a set of auditor defined rules. System alarms and reports call the auditor's attention to any deterioration or anomalies in the system. Continuous Process Auditing then, is really an analytical review technique since constantly analyzing a system allows the auditor to improve the focus and scope of the audit.

Furthermore, it is also often related to controls as it can be considered as a meta form of control (audit by exception) and can also be used in monitoring control (compliance) either directly, by looking for electronic signatures, or indirectly by scanning for the occurrence of certain events. The accounting literature has suggested other forms of supplementing traditional control techniques by creating a formal methodology of internal control representation and analysis [Bailey et al., 1985[7]; Bailey et al., 1986[8]) or by using the entity-relationship approach [McCarthy 1979[9], 1982[10]] The technology used in the CPAS effort is described by Vasarhelyi et al.[11]

Auditor and knowledge issues

The set of analytics and heuristics used in CPAS included a wide variety of algorithms ranging from flow-based rules to expert algorithms drawn using techniques in knowledge engineering. These algorithms will be used both in the auditor platform, as analytical supplements, as well as impounded into software probes in the monitoring stage.

Expert systems techniques have been examined by several auditing researchers [see Kelly et al, 1988] as well as implemented in practice on a limited basis dealing with certain tax (tax accruals) and financial accounting issues (e.g. bank loan portfolio estimation) [Hansen and Messier, 1987[12]; Vasarhelyi, 1988[13]]. Audit knowledge is needed to supplement the simple comprehension of the system being audited and to deal with the very complex stage of data gathering, analysis and

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[7] Bailey, A. D. G. L. Duke, G. E. Gerlach, C. E. Ko, R. D. Meservy and A. B. Whinston. "TICOM and the Analysis of Internal Controls," **The Accounting Review,**(April 1985), pp. 186-201.

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[11] Vasarhelyi M. A., F. B. Halper, and K. E. Ezawa, "The Continuous Process Audit System: A UNIX -Based Auditing Tool". *The EDP Auditor Journal*, 1991, vol. 3, PP 85-91.

[12] Hansen, J. V. and W. F. Messier Jr., "Expert Systems in Auditing," **Auditing: A Journal of Theory and Practice**, (Autumn 1987), pp. 94-105.

[13] Vasarhelyi, M. A., "Expert Systems in Accounting and Auditing," **Artificial Intelligence in Accounting and Auditing**, (Markus Wiener Publishing Company, 1988), Vols. 2 & 3, 1994..

knowledge organization [Buchanan and Shortliffe, 1984[14]] necessary for programming the auditing probes.

The CPAS prototype was tested on two very large financial systems. The first application of the CPAS technology was an evolving system whose features changed rapidly. The idea was to put a prototype in place that contained basic analytics and then work with the auditors, as they used CPAS, to build more expertise into the system. The audit knowledge elicitation process focused in three areas: archival recording, heuristic discovery, and methodological development.

Archival Recording:

Interviews with auditors and examination of working papers and audit reports for identification of current audit steps, items of data being examined, specific rules concerning required audit evidence; and any actual procedures of data gathering, search and analysis. This process is analogous to the work that tries to establish descriptive models of auditor behavior. For example "think aloud" techniques [Biggs and Mock, 1983[15]] provide some insight on the auditor's thought processes.

Heuristic Discovery:

Application of knowledge engineering techniques to identify non-formulated rules, desired tooling, types of inference, methods of fuzzy set resolution, etc. (Shimura and George, 1973[16]; Shank and Abelson, 1977[17]; Hayes-Roth, 1978[18])

Methodological Development:

Working with auditors to further develop the "Continuous Process Audit" methodology, monitoring the usage of the auditor workstation in the measurement phase, and impounding more audit expertise into the audited system. [Shaw and Simon, 1958[19]; Simon 1973[20], 1979[21])

The problem domain in question tended to be one with "diffuse knowledge" [Halper et al., 1989], where a large set of sources of knowledge were necessary and knowledge was ultimately captured from a much wider set of experts than originally conceived. The issue of startup cost to impound the system description into the CPAS platform and the maintenance of the knowledge base became very important. However, the process of knowledge acquisition and recording used under CPAS is

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[14] Buchanan, B. G. and E. H. Shortliffe, **Rule-Based Expert Systems,** (Addison-Wesley Publishing Company, 1984).

[15] Biggs, S. F. and T. J. Mock, "An Investigation of Auditor Decision Processes in the Evaluation of Internal Controls and Audit Scope Decisions," **Journal of Accounting Research**, (Spring 1983), pp. 234-255.

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[20] Simon, H.. "The Structure of III Structured Problems", **Artificial Intelligence**, North-Holland Publishing Company, (Vol.4 1973) pp.181-201.

[21] Simon, H, "Information Processing Models of Cognition", **Annual Review Psychology**, (Vol.30 1979), pp.363-396.

not unlike the phases of internal control evaluation and documentation for workpapers that an auditor has to perform. The level of auditor comprehension of the system tends to be deeper under this approach if the auditor (not a system analyst) is to perform knowledge capture.[22]

Consequently, the CPAS approach probably requires a higher audit startup cost than the traditional audit but the level of audit examination is also consequently deeper and more reliable. The CPAS approach is substantially different from the traditional one and requires balancing of audit evidence and timing of the audit process. Given this, the issue of resistance to change may arise. This can be handled by the issuance of an audit manual that describes how to audit with CPAS and extensive training and technical support of the auditors in the engagement. to represent accounting events.

Ultimately, if a system is monitored over time using a set of auditor heuristics, the audit can rely purely on exception reporting and the auditor is called in only when exceptions arise. Impounding auditor knowledge into the system means that tests that would normally be performed once a year are repeated daily. This methodology will change the nature of evidence, timing, procedures and effort involved in audit work. The auditor will place an increased level of reliance on the evaluation of flow data (while accounting operations are being performed) instead of evidence from related activities (e.g. preparedness audits). Audit work would be focused **on audit by exception** with the system gathering knowledge exceptions on a continuous basis.

ELEMENTS OF THE CCM EFFORT

Levels of Monitoring

While auditing is a form of ex-post-facto monitoring, it does not satisfy the three basic axioms of monitoring:

a. that a process is constantly measured

b. that standards exist of system functioning

c. that variances are observed and management is given opportunity for prompt and close-to-the-event intervention.

It was desirable to differentiate between measurement and monitoring: **Measurement** entailed drawing metrics and actuals using the actual systems-cycle related data[23] to gather measurement. **Real-time-monitoring** implies status-checks through the process with the ability to interrupt or alter the process during its execution. These are actual extremes in the range of monitoring that must be explored as alternatives to the design on monitoring systems.

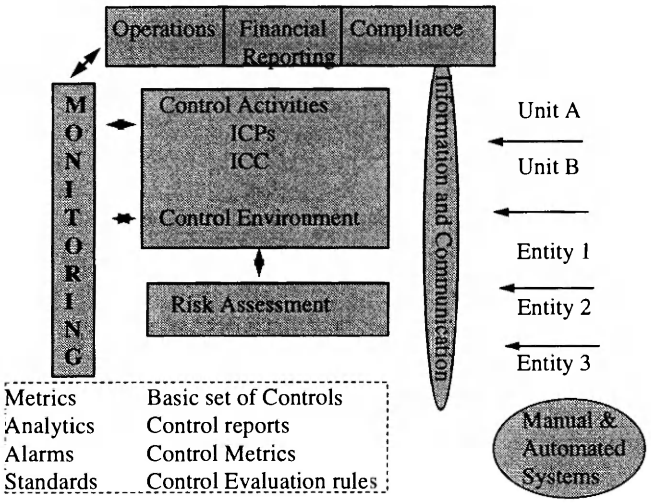
[22] In the long range much of this work can be linked to the use of CASE type tools were the knowledge is captured at design and could be easily transported, if not directly used, to the platform.

[23] For instance, drawing copies of regular operational daily reports, at the end of each day, to measure what is happening to the system.

Definitions

Both COSO[24] and SAC[25] present a comprehensive view of a framework for the study, understanding and review of internal controls. On the other hand substantial degree of operationalization is necessary for their use in practice. Consequently, most large audit firms and internal audit departments have developed operational manuals for internal control work. Auditing textbooks [26] tend to organize these procedures at a higher level with emphasis on qualitative assessment.

Figure 3: COSO, SAC & CCM



Continuity equations

Technology is substantively changing the architecture of data processing systems. They are evolving from large batch oriented mainframes to a more distributed, relational-databased environment. Eventually they will evolve towards hardware using massive parallelism on a distributed basis, with intelligent sharing of data and processes across a flexible network.

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[24] Internal Control- An Integrated Framework. Committee of Sponsoring Organizations of the Treadway Commission, 1992. pp. 13-15.

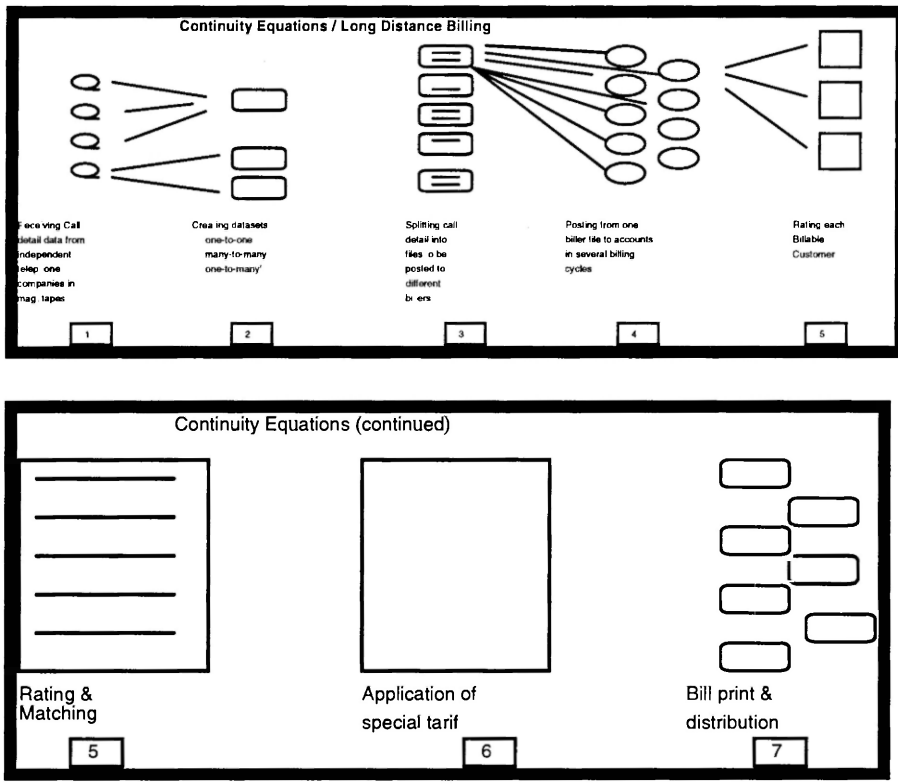
[25] Institute of Internal Auditors, **Systems Auditability and Control: module 2, audit and control environment,** Altamonte Springs, Florida, 1991. (Page 2-1)

[26] See Wallace, W. A., **Auditing**, PWS-Kent , Boston, 1991, chapter 9 or Arens, A. A., & Loebbecke, J. K., **Auditing: An Integrated Approach, Prentice Hall, Englewood Cliffs, N. J.., 1991, Chapter 9.**

Nevertheless, the intrinsic nature of the business transaction will continue to rely on two main elements; (1) a "batch" transaction[27] representing an economic activity, and (2) the updating of a "master status" file. Furthermore, it will be essential to keep records of the individual transactions on a one-by-one basis (for accountability), and be able to trace the path of a transaction through the business processing entities.

On the other hand, financial system architectures are progressively forcing upward and downward integration among systems through its main elements. Data transfers are the hinges among many modules. The modules are part of a diverse set of business functions that may or may not belong to the same division, department, organization, or company. Figure 4 illustrates a fictitious system for billing long distance telephone calls and their intrinsic elements.

Figure 4: Continuity Equations



[27] An online posting can be seen as a nearly immediate "batch posting" of one (or more) records.

The point being made in this rather detailed description, is the need for control **along multiple variables,** and the progressive change of **which control variable** on which to focus. This example will be continued in terms of the development of the concepts of CPAS and CCM. Table 1 continues this discussion linking steps and control variables.

Table 1
Steps, Process, and Control variables

Step #	Process	Control variables
1	tape management	number of tapes
2	dataset management	number of datasets
3	call detail separation	number of datasets
		number of messages
		call-minutes
4	account posting	number of messages
		call-minutes
		number of accounts
5	rating & matching	call-minutes
		dollars
		number of accounts
6	special tariff application	modified dollar unit
		dollars
		minutes / messages
7	bill print & distributions	number of bills printed
		number of customers
		messages / dollars/ mod. dollars

Key control variables, Transition ratios, and Stability

Once processes are defined in terms of **key control variables**, **transition ratios** and their **stability** must be specified. For example, step # 1 measures manually the number of tapes received each day. Tapes are manually labeled, read for heading labels and placed in holding racks. The location of these racks is encoded into the system, or a process code-based location used.

Key control variables are the ones deemed by the auditor/analysis as key to the measurement process. Transition ratios are the standards of conversion between the key control variables between stages (vertically and horizontally). Stability ratios are the variance standards expected between stages.

The ensuing step # 2 encompasses reading the tapes into the system and creating "datasets." The **key control variable** in this stage is datasets, and the transition ratio may be estimated to be 2.3, where on average for every 2.3 tapes one dataset it received. This **transition ratio** of 2.3 creates a more specific and usable standard than something like average number of datasets for the 7th day of the month. If the transition ratios vary between 1.8 and 2.8 the process is considered more **stable**

than a process whose ratio (for one standard deviation as an example) varies between 1.6 and 3.0. While, for example, generic transition ratios may be adequate, further information about the process may divide suppliers of data into IOCs (independent operating companies) where the transition ratio is **.7** and BOCs (Bell Operating Companies) where the transition ratios tend to be **2.7.**

The same reasoning may follow between steps #2 and #3 where it may be formulated that each dataset has in average 130,000 messages. Consequently for every tape in step 1 one should expect 130,000/2.3 messages. The chained extension of the argument continues. If each message is rated in average at $.71 and volume discount plans draw 25% discount to 47% of the population, each tape may entail billing of 130,000/2.3 x .71 - 130,000/2.3 x .71 x .25 x .47.

Integrating manual and Automatic controls

While the evolution of information processing technology has clearly affected operations, management and auditing, little attention has been given to the conceptual evolution of automation integration.

For example, in the front-end processing of receivables, several controls may take place:

1. sequential numbering of sale invoices;
2. batch headers in their transmission;
3. recalculation by a clerk;
4. supervision by a supervisor of the clerk with sign-off.

If this process gets automated, with a hand-held sale receipt device collecting the data, basically all these four functions will be replaced by computer processing.

1. Transactions may be automatically numbered (does not perform a control function but may help in tracking).

2. Batch headers may disappear if online processing is being performed.

3. Recalculations are not necessary, but their function is replaced both by reviews in system approval and system audits of general controls.

4. Supervision disappears, and with it the "sniff test" ability, which entail the detection of the very unusual[28] transactions or activities.

The above example illustrates the problems, changes and opportunities that arise therefore with automation and integration of corporate recording activities. While the development of integrated transaction processing systems and its simultaneous reengineering[29] are highly desirable events from the control standpoint, the most common occurrence is partial automation where a particular process, say creation of sale invoices, is automated.

Spot automation leaves us, typically, with inadequate controls as controls are considered and created for the new automated process, but its complementary elements are not reviewed.

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[28] Advanced techniques of pattern recognition, may in the future create software, with the ability of performing "sniff tests" or to replace the human ability of recognizing the unusual without anticipation by the programmer.

[29] Davenport & Short, " The New Industrial Engineering: Information Technology and Business Process Redesign," Sloan Management Review, Summer 1990.

Continuous Control Monitoring defined

Continuous Control Monitoring is a management methodology aimed at facilitating corporate operations, supervision, and meta-supervision, through the constant measurement of corporate activity, its comparison against standards, and the reporting of discrepancies, leading to corrective management action. Continuous Control Monitoring puts the emphasis on controls and formalizes the control monitoring process. CCM adds focus to the role of controls in CPAS by viewing monitoring data from a control framework.

Continuous Control Monitoring entails audit involvement from cradle-to-grave in the design, operation and modification of corporate controls. Its main steps entail:

1. involvement in the design of corporate/system controls both of manual and computerized nature;

2. involvement in the setting of standards for control and operations;

3. development of a system of monitoring the operation of controls;

4. development of a system of reporting control functioning;

5. interfaces and support of the internal/external audit activity.

For control monitoring an expanded set of systems features is desirable. The basic concepts necessary to create the expanded features are:

basic-set of controls: the knowledge engineering process defines key-controls to be monitored. While the total set of controls in a system is a fuzzy set, as the human component allows for open-concept, open-ended observation and scrutiny, experience tends to dictate the key controls to be defined and monitored.

For control monitoring, an expanded set of systems features is desirable. These include a basic-set of controls to be monitored, a series of **control reports**, a macro-schema of **control indices aggregation rules**, a schema of **control relationships** and ultimately a set of **control metrics** that aggregate control performance, leading to a final **control evaluation measure**. The idea of a meta control number is similar to various quality measures that certain world-class companies use. For example, Federal Express uses a Service Quality Indicator (SQI) to manage the quality of its delivery process. The measure consists of twelve components that relate to customer dissatisfaction which are weighted based on customer feedback.[30]

- **control reports,** specific reports that contain information on particular control(s)

- **control indices aggregation rules,** particular rules on how to mix controls

- **control relationships:** formal specification of the relationship among controls; for example if a control is **redundant** if another control is in place, or it is **complementary** to another control.

[30] Batting 1000, AT&T Quality Publication, 1992.

- **control metrics:** particular measures relative to a control, typically contained in a control report

- **control evaluation measure:** the result of the aggregation of existing controls upon a process

While CCM can be accomplished in purely manual systems with actual manual CCM procedures, the cost/benefits of the approach indicate the need of at least a CCM system even on mainly manual customer systems.

The Continuous Control Monitoring System (CCMS)

The CPAS[31] system allowed for continuous process audit at AT&T financial systems. An overview of this system was described in Figure 1 above. This figure, describing the CPAS system, shows the auditee system, electronic copies of operational reports being extracted for audit purposes, and a hierarchical analysis and reporting system, for audit and review. The knowledge engineering process identifies system features, flowcharts system flows, defines metrics and analytics, defines reports and alarms, and requires the information provisioning. Auditor reports and reconciliations are "wired-in" for **audit by exception.**

As stated above, for control monitoring, an expanded set of systems features is desirable. These include a **basic-set of controls** to be monitored, a series of **control reports**, a macro-schema of **control indices aggregation rules**, a schema of **control relationships** and ultimately a set of **control metrics** that aggregate control performance, leading to a final **control evaluation measure**.

A system for such an approach could be designed with a modified version of the CPA system.. Figure 5 below summarizes such a system:

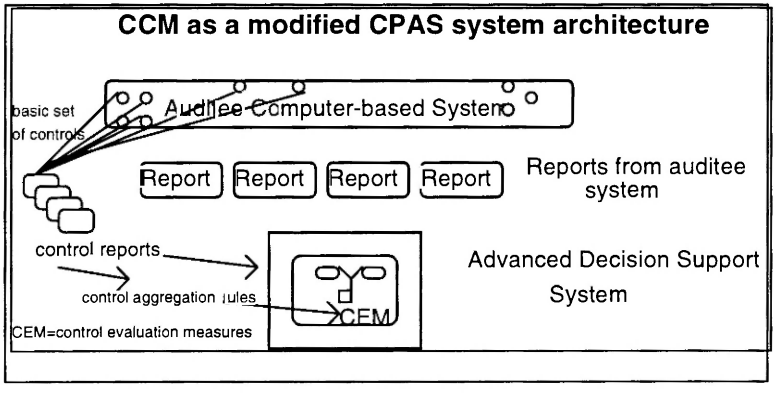

Figure 5

The schema for controls works similarly to the basic CPAS concepts. Control metrics are drawn from manual or automated systems. While in traditional systems reports focus on transactions, in a CCM application, obedience to controls and control performance are metered, reports issued, an

[31] Vasarhelyi, M. A. , Halper, F. B. & Ezawa, K. J., "The Continuous Process Audit Systems: A UNIX-based Auditing Tool," **The EDP Auditor Journal**, Vol. 3, pp. 85-91, 1991.

aggregation schema concocted and control evaluation measures issued for different cycles and for the system / organization in its entirety.

Measuring Manual Control

The term "manual controls" is a misnomer. It describes processes like authorizations, segregation of duties and supervision which do not imply actual "manual" activity, but the existence of a particular process, activity or organizational structure. A better nomenclature would divide controls into "automatic" and "non-automatic." We will use these terms interchangeably.

The ensuing control measurement procedures illustrate methods of capturing the use/effectiveness of a particular manual control to be entered into the CCM system.

a. authorizations: a program of systematic review and count of authorization signatures and the preparation of a report into the system. Verification of electronic signatures or manual review of signatures.

b. validity: systematic review of validation procedures into the Continuous Control Monitoring System (**CCMS**)

c. population controls: counts entered and matching number of entries into the CCMS

d. process controls: manual reconciliations recorded, their variances recorded and these results entered into the overall control scores.

e. coverage: periodic review thorough observation and trial testing of issues such as segregation of duties, supervision, obedience to rules and procedures, and insurance. Coverage controls relate to human processes that potentially decrease the incidence of discrepancies. Issuing a rating to these measures and recording into the CCMS.

f. access: periodic review, review drills, voluntary reporting by the controlee and recording into the CCMS. These relate to physical access to computer facilities, warehouses, etc.

g. audit: not necessary unless the other measures are not performed or report problems.

h. compliance with GAAP: independent peer reviews and or by accounting standards units in the organization. Use attested financial statements as references and look for changes to be reviewed.

i. management controls: selection of key manual systems (or analyses) that management relies to run the company, review of these with an eye towards accuracy, regularity and what they are saying. Draw on key economic health indicators. use these as "going concern" warning lights.

Measuring in Automatic Controls

The naive view of data processing control assumes that once a system is thoroughly reviewed and tested, its computations are correct and the data flow reliable. An exception to this reasoning are the well publicized events of computer fraud with "Trojan horses," "backdoors" or "exemption blocks" created by fraudulent system developers, which are difficult to detect in the voluminous maze of large extant application systems. The reality, however, is that no matter how

thoroughly a system is tested, not all combinations of potential problems can be identified. The combinatorics of the paths that data may travel are numerous. All exceptions cannot be accounted for. Furthermore, even if a system is (1) thoroughly tested, (2) has not been changed and (3) has operated for many years, weaknesses may exist. For example, upstream systems may have been changed, manual controls prior to the automated portion modified and/or data capture systems automated. These lead to the often observed strange data occurrences, freaky data variances and crashes that may wipe out systems.

The following control measurement procedures illustrate methods of capturing the use/effectiveness of a particular automated control to be routed into the CCM system. Procedures marked with a double asterisk (**) are reasonably similarly evaluated both in manual and non-manual systems.

a. authorizations: are programs of systematic review and count of electronic authorization signatures. Spot-checks on these authorization and range tests on the allowability of particular authorization. Maintenance of statistics on the actual approval helps avoid opportunistic approval circumventing corporate authorization policy[32]. High level statistics on overrides of standard system controls should also be maintained.

b. validity: is a systematic review of validation procedures entered on a random review basis into the Continuous Control Monitoring System (**CCMS**) (**)

c. population controls: are automatic population counts extended by time-series comparisons over time of population counts, values and other control variables that are part of the continuity equations.

d. process controls: are automatic reconciliations, and their variances recorded, and these results entered into the overall control scores.

e. coverage: is a periodic review thorough observation and trial testing of issues such as segregation of duties, supervision, obedience to rules and procedures, and insurance. Issuing a rating to these measures and recoding into the CCMS. (**) These tests and evaluations should have a different meaning and rating in automated systems.

f. access: is a periodic review, review drills, voluntary reporting by the controlee and recording into the CCMS. Automatic pattern evaluation of accesses and usage of facilities should be observed.

g. audit: is not necessary unless the other measures are not performed or report problems. (**)

h. compliance with GAAP: involves independent peer reviews by accounting standards units in the organization. Use attested financial statements as references and look for changes to be reviewed. (**)

i. management controls: involve selection of key manual systems (or analyses) that management relies to run the company, review of these with an eye towards accuracy, regularity and what they are saying. Draw on key economic health indicators; use these as "going concern" warning lights.

In the event of an EIS[33], automatic capture of key-indices is available. Otherwise, a more extensive review, analogous to the type needed for the development of an EIS, should be performed.

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[32] For example, if a manager's authorization level is $1,000 and he/she repeatedly breaks purchases down into parts of lesser value but in total costing over the authorized level.

[33] Rockart & DeLong, op. cit., "Executive Support Systems", Dow Jones - Irwin, Homewood, IL. 1988.

Knowledge Acquisition

The process of knowledge acquisition presented the major challenge of the CPAS/CCM efforts as unlike most of the traditional ES efforts the sources of knowledge were multiple and disperse. While it was possible to rely on experts for focus and heuristic development much knowledge was impounded in the software itself, contained in systems documentation, and / or obtainable only by system observation. Table 2 describes the natural progression for knowledge acquisition.

Table 2- **Knowledge Acquisition**

Step	**Purpose**
unstructured interview	understand problem domain
structured open-ended	understand problem structure
interview	determine expert vs. novice
task analysis	use reports to map
	out basic snap-shot analysis
CPAS utilized	build expertise into system
	by using CPAS to map out more
	sophisticated analysis

Discussion

The knowledge base for a CPAS-like application needs to contain information about the system itself (functional and operational) as well as how to analyze the system. We found it convenient to think of the financial system in terms of an algebraic type model and to define parts of the analysis in terms of algebraic variables. Although the knowledge engineers did write up the specifications using algebraic type equations, there was definite reluctance on the part of some people to think in these terms. The greater the expertise the more comfortable the users were with the concept. In fact, these people did actually have a model of the system in their head and found the variable notation natural.

Novice auditors seemed to focus only on system flowcharts and metrics when asked how they analyzed the system. This may be because they didn't really understand the concept of a continuous audit. Typically auditors will work off only a few days of system data when doing an audit. The continuous process audit concept was new and not appealing to some. So our initial analysis focused on a snapshot analysis of the system (i.e. looking for completeness of input). However, once the auditor/manger used the system and saw the trending information available, they would start to ask for additional analytics. We therefore saw the process as iterative and the goal was to use CPAS itself, to help build audit and management expert knowledge.
We found knowledge to be dispersed and heterogeneous. Furthermore, its was very difficult to make an a priori estimate if experts actually existed in a particular area and if they would provide usable heuristic rules. Ultimately, knowledge came from manuals, system charts, system analysis, user management and auditors.

The automation of this knowledge, when we impounded diagnostics into the system, was questionable as there was very little validation of the rules being "wired in."

In the future a taxonomy of elements of system influence must be developed and measured over time. Human diagnostics of system problems must be coded along this taxonomy and system adjustments/corrections validated across history.

Knowledge Representation

In the initial implementation of CPAS, SQL was used to extract data from the database. For example, individual metrics were calculated in separate SQL queries. More complex analytics were calculated using SQL embedded in C. Since the queries did not resemble the algebraic specifications, it made the analysis more difficult to validate and maintain. We felt the process could be improved if the implementation language more closely resembled the algebraic language used by the knowledge engineers. Ideally, this language could be used directly by the knowledge engineers in place of the specification language as a knowledge acquisition tool. This would cut down on implementation time and make the analysis easier to maintain and validate.

For example, the user might be interested in electrical usage (in kwats and records) that is accepted to be billed from three different places in a northeast region (i.e. New York City, Queens, and Brooklyn). Data related to this analysis might be found on three different daily reports, one each for New York City, Queens, and Brooklyn. Included in the report is information about the date, region, location, usage errored out, and usage accepted to be billed. The data can be extracted from the reports and put in a database table. The database table adds structure to the analysis that the individual reports did not have.

Table 3 represents an output table from a relational database. This table was created using a simple SQL statement. The table shows a schematic view of usage (in records and kwats) from three different sources (New York City, Queens, and Brooklyn) for a hypothetical utility company. Certain parameters which were supplied to the query (date and region) do not appear in the table. The database contains information about errors (err1, err2) and the number of rec and kwats finally accepted to be billed. This data may be used to determine error rates in the northeast region for a particular day.

Table 3- **Output of relational database**

units	src	err1	err2	acpt
rec	NYC	0	2	300
rec	QUEENS	2	3	350
rec	BKLYN	3	0	350
kwats	NYC	0	50	1000
kwats	QUEENS	8	88	732
kwats	BKLYN	25	0	1500
date=4/1/89	region=NE			

In the table, units and src are indexing information. The other three column labels (err1, err2, and acpt) are values associated with these names. The software uses the label information in output tables to produce lists of name-value pairs. For example:

```
rec[NYC,err1] = 0
rec[NYC,err2] = 2
rec[NYC,acpt] = 298
.
.
kwats[BKLYN,acpt] = 1500
```

are name value pairs that represent the exact information found in Table 3. To use the representation, the user needs to know where the key columns stop and the data begins (err1,err2,acpt) and how the brackets are used. These name-value associations are produced automatically by the software, for later use in algebraic equations. Once the name-value pairs are generated the array language will operate on them. In our array language, we define "index variables" such as NYsrc and Errors (see below), whose values are implicitly iterated over when they are used in expressions. Also, the language uses a summation convention, whereby index variables appearing on the right side of an equation and not on the left are summed over before assignment takes place. Other features of the language include the ability to deal with missing data.

For example, we may want to calculate the error rate for units= rec for error types 1 and 2 for the entire northeast region. We can sum all of the accepted records, calculate all errors, and the error rates, using the following equations:

Input calculation module

```
[NYsrc] = {NYC, QUEENS, BKLYN}
tot.acpt[NY] = rec[NYscr, acpt] #implicit summation
tot.input[NY] = rec[NYsrc,err1] + rec[NYsrc,err2] + rec[NYsrc,acpt]
```

Error calculation module

```
[Errors] = {err1,err2}
tot.rec[Errors] = rec[NYsrc,Errors]

percent.error1 = (tot.rec[err1]/tot.input[NY])*100
percent.error2 = (tot.rec[err2]/tot.input[NY])*100\f1
```

The line "tot.acpt[NY] = rec[NYsrc,acpt]" is equivalent to

```
tot.acpt[NY] = rec[NYC,acpt] + rec[Queens,acpt] + rec[BKLYN,acpt]
```

and the line "tot.rec[Errors] = rec{NYsrc,Errors]" is equivalent to two assignments:

```
tot.rec[err1] = rec[NYC,err1] + rec[QUEENS,err1] + rec[BKLYN,err1]
tot.rec[err2] = rec[NYC,err2] + rec[QUEENS,err2] + rec[BKLYN,err2]
```

percent.error1 and percent error. 2 can be compared against a standard. The output from this "model" can also be used as input to more expert rules.

UNIX-based CPAS Implementation

The CPA concept required flexible-modular design and a high degree of flexibility with the purpose of concept-testing and prototyping. Mainframe-based development was deemed too intrusive and too costly. Consequently a workstation-based approach with UNIX-type transitivity and pixel-oriented graphics was chosen.

The CPAS software was implemented under a NeWS windowing system and a SUN workstation. The NeWS system, at that stage, possessed the best set of "widgets" and development tools. It used "postscript" as its imaging language and could use a screen, a file, as well as a laser printer as an output medium.

The entire software was constructed using standard UNIX tools with a minimum of low-level programming. The data were generated in the IBM mainframes in the form of standard user reports. These reports, created with the traditional system development process were analyzed by a "knowledge engineer" and specific fields chosen for collection. JCL specs were included in the application control procedures to specify that a particular report's copy needed to be sent to a particular report distribution node. This JCL specification was the only (and minimal) intrusion in the application.

Once the report was sent to the receiving destination it was placed in an electronic storage bin. A connected UNIX gateway would run periodic (say every 10 minutes) "**DAEMONS**" and capture (snurf) these reports, transform them into mail messages and **mail** (a standard UNIX function) them to the CPAS workstation. Under certain conditions **uucp** (UNIX to UNIX Communication Protocol) was used to transfer the report file to the CPAS workstation. These reports, upon arrival at the CPASW were identified and scanned for the desired data. For example a re[port named A121 would be identified and an A121.awk *XXXxxx program scanning routine[34] would be activated. The data extracted would be placed in a relational database. A commercially available relational database (INGRES) was used as a storage device separating the data gathering portion of the system from its data analysis and delivery device.

The primary user interface (called Flow Front) displayed six main items: 1) a symbolic representation of the application system, 2) a hierarchy box representing the main levels of the system, 3) boxes displaying the values of specific metrics, 4) window with analytic-graphs, 5) window with representative tables, and 6) windows with text containing helps and system text. Furthermore the screen contains buttons, slide bars and touch-sensitive areas.

The graphic interface design device was called "**Flow-Edit**" and is not unlike many graphic design devices now available both in the UNIX (e.g. xxxx) and the DOS (e.g. Harvard Graphics) worlds.

The hierarchy box showed the hierarchical levels of the screens and allowed for moving rapidly among the levels.

Specific metrics boxes contained data represented to be moving along a flow or contained in a level. These metrics were the result of direct **sql** queries to the RDB.

[34] Both **sed** and **awk** are pattern scanning languages designed for the identification of specific sequences in text.

The graphs contained in the windows representing analytics were drawn by a statistical package indigenous in the UNIX environment called **S.** This package developed for "exploratory data analysis" contains graphical features of great value and was used in the generation of graphs.

Both the tables and text were generated using UNIX's text editing, formatting and WYSIWIG features enriched by the power of postscript display on to the screens

The concept, however, can be extended and can be implemented piece by piece using standard PC tools. Conceivably, the methodology can be implemented in many different ways, from a pure PC implementation to a full-fledged distributed computing solution with the "audit computer" as the self-contained destination of monitoring/measurement data.

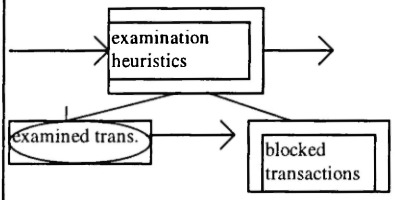
Discussion

The first software steps in the CPAS effort were performed in 1987/88 when GUI, object-oriented, and workstation-based technologies were still at a rather primitive stage. Many of the envisaged tools are now reality even in the PC/DOS environment. Consequently the scope and domain of the effort could be considerably changed. Now it is quite feasible to develop an audit monitoring system under Windows 95 and run it on a Pentium system. Furthermore the methodology can substantially enrich particular transaction oriented software packages and it is conceivable that it could be impounded into its features.

FORTHCOMING ELEMENTS

Several of our papers have predicted the need for **"Black box auditing"** (**BBA**)where the transaction flow would pass through a black box containing auditor heuristics that identify fraudulent or erroneous transactions.

Figure 6: **Black Box Auditing**



We have performed some experimentation in this area and several basic questions arose:

- do auditors have rules that can be extracted for emulation?
- how do you assess probabilities to flagged transactions?
- how do you decide on the cost x benefits of further examination of flagged transactions?
- what rules do you put in effect for process interruption on a particular (or particular set of) transaction(s)?
- are there different categories of transactions to be scrutinized (e.g. fraudulent vs erroneous vs irrelevant)?

Furthermore, it seems, from our preliminary experimentation that **BBA** as conceived originally is not sufficient. While individual transactions may be adequate, patterns may develop that are of importance to system monitoring (for example, unexpected types of fraud and recurring erroneous

postings). Two technologies of great appeal, that can be used simultaneously, and in coordination or independently, are emerging: Data mining[35] and intelligent agents[36].

Data Mining

Data mining lets the power of computers sift through large data stores. A wide variety of applications are emerging for the technology[37] among which are patterns on sales data, semantic construct identification, telephone calling patterns, etc. Three major types of tools are available[38]:

- query and reporting tools
- multidimensional analysis tools
- intelligent agents

Agents

Agents[39] [40] [41] are natural elements for system monitoring and analysis. One can imagine an alternate paradigm whereby the transactions do not flow through an audit detection pipe as described in Figure 6 but agents roam through all parts of the system with the same objectives specified. While this approach would require wider and less identifiable algorithms, it has the appeal of providing a wider and more subtle monitoring, that cannot be bypassed easily by intelligent algorithms.

CONCLUSIONS

While the original work on the CCM / CPAS may have been somewhat premature, great interest is this type of work is emerging. This is due to the fact that integrated online systems are not tractable by traditional auditing methods and losses can be too large prior to the realization, through traditional methods, that there is a control leak.

While, algorithmic and analytic solution have been prevalent in the past, brute force solutions, very rich in computational requirements, are now possible and likely to be useful. Solutions that subject each transaction to intensive analytic (computational) scrutiny as well as mining agents that frequently travel through large databases are not only possible but, considering the economics of modern computing, quite likely and desirable. The minimal cost per computer cycle makes these efforts clearly cost beneficial due to their deterrent and early detective action.

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[35] DeJesus, E. X. "Data Mining," **BYTE**, October 1995, p.81

[36] Riecken, D. (Ed.) , " Intelligent Agents," **Communications of the ACM**, July 1994, Vol 37, No. 7, pp. 18-21.

[37] Hedberg, S. R., "The Data Gold Rush." **BYTE**, October 1995, p.83-89.

[38] Watterson, K., "A Data Miner's Tools," **BYTE**, October 1995, p.91-96

[39] "Conversations with Marvin Minsky about agents", **Communications of the ACM**, July 1994, Vol. 37, No. 7, pp. 23-29.

[40] Maes, P.,"Agents that Reduce Work and Information Overload," **Communications of the ACM**, July 1994 Vol. 37, No. 7, pp. 31-40.

[41] Norman, D.,"How Might People Interact with Agents," **Communications of the ACM**, July 1994, Vol. 37, No. 7, pp. 31-40.

The agent terminology is recent but some of its main principles have been explored in the last decade. Interlocked networks and large databases give the opportunity for substantial benefits from software agents. System and data monitoring problems offer great potential areas for exploratory, pattern recognition and review agents.

Extant research has not yet defined the parameters of the utilization of agents in AI/ES in accounting research. The advent of the Internet as a pipeline for accounting systems and as a source for data gathering, as well as the increased use of EDI in corporate information systems makes this research even more important.

Research on the nature of agents is of essence. Regardless of auditor's desires, modern online systems will be permeated by functional agents performing specific tasks. These agents will be part of the environment but will also increase the risk of systems. It is not inconceivable that between friendly agents systems will also find viruses and intrusive objects. While computer science and architectures will work to provide a safe and productive environment for agents this same work is creating substantial business threats. It is up to AI/ES researchers in accounting to deal with these threats.

In conclusion, it is important to mention what we view as of the major weaknesses in extant accounting research. We have been unable to well characterize, represent and deal with the "soft controls" of information systems. It is still very difficult to conceptualize and measure controls such as coverage and supervision as well as to integrate these measures with an overall view of system controls. It is highly desirable that AI/ES research in accounting focus on automatic methods of measurement of manual systems and their interaction with computer-based processes.

Discussant Comments on "The CPAS/CCM Experiences: Perspectives for AI/ES Research in Auditing"

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Having wandered from the halls of academe this past year, it is probably useful to make a few observations from one tainted by the "real world" so readers can appropriately calibrate my comments.

First, this past year has reaffirmed something I have been observing for several years—our financial systems architecture is in a sorry state. Its utility is being question more and more, and organization executives are more open to investing in meaningful changes to the financial system than ever before.

Second, layering an auditing decision support system (DSS) on top of the current financial system does not address the underlying architectural problems and therefore is unnecessarily costly and cumbersome.

Third, auditors are sitting on the sidelines of business and information system transformation projects which often result in business and information processes for which they are wholly unprepared to audit.

Fourth, business and information process transformation projects often result in major changes to an organization's business and information process risks and call into question the utility of traditional control philosophies and techniques.

Fifth, risks and controls are becoming more critical than ever before, and are often more manageable with a different control philosophy that embraces technology as a tool for enhancing control rather than something that only increases an organization's risks.

Sixth, auditing has a real opportunity to enhance its value by preparing to be much more involved in business and information process transformation.

As I have read the Jenkins Committee report, and early drafts of the Elliott Committee report, I believe my observations are not nearly as heretical as they might have been perceived 10 years ago. These two reports underscore the need the profession has to be involved in serious introspection in order to face to new challenges and opportunities in the market place.

With these observations in mind, I used two papers that have laid out a framework for evaluating artificial intelligence based research:

> Denna, E. L., J. V. Hansen, and R. D. Meservy, "Development and Application of Expert Systems in Audit Services," *IEEE, Knowledge and Data Engineering*, June, 1991.
>
> McCarthy, W. E., E.L. Denna, G. Gal, and S. R. Rockwell, "Expert Systems and AI-based Decision Support in Auditing: Progress and Perspectives," *Intelligent Systems in Accounting, Finance and Management*, Jan, 1992.

The two primary contributions of these papers are as follows.

The first paper provides a framework for classifying the contribution of a piece of research. As is illustrated in Figure 1, there are three primary areas of contribution: knowledge acquisition, knowledge validation, and knowledge representation. It is rare to find work that provides significant contributions to more than one of these areas primarily because AI work tends to inherently have scope problems. Trying to make a fundamental contribution to more than one of these areas is both dangerous and difficult. Dangerous because closure is made much more challenging, and difficult, because tackling more than one area makes it difficult to specifically identify the contribution and further compounds the closure problem. The paper calls for focus by researchers and lays out a potential agenda for those interested in pursuing Al-based audit research.

The second paper adapts the March (1988) framework for classifying computer science research to the Al-based audit research problem in order to provide some guidance to the question of whether a piece of work is research or development. At the time, the literature seemed to have an avalanche of what was claimed to be Al-based audit research. The authors conclude that, "Building software systems which make marginal improvements with known approaches in established domains is definitely development, while building software systems which make significant improvements with novel approaches in unexplored domains is most certainly research" (p. 62). The intent of the authors was to provide some guidance for distinguishing research and development for publication purposes.

With this as background I would offer the following observations of the paper at hand:

First, I am unclear as to the contribution of the paper in terms of the framework offered by Denna, Hansen, and Meservy (1991) or as to whether the work is better viewed as research or development. This conclusion is the result of not seeing any specific contribution to the domains of knowledge acquisition, knowledge representation, or knowledge validation, nor is there any specific evidence of the work providing "significant improvements with novel approaches in unexplored domains." In making this observation, I am not suggesting the work is neither valuable nor interesting. Frankly, the problem domain and approach are both very interesting and the ideas appear valuable. Nonetheless, the contribution is unclear using the two papers I have cited as evaluative works.

Second, the CPAS/CCM architecture appears to be a function of the traditional financial systems application architecture. A fundamental change in the nature of the financial systems architecture may well make the CPAS/CCM architecture entirely useless or require fundamental changes. This would actually be an interesting follow-up test to perform. A corollary to this observation is the question of how much of extant audit expertise is applicable when an organization undertakes a fundamental transformation of its financial systems or its business processes. It seems this question would need to be resolved before attempting a work as large in scope as the CPAS/CCM project.

Third, I have difficulty concluding whether CCM actually has demonstrated intelligence (what McCarthy, Denna, Gal, and Rockwell [1992] refer to as deep knowledge) or even rudimentary expertise, or whether the application is more appropriately a sophisticated amalgam of mathematical models. If the latter, the work is probably more appropriately viewed as a statistical modeling application, and should thereby be evaluated as such, rather than as Al-based work.

Overall, I think the paper could be significantly improved if the author would clearly specify the contribution to the domains of knowledge acquisition, knowledge representation, or knowledge validation. Without such clarity, readers will be left to wonder whether the piece approaches the purely research hurdle of making "significant improvements with novel approaches in unexplored domains."

3

Digital Analysis and the Reduction of Auditor Litigation Risk

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INTRODUCTION

Digital analysis is an audit technology that has recently been introduced to the auditing community. The tests are based on mathematical principles first published in 1881. However, it is only due to recent tax evasion and auditing research, and the decline in the cost of computing, that the techniques have become viable from a cost/benefit perspective. This paper discusses the potential of digital analysis to reduce the litigation risk of auditing.

The basis of digital analysis is that, in the absence of certain types of fraud and other irregularities, the digital frequencies of client financial data should conform to Benford's Law. Since Benford's Law is expected to govern the digital frequencies, the literature is reviewed so that users can assess the feasibility of this assertion. The chronological review concentrates on the factors relevant to an audit application. The objective is to demonstrate that the expected frequencies of Benford's Law do form a valid *a priori* distribution.

Extracts from the literature on auditor litigation are reviewed. Joint and several liability makes litigation potentially very expensive. A principal defense is non-negligent performance or, stated differently, that the audit was conducted in accordance with generally accepted auditing standards. The responsibility of the auditor to detect errors and irregularities is however still open to differing interpretations.

The conclusion discusses the viability of digital analysis as a litigation reduction risk tool. If used correctly, digital analysis has characteristics that would work favorably for auditors in a litigation situation. A major advantage is that it removes some subjectivity from the decision as to whether client data appears to be reasonable.

BENFORD'S LAW

Newcomb (1881) notes that the first pages of books of logarithm tables appear to be more worn than the later pages. Since people used these books like dictionaries, it seemed that the first pages were *used* more than the later pages. The first pages coincide with numbers with low first digits. Newcomb, an astronomer, suggested that the first few pages were worn because people had to look up the logarithms of numbers with low first digits more often than the logarithms of numbers with high first digits. The modern equivalent would be observing that the keys of the low digits on a computer or calculator were more worn than the keys of the higher digits. Without much explanation, Newcomb presented the probability of the occurrence of digits in lists of natural numbers. He stated that the usefulness of the discovery was that if someone were presented with a list of digit strings, they could conclude whether the list was the logarithms of numbers, or the numbers themselves.

Benford (1938) does not cite Newcomb, yet his introduction makes the same observation about worn logarithm table books as does the Newcomb introduction. Benford, a physicist at the GE research laboratory, empirically tested the frequencies of digits in numerical data using 20 lists of numbers (20,229 observations). The lists covered data that were both independent and weakly dependent. Independent lists were constructed from sources such as the first 342 street addresses of the then current American Men of Science, and a complete tabulation of the numbers appearing in an issue of Readers Digest. Weakly dependent lists included mathematical tables from engineering handbooks and tabulations of weights and physical constants. Benford computed the frequency of the first digits for each list and averaged the frequencies to obtain his actual (observed) results.

For audit purposes the details of Benford's lists and the level of conformity of his lists is not all that relevant. What is relevant is the mathematical assumption underlying the expected frequencies. Benford stated that natural data when ordered (ranked from smallest to largest) should form a geometric sequence. The geometric assumption is the basis of the Law and Benford (1938, 562) states that, "In natural events and in events of which man considers himself the originator, there are plenty of examples of geometric or logarithmic progressions." He cites a number of real world settings such as our sense of brightness, loudness, and weight, engineering and astronomical measurements, and the musical scales. Benford concluded that "Nature counts geometrically, and builds and functions accordingly."

Benford used integral calculus to derive the formulas for the expected frequencies of the various digits in the various positions in a number. A comprehensive table of the expected frequencies and formulas is presented in Nigrini (1996a). If a list of numbers does not (at least approximately) follow a geometric pattern (when ranked from smallest to largest), the frequencies of Benford's Law will not apply to the list of numbers.

The first follow-on papers were published by Goudsmit and Furry (1944) and Furry and Hurwitz (1945). The first paper suggests that Benford's Law is merely the result of the way that we write numbers and the second paper is a mathematical discussion of Benford's formulas. Interestingly, Stigler (1945) wrote a working paper in which he challenged the basis of Benford's Law and gave an alternative distribution of the digits in lists of numbers. Even more interesting is the fact that Nobel-laureate Stigler never published the paper. Stigler's logic is severely questioned in Raimi (1976) and it would therefore appear that to win a Nobel prize, one should know what to publish and what to leave in working paper format.

The sixties

The most significant advance in the field in the 1960s was by Pinkham (1961). Pinkham posed the question that if there was indeed some Law governing digital distributions then this Law should be scale invariant. In other words, if the digits of the areas of the world's islands, or the length of the world's rivers followed some Law, then it should be immaterial if these measurements were expressed in (square) miles or (square) kilometers. He went on to prove that Benford's Law is scale invariant under multiplication. In other words, if all the numbers in a list that followed Benford's Law were multiplied by a (nonzero) constant, then the new list would also follow Benford's Law. A list of numbers that conform to Benford's Law is known as a Benford Set. What is notable is that Pinkham proved that *only* the frequencies of Benford's Law were invariant under multiplication. In other words if a list of numbers has digit frequencies other than those of Benford's Law, then multiplication by a (nonzero) constant will result in different digital frequencies. I believe that the closer the fit before multiplication (irrespective of the constant), then the closer the fit after multiplication. I found it interesting that Pinkham's introduction states that any reader formerly unaware of Benford's Law would find an actual sampling experiment

"wondrously tantalizing." Twenty-five years ago such an experiment would have required a great deal of effort. It is only with the recent introduction of digital analysis software that such an experiment would really be wondrously tantalizing without being mentally exhausting.

Good (1965) was the first to use Benford's Law. He noted that certain random number tables had been formed by taking the middle three digits of the areas of English parishes. Good claimed that this would not produce random number tables because under Benford's Law not all digits are equally likely, and such a table would have biased digit sequences.

There were two developments in 1966. Feller (1966) developed a proof that the empirical distribution of any integer appearing as a first digit in observational data follows Benford's Law. Flehinger (1966) also developed a proof that first digits should follow Benford's Law. Flehinger's proof has been criticized because she uses a special summation and averaging method (Holder sums), and mathematicians contend that using special tricks that end up with Benford's frequencies do not constitute a proof.

Adhikari and Sarkar (1968) provided a few theorems relating to numbers distributed uniformly over the range 0 to 1 (written (0,1)). They showed that after certain mathematical operations the numbers formed a Benford Set. Raimi (1969a) provided mathematical support for Benford's Law using Banach and other scale invariant measures. Raimi (1969b) is an excellent non-mathematical review of Benford's Law with some intuitive explanations of what thereafter came to be called "the first digit phenomenon" in many papers. Adhikari (1969) followed his earlier paper with a few more theorems. Knuth (1969) completed the sixties with a simplified proof of Flehinger's result and a reasonably in-depth discussion of Benford's Law.

The seventies

The seventies started with Hamming's (1970) discussion of the usefulness of Benford's Law. Hamming considers the mantissa distribution of products and sums and gives applications of Benford's Law in round-off error analysis and computing accuracy considerations. The early seventies also started a stream of articles by Fibonacci theorists that showed that the familiar Fibonacci sequence (1,1,2,3,5,8, ...) follows Benford's Law perfectly. For the mathematically curious I should stress that the sequence should have more than 100 elements. The more elements, the closer the fit.

Varian (1972) advocated another use for Benford's Law. He tabulated the first digit frequencies for a few sets of demographic data. The original data conformed quite closely to Benford's Law. He then checked the frequencies of forecasts made from the data. The forecasts also followed Benford's Law. Varian concluded that checking forecasts against Benford's Law was a potential test of the *reasonableness* of the forecasts. After Varian there were a few more papers that addressed the potential usefulness of Benford's Law. Tsao (1974) applied Benford's Law to roundoff errors of computers.

Goudsmit (1977) provided an interesting bit of insight. Benford's 1938 paper was followed in the 1938 journal by an important physics paper by Bethe and Rose. This was the reason that Benford's paper caught the attention of physicists. Goudsmit himself coauthored the first two papers on the topic. It is amazing to think that had a stream of literature not been started by the readers of Bethe and Rose, that Benford's gem would not have been noted by academics or practitioners. I can only speculate that even if accounting practitioners noted casually that more numbers began with a 1 than any other digit, they would probably not have thought that exact expected frequencies existed.

The eighties

The eighties began with two papers that again addressed the potential usefulness of Benford's Law. Becker (1982) compared the digit frequencies of failure rate and Mean-Time-to-Failure tables with Benford's Law. He concludes that Benford's Law can be used to "quickly check lists of failure rate or MTTF-values for systematic errors." Nelson (1984) discussed accuracy loss due to rounding to two significant digits. He used Benford's Law to compute the average maximum loss in accuracy.

A literature set would not be complete without some challenges to the concepts. Such challenges should be expected, especially given the counter intuitiveness of Benford's Law. What is surprising in this case is the source of the challenge. Raimi (1985) discusses the basis and logic of Benford's Law. His paper concludes with an extract from a letter from Samuel Goudsmit (dated 21 July, 1978) in which Goudsmit claims that:

> ... To a physicist Simon Newcomb's explanation of the first-digit phenomenon is more than sufficient "for all practical purposes." Of course here the expression "for all practical purposes" has no meaning. There are no practical purposes, unless you consider betting for money on first digit frequencies with gullible colleagues a practical use (Goudsmit as quoted in Raimi 1985, 218).

Recent tax evasion and auditing research show that there *are* practical uses of Benford's Law. It is interesting that (1) Goudsmit published the first paper on Benford's Law after the publication of Benford's paper (Goudsmit and Furry, 1945), and (2) Ian Stewart wrote a paper on Benford's Law that starts with a story about a trickster betting on first digits with the public at a trade fair in England (Stewart 1993).

The first accounting application was by Carslaw (1988). Carslaw hypothesized that when corporations' net incomes are just below psychological boundaries, managers would tend to round these numbers up. For example numbers such as $798,000 and $19.97 million would be rounded up to numbers just above $800,000 and $20 million respectively. The belief was that the latter numbers convey a larger measure of size despite the fact that in percentage terms they are just marginally higher. Management usually have an incentive to report higher income numbers. A sign that this rounding-up was occurring would be an excess of second digit 0s and a shortage of second digit 9s. A natural academic question was an excess and shortage as compared to what yardstick. Carslaw used the expected second digit frequencies of Benford's Law. His results based on reported net incomes of New Zealand companies showed that there were indeed more second digit 0s and fewer second digit 9s than expected.

The 1980s were a strong foundation for the advances of the 1990s. Hill (1988) provided experimental evidence that when individuals invent numbers these numbers do not conform to Benford's Law. Hill's subjects had no incentive to bias the numbers upward or downward. Hill used the basic Chi-square and Kolmogorov-Smirnoff tests plus a little subjectivity to evaluate his results. The analysis suggests that more work is needed when it comes to evaluating results objectively.

Carslaw's paper was soon followed by Thomas (1989). Thomas found excess second digit 0s in US net income data. Interestingly Thomas also found that Earnings Per Share numbers in the US were multiples of 5 cents more often than expected. My own research has shown that the rounding-up phenomena is present in net income numbers of random samples of UK companies and Canadian companies. My research has also shown that this phenomenon is absent in the quarterly results of the 650-700 largest companies in the US. *The Wall Street Journal* tabulates these numbers about

six weeks after the end of each quarter. It is interesting that rounding up does not occur in the largest corporations, especially when quarterly earnings can be relatively easily rounded-up.

The nineties

The nineties have provided advances in the body of empirical evidence, and mathematical and auditing theoretical developments. Papers increasing the body of empirical evidence on the applicability of Benford's Law include Burke and Kincanon (1991) who test the digital frequencies of physical constants. Buck, Merchant, and Perez (1993) show that the digit frequencies of alpha-decay half-lives conform to Benford's Law.

One paper deals with a phenomenon affecting our everyday lives. Christian and Gupta (1993) analyzed taxpayer data to find signs of secondary evasion. Secondary evasion occurs when taxpayers reduce taxable income from above a table step boundary to below a table step boundary. The table steps referred to are the tax tables in US income tax returns that are used by taxpayers with incomes below $100,000 to determine their tax liability. The tables are meant to assist those that would have difficulties with using the formula. Generally the reduction in taxable income of a few dollars (when the income is just above a table step boundary, say $40,102) could lead to a tax saving of $50 times the applicable marginal rate. Christian and Gupta assume that the ending digits of taxable incomes should be uniformly distributed over the 00 to 99 range, and Benford's Law is used to justify this assumption.

Craig (1992) examines round-off bias in EPS calculations. He tested whether EPS numbers are rounded up more often than rounded down, indicating some manipulation by managers. Unfortunately his paper falls a little short theoretically. He acknowledges that Benford's Law exists and that it could affect digit frequencies. Yet he chooses to ignore it in his analysis. It was disappointing to read a paper that searches for a bias but ignores such an important consideration. What Craig might not have realized was that Benford's Law would work in favor of his detecting manipulation. Since Benford's Law favors lower digits the probability of rounding down an EPS number to whole cents is larger than the probability of rounding up an EPS number. His roundup frequency of .551 was therefore more significant than he realized.

Nigrini (1994) questions whether the digital frequencies of Benford's's Law can be used to detect fraud. Using the numbers from a payroll fraud case, he compared the first two-digit frequencies to those of Benford's Law. The premise was that over time individuals will tend to repeat their actions, and furthermore people do not think like Benford's Law, consequently their invented numbers are unlikely to follow Benford's Law. Their fraudulent numbers might stick out from the crowd. For the ten-year period of the fraud the fraudulent payroll numbers deviated significantly from Benford's Law. Furthermore, the deviations were greatest for the last five years. Presumably the fraudster was getting into a routine and did not even try to make up different numbers.

By the mid-1990s it seems that strides were being made in both the mathematical and application aspects of the Law. Boyle (1994) adds to earlier theorems by generalizing some more specific work in the 1960s. Referring to Benford's Law as the log distribution, Boyle proves that:

1. The log distribution is the limiting distribution when random variables are repeatedly multiplied, divided, or raised to integer powers, and

2. Once achieved, the log distribution persists under all further multiplications, divisions, and raising to integer powers.

Boyle concludes by asserting that Benford's Law has similar properties to the central limit theorem in that Benford's Law *is* the central limit theorem for digits under multiplicative operations.

Hill (1995) clearly represents the most significant mathematical advance since Pinkham (1961). After reviewing my work and other empirical studies, Hill shows that if distributions are selected at random (in any "unbiased" way), and random samples are then taken from each of these distributions, the significant digits of the resulting collection will converge to the logarithmic (Benford) distribution. This helps explain why the significant-digit phenomenon appears in many empirical contexts, and helps explain its recent application to computer design, mathematical modeling, and detection of fraud in accounting data. In other words, Hill shows that Benford's Law is the distribution *of all distributions*. It would be valuable if simulation studies draw random samples from the family of common distributions, to confirm Hill's theorem.

Nigrini and Mittermaier (1996) propose six digital tests that could be used by external and internal auditors. External auditors could use the tests to determine if a data set appears to be reasonable and to direct their attention to questionable groups of transactions. Internal auditors could also use the tests to direct their attention to biases and irregularities in data. The six tests are the first six tests listed in Appendix A.

In Nigrini (1996a) I develop a Distortion Factor model that signals whether data appears to have been manipulated upwards or downwards. Based on the digit patterns, are there signals of an overstatement or signals of an understatement? The empirical tests include digital tests of interest received and interest paid data for US taxpayers. The interest data conformed quite well to Benford's Law, but for interest received there was an excess of low digits as the first digits in interest numbers suggesting an understatement of these numbers. In contrast there was an excess of the higher digits as the first digits in interest paid numbers, suggesting an overstatement of these numbers. The paper cites a study by the Dutch Ministry of Finance in which interest paid numbers per the third-party bank returns showed a near-perfect conformity to Benford's Law. In the absence of errors these should have been the interest received numbers declared by Dutch taxpayers.

In Nigrini and Wood (1996) we analyze the population counts for the 3,141 counties of the United States per the 1990 census. There was a near-perfect conformity to Benford's Law. The 1991 and 1992 population forecasts also had a near-perfect conformity to Benford's Law. Using goodness-of-fit tests there was an even closer fit of the forecasts than the actual count numbers.

Nigrini and Levy (1996) develop a small sample test based on digital frequencies. The first seven tests in the Appendix require large samples (more than 1,000 observations). The individual Distortion Factor model caters for small samples and facilitates the detection of abnormal digit patterns. Using this model small data sets can be ranked in terms of their nonconformity and the worst conformers could be selected for closer scrutiny. Furthermore, data can be partitioned into subsets and conclusions can be drawn as to which subsets have the lowest level of conformity and which subsets have data that appears over or understated. In a tax situation the subsets could be regions of the country or certain attributes of taxpayers (balance due or refund due).

My most recent work in the field is directed at reaching objective conclusions in an auditing context. Does the data conform to Benford's Law within tolerable error bounds? The forthcoming Global model (Nigrini, 1996b) will allow data sets to be ranked in terms of their conformity to Benford's Law. The model is a composite test of the first six tests listed in the Appendix. The model will give a score of 1 for perfect conformity, and 0 for the worst case of nonconformity (all numbers in the list equal a string of two or more 9s). This test will allow auditors to rank data sets. For example, the inventory counts of 25 warehouses each having 20,000 products could be ranked,

and attention directed at the least conforming data set. Alternatively an airline could compare the digit frequencies of its tickets issued to the frequencies of refunds issued.

AUDITOR LITIGATION

The status of the liability crisis in the US is documented in the joint paper by the Big 6 (Arthur Anderson & Co. et. al., 1992). The Big 6 senior executives state that the present liability system has produced an epidemic of litigation that is spreading throughout the accounting profession and the business community. They openly criticize the doctrine of joint and several liability that makes each defendant fully liable for all assessed damages in a case, regardless of the degree of fault. They estimate that in 1991, the total expenditures for settling and defendant lawsuits were 9 percent of auditing and accounting revenues. There appears no end to the continuous upward spiral.

An implication is that increased litigation costs increase the cost of audit services and tend to reduce access to the capital markets. The large firms are avoiding high-risk clients, and smaller and medium-sized audit firms are dropping their public clients or abandoning their audit practices altogether. The litigious practice environment is making it increasingly difficult to attract and retain the most qualified individuals at every level. The Big 6 make the strong case for ending the joint and several liability rule, and state their preference for a proportionate liability rule. They conclude that the Big 6 are exploring all possible alternatives for reducing the liability threat. It is disappointing that this report focuses almost entirely on a call for legal reform. No mention is made of the reduction in liability that could arise from improved audit technology.

Arens and Loebbecke (1991) outline the four sources of legal liability. The first source is where the client sues the auditor for not discovering a defalcation during an audit. The increase in litigation is partially due to the greater complexity of auditing and accounting because of factors such as the increasing size of business, the existence of the computer, and the intricacies of business operations. They note that the typical lawsuit involves a claim that the auditor did not discover an employee defalcation due to negligence in the conduct of the audit. The lawsuit could be for breach of contract, a tort action for negligence, or fraud. The principal issue in cases involving alleged negligence is usually the level of care required. One of the principal defenses against negligence is that the audit was performed in accordance with generally accepted auditing standards. Non-negligent performance is also a defense available against suits initiated under Section 10 and Rule 10b-5 of the federal Securities Exchange Act of 1934.

Arens and Loebbecke describe a number of steps that the profession could take to reduce the threat of litigation. The first item on their list is research in auditing. They highlight the fact that continued research is important in finding better ways to uncover unintentional misstatements or management and employee fraud. On an individual level they include in their list of specific actions that could reduce liability, (1) perform quality audits which require that appropriate evidence be obtained and appropriate judgments be made about the evidence, and (2) proper documentation through good working papers which is essential if an auditor has to defend an audit in court.

Carmichael, Rennie, Rennie, and Willingham (1995, 162) review management fraud. Their suggested approach is that auditors first assess the likelihood of material fraud in the client company's circumstances and then, if material fraud is assessed as likely, plan the audit to provide reasonable assurance of detecting it.

Kell and Boynton (1992) note that prior to the issuance of SAS 52, the auditor was only required to plan the audit to *search* for errors and irregularities that would have a material effect on the financial statements. SAS 53 extends the auditors responsibility to design the audit to provide

reasonable assurance of *detecting* errors and irregularities that are material to the financial statements. The auditor is expected to exercise due care and a proper degree of professional skepticism in performing the audit and in evaluating the findings. The failure to detect a material misstatement in the financial statements does not, in and of itself, indicate that the audit was not made in accordance with GAAS. Their anti-litigation strategy is that the auditor comply fully with professional pronouncements in each audit engagement, and the use of sound professional judgment during the audit.

The National Commission on Fraudulent Financial Reporting (1987) noted that users of financial statements expect auditors to bring to the reporting process technical competence, integrity, independence, and objectivity. Users also expect auditors to *search for* and *detect* material misstatements, whether intentional or unintentional, and to prevent the issuance of misleading financial statements. Four steps were identified to improve the auditor's ability to detect fraudulent financial reporting. First, the profession must recognize its responsibility to design the audit scope to consider the potential for fraudulent financial reporting and to design audit procedures to detect such reporting. Second, independent public accountants can and should do more to improve their detection capabilities. Third, audit quality should be improved. Fourth, users should understand the nature, scope, and the limitations of an audit.

Palmrose (1988) states that the value of external audits derives from users' expectations that auditors will detect and correct/reveal any material omissions or misstatements of financial information. Failure to do so is termed an audit failure, which typically results in litigation when clients/users incur losses in conjunction with materially false or misleading financial information. The suggestion is made that users can view auditors with relatively low (high) litigation activity as higher (lower) quality suppliers. Palmrose finds that non-Big Eight firms had higher litigation occurrence rates than the Big Eight and concludes that the Big Eight are quality differentiated auditors.

Lys and Watts (1994) state that there are three factors necessary for a disclosure lawsuit. These are (1) the existence of a cause, (2) plaintiffs' discovery of cause, and (3) the net benefits to the suit. The existence of a cause depends on (1) the probability that management issues false or misleading financial statements, (2) the probability that the auditor failed to discover that the financial statements are false or misleading, and (3) the existence of loss by a plaintiff. Structured technologies use statistical sampling, structured internal control evaluations that lead to a prescribed audit plan, formal means of integrating test results, and less audit staff per partner. Unstructured technologies rely more on subjective judgment. They do not state which technology is more likely to discover financial statement problems when they exist. But to the extent that structured technology provides better documentation of the conduct of the audit, it may provide a more effective defense in a lawsuit. The results of their empirical study suggest that the likelihood of a lawsuit is *greater* if the auditor uses a *less* structured audit technology.

DISCUSSION

A decrease in employee morale or employee loyalty is a red flag that should signal an increased potential for employee fraud. The 1990s has seen large scale restructuring by US businesses. Employees in the US are currently very insecure about their jobs. The large scale restructuring and job insecurity has some detrimental consequences. In business, the climate is now much more one of "them and us." Employees that were not laid off have seen the harsh impersonal nature of downsizing when friends and coworkers were given pink slips despite many years of loyal service (Globe and Mail, 1996). The impersonal harsh treatment given to workers during a restructuring must have the effect of lowering morale and employee loyalty. Employees might even see fraud as a means of saving up for the day when they too are laid off with short notice. The

temptation or moral justification for employees to commit fraud has increased. Managers are also not immune to the stress of insecurity. Managers know that they too could be laid off hence they have an increased incentive for outright embezzlement or fraudulent financial reporting.

The increased potential for fraud, together with the publics' perception of the auditor's responsibilities to detect fraud, increases the magnitude of the problem. For example, the attorney for Leslie Fay stated that Leslie's Fay's board relied on false information as blessed by its auditor, BDO, whose job it was to protect the company from fraudulent bookkeeping (The Wall Street Journal, 1995a). Unfortunately, the attorney's opinion is shared by others, notably jury members. In the Phar-Mor case a federal jury *unanimously* found Coopers and Lybrand liable to a group of investors on fraud charges in the 1992 fraud and embezzlement case of its former client Phar-Mor Inc. (The Wall Street Journal, 1996a). Coopers was found liable both under federal securities-fraud law and Pennsylvania common-law fraud.

From the above two cases it can be seen that irrespective of how the Auditing Standards Board tries to position itself with respect to fraud detection, the lawsuits continue. Furthermore, the lawsuits bypass the SASs and are filed under securities or common-law fraud. The profession cannot use ASB statements as a defense, and in addition, common profession-wide or firm-wide defenses are not too helpful because the liability laws differ from state to state. Clearly Coopers was not saved by any defense in its loss in Pennsylvania. To complicate the situation further, the ASB is in the process of revising its draft SAS related to fraud (Pany, 1996). The task force continues to work on the overall structure of possible guidance on the consideration of fraud in a financial statement audit. The draft contains a requirement that, on each audit, CPAs make an assessment of whether there is a heightened risk of fraud.

With respect to auditor litigation, on one side of the litigation spectrum we have those cases where the auditor was lacking due diligence. Clearly damages are due to the plaintiff in such cases. On the other side of the spectrum are those cases where the auditor used due diligence. Clearly here no damages are due to any plaintiff. In the center portion of the spectrum is the gray area where due diligence is questionable.

Within the gray area, plaintiffs have a clear monetary incentive to claim a lack of due diligence. Also within the gray area defendants (auditors) have a clear monetary incentive to be claim that the audit was done with due diligence. Irrespective of how the Auditing Standards Board and the profession try to limit auditor exposure by trying to define due diligence, there will still exist a gray area in which plaintiffs have a clear monetary incentive to sue.

Using digital analysis based on Benford's Law as an auditing tool is advantageous to auditors because it *reduces* the size of the gray area zone. Digital analysis, as described in Nigrini and Mittermaier (1996) has two basic objectives. First, as an analytical procedure it confirms the *reasonableness* of the data. Second, as a directed sampling procedure, it *directs* the auditor's attention to transactions or groups of transactions that merit further audit attention. It is a tool that if used properly, will *detect* the fraudulent transactions that are the subject of many lawsuits. It is most appropriate when used to detect fictitious transactions such as the cases listed above, or other cases such as L.A. Gear's fictitious inventory (The Wall Street Journal, 1995b), or Bennett Funding Group's office equipment leases that did not exist (The Wall Street Journal, 1996b).

The first advantage of digital analysis is that jury members will find the techniques easy to understand and a credible source of evidence. People find Benford's Law interesting because it is somewhat counter intuitive. Use of even the basic digital tests will impress a jury and will favor a due diligence decision. Not using digital analysis will have the opposite effect. If plaintiffs can show that tests existed that would have detected the fraud, but such tests were not used, the auditors

can expect to lose the case and face damage awards. Plaintiffs can run digital tests on all sorts of permutations, combinations, and subsets of the data until the fraudulent transactions stand out as clearly significant deviations. In other words, plaintiffs can run the tests until the fraudulent transactions are near the top of the directed sampling list. They can massage the data until they obtain the most favorable output to make their case.

The second advantage is that for most of the tests an objective conclusion can be reached, such as there was not enough evidence at the 0.05 level to reject the null hypothesis that the data conformed to Benford's Law. The more opinions are based on objective tests, the more the auditor stands to show due diligence. Objective tests lend themselves to being more concrete evidence in a set of working papers.

The third advantage is that digital analysis tests can be carried out on most balance sheet and income statement items. The only exceptions are the equity accounts that may contain too few entries to test for statistical significance. Consequently, each and every business transaction of the auditee could be represented somewhere on the digital graphs and tables. The jury might be more likely to accept the due diligence argument when it is shown that every single transaction appeared somewhere on the output graphs. The fact that the fraudulent transactions did not stick out enough to be noticed could be ascribed to the fact that deviations from Benford's frequencies are expected due to chance alone. That is, Benford's frequencies are a set of expected frequencies, and all expectations have room for deviations from the expected values.

Digital analysis is also a sign that auditors are using the most recent computer technology. Many transactions now occur only in electronic format. This makes traditional paper-record auditing impossible. Advanced payment systems have electronic transaction matching systems, the output of which needs to be tested for reasonableness. In other situations the sheer volume of transactions makes a representative sample costly due to the costs of substantive procedures. Using technology to audit technology will impress jurors. Using technology to audit large volumes of data is cost effective.

From a professional perspective, digital analysis levels the playing field. Research shows that the Big Six are quality differentiated firms. Digital analysis is a technology that can be used by all members of the profession, both large and small. Digital analysis tests could become part of an expert system giving all auditors access to expert knowledge. I currently view it as a decision support system, the decision being whether detection risk and control risk are at acceptable levels.

Auditors using digital analysis must use the techniques properly. There should be adequate internal guidance. Users should know enough about the mathematics to form an *a priori* opinion as to whether a data set should conform to Benford's Law. Users should be trained as to how to interpret the output. Auditors that use the tool, but fail to interpret the output correctly, would find it more difficult to use the due diligence defense.

The recent declines in the cost of computing power and increases in the ease with which software can be purchased or written, make digital analysis more and more attractive from a cost/benefit perspective. As an anti-litigation tool it can be used by auditors to demonstrate that they have met or even surpassed the due diligence criteria.

Appendix A: Summary of Digital Analysis Tests

1. **First digits** (1, 2, ... ,9). Probabilities range from 0.046 to 0.301.

2. **Second Digits** (0, 1, ... ,9). Probabilities range from 0.085 to 0.120.
Tests (1) and (2) flag large samples (relative to the population).

3. **First two-digit combinations** (10, 11, ... , 99). Probabilities vary from 0.004 to 0.041.

4. **Last two-digit combinations** (00, 01, ... , 99). All probabilities equal 0.01.
Tests (3) and (4) are best-suited to selecting audit samples.

5. **Tests for rounding.** A strong test for the prevalence of rounding or estimation. Test only gives a small sample if multiples of 100 or 1,000 are selected.

6. **Hit parade test.** This is a strong test for the abnormal recurrence of certain numbers. Test usually gives a very small sample as being in need of attention.

7. **Distortion Factor Model.** This test signals whether a data set appears to be over- or understated. It gives the percentage over- or understatement and the statistical significance can be calculated.

8. **Global test.** A global test for conformity of a data to Benford's Law where all digits and digit combinations are taken into account. A score of zero signals the most extreme case of non-conformity and a score of one signals perfect conformity. Algorithm and significance scores available in June, 1996.

9. **Test for small samples.** This test will score small samples (e.g., eight observations) according to the extent of abnormalities therein.

10. **Summation Theorem compliance.** This test checks for compliance with Nigrini's Summation Theorem. Test is appropriate to detect abnormalities in $[10^m, 10^{m+1})$ strata. Test suited to data that are only expected to approximate Benford's Law (medical expense claims) or where there are many relatively small numbers.

11. **Second Digit Probability Revision.** This test used corrected second digit expected probabilities when there is non-conformity in the first digits of a data set.

12. **Patterns test.** This series of tests identifies patterns in the digital frequencies. Test is appropriate when subsets are ranked in terms of abnormal patterns. The population could be payments for a period, and the subsets could be individual suppliers. Test will identify the suppliers with digital patterns that deviate most systematically (i.e., with a pattern to the deviations). Test cancels the need to test each supplier individually and to rank them in terms of systematic patterns. Available by August, 1996.

13. **Non-Benford data test.** These tests would apply to data that is not expected to follow Benford's Law such as medical expense claims, USDA Food Stamp Program claims, or checking account transactions (especially if they include ATM transactions). Expected digit frequencies are formulated based on past experience (i.e., empirical data) and (1) to (12) are amended to test for deviations from the revised expected distribution.

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Discussion of "Digital Analysis and the Reduction of Auditor Litigation Risk"

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Mark Nigrini's paper, Digital Analysis and the Reduction of Auditor Litigation Risk, is a leap forward for the audit profession, and I believe that this is an important contribution as we increasingly invest in information systems auditing. So any comments that I have on the paper should not be construed as arguing with the value of digital analysis. In fact, I advocate that future research be directed to finding more ways to analyze data and detect the anomalies which might indicate the existence of material fraud, misuse of corporate funds, errors, or misstatements.

Digital Analysis Overview

The essential point of this paper is that digital analysis, used in conjunction with an audit, will reduce an auditor's risk of litigation. Let's look at an example.

Frank Benford discovered that there are natural and predictable patterns when one looks at how frequently the numbers appear in large data sets. One of the more significant observations that he made involved the first two digits. Take a simple data set as shown below:

$15,987.90
3,894.94
.73
100.00

Taking the first two digits of each number (respectively, 15, 38, 73, 10) we can see that each of these digits are different. But Benford, and others mentioned in the paper, found predictable patterns in large sets of data. They found, for example, that there are more 10's than 99's. And more 11's than 98's; more 12's than 97's, and so on. As they looked at more and more data, they found that, in absence of some human intervention, the data should conform to a given pattern.

The author has taken this work further by proposing 13 methods of examining data, including tests for rounding, estimation, and conformance with known patterns. He has expanded the concept and presented it effectively so that those of us in the business of auditing can apply it.

Observations from Practice

Ernst & Young has used digital analysis and found that it does, at times, lead to some very interesting conclusions. Examples include:

* Frauds, usually low level ones, are sometimes perpetrated through a stream of transactions. Some perpetrators accomplish this by using a recurring pattern of transactions. Such a pattern may be detected through digital analysis and subsequent follow up on the transaction.

* Operational inefficiency: Considering the cost of issuing one check, our clients may not be aware of ineffective procedures which entail the issuance of many thousands of extra checks or other paperwork. (Example: One company issued 20,000 checks for amounts equal to $25, $50 and $75 as they matched employee contributions to charity. Would it have been more efficient to accumulate such checks? Companies might devise a different approach, particularly when the cost of issuing a check can be more than $10.00 per transaction.

* Internal Control circumvention. Most companies have signing levels of responsibility for disbursements (e.g. $5,000 by managers, $25,000 by senior managers and over $100,000 by two or more senior managers.) There have been situations where digital filter detect a cluster of transactions just under the authorization limits (e.g.$4,999), as individuals seek to circumvent the control system. Such discrepancies may not be fraudulent, but raise issues of internal control compliance. Detection can be an effective means of strengthening the internal control system at a relatively low cost.

* Digital analysis may also reveal if there has been a tendency for management to "manage the numbers," for instance, by rounding up numbers to make them look slightly higher.

In essence, this type of analysis is effective in determining if there has been some form of human intervention in the numbers that require further investigation. As such, digital analysis has the potential to provide a whole new way of analyzing data, and a technique to look at large data sets to detect anomalies.

Areas of Debate

While I have some areas of debate, and recommendations for improvement, I do not in any way intend to discount the value of this research. This paper is breaking new ground in analytical procedures, and it will have immense value for auditors as we rely more and more on technology and anomaly detection to replace conventional testing.

A. I take issue with the discussion on auditor litigation, which makes some assertions that are not correct. The paper indicates that the costs of settlements and legal defense were escalating at an alarming rate, and that was certainly true until 1994. But it goes on to state that there appears no end to the continuous upward spiral.

Looking back ten years from the time-frame referred to in this paper, one could project that there was no end in sight. In fact, in 1993, taking a look at the pace of litigation and settlements for all of the Big Six over a ten year period, one would project that by 2001, these costs would exceed the total revenues of the Big Six. Clearly, that situation required remedy. This is now occurring, and, in fact, the upward spiral has been reversed.

This has occurred because:

1. Firms became much more risk averse. This is evidenced by mass firings of high risk clients by many of the firms, and much more care exercised in gaining new clients. Firms have also instituted continuing reviews of client integrity and business risk so that risk is understood and managed.

2. Firms became much more vigilant in issuing opinions and scrutinizing questionable transactions or disclosures. The profession went back to basics in skepticism and exercising due care.

3. In the US, each firm now is a Limited Liability Partnership rather than just a partnership. Thus, the individual liability of each partner has been decreased, even though the firm's total capital remains at risk.

4. Efforts by the profession to influence Federal legislation were successful, as evidenced by the Private Securities Litigation Reform Act of 1995.

5. There has been increased vigilance on the part of corporate audit committees and boards to the danger of management fraud, poor controls, and environments that are conducive to dishonesty. This is partly a result of the litigation, and partly a response to the needs of shareholders and the financial community for integrity in financial reporting and corporate conduct.

B. The paper quotes the work of Arens and Loebbecke (1991) and concludes that a major source of legal liability is failure to discover a defalcation during an audit.

There is no question that auditors are sued for such occurrences, but our experience differs from this conclusion. In 1993, we conducted a study of litigation against auditors and found that the primary factor was the risk inherent in the business of the client.

We found that clients that were in high risk industries, in high risk businesses, or where management integrity was questionable, were the primary cause of litigation. Studies conducted by other Big Six firms revealed similar results.

We found that WHO you audit is the major risk factor; not the nature, scope and timing of audit procedures. In other words, if you were auditing an S&L in the late 1980's, you were auditing a powder keg. I suppose you could say the same thing for many of the famous "failures" where auditors have been held to be liable in some form.

This is why there has been so much emphasis by the Big Six on client acceptance and retention. And, as we have improved our ability to assess this risk, we have been effective at reducing litigation against us.

C. Any time that we talk of fraud, it is important to make a clear distinction between management fraud -- such as deliberate misstatement of the financial statements -- and employee theft, which involves the misappropriation of corporate assets for personal gain.

Audit standards require us to consider the potential for management fraud, and material misstatement due to employee fraud.

Digital analysis has detected employee fraud, and circumvention in internal controls that could ultimately lead to an environment where fraud could occur. By detecting such fraud, an auditor has performed a valuable service for their client, and may have reduced their own risk of an audit failure. External auditors may find that digital analysis is a technique to provide some incremental assurance that management fraud did not occur, or that internal controls were not circumvented. I believe that internal auditors, who have the primary role to play in the detection of employee fraud, will make great use of digital analysis as a technique to detect such frauds, and increase the total strength of the control system.

D. The paper makes extensive use of the term due diligence. In the U.S., due diligence is an agreed-upon procedure that is usually conducted in conjunction with an underwriting of securities. We use the term "due professional care" referred to in the generally accepted auditing standards.

E. Lastly, in an amendment to this paper, the author postulates that if an auditor were to use digital analysis, they may avoid an assertion of gross negligence. I fundamentally disagree with this conclusion.

Gross negligence can occur when it is found that an auditor made reckless disregard of audit standards and there was, in fact, no reasonable basis to issue an audit opinion. Digital analysis

could help corroborate an auditor's defense that they were not reckless, but, by itself, does not excuse an auditor for applying poor judgment, or having a poorly trained staff, or failing to exercise due professional care in other facets of the engagement.

Digital analysis is one technique, but is not, by itself, an all-purpose test of reasonableness or propriety. For example, digital analysis will not detect a key item, such as a very material transaction. In a series of disbursements ranging from $1.00 to $1,000,000, with 99.99% of the disbursements between $100 and $100,000, digital analysis would not necessarily detect the disbursement for $950,000 that may or may not be fraudulent. This does not negate its potential, but we cannot place reliance on any one tool or technique to form a conclusion.

Conclusion

So, where, in the face of my comments, does digital analysis fit in?

I believe that the audits of the future will be much more focused on the total business risk of an enterprise; make much stronger use of information technology to detect anomalies, exceptions, errors and misstatements; and be performed almost continuously. In fact, all of the firms are moving in this general direction to meet the needs of the financial community and adapt to a changing environment.

Digital analysis is one technique, of which there will be many, to enrich and enable the whole area of audit technology. In fact, I believe that Mark Nigrini has made a significant advance in the whole area of anomaly detection with the publishing of this paper. He has advanced the thinking by posing 13 methods to detect anomalies. We are strong believers in this area as a wave of the future.

Much work needs to be done in an area I call "Analytical X-rays." Just as x-ray technology advanced the cause of medicine, so to will a new generation of analytics advance the cause of high tech auditing. In fact, I believe that the academic community, particularly those of you with a strong mathematics or engineering background, could help advance the profession by adapting algorithms to the field of auditing to enable anomaly detection.

A very important element in moving this forward now shifts to the accounting profession. I believe that the profession has an obligation to embrace these techniques, and to encourage their adoption. And we need to begin to think beyond the characterization of analytical x-rays as mere "analytical procedures." Often, auditors think of analytical procedures (such as a year to year comparison of financial ratios) as providing a relatively low level of assurance. As we develop sophisticated methods, we should determine how such procedures could be used as substantive procedures. If we could deploy tools and techniques that look at data in a systematic way -- looking for known patterns and searching for anomalies -- auditors would achieve the goal of increasing the total value of their services to clients while reducing their own risk of an audit failure.

More powerful analytics will not be a substitute for auditor judgment, or for understanding the inherent business risk of a company or an industry, or inappropriately applying accounting principles. They would not have saved the profession from the litigation crisis. But, if they are woven into the fabric of an audit, they may very well help us to reduce the overall risk of auditing and increase the reliability of the audit opinion.

4

The Institute of Internal Auditors
Business and Auditing Impacts of New Technologies

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New developments in the regulatory, professional, and technology realms are among the most powerful influences on businesses today. As organizations struggle to compete and remain viable in a global economy, management at all levels finds the need for increased skills and new competencies. Auditors too struggle with issues impacting the auditing profession, audit services rendered and the expectations of those relying on audit services.

New technologies introduce powerful capabilities to any staff member. Activities previously reserved for technical experts or skilled clerical staff are now among the growing responsibilities of middle and upper management. Technical details of how enterprise communications systems are set up, monitored and maintained can have major impacts on an organizations continuing ability to stay in business. Thus, it is no longer sufficient to leave such details to specialists, whether this statement is made about auditors or about activities subject to auditing.

THE CONCEPT OF AUDITABILITY

Auditability is a central concept for any process or system wherein it is important to rely on the products or results. To assure auditability a system must provide proof that its results are reliable, and must have features such that an independent, objective review of transactions processed, data stored, and output provided can identify sufficient reliable evidence of continuous security, accuracy, privacy, and availability of information. System auditability features must be required at all levels in an organization and across organizational boundaries in order to extend appropriate assurances to any stakeholder in the organization.

Auditability objectives must be stated by management expressing specific responsibilities for the results of system processing. The auditing profession acknowledges that audit and control concerns extend beyond the realm of accounting and financial reporting to encompass the many issues and subject areas potentially impacting the viability of an organization or the ability to accomplish an organization's objectives. The structure of internal controls therefore must meet control and auditability objectives across a broad spectrum. Auditability objectives for the internal control structure can be identified at three levels: Governance, Assessment and Reporting, and Technology.

Governance

Boards of Directors, Audit Committees, Senior Management:
Senior and board level management expect auditability to assure effective information for governance. Protection of owner equity, public perception, and compliance with laws, regulations and expectations are important governance elements of auditability. The internal control structure of an organization requires the necessary elements to provide assurance at the governance level.

Assessment & Reporting

Self Assessment, Audit Assessment, Management Reporting:
To provide assurance, the internal control structure must include management assessment and reporting techniques that demonstrate controls' continuous effectiveness. Management assessment practices should be authenticated by audits to assure their ongoing reliability.

Technology

Management (all levels), IT Management, Systems Users, Auditors:
The principle application of controls in virtually all organizations today is in the information systems and technology that provide the basis for performing, reporting, and archiving the history of all events and transactions. Thus the principle manifestations of auditability are within the areas of systems auditability and control. The Institute of Internal Auditors Research Foundation provided the necessary research to develop and publish the definitive work in this area known as the "*Systems Auditability and Control*" (*SAC*) reports.

Major Technology Auditability Areas

SAC identifies major technology auditability areas as:
- Information Resources Centers
- Operating Systems and Systems Software
- Systems Development and Maintenance
- Business and Production Applications
- End-user and Client/Server Systems
- Telecommunications and Networks
- Security, Contingency Planning and Disaster Recovery
- Advanced and Emerging Technologies
-

Specific modules and case studies of the *SAC* reports address each of these technology subject areas. This paper addresses some areas where new technologies and other pressures are bringing about organizational changes. It discusses the enterprise impacts of new and emerging technologies. It examines the technology effects on business and technical management, and describes major changes for the auditing profession.

BUSINESS CHANGES RESULTING FROM TECHNOLOGY CHANGE:

New Technologies and Business Practices

Issues arising from current trends in technologies or business practices, and management actions for successful implementation:

Business process reengineering can occur because new techniques are available through practical applications of new technologies. Concurrently there is a need for almost constant retraining of staff in many business areas because new skills and knowledge are needed to use new tools, apply new procedures, and understand new interfaces between management, business peers, customers, and service providers.

New rules for competitive advantage emerge as new technologies redefine the: market place, elements of communication between business partners, components of production scheduling and efficiency, margins for tolerance and profitability, means for information service delivery, definition of timeliness, and much more.

As an example of business changes resulting from use of new technologies, many large organizations will not trade with other organizations unless transactions for ordering, delivery scheduling, billing, and payment processing are all handled through electronic data interchange. EDI processing allows greater control over inventory management, manufacturing processes, delivery schedules, cash management, human resources, and other business elements. Standards for

EDI transactions, processing and communications protocols are somewhat mature and well documented although such standards are not universally accepted. Use of EDI includes specific risks as well as new control and auditing tools.

By eliminating unnecessary processing steps, time delays, warehousing, spoiled goods, and other costly factors, a provider of products or services can reduce prices and redefine the rules of competitive advantage. EDI and other forms of electronic commerce are reshaping processes from acquisition of raw materials, through processing and distribution, to retailing and settlement of financial transactions. Entirely new business relationships are defined through the redistribution of responsibilities between manufacturers and retailers, eliminating wholesalers and warehousing, and assuring availability of goods when and where needed. These new relationships both take advantage of, and rely heavily on the interface of diverse systems coordinated via networks, accomplishing both common and disparate objectives.

New devices and techniques in the marketplace not only automate the processing of previously time consuming, sensitive, tedious, and error prone manual activities such as cash register operations, but also provide data directly usable by numerous related operations. For example, scanners at retail counters can provide data for daily sales analysis, customer history, inventory management, manufacturing and distribution forecasting, trading partner financial settlements, analysis of marketing campaigns or promotional pricing, determination of seasonal or geographical fluctuations, and more.

Control, Security and Auditing Issues

Major control, security and auditing issues relevant to technologies and business practices, and techniques for addressing them:

Migration of Controls and Security: As systems change in scope and employ new technologies, the location and purposes of controls tend to migrate to new system elements. At one time controls were centralized within the central computer and all the various control elements related to the centralized control structure. As application system capabilities expanded, certain controls migrated into applications. As database management systems matured some controls migrated to the DBMS environment. Each new element added to a system has the potential of altering the location of important controls and possibly subjecting them to varying degrees of reliability.

Modern computing environments are most often characterized by the network as the central element with individual computing devices on the network identified as servers, clients, or both. The former central computer system is now just another server on the network. Network security is a key element of system control, and trust relationships must be defined for networked devices, users, and even business partners through features of the network operating system and its interface with other systems and networks.

The security and control of any computer on a network is dependent on the privileges provided to trusted users and to access rights and trust relationships defined for other network devices and remote users. Security of networked systems is also dependent on the systems' ability to defend themselves against unauthorized access. Security and control elements are implemented through a variety of system features that often are immensely complex and esoteric to a specific environment of brand named hardware, software and network components. Security and control components may reside within operating systems, network components, specialized systems software and hardware, database management systems, program objects, application systems, and many other locations. Security within networked systems may be dependent on the "weakest link" within the network because of the inordinate expense of individually securing each networked component

against all potential breaches of security that could occur due to control failures within other components of the network.

Centralized Controls Administration: As systems and system components are distributed across diverse environments, it becomes ever more important to centralize the administration of security and control within an organization. The organization's central control group must be responsible for prescribing and administering effective control practices across all organizational elements. Centralized control must also administer controls over communications with entities outside the organization (such as business trading partners communicating over a value added network, and other outsiders with a vested interest in the integrity of information provided). Obviously staff resources in such a group need strong expertise in systems technology and business controls as well as the ability to deal with personnel across organizational boundaries and at varying levels of management.

Security and control guidelines must be consistently applied to all systems regardless of size, location, technical complexity, or number of users. A seemingly minor system running on a personal computer can be a point of entry to other systems on the network. But security guidelines are also restrictive in nature and must be tailored to appropriate business practices in the immediate areas to which they apply. Thus the centralized control group must be sensitive to risk management issues and cost effectiveness of controls.

Management Responsibilities for Controls: More important than the features of the operating systems, networks, or even the application systems are the organization's policies and management's attitudes about security and control. An inherently insecure system can be secured within an environment of effective controls. The most secure systems available can be compromised by ineffective application of systems environmental controls. Therefore it is important that management at all levels be provided the knowledge and tools needed to assure consistent and effective application of controls.

The application of technologies such as those found in client/server systems and networked environments requires new rules for such traditional controls as: separation of duties, security and access protection, data administration, software distribution, and backup and recoverability. Often members of management responsible for meeting control objectives are not familiar with them and lack appropriate guidance in their implementation. Management not familiar with traditional systems risk issues may be first unaware of the risks, and second unable to identify appropriate control techniques when risks are identified. Transversely, management not familiar with new technologies may prescribe ineffective control techniques based on obsolete knowledge of systems design features and components.

Control objectives have often been expressed in terms of traditional system features and personnel assignments. For example, the separation between programmers and production systems operations was initially required to reduce the likelihood that individuals who understand system features could cover up errors or fraud through access to live transactions or software, or disclose sensitive information. In a client/server environment there are new requirements for separation of duties as one person may perform the tasks of system design and development, programming, testing, computer operations, transaction processing, error correction, reviewing of system results, and storage of history records. Thus separation of duties must be defined at a level that will provide detection of unauthorized activities by some other business unit operating under a separate control structure.

Assessment of Control Objectives: Controls must be designed to do more than reduce risk. They must provide an environment of effective control at reasonable cost. Therefore managers must be

alert to new system features that can allow the elimination of expensive or complex controls in favor of more cost effective control techniques. Management actions to provide an acceptable level of risk should take into account economies of scale and the relative costs of preventing versus detecting and correcting errors.

Controls can be applied using a variety of techniques, and new technologies can change the factors used to evaluate the cost effectiveness of controls. For example, the cost of continuous control monitoring or auditor use of expert systems technology may have been prohibitively expensive in all but the largest systems environments just a few years ago, but may be regarded today as attractive alternatives to sampling or after the fact analysis.

Control self assessment should be a cornerstone of ongoing assurance of internal controls. This implies an effective self assessment process as well as the auditor's assurance for systems and activities subject to control. The organization's internal control structure must be a cohesive and comprehensive system as described in the COSO report, "Internal Control - Integrated Framework" published in 1992. The COSO report acknowledges the importance of information systems controls and refers to the *Systems Auditability and Control* reports for appropriate detail. The *SAC* reports specifically address business and technology risks, control objectives and techniques, and the roles of auditors in assessing overall systems security and control.

The auditor's first task in assessing system security is to examine the controls environment for the organization and determine whether the practices enforced are supportive of reliable computing. If so the auditor may proceed to examination of specific controls. If an effective control environment is not enforced, then the auditor will proceed to examine areas of greatest known exposures, and conduct tests to identify the extent to which systems are at risk.

Auditor Involvement in Developing Systems Controls: In times past, management hoped to rely on auditors to provide the level of expertise needed to assess the adequacy of controls designed for new automated systems. Unfortunately there are at least three flaws in the theory that auditors can provide the needed controls expertise for new systems designs:

1. There are not enough auditors to participate in all significant systems design and development projects. This condition is exacerbated in the proliferation of distributed, client/server, and networked systems acquired, developed and implemented outside of a central information systems group.

2. Reliance on auditors to specify control objectives and appropriate techniques removes the responsibility for controls from those designing the systems and those who will use them when they are completed. The education of systems designers, developers, and user management, as well as auditors, in the areas of risk management and application of controls is essential to ensure the ongoing effectiveness of future systems development and implementation. Auditors must not accept responsibility for controls design and must avoid activities that give the appearance of being responsible for defining controls. Using auditors to specify controls impacts their independence and objectivity. Section 100 of The IIA's Standards for the Professional Practice of Internal Auditing states that "INTERNAL AUDITORS SHOULD BE INDEPENDENT OF THE ACTIVITIES THEY AUDIT." All auditing standards have similar provisions.

3. While it is appropriate for an organization to wish to take advantage of the auditor's controls expertise to prevent mistakes in systems design and implementation, there are significant problems in trying to skirt the independence issue by planning to use other auditors to perform subsequent audits after a system is completed. The worst of these problems are presented as

issues one and two above. Significant audit expertise is needed to evaluate the organization's methods for developing and implementing systems. The systems development processes are themselves a system which produces other systems. Until the auditor has addressed the issue of how controls are designed into all systems it is fruitless to attempt to assure controls are designed into individual systems. Indeed an organization would be well advised to provide assistance to the internal auditing function while new systems are being designed to help identify systems features that will improve their auditability and provide continuous real time or soon after the event monitoring, error prevention and detection and other important controls.

An organization's security and control guidelines must specifically address auditability and control features and capabilities, provide specific guidance, and include audit considerations for all automated systems. Security and control guidelines should be examined by the auditors to assure they are appropriate given the operating environment, and will provide a reasonable baseline for individual system audit assessments.

The organization's auditors may or may not be involved in developing security and control guidelines for any given system or operation, but should assure the element of auditability is clearly understood by those responsible for providing and implementing the guidelines, and that auditors are automatically included as users of systems auditability features. Auditors then should examine proposed auditability feature designs for major new systems or revisions and assure the tools and techniques identified will be appropriate.

Continuous Control Monitoring and Continuous Process Audit Systems: As many systems process extremely large volumes of data including sensitive transactions with tight time constraints for preventing, detecting and correcting errors, many traditional audit techniques such as sampling or annual assessments can no longer be effective. Therefore auditors are using continuous control monitoring (CCM) and continuous process auditing systems (CPAS) to alert them to potential systems problems in time to take appropriate actions.

CCM and CPAS techniques can monitor data for transactions or events and compare them against expected criteria for such transactions or events. If data patterns indicate anomalies or known error conditions, the related transactions and supporting information can be captured and reported to the auditors for investigation. If a data anomaly is determined to represent an unusual but legitimate series of events, then the system's experience base or analytical rules can be modified to recognize such events in the future. Artificial intelligence or expert assistance features built into systems can improve their ability to identify anomalies and known risk or error situations, capture relevant information, and alert management as soon as a problem is detected so they can address problems before they get out of hand.

Use of CCM or CPAS as audit tools will likely raise the demand for controls of this type for use by managers as they will not want the auditors to know all the details of their problems before they even know the problems exist. Thus, an effective means of improving the overall state of systems auditability and control is for auditors to use advanced technologies and then share their techniques with management in the areas to be audited.

There has been some speculation that the use of advanced control and security techniques including CCM, CPAS, and artificial intelligence will lessen the need for auditors. However, until human nature changes and people stop making mistakes, there will always be a need for independent assessment of the reliability of systems and information. The auditor's job will, however, require the application of sophisticated knowledge and techniques as future audit tasks will include the validation of built in system audit features and the assessment of the general controls that assure the continuous effectiveness of such features.

Technical Details Integral to Control, Security and Auditing

Technology impacts on business practices, management issues, control, security and auditing issues.

As controls migrate into and among new technology system components, with the related impacts on business and management issues, new rules for assessment and attestation will change audit practices as well as the purposes and expectations of audits.

Some of the key enabling technologies applied in systems today include distributed systems, object technology, internetworking, expanded storage, and intelligent systems. Few technical systems experts can be expected to comprehend the complexities of this small but meaningful subset of new technologies. Even fewer can be expected to understand how they relate to each other and the collective impacts on controls resulting from their simultaneous implementation within an organization. Yet as new technologies are implemented within every component of an organization, the auditor is expected to: use appropriate judgment to evaluate and assess control strengths and weaknesses; design and conduct meaningful tests and evaluate test results; and render opinions on the validity of financial information, the integrity and reliability of other information and systems, compliance with laws and regulations, and any number of other expectations wherein independent assurance is valuable. Clearly the expectations of auditors and their ability to deal with both broad scope issues and extreme technical details are increasing.

The experienced auditor who can address modern business systems is in great demand. However, even the best and most technically competent auditors cannot know everything about new technologies and cannot examine all the significant risk components for an organization's systems. The following sections address some of the intricacies of new applications of technology and how knowledge of the systems described is important to the audit function. Also addressed are the interactive roles of auditors with the management responsible for implementing new technologies and with those responsible for or relying on system processing results.

ENABLING TECHNOLOGIES

The availability of inexpensive yet powerful computing and network components enables the implementation of client/server systems and local area networks as well as many other new applications of technology. The structure and techniques of both business and technical controls in these environments are dramatically different from traditional controls. Further the controls rely heavily on technical components that may be difficult to understand, are subject to constant change, and may be based on emerging standards or no standards at all.

Assessing the integrity and reliability of client/server and LAN based systems and attesting to the validity of information produced from such systems represents significant challenges to management, auditors, and technology professionals. Fortunately the level of interest in controls and auditability of systems is increasing in both the providers and consumers of such systems. Security, control and audit guides have begun to emerge as critical components of systems being considered for acquisition. However, much of the implementation of client/server and LAN based systems uses custom combinations of individual components from a variety of sources and a range of services from independent providers. Further, audit appraisals of such systems are often based on first time reviews of unfamiliar technology using tools and techniques that may also be new and/or unproven. Specific management and audit challenges addressed below are excerpted from the 1994 "Advanced Technology Supplement" (Module 13) of the *SAC* reports.

Client/Server Architectures

Implementations of client/server systems take advantage of enabling technologies that provide modularity, portability, interoperability, and flexible communications between system components. Technically speaking information processing, storage, and interface with system users can be applied cooperatively across a mix of interconnected processors in a client/server environment in a logical versus physical architecture. Thus it may be difficult to identify a specific machine or processing environment where a critical system component resides, and the architecture may change dynamically based on the availability of versus demand for processor cycles, storage capacity, or communication bandwidth. The considerations of security, accuracy, privacy, availability, auditability, etc. are directly impacted by technical issues of design, capacity, scalability and performance.

Evolving Management Issues related to client/server systems implementations include:

- Training of information technology and end-user staff - Training includes use and application of new tools, functionality, responsibilities, languages, operating systems, user interfaces, etc.
- Planning the migration - Migrations to client/server technology may include new approaches in budgeting, use of support staff and/or consultants, new roles and responsibilities, etc.
- Dealing with multiple vendors - Separate vendors may provide hardware, software, networks, network services (i.e. VANs), consulting, conversions, implementation, testing, etc.
- Packaged products and application enablers - The rush to develop new products may result in components that lack functionality or perform inconsistently, thus increased attention to specifications and testing is important although personnel may lack such expertise.
- Benefits of successful implementations - While significant benefits such as improved work flow, reduced cycle time, reduced costs and greater availability of information are possible through client/server technology, it is important to assure the benefits are real and are not traded against negative impacts such as decreased reliability or control.

Control, Security and Auditing Issues for client/server technology are similar to those for other environments, but the tools, techniques and audit approaches may be dramatically different:

- Development and implementation of client/server platforms employ new approaches that may be unfamiliar to management and auditors yet may occur simultaneously across broad segments of the organization for both mission critical systems and those of lesser importance.
- Management of transaction processing in a distributed environment may include execution across a network of distributed systems involving multiple transaction types processed locally on a particular client or server system. The system transaction processing control features should support discrete, consistent, isolated, serialized, and durable characteristics. These are provided by such technical controls as transaction identifiers, checking the status of all participants to a transaction, executing a two phase commit algorithm, detecting and resolving deadlocks, and coordinating transaction recovery.
- Management of data and process workflows may involve new or unfamiliar data management techniques such as snapshot, replication and fragmentation. Data distribution is dependent on the intended use, is implemented via distributed data management techniques, and will affect such control considerations as administration, access and currency.
- Securing the environment is a complex task due to the number of access points, the concurrent operation of multiple user sessions, and extensions of data access and update capabilities. System access points must be examined both individually and collectively.

Technical Perspectives: Security, control and auditing of client server systems are complex and subject to constant change.

Multi-tiered client/server environments are structured to support cooperative processing and to provide flexible domain and workgroup definition. Scalability is an important design consideration as are the features supporting graphical user interfaces (GUI), message passing concepts and remote procedure calls. Networked structured query languages provide a particular environment supporting requests and associated data from one process to another which may include clients and servers residing on different systems possibly under different operating systems. As the client/server environment employs distributed database and/or transaction processing functionality it is also common to use an intermediate software layer (middleware) that provides connectivity and unification services to remote sources of data or coordinates transaction processing among distributed and often heterogeneous servers on the network. In such environments network interface administration becomes a critical system control that should be subject to constant monitoring and frequent audit attention.

Local Area Networks

LANs and LAN based systems are subject to most of the same management, control, auditing and technical concerns as client/server systems and in many cases are components of such systems. Additionally there are some specific concerns related to the use of LANs in an organization.

Evolving Management Issues: LANs are rapidly becoming one of the most important components of the organization's internal control structure. They are expanding in size and speed, and provide processing for applications critical to business success. Through connections to other LANs, networks and platforms, LANs are becoming extensive repositories of production data and programs. They are also becoming the testing ground for new applications of technology and new interfaces between business functions.

LANs are becoming the central nervous system for businesses as they link together important components both within and outside the organization. For IT managers LANs may also become the center for their anxieties as LANs are subject to disruptions with effects ranging from minor annoyances to catastrophic results. Fault tolerance and security features are often added after a network begins to mature rather than during initial implementation. Network management is dynamic as both the technologies and business uses of LANs change continuously.

A primary incentive for installing a LAN is to share and consolidate information resources otherwise confined to single systems or stand-alone user groups. Both opportunities and risks are introduced as LANs facilitate data sharing, improve communications and cooperation, reduce processing time, and allow redeployment of resources. The system components allowing these changes also change rapidly thus relocating system processes, capacities and controls.

As organizations downsize, merge, expand, or otherwise change, network administration must keep pace with the changes. Ideally all subdivisions of an organization would conform to computing and network standards. In reality system types typically are diverse and the interconnecting of LANs is both complex and costly. Internetworking introduces management and control concerns that can impact the integrity of systems and information.

Networks connect more than just computers and peripheral devices. They support workgroups sharing, hopefully, common objectives. System applications supporting workgroups can actively control the flow of work between departments improving the overall control environment. Faster and bigger networks and the mixing of LANs with WANs (wide area networks) and the Internet continue to provide enhanced communication and processing services. Electronic commerce over

open networks is a pioneering activity to most organizations and will introduce significant new opportunities as well as new threats and risks.

Control, Security and Auditing Issues: LANs are not yet a mature technology. Most LANs were originally designed and implemented to be more open than secure. Mission-critical applications have migrated to LAN based systems. And a combination of interlocking techniques is required to provide an acceptable level of control for LANs.

Organizational considerations for LAN security and control arise because nontechnical people with little or no specific training find themselves responsible for fundamental computer security and control, network administration, and other issues that merit attention at the organizational policy level but may never have been addressed. New working relationships are formed among departments, and potential conflicts of interest and other control concerns can arise. Appropriate remedies for these concerns include: senior management support for security initiatives, development and enforcement of pervasive security policies, periodic security awareness programs, specific security responsibilities in LAN administrator job descriptions, specialized security training for LAN security administrators, centralized LAN security management, and effective auditing of LAN security management. (Such issues will likely be addressed in generalized audit questionnaires for computer security and control but may not directly apply to the LAN and interconnected networks environments. Thus customization is needed within the audit approach and training may be needed by technical auditors to address LAN audit concerns.)

Logical security, potentially impacting the entire organization, may be implemented at the network level. Historically logical security was provided at the application level or within specialized systems software. Changes needed in logical security or related control techniques were required to go through established change control parameters and procedures. Networks today and tomorrow provide the mechanisms to restrict or allow access to individuals or groups based on complicated control parameters. LAN security controls may also be the first line of defense for virus protection, enforcement of software copyright provisions, and other controls.

Operational network management issues, network software change control, continuity of processing and contingency planning, and physical security are all traditional controls migrating to new homes within networks and client/servers systems. Again the management and audit approaches to such controls will require constant attention due to the volatile environment.

Technical Perspectives: Management and auditing of LANs includes the need to understand the underlying enabling and supportive technologies providing improvements in LAN speed, performance, enhanced network data handling, and value for money. New technologies are the bases for bigger and faster networks, and will significantly impact network topology, management, security, control, and continuity of processing.

Increases in speed and network data handling result from both improved network components, such as fiber optics, and from new uses of existing technologies such as Copper Distributed Data Interface (CDDI) and fast ethernet over existing twisted pair and coaxial wiring. Optical fiber is inherently more secure than copper wiring, so concerns for speed and cost effectiveness may also be impacted by control concerns. The need to carry voice, data, images, and even video over LANs is expanding. Technologies supporting such capabilities include Asynchronous Transfer Mode (ATM), Switched Multimegabit Data Service (SMDS), and Frame Relay. Standardization issues for these technologies are impacted by the telecommunications industry perhaps to a greater extent than the concerns of LAN users. Nontechnical managers and auditors may be only peripherally aware of the technical and/or standards issues in network management.

Network management tools that allow continued growth and increased performance also include some highly technical components. However in order to distribute control of LAN administration to nontechnical staff, management, operational and problem solving tools must be easy to use and powerful enough to include network configuration, administration, monitoring, problem detection, analysis, and repair.

Interconnectivity among LANs and with other networks is required and increasing in most organizations today. Sharing information resources across different computer platforms, merging organizations with dissimilar technology, and the need to access information outside the organization are some of the many reasons for interconnectivity. For the network manager, and the auditor, each connection provides a possible failure point for security, operational efficiency, continuity of processing, and contingency planning.

Competing communications protocols, internetworking devices such as bridges, routers and firewalls, variations in network operating systems software, and the potential difficulty in even identifying the source of network-based services are among the many technical issues facing LAN managers and auditors. Fortunately the technology vendors are beginning to take a more active role in working with the security and auditing professions to not only provide better security and control features and options, but to also better explain their use and to reduce the amount of risk inherent in systems used with only the default features activated.

EMERGING TECHNOLOGIES

Numerous advances in technology are impacting business in new and often unanticipated ways. In addition to the obvious benefits of the technology there are also new control concerns and new opportunities to improve security, controls and auditing. Anticipation and advanced warning are two important elements to assure auditors will be in a position both to positively impact the auditability of new systems and to develop the expertise needed to audit them. Training and participation in the analysis of emerging technologies is essential to the future effectiveness of the auditing profession and the individual practitioner.

Object Technology

Important changes are occurring in the definitions of basic parts from which software applications are constructed. The great hope for object technology is a dramatic improvement in software development through the reuse of standard software parts rather than the reinvention and reconstruction of the same parts in every new application.

Enterprise impacts of object technology should be realized in improvement of the design, development, testing, implementation and maintenance cycles for systems. Also object technology may shift the organizational placement of systems analysis and programming activities. Libraries of trusted and audited software objects may be prepared and maintained under conditions roughly equivalent to traditional systems development and subject to equivalent controls, but the use and reuse of these objects may be available to virtually anyone in the organization with a need to produce information from available data.

New systems can more closely simulate actual business processes as, for example, workflow software may visually and explicitly depict the manner in which financial transactions are processed. Graphical instrumentation for financial and business procedures can also provide managers with more specific and more intuitive information about decisions they make.

Applications will be easier to use and modify as software objects are combined with point and click tools allowing them to be used with the same relative ease as PC spreadsheets and databases. While software professionals will be needed to cultivate collections of useful objects, users will be able to assemble objects in novel and useful ways.

New skills are required for systems developers using object technology as new techniques as well as new problems emerge. Significant changes in control concepts are emerging in both the technical and user arenas. New tools reputed to be self documenting will fall short of this expectation. Rapid application development and prototyping will sometimes be used to rationalize gaps in requirements analysis and system design to the detriment of software quality.

Object technology will also provide opportunities for new auditing approaches as object tools are combined into software development environments and standard control and audit objects can be included into tool libraries for both programmers and auditors. For example, an embedded expert audit object could alert the auditor when conditions are identified in a CASE (computer assisted software engineering) repository of system specifications that fall within the parameters of systems selected for specific audit attention. The auditor could then take steps to address auditability features while the system is being designed.

Technical overview: Information about object technology is important to understanding why this technology is significant to new directions in security, control and auditing. The anatomy of an object differs significantly from traditional programming. Software objects combine both programming instructions and data manipulation into the concept of an object. Traditionally data and processing components have been separated which provided an important control technique.

Classes, instances, subclasses, and inheritance are new concepts in terms of how software objects are designed, categorized, used, reused, and structured to accomplish system tasks. Object languages take into account the different messages that may be passed to an object, and the source of such messages, to determine the actions to be taken. Storage systems too change as object oriented databases facilitate the combining of data and the instructions needed to process that data in a logical structure to interface properly with physical device and network features.

Design methodologies and new concepts in development tools introduce opportunities to refine systems development methodologies. However these methodologies are not mature and there is a general lack of precedents for estimating object oriented development tasks and schedules. Auditors may find the need to specifically address object development methodologies to assess the development and use of reusable objects, class libraries and frameworks for object and data management, analysis and design, testing, documentation, and object change control.

Distributed objects combine the techniques, as well as the risks, of managing object oriented systems across distributed client/server environments. The challenge is to package software in self contained modules that can then be transported in some secure manner to other machines for processing. Distributed processing provides a severe test of standards, either proprietary or open.

Object technology incorporates new features not necessarily intuitive to those experienced in traditional programming languages and approaches. Auditors should understand these features and their benefits to provide the insight needed to specify auditability features for systems standards and specifications. Object concepts also have significant implications for system testing and documentation and controls for these important functions.

Open Systems

The paths to open systems are based on the desired features of interoperability, scalability, portability and compatibility. These features are provided through development of and adherence to open systems standards. There are significant benefits to be gained through development and implementation of open systems standards, but as in any standards oriented issue there are also the concerns of which standards to follow and how standards will be impacted by technology innovations.

Enterprise impacts of open systems can depend on the organization's flexibility and the existing investment in legacy systems. Investments in technology and systems applications will impact the organization's approach to migrating toward open systems environments. Open systems concepts may be based on either public or prevalent standards. Either way there is no assurance today that such standards will long endure.

UNIX systems are a good example of proprietary and industry standards and how they do and do not work together. As an open system, UNIX should support portability of software and systems across platforms and different vendor systems. However there are many proprietary versions of UNIX and there have been many UNIX standards setting initiatives. UNIX today is a collection of individual operating systems specific to individual vendors and designed to run on specific processors. Applications for UNIX may be specifically designed for portability across platforms, by avoiding vendor specific enhancements to features or even controls, but even so it will most likely be necessary to recompile programs as they are moved to another UNIX environment.

The role of open systems in distributed processing is to promote the interoperability of processes across diverse environments. However, open systems do not happen automatically or overnight. Auditors should be on guard to assess the effectiveness of management actions to plan and implement open systems as well as to prepare the organization to manage them.

Technical Overview: Open systems include three layers of architecture. It is important to understand the components making up each layer because of the impacts changes in them will have across any given organization and its dependence on open systems architecture.

Layer 1 - Computing hardware is the foundation for systems. It is profoundly impacted by advancements in the microprocessor arena. Standardization at this layer is primarily de facto and is driven by the large investment needed to sustain a presence in the industry. Standards are also impacted by consortia among industry leaders.

Layer 2 - Operating environment provides the interfaces to the hardware and application layers. This layer is highly volatile and includes operating systems, graphical interfaces, system software, and network protocol. Open operating systems today are designed with a layered approach to accommodate changes in either layer one or three via standard interfaces. Layer two software developers have also begun to recognize the importance of security and auditability and have taken steps to work with the auditing profession to define and document security, control and audit guides for their products.

Layer 3 - Application enablers include computing languages, CASE products, database management systems, and packaged software. Packaged software is by nature proprietary so there is little openness at this level. Some vendors are beginning to see advantages to building packages that can share information across applications. These packages still tend to be proprietary and typically are designed to give the vendor some advantage over other vendors.

Auditors who are able to address security and control issues across open systems also tend to specialize in specific packages and environments. Auditors using audit software in open environments must also address the issues of portability and scalability and can be more effective in organizations where management has a high regard for the value of organizational standards.

Multimedia

The emergence of multimedia tools and the rapid acceptance of these tools in the workplace is changing the nature of the work, the forms of information, the concepts of control, and the techniques whereby an organization interfaces with suppliers, customers and partners. Multimedia also changes the nature of evidential matter used for control and audit assessments.

Enterprise impacts of multimedia will tend to motivate the acquisition and creation of this technology over time and the pace of change will increase as the technologies become more affordable and more widely used.

Multimedia involves the combining of two or more of three specific elements: moving pictures, sound, and graphics. Text is assumed to be included in multimedia although it may not be an essential component as systems combine voice recognition, magnetic stripes, universal product coding (UPC or bar codes), touch sensitivity, and other means of communicating without necessarily using any specific written language. As audit evidence has traditionally been based on text and numbers in human or machine readable form, the auditing profession will have to closely follow developments in multimedia as records of auditable transactions and events migrate to these technologies.

As organizations transition to more powerful user workstations, sound and CD-ROM are often included as standard features. As the Internet and World Wide Web (Web) are exploited as new tools for gathering and distributing information, multimedia becomes a de facto standard. As multimedia becomes an accepted component of business communications there is greater demand and increased requirement for telecommunications capability with increased bandwidth to cover the increase in size of messages transmitted.

New applications in sales and marketing emerge as customers are reached via the Internet or other multimedia applications. Thus it is essential for auditors to have specific knowledge of the factors impacting the feasibility, use, control, security and auditability of systems using multimedia components. New techniques for securing transactions across open networks will likely be resolved first for text transactions and then transition to nontext communications. (Although encryption, for example, is already widely available for voice communication.)

Technical overview: Multimedia systems require additional hardware and software components to support audio, graphics and video. Multimedia development should follow typical system development controls taking into account business and technical feasibility, user requirements, hardware and software vendor stability, and the extent to which industry standards exist.

Technical approaches to assessing controls over multimedia implementation can involve reviews of new input and output media, new forms of storage and storage media including new techniques for data compression, and new systems software components. While the involvement of auditors in reviewing multimedia systems may not seem important because early systems are likely to be of a non-critical nature, these early implementations may set patterns and control standards for subsequent mission critical systems.

As tools for communicators migrate into multimedia it is important that promotional staff and other communicators be brought up to speed in these technologies. Advertisers today who focus exclusively on developing printed ads and brochures are instantly obsolete when the organization shifts its marketing objectives to include use of video, audio, the Web, and other multimedia techniques. Many organizations today are scrambling to provide a multimedia infrastructure as employees develop new tools and approaches such as preparing Internet or intranet Web pages.

Intelligent Systems

Artificial intelligence and/or expert systems (AI/ES), when successfully applied, may be invisible or nearly invisible in the business functions using these technologies. People often think a system should have greater intelligence than to create the results they see. ("Why would they do such a stupid thing?") But they may not understand the complex relationships between data, rules, and analytical techniques which make systems perform more intelligently or the challenges inherent in increasing the state of intelligence in systems.

Enterprise impacts of AI/ES should be understood by management in order to recognize areas where the organization depends on specialized expertise and determine if AI/ES could be applied to an advantage. Potential areas for AI/ES application include: expertise and performance bottlenecks, functions with high training costs, and activities dependent on characteristics of large volumes of data as in forecasting or monitoring of unusual transactions or events. AI/ES techniques are made available and feasible through advances in the technologies of data management, faster and cheaper processors, and improved analytical programming techniques.

AI/ES can provide increased sharing of experience through encapsulating that experience in the programmed rules and structured data of a knowledge base. Decreased dependence on human experts may be a desired result of AI/ES especially in areas where expert assistance is needed by a larger group of people than can be served by the available number of human experts. Taxation knowledge is an example of specialized expertise needed by a large body of people (tax payers and auditors) who are not necessarily tax specialists. Because of the large body of highly specific rules, taxation is a good area for AI/ES. However, shifting the dependency on expertise from humans to systems provides both opportunities and the responsibility to assure such experts perform reliably.

Greater leverage of historical data may be provided if AI/ES techniques are applied against such data. Increased productivity and competitive advantage are other potential incentives to invest in developing AI/ES. In any case the application of this technology creates another area subject to validation and auditing as such systems may be, or soon become, mission critical.

Technical overview: Expert systems use facts, relations, and heuristics expressed as rules and frames, and therefore are declarative. This is in contrast to conventional programs which are based on explicit control over the sequencing of operations and therefore are procedural. A variety of tools, languages and techniques are available for constructing expert systems ranging from extensions to general purpose programming languages to highly structured software environments called "expert system shells." Applications that are natural candidates for AI/ES are those where the human decision making process can be seen to follow a set of rules that can be articulated. Examples include review of insurance or loan applications or insurance claims.

Specific technologies applied in AI/ES include neural networks and fuzzy systems. A brief description of each may help explain why understanding of these technologies may be important to auditors. Auditors charged with validating the results of such systems will need much more than a cursory understanding of the technology.

Neural networks are built from historical data describing a situation and its outcome. Neural networks are pattern detection schemes, a point made clearer with the following example: Graduate students in a UK university constructed a general purpose coin box using neural networks. There is a slot for the coin, a sloping ramp where it rolls down, and a wall where the coin collides and stops. The data for this system are obtained from a microphone that listens to the coins drop. Over repeated trials, as a coin is put into the box the sound of its drop is digitized and the identity of the coin is revealed to the software. Eventually the neural system
is able to discriminate among coins by detecting patterns in the acoustical data.

Neural networks are built from elements that each behave somewhat like individual nerve cells (or neurons). Each neuron can be thought of as a single, simple processing unit. Large numbers of neurons linked together in densely interconnected layers form a neural network. Some neurons are sensors that receive input from the user or the outside world, others are effectors and are the output of the network. Nodes are linked mathematically. When input data are presented to the model, calculations lead to an outcome or conclusion. Each neuron in a neural net receives signals from some number of sources or other neurons, and sends a signal on to others. However, in determining the signal it sends on, it can weight each of its inputs to reflect how much attention it is paying to that input. Neural networks "learn" by adjusting these weights, which can be thought of as representing the strength of the connections between individual neurons. Training algorithms incrementally change the interconnection strengths between many pairs of neurons until the network gives correct answers for a set of training data.

Fuzzy systems contain programs with variables whose values are expressed as a fuzzy set. Elements of the fuzzy set carry weights to indicate their degree of membership. Degree of membership indicates the extent to which an element conforms with the overall premise of the set. For example, 35 and 45 degrees Fahrenheit may both be members of the set "cold temperatures," however, 35 degrees would have a higher degree of membership. Calculus is often used to compute the weights of the fuzzy set in the "fuzzification" phase. These weights are applied against a predefined rule set to determine the strength of output results. Additional calculations are then performed to resolve vague or conflicting results during the defuzzification" phase. The output of this phase is a concise final result.

Fuzzy systems consist of: A rule base; a fuzzy set (i.e., data describing the imprecise environment such as cold, cool, warm, and hot, or low, medium, and high); input data (e.g., temperatures); and degrees of membership (i.e., the strength of relationship between each input value and each fuzzy set value).

Auditing implications for AI/ES are based on the fact that applications of this technology are increasing and having important impacts on many organizations. In the course of audit assignments the auditor may find a need to increase or acquire technical understanding of expert, neural, fuzzy or other intelligent systems to address control, security and audit risks. An audit engagement may require the auditor to: ensure sufficient and accurate base data are accumulated for neural networks; ensure procedures are in place to update neural networks as new or revised data become available; and consider legal implications of reliance on intelligent systems for business decisions making purposes. As organizations expand their use of AI/ES, internal auditors may find it important to maintain active involvement in expert systems development and to evaluate whether intelligent systems might add value to the auditing function.

IMPACTS ON INFORMATION TECHNOLOGY MANAGEMENT

Emerging technologies bring about significant changes in the processes employed within IT functions as well as the relationships of IT with other elements of organization management, governance and auditing.

Strategies and tactics for planning and managing systems change as the roles of system design, programming, analysis, operations and other traditional IT functions are distributed to nontechnical areas of the business. IT historically has been perceived as a bottleneck in many organizations inhibiting the expansion of new systems due to the scarcity of systems personnel and huge project backlogs. In distributed systems environments IT personnel may still be the scarce resource that is consequently unable to provide structure to the explosive growth of systems and networks throughout the organization. IT specialists may then be called upon to provide support and troubleshooting for systems over which they have no control and with which they have no experience. Incompatibility among networks, data structures, software packages, electronic mail systems, communications protocols, and many other technology components are some unfortunate potential side effects of user controlled growth in distributed systems. IT typically inherits the challenge of recombining disparate systems into the cohesive framework needed to support business continuity and growth.

Relationships with technology vendors may shift in organizations where IT is not involved in a centralized control over acquisition of systems resources. In addition to the incompatibility issues mentioned above, an organization may lose benefits of bulk purchasing and favored status from suppliers who know the volume of business associated with large customers.

Skills required by application developers change significantly with the introduction of new technologies such as those described in this paper and the *SAC* reports. Roles for a distributed base of systems users and managers must be defined not only from a technical perspective but also in relation to the policies and procedures needed to protect the organization from new risks such as those brought on by software piracy, invasion of privacy, and introduction of viruses.

The cost structure for feasibility of systems design, management, and maintenance is in constant flux as technologies emerge and mature. The organization's strategies of employing newer versus more mature technologies will also affect the decision processes for technologies, applications, and techniques to employ.

Dependencies on systems components shift as new functionality is added to systems and networks. Network firewalls which previously were obscure components of highly sensitive or secret systems are now critical elements of networks allowing or preventing remote access. Firewalls may also be single points of failure potentially impacting the entire organization if they have not been incorporated into the business recovery plan.

IT management must continuously assess security threats and vulnerabilities from an enterprise perspective. The move from well controlled centralized mainframes to decentralized and distributed desktop and client/server environments has a huge negative impact on security. Rather than controlling security for systems environments IT must encourage and promote participation of the security function in technical and operational initiatives.

Methods for authenticating systems users and their activities may not be standard options in systems selected to satisfy operational objectives and they may or may not be available as add on features. Then as systems and networks are interconnected IT has the challenge of protecting sensitive

network components from unsecured systems while establishing trust relationships between various domains and work groups sharing networked resources.

Monitoring tools for systems and management controls are expanding in availability and functionality but their use must be explicitly required for all sensitive systems if any degree of security, control and auditability is to be maintained. IT management too will be impacted by shifting emphasis in strategies for contingency planning and disaster recovery. Again backup and recovery tools may or may not be integral components of systems and networks, but the adequacy of any such techniques can only be assured in an environment where overall business recovery planning is integral to all system management and user responsibilities and recovery practices are regularly tested.

IMPACTS ON INTERNAL AUDITING MANAGEMENT

Auditors as users and reviewers of technology must maintain a keen awareness of new and increased areas of risks and the shifting control responsibilities and techniques.

Determining the Auditing Approach

For any organization this involves assessing ongoing business requirements and comparing them to short and long term automation strategies. Management's philosophy toward automation must also be taken into account when considering the appropriateness of plans, budgets, and stated objectives.

The IT organization structure and whether the organization employs a steering committee for automation resources will impact the expectable level of controls and auditability in the various systems areas subject to audit. The extent of deployment of user controlled systems and networks and the availability of centralized resources to authorize and/or support end user systems is also significant. The greater the extent of distributed activities and systems, the greater the need for a centralized control over the acquisition, deployment and ongoing control over system resources.

Factors to consider in planning the scope and extent of audit activities, and the specific audit expertise needed to accomplish audit objectives include:

- Hardware and software systems and platforms for business and production systems in use as well as systems in planning and development,
- Automation policies and standards, service level agreements, quality assurance, performance monitoring and results,
- Security and control requirements, control system structures, contingency planning, and disaster recovery.

Technical Auditing Resources

Determining the technical resources required for any audit engagement must take into account the professional responsibilities of auditors and the expectations of those served by the audit function. The IIA's "Model Curriculum of Information Systems Auditing" defines technical expertise for auditors at three different levels of technical involvement. Level one technical competence is the minimum level of technical knowledge expected for all auditors from entry level to the chief audit executive. A level one auditor should understand basic technology and system concepts and be able to understand the system components supporting any business activity subject to audit. All auditors should, for example, understand the difference between application systems and systems software and have a general understanding of which systems should contain general business and process controls. They should also be able to carry out routine audit tests using

automated tools as provided by technical support staff, and understand the purposes and results of such tests.

The ability to manage audits in an automated environment requires a degree of knowledge defined as level two in the Model Curriculum. Auditors in charge of audit projects should be able to assess operations and system structures and determine where the control points should be in such environments. Further, level two auditors should be able to conduct preliminary analyses and determine the types and extent of testing required for business application systems. They should then be able to evaluate test results and assess whether weaknesses or errors are based in the application, the network, supporting systems software, or other systems components, inappropriate system design features, improper use of system components, weaknesses in system and program change control, user or operator error, inadequate monitoring, or some other systemic cause; and to whom specific findings and recommendations should be addressed.

The level two auditor should know when to alert audit or business management of a finding based on its degree of seriousness and when to call for specialized audit support expertise to further investigate technical matters or to deploy specialized audit support tools. Level two auditors should be capable of passing the Certified Internal Auditor examination demonstrating their competence to perform audits with appropriate support in any given environment subject to auditing. The competent level two auditor understands overall business concerns and audit roles and responsibilities and how they are impacted by systems and changing technologies.

The ability to develop and conduct technical systems audits is typically the responsibility of auditors defined at level three in the Model Curriculum. Level three auditors may specialize in individual audit areas such as networks, operating systems, database management systems, or even major applications and will become intimately familiar with brand named components of systems and how individual system components interact with other components as in networks or the use of special security monitors for a particular operating system or communication environment. Level three auditors may or may not be capable of functioning at level two depending on whether they have broad business and auditing knowledge in addition to in depth technical knowledge.

Technical auditing resources include the tools used by auditors at all levels. Audit tools provide both localized and remote auditing capabilities. For example, the auditor's initial review of local area networks in an organization may reveal a standardized structure with central control including standard system components and features. In such an environment the auditor can then develop an audit tool that can be transmitted to any LAN server and run on a prescribed schedule with the results transmitted back to the auditor for review. While such a system will require specialized knowledge to develop, the time and money savings of eliminating auditor travel to each LAN site can be significant.

Other audit support tools should also be centrally controlled for an organization. Auditors should use standard tools for accessing data, routine and specialized analysis, spreadsheet and databases, word processing, communications and other productivity techniques.

Communication capabilities of auditors should be germane to the realm of their audit coverage. If auditors function within a local environment then local electronic mail should be sufficient - unless the organization makes use of global electronic communications, then the auditor should also use global communications tools both to support their efforts and for familiarity purposes. Similarly the mix of audit support tools should closely follow the types of tools used in all areas of the organization(s) subject to auditing.

Self assessment as an auditing tool should include assuring the self assessment tools used by management support auditability objectives. The auditor should be able to attest to the validity of self assessment as applied throughout the organization, particularly in those areas where self assessment is an integral component to proving compliance with laws and regulations.

Continuous control monitoring (CCM) and continuous process auditing systems (CPAS) as previously described in this paper and more fully addressed in a manuscript by Professor Miklos Vasarhelyi (currently unpublished) are the tools that will define future effectiveness of systems and processes subject to auditing. The audit application of CCM and CPAS tends to improve management acceptance of such tools and leads to the use of greater intelligence in interactive system monitoring and control procedures. Artificial intelligence in expert audit assistance systems will improve the auditor's ability to apply both local and remote auditing techniques. Ideally systems and networks in the future will have robust native security, controls, monitoring and auditing features. In such environments auditors will be challenged to validate the ongoing effectiveness of such features and to design continuous improvements to knowledge based intelligent audit systems.

Auditing Management Strategies

Auditing management strategies for any organizations will be based on both professional auditing standards and the expectations of those relying on the results of audits. Financial and compliance auditing continue to be premier areas of audit attention, but no longer constitute the clear majority of all auditing activity. The 1991 *SAC* reports documented the first research showing financial/compliance auditors as less than 50% of the population of internal auditors surveyed. As indicated in the previous section of this paper on technical auditing resources, even financial/compliance auditors have significant responsibilities to address technology and other areas of organizational impacts in their work.

Operational and functional auditing are also heavily impacted by new and emerging technologies as they provide the bases for business process reengineering and other organizational changes. An appraisal of the feasibility of combining two separate organizations or functions, for example, must address the compatibility of systems and system management philosophies for the two organizations and the estimated impacts of combining them.

Quality and environmental auditing have emerged as relevant areas in virtually all organizations. The competence of auditors in these areas is based on strengths in both auditing expertise and quality or environmental management matters. In many cases the level of technical knowledge required for these specialties is similar in depth to specialized knowledge required of IT auditors. Further, quality and environmental auditors should be expected to be competent in the use of IT auditing tools and to maintain other areas of technical competence as described above.

IT auditing in many audit organizations is still searching for an identity. Attempts to promote technical expertise in "nontechnical" auditors has lead to various approaches described as integrated auditing. In some cases technical auditors were assigned to support teams of nontechnical auditors. In other cases the IT auditing function was eliminated under the theory that all auditors would address technical issues during their routine audits. Both of these approaches have met with difficulty as technical auditors quickly lose their edge as they are removed from performing technical functions, and nontechnical auditors do not have the expertise needed to address controls in complex systems environments.

Audit Administration

Audit administration must take into consideration the availability and use of technology tools, the ongoing development of such tools, and the training of auditors in their use. Support tools as well as specific audit standards must be provided by audit management for: planning and scheduling, setting audit objectives, pre-audit work, conducting the audit, evaluating results, communication of audit results, maintaining audit archives and supporting databases, providing potentially global access to audit databases by traveling and remote audit staff members, and follow-up on audit recommendations. Specific responsibilities of professional auditors in meeting audit expectations are both the subject of using the right tools and maintaining specific competence in an ever expanding realm of knowledge areas.

Professional auditing organizations all over the world are addressing issues and standards relevant to technical auditing and the technical competence of auditors. The International Federation of Accountants (IFAC) recently formed an Information Technology Committee (ITC) specifically to address technology issues relevant to accountants and auditors worldwide. At the initial meeting of this committee representatives from seven countries representing fourteen different professional associations addressed an action plan to cover high priority technology issues in auditing and accountancy.

Professional auditors in internal auditing and public accounting are collectively addressing important issues in: defining the roles and responsibilities of auditors in relation to technology, addressing the technical competence and related credentials of audit professionals, continuing technical education requirements, use of technology tools, meeting expectations of the auditing profession in general and specifically in technology matters, defining the professional body of knowledge for auditors, technology standards and technology auditing standards, the availability of supportive information and communications for audit practitioners, and much more.

1994 SYSTEMS AUDITABILITY AND CONTROL REPORTS

Much of the information in this paper is based on research by The Institute of Internal Auditors Research Foundation and is covered in greater depth in the *SAC* reports. The 1994 updates to *SAC* include the following modules and individual chapters.

***SAC* Module 11 - Emerging Technologies**:
1. Executive Summary
2. Object Technology
3. Open Systems
4. Telecommunications
5. Mobile Systems
6. Information Security
7. Document Management
8. Multimedia
9. Intelligent Systems

***SAC* Module 13 - Advanced Technology Supplement**:
1. Executive Summary
2. Client/Server Architecture
3. Local Area Networks
4. Electronic Data Interchange
5. Business Process Reengineering
6. Outsourcing

7. Private Branch Exchanges
8. Electronic Mail

SUMMARY/CONCLUSION

The auditing profession is dealing with technology issues in a variety of ways. The level of technical knowledge needed by auditors is increasing constantly both for auditors in general and for technical audit specialists. Auditors too are working to address the concepts of security, control and auditability and how they can best be implemented by those responsible for the organizations, activities and systems subject to audits. A critical element in the future viability of professional auditing will be how the profession addresses questions of technical competence for auditors and the related impacts on the credibility of work performed by, and opinions expressed by auditors. Technology is not a new concern but the increasing rate of technological innovation is increasing the pressure on auditors to devote more attention to technology matters.

This paper was prepared by Charles H. Le Grand, Certified Internal Auditor. The observations and opinions expressed do not necessarily represent those of The Institute of Internal Auditors or The IIA Research Foundation. However, the content of this paper is generally based on and consistent with the research, educational and other materials prepared and released by The IIA over the past 20+ years as related to evolving issues in technology and the corresponding positions of the profession of internal auditing as expressed by and through The IIA. Comments, questions and rebuttals are invited. Please direct them to the director of technology at IIA headquarters.

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Meeting The Challenge of Technological Change - A Standard Setter's Perspective

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INTRODUCTION

Will there still be work for auditors in the year 2016? The continued existence of a meaningful role for external auditors will depend to a great extent on how well the auditing profession can adapt to the continuous and rapid advances in information and communications technology (IT) and the changing information needs of users. While adapting to change ultimately is the responsibility of the individual public accountant, standard setting is vital to helping the profession as a whole move forward and continue to the meet the public's evolving needs and expectations.

Effectively assessing and reacting to the impact of technology is a matter of survival for auditors. In *The End of Work* Jeremy Rifkin notes that "a survey of recent technological developments and trends in agriculture, manufacturing and service sectors suggests that a near workerless world is fast approaching and may well arrive before society has sufficient time to either debate its broad implications or prepare for its full impact."[1] Evolving IT is rapidly making its way up the work ladder, replacing not only many blue-collar manufacturing jobs and white collar clerical positions but also an increasingly significant number of middle management positions.[2] And some professions are beginning to face serious competition from computers which solve the mysteries of the more mundane aspects of professional practice, enabling laymen to do the work themselves or hire a software-armed paraprofessional."[3] The question then is how will auditors cope with, or perhaps even thrive in, a high-tech environment.

High-tech environment

High-tech has been defined as "a term for sophisticated, often complex and specialized innovation."[4] The concept of a 'high-tech environment' is subjective and constantly changing as IT evolves. However, IT can be viewed as having two fundamental functions, whereby it:

(a) automates (i.e., replaces the human body with a technology that enables the same processes to be performed by a machine with more continuity and control); and simultaneously

(b) 'informates' (i.e., generates information about the underlying productive and administrative processes (activities, events and objects) through which an organization

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1 Rifkin, Jeremy, *The End of Work*, page 106.

2 Ibid., chapter 1.

3 Ross, Philip E. "*Software As Career Threat*", Forbes, May 22, 1995

4 Microsoft Press *Computer Dictionary*, 2nd Edition, 1994

accomplishes its work). It provides a deeper level of transparency to activities that had been either partially or completely opaque... For example, scanner devices in supermarkets not only automate the checkout process but also simultaneously generate data that can be used for inventory control, warehousing, scheduling of deliveries and market analysis.[5]

The AICPA Technology Division annually identifies the 15 technologies which have, or will have, the most significant effects on CPA's and the entities they service.[6] The automating and information functions underlie all of these technologies and have a profound effect on the way an organization defines and conducts its business and the control elements it establishes to help achieve its objectives. How will these functions affect auditors as technology continues to rapidly develop? This depends on:

(i) whether auditors can effectively respond to changes in the conditions which have traditionally driven the need for audit (assurance) services and thereby meet the changing needs and expectations of users; and
(ii) whether standards, and related guidance, are developed in tandem with the needs of users and providers of assurance services to help ensure that sufficient appropriate information is available on which to base decisions and thereby improve organizational performance.

This paper provides a brief overview of these matters, and contends that if auditors embrace new IT and seize the opportunities it provides, the future of the auditing profession looks bright.

A CONTINUING NEED FOR AUDITORS IN A HIGH-TECH ENVIRONMENT

In 1973, the American Accounting Association (AAA) released *A Statement of Basic Auditing Concepts* which contains a useful model of the communication of accounting information and the role of the audit function (see Exhibit 1).[7] The elements of this model continue to apply in a high-tech environment, but with significant changes in the nature and availability of subject matter, the information that can be developed and reported using the subject matter, and the types of objective assurance services and related standards that are needed. Exhibit 2 re-works the AAA model to reflect these changes. The AAA model refers to four conditions creating a demand for auditing.

- conflicts of interest between preparer and users;
- consequence of information to users;
- complexity of subject matter and audit process; and
- remoteness of users from subject matter and preparer.

In a high-tech environment, these four conditions still result in a need (opportunity) for objective assurance services, but the nature, timing and extent of such services, and how they are performed, change significantly.

Conflicts of interest between preparer and users

The sophisticated, complex and specialized innovations associated with a high-tech environment are unlikely to affect conflicts of interest between preparers and users. The objectives,

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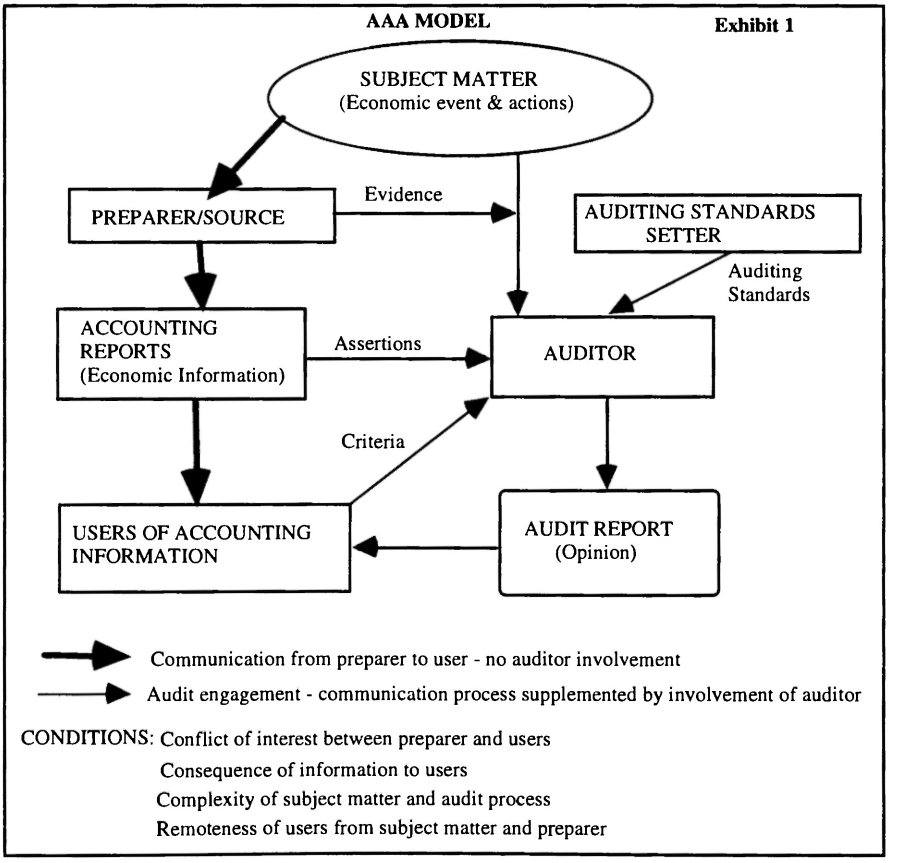
5 *In the Age of the Smart Machine - The Future of Work and Power,* Shoshana Zuboff, (pgs. 9-10)

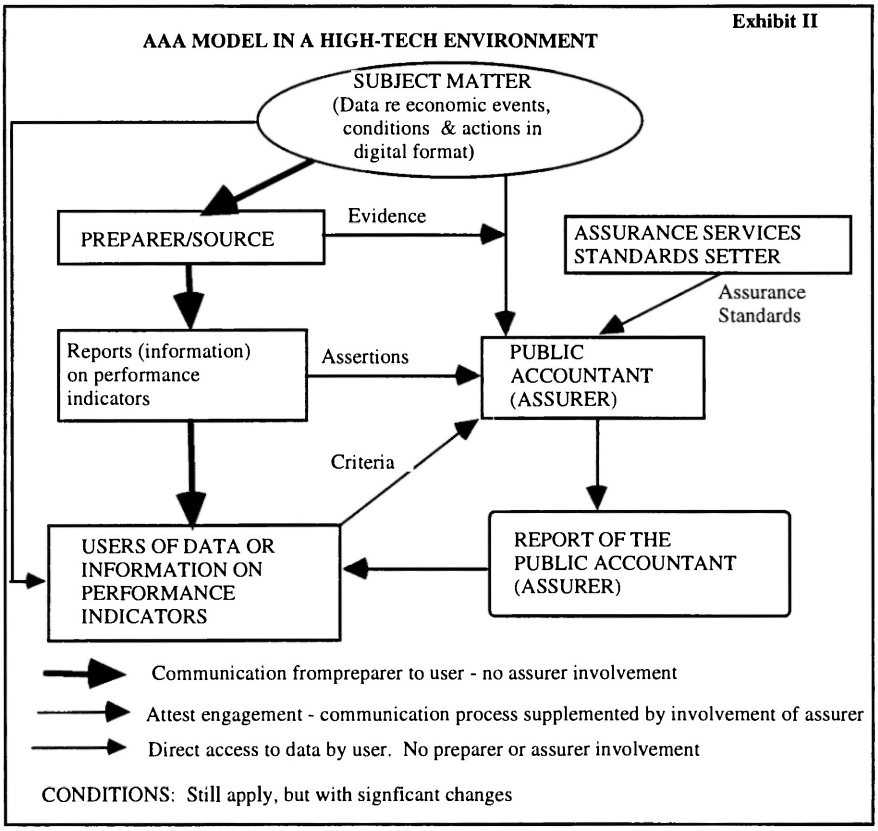
6 AICPA *Infotech Update*, Winter 1995.

7 American Accounting Association, *A Statement of Basic Auditing Concepts*, pg. 11

desires, attitudes that may lead preparers to promote their own self-interest by biasing reports (either deliberately or unintentionally) endure in a high-tech environment. The AICPA Special Committee on Financial Reporting (the Jenkins Committee) has stated that credibility of reporting is still a serious problem, since investors, creditors, and their advisors believe that the reports of many companies reflect the natural tendency of management to report information in the best possible light and to avoid reporting poor company performance.[8] Accordingly, actual or perceived conflict of interest will continue to be a primary driver of a need for an objective attest function. The high-tech environment may provide a user with greater opportunity to forgo the attest function and obtain direct access to the underlying data without the use of an assurer, but whether a user would take this course of action is primarily a function of the complexity and remoteness conditions discussed below.



8 The AICPA Special Committee on Financial Reporting, "The Information Needs of Investors and Creditors"



Consequence of information to users

The AAA model states that the more significant the consequence to the user of acting on insufficient or inappropriate information, the more importance he or she will attach to receiving objective assurance. In a high-tech environment, the basic nature of the actions taken by users (e.g., invest, disinvest, loan, demand payment) do not change significantly. However, IT has a significant effect on:

(i) the nature and extent of data and information which may be made available to users; and
(ii) the time-frame in which users expect to receive information relevant to their decision-making.

Effect of IT on the nature and extent of data and information available to users

Because of the power of digitization, a high-tech organization can use IT to capture, analyze and report a wide range of both financial and non-financial performance measures regarding factors that are critical to the organization's success.

Such performance indicators often would include:[9]

- market/customer indicators (e.g., of measures of product quality, speed of production, on-time delivery; customer demographics, new product introduction)
- internal business process indicators (e.g., measures associated with processes associated with an organization's critical success factors, such as new product development);
- human resource indicators (e.g., measures of employee's competence and skill growth; morale; ability to be innovative and creative);
- competitor indicators (e.g., measures tracking competitor's performance on the same dimensions as those of the organization);
- environmental indicators (e.g., measures of air and water quality; extent of recycling); and
- financial indicators (e.g., revenue growth, customer and product profitability; cost trends, asset management; return on invested capital and equity; return on R&D; cash flows).

Performance measures often will focus on history (i.e., events that have occurred that have resulted in current conditions, risks and uncertainties) but, through the use of IT, these measures can also be designed to provide a basis for more meaningful future-oriented information (i.e., forecasts and projections) which may be even more relevant to the decision-making process of users.

Each performance measure will have varying degrees of relevance to the decisions of particular users, depending on the users' objectives. However, these measures, overall, may become more important than historical cost financial statements as decision-making tools of users. The Jenkins Committee, the Inter-institute Vision Task Force (of the CICA and Provincial Institutes of Chartered Accountants in Canada) and numerous others have expressed the view that the traditional historical-cost annual financial statement distributed on paper is unlikely to continue to satisfy the market's need for timely and relevant information. However, if these new performance measures are vital to decision-making, it seems reasonable to suppose that users will want objective assurance regarding the reliability and relevance of such measures.

Shortened time-frame for decision-making

The use of IT has increased the speed with which new information can be made available (and older information made irrelevant) and accordingly the speed with which many decisions can, and need to be, made. Annual audits of financial statements are likely to become less important because users need more timely information. However, auditors have an opportunity to develop assurance services that respond to a short decision-making time frame. For example, the AICPA Special Committee on Assurance Services (the Elliott Committee), particularly its Information Technology Sub-Committee has discussed methods by which auditors may be able to monitor and report on performance measures on a real-time basis. The methods include:

- the introduction of numerous electronic sensors (owned or controlled by the auditor) at key checkpoints in the organization's information systems, with the sensors automatically identifying subject matter that requires attention; and
- continued development of audit software agents to provide auditors with the capability to search for unusual patterns and/or corroborative patterns in the organization's data

9 Faculty of Finance and Management of the Institute of Chartered Accountants of England & Wales, "Good Practice Guideline - Developing Comprehensive Performance Indicators"

bases, and the data bases of other entities involved with the organization (e.g., its EDI partners).

Such methods, of course, require auditors to embrace IT and use it effectively to meet user needs.

The Elliott Committee has also discussed other possibilities of making assurance reports available on a more timely basis. For example, if a user desired assurance regarding the integrity of a database (e.g., a report on the effective operation and continuity of controls (including security controls) over a database system having a link to the Internet), the system could be designed to enable the user to click on an 'assurance icon' to have access to the assurer's report (perhaps for a fee). Another example would be to design a database system to enable users of particular types of data to obtain immediate access to the assurer's latest report on the reliability of those data.

Complexity of the subject matter and the audit process

The AAA model is based on a premise that the need for an audit performed by a qualified professional will increase because, as the subject matter, and the process by which it is converted into information, become more complex:

(i) the user of information will find it increasingly difficult or impossible to be satisfied as to the quality of the information being received;
(ii) the possibility of errors in the information increases; and
(iii) the audit process to assess the quality of information demands a level of expertise not possessed by the average user of information.

Increased difficulty in assessing the quality of information

In a high-tech environment, most subject matter can be put into a digital format, thereby increasing not only the volume of information that may be made available to users, but also its level of complexity. Also, users may find the environment in which they must interpret information more complex because they can receive information (often relating to the same subject matter) from a myriad of on-line services and databases.

The IT sub-committee of the Elliott Committee has identified a significant opportunity for the auditing profession to help users sort out complex information by providing user decision-modeling assurance on: problem definition; decision model selection / specification; decision model information requirements; information sourcing / finding; information analysis / interpretation / relevancy; evaluation of alternatives and trade-offs; implementation of actions; and outcome feedback.

Possibility of errors

No advance in IT will entirely eliminate uncertainty about the accuracy of information it produces (i.e., the uncertainty principle, a basis for quantum mechanics which governs the behavior of transistors and integrated circuits, is a fundamental and inescapable property of the world).[10] However, IT can significantly reduce errors since computers and other forms of IT are much more effective than humans at performing vast numbers of repetitive tasks with a very high rate of accuracy. Further, the quality of software and hardware likely will continue to improve as the

10 Hawking, Stephen, *A Brief History of Time*, pgs 55-56

process of developing them is itself increasingly automated, reducing the risk of human error in the process.

However, a disturbing trend for information suppliers, users and auditors alike is a decrease in the level of human knowledge and skill needed to challenge erroneous information generated by IT. It has been observed that when manual tasks are computerized, the art and skills previously used to manually operate a machine are lost. This loss means that operators no longer have 'checkpoints in reality' that allow them to confront the accuracy of the computer information.[11] If it is valid to generalize this problem beyond the work environment, it seems that users should recognize their own inability to assess the reliability of information received, and accordingly look to auditors to provide assurance on the information. This assurance could be indirect, taking the form of an opinion that the controls over the systems generating the information are operating effectively. On the other hand, blind trust by users that IT-generated information should be almost error-free is not beyond the realm of possibility.

Level of expertise required to perform audits

Auditors who are well-versed in technology often question whether certain auditors (let alone lay-persons) are capable of performing an effective audit in a high-tech environment. The auditors whose performance is being challenged are those who want to continue to take a substantive approach and audit 'around the computer.' As the use of IT such as EDI gains in popularity, the substantive approach will no longer be practicable. As noted in the recent Auditing Procedure Study *Audit Implications of EDI* jointly developed by the CICA and AICPA, paper documents will no longer be available, and assessing the completeness, accuracy and authorization of transactions will require an understanding of EDI controls embedded within the computerized systems.[12] Also, the most effective way to audit an entity using EDI may involve the use of continuous auditing techniques and on-line real-time auditing tools such as an integrated test facility, embedded audit modules and concurrent audit tools.[13]

Most lay-persons are not interested in spending the time and money to acquire expertise in auditing, particularly expertise involving sophisticated audit tools. Auditing is seen by many outsiders as a tedious profession practiced by the sincerely dull.[14] They would prefer that someone else, with the required expertise, perform the service. This is not to say that some laymen might not want to make use of data extraction tools that may become easy to use with advances in IT. However, expertise in auditing goes well beyond data extraction, and a scenario whereby users commonly perform their own audits, because they have acquired the professional expertise and want to make the effort, seems unlikely.

Remoteness of users from subject matter and preparer

The AAA model takes the position that even if the user of accounting information has the ability to reach a conclusion on the quality of information received through his or her own direct efforts, and has the desire to do so because of the consequences of inferior quality information, he or she may be prevented from doing so by certain barriers, which are components of 'remoteness.'[15]

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11 Zuboff, pg. 66

12 AICPA and CICA, Auditing Procedure Study *Audit Implications of EDI.*, pg. 3

13 Ibid chapter 6.

14 Westell, Don, Toronto Globe & Mail, March 19, 1996

15 AAA. pg. 10

Anderson refers to these components as geographic remoteness, legal remoteness and economic remoteness.[16]

Geographic remoteness

Geographic remoteness (the physical separation between the user and the data and data provider) was considered a significant impediment in 1984 but is now irrelevant. In the public domain, for example, the primary focus of the Internet is to provide an immediate link between people and businesses geographically dispersed throughout the world. Information filed with the SEC's EDGAR system is now available on the Internet. In a more private domain, if an information provider and user become trading partners using EDI, their physical location has no effect on the ability of technology to provide them with immediate links to each other's data. Geographical remoteness is no longer a raison d'etre for assurance services.

Legal remoteness

Legal remoteness (the absence of an enforceable right, by statute or contract, to direct access to data by a user) remains a significant factor which leads users, who perhaps would prefer direct access to data, to use an auditor. Historically, providers of information have been reluctant to allow unrestricted access to their data, even though this may be technologically feasible, since this may not have been in their best interests. While EDI requires greater access by customers and suppliers to information once considered highly confidential (e.g., inventory levels; production plans), there are drawbacks. For example, sensitive information may be inadvertently or deliberately disclosed on the network or in the mailbox system, and increased access to computer systems could increase the opportunities to change an entity's computerized records and those of its trading partners, enabling significant fraud to be perpetrated.[17]

Also, in many jurisdictions, there is still legislative support for restricted access to corporate information. For example, under Corporations Acts in Canada, shareholders have no right of direct access to the records of the company whose shares they hold. This right of direct access is granted to the external auditor.

Economic remoteness

Economic remoteness occurs when the costs (time and money) of directly accessing data outweigh the related benefits.)[18]. Traditionally, there are those who have had right of access to an entity's data but have chosen not to exercise it, because the costs of doing so outweigh the benefits. For example, taxation authorities, who typically have access to the records of an entity to perform tax audits, visit only a relatively small number of entities (for which taxpayers are most grateful.) Such visits are not economical, and the taxation authorities typically only monitor the information filed, including audited financial statements. However, many tax returns are now filed electronically. Will the next step be electronic access by taxation authorities to personal and corporate files? Taxation authorities might see the benefits of such access outweighing the costs, but this view would not likely be shared by taxpayers.

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16 Anderson, R.J. *The External Audit*, 2n Ed. 1984, pg. 5

17 AICPA/CICA Joint Auditing Procedure Study pgs 19-22

18 AAA pg. 10

EDI provides a useful example of where benefits often outweigh the costs of establishing relatively extensive and complex electronic links between entities. Costs of EDI include hardware and software costs associated with the installation, systems development costs, initial maintenance of the data entry system, legal and administrative costs associated with setting up trading partner relationships, network communication and security costs and training. As well, there are exposures such as total systems dependence, loss of confidentiality, potential increased exposure to unauthorized transactions and fraud, concentration of control within the computer systems, increased reliance on third parties and potential legal liability. For the EDI arrangement to work, the partners must be satisfied that these costs and exposure may be more than offset by the related benefits which include quick response and access to information to process transactions, cost efficiency associated with lower inventory levels, improved production schedules, reduced paper work, better communications and customer service and integration of other systems, such as Just-In-Time inventory.[19]

In situations when EDI or other forms of IT are used to establish close links among parities, there is still a need for objective assurance services, even though the parties can satisfy themselves regarding the accuracy and completeness of the data they exchange. For example, third party service providers, such as Value-Added Networks (VANs) may find it necessary to have an objective assurer issue a report on whether the VAN's controls are operating effectively. Also, the linked parties will still typically have to provide information to outside users, who will require objective assurance on such information.

Summary

The conditions identified by the AAA as creating a demand for auditing change to some extent in a high-tech environment. However, overall, they create a demand (or at least an opportunity) for a wider range of assurance services. Part of the effort needed to take advantage of these opportunities will be the development of standards responsive to user needs.

19 AICPA/CICA Joint Auditing Procedure Study chapter 3

DEVELOPING STANDARDS RESPONSIVE TO USER NEEDS

Information users in a high-tech environment still need standards to assess the quality of information received and the quality of services provided by the assurer. However, standards have to evolve to be more responsive to the changing needs of users in a high-tech environment. This requires an assessment of how the continued and rapid changes in IT should affect the nature and extent of updated or new standards to be developed, and the process for developing such standards.

Nature and extent of updated or new standards to be developed

The financial statement audit model is relatively easy to apply in practice. The auditor performs the audit in accordance with generally accepted auditing standards to obtain sufficient appropriate evidence to enable him or her to report whether the audited entity's financial statements have been prepared by management in accordance with generally accepted accounting principles. Key elements of this model include;

(i) an accountability relationship between the provider (management) and users (shareholders and others) of the information;

(ii) the need for management to prepare the statements in accordance with criteria (generally accepted accounting principles) which reflect the needs of a large homogenous group; and

(iii) the need for the auditor to perform the audit in accordance with the standards governing his or her profession (i.e., generally accepted auditing standards), with the basic requirement that the auditor possess the professional expertise to perform the service.

These key elements need to be reconsidered in developing updated or new standards in a high-tech environment.

Accountability relationship

Largely because of IT developments, there is an opportunity (need) for public accountants to provide assurance on a wide range of performance indicators. The CICA has taken its first major step to recognize the need for a broader range of assurance services by issuing an Exposure Draft (ED) *Standards for Assurance Engagements,* the responses to which are now being analyzed.[20] This ED defines an 'assurance engagement' as an engagement where, pursuant to an accountability relationship between two or more parties, a practitioner is engaged to issue a written communication expressing a conclusion concerning a subject matter for which the accountable party is responsible. The ED defines an 'accountability relationship' as a prerequisite for an assurance engagement. An accountability relationship exists when one party ('the accountable party') is answerable to and/or is responsible to another party (the 'user') for a subject matter, or voluntarily chooses to report to another party on a subject matter. The accountability relationship may arise either explicitly, as a result of an agreement or legislation, or implicitly because a user can be reasonably expected to have an interest in how management has discharged its responsibility for a subject matter.

The need for an accountability relationship is consistent with the AAA model for communication of accounting information, and the audit service which supplements this communication process. This need distinguishes an assurance engagement from a management consulting engagement where there need not be a provider of information who has a responsibility to users. Such a distinction would

20 CICA Auditing Standards Board, ED "Standards For Assurance Engagements", 1995

seem necessary to put a reasonable boundary around the types of services demanded in a high tech environment that can, and should, be addressed by standards. That is, standards should be meant to address situations where there is a primary communication process between a preparer and a user of information, and a supplementary communication process whereby an assurer attests to the quality of the information. The assurer normally will focus on verifying assertions underlying the report of the information provider.

However, this model may be challenged by some. For example, the Elliott Committee has discussed the need for 'user decision modeling assurance'. This type of 'assurance service' does not involve an accountability relationship (i.e., the information provider cannot be held responsible for the user's decision-making model). The Committee admits that it would be taking a very broad perspective in defining an assurance service as any service that assists information users in improving the quality of their decision-making information.

Public accountants obviously can provide services when an accountability relationship does not exist. But an effective standard setting process for assurance services needs to be based on a clear model involving responsibilities and criteria related thereto. For example, postulates underlying assurance engagements, such as the objectivity of the assurer, professional skepticism, and assumption of management's good faith, become irrelevant when the engagement does not involve someone who is accountable to another party. From a standard-setting viewpoint, defining assurance services to comprise all types of consulting services would not seem to be workable.

Standards to meet needs of specific users

Generally accepted accounting principles are designed to meet the needs of a large homogenous group of users. The evolution of IT now makes it possible for users to more readily access data and information to meet their own specific needs. Accordingly, standards are needed which relate to assurance engagements designed to address the needs of specific users.

The CICA's ED *Standards for Assurance Services* recognizes this change in needs. This ED is meant to provide a framework on which standards for specific types of assurance services should be based. It states that when practicable, the practitioner should reach an understanding and agreement with the intended user and with management as to the objective of the assurance engagement. This understanding will assist the practitioner in assessing whether the conclusion can be meaningful to intended users. The ED also reaffirms the concept in the AAA model that users need to provide criteria (directly or indirectly) to the assurer. The ED:

- defines suitable criteria as those yielding information useful to intended users, stating that the criteria are 'context-sensitive' (i.e., relevant to the particular circumstances) and that without suitable criteria, inappropriate conclusions may be drawn; and

- states that the practitioner should use generally accepted criteria in forming his or her conclusion except when, and only when, the intended users of the practitioner's report are an identifiable limited group of users and such users agree their needs are met by using criteria other than generally accepted criteria. In such cases, the practitioner's report should include a caution that the report is intended only for the use of the intended users because those users have agreed to criteria other than generally accepted criteria.

The ED, however, introduces a concept which is foreign to the AAA model - the 'direct reporting' engagement. In such an engagement, management does not provide a report to users, and accordingly makes no assertions regarding the information. This can result when management refuses to acknowledge its accountability relationship with one or more users, or when it

acknowledges the accountability relationship but has not (or will not) prepare reports on information required by the users. This situation is a fairly common occurrence in the public sector (GAO) where legislation empowering an entity may be open to interpretation regarding for what the entity is accountable and to whom. In these circumstances, the ED takes the position that the assurer needs to obtain evidence to be satisfied first, that an accountability relationship does, in fact, exist, and second, that suitable criteria for the engagement can be identified or developed (with such criteria being explicitly described in the assurer's report). The group of users affected may constitute a wide variety of people (e.g., stakeholders in a government entity) so direct consultation with them regarding their needs and what they would consider appropriate criteria may not be practicable.

The use of a direct reporting engagement may be controversial because it effectively allows the preparer to be left out of the communication model in certain circumstances. However, these circumstances do exist in practice, so that the key question may be to what extent standards and related guidance need to be developed to assist practitioners in assessing the suitability of criteria for engagements intended to meet specific user needs.

Does this move towards meeting the needs of specific users mean the end of general purpose financial statements? Likely not. General purpose financial statements provide a useful overview of the results of an entity's efforts to meet its objectives. Generally accepted accounting principles continue to evolve to make general purpose financial statements more relevant to users. For example, in 1995, the CICA issued new generally accepted accounting standards regarding the disclosure and presentation of financial instruments which includes disclosure of matters such as interest rate risk, credit risk and cash flow risk.[21] Initiatives to make historical cost financial statements more relevant by incorporating more 'soft-information' into them are likely to continue.

Defining professional expertise

The AAA model states that "to be judged competent, the auditor must possess the common body of knowledge with an in-depth understanding of the subject matter from which the information is drawn, of the process by which the information is developed, and of the audit process. In addition, the auditor must have acceptable experience at an appropriate level of work in the application of relevant knowledge to real-life situations."[22] This concept is reflected in generally accepted auditing standards which require the auditor to have adequate technical training and proficiency in auditing. However, with the evolution of IT and the resultant broadening and complexity of subject matter that may be dealt with by assurance services, it is no longer clear what types or level of professional expertise are expected of the assurer.

Need for expertise in IT concepts and functions

Auditing standards currently do not give appropriate recognition to the pervasiveness of IT or the auditor's need for expertise in the concepts and functions associated with IT to competently perform a financial statement audit, let alone the expanded range of assurance services that are needed in a high-tech environment.

There is a need for IT concepts and functions to be integrated into auditing standards and related guidance, rather than being treated as a supplementary topic. The AICPA has started this process as a result of its project on 'electronic evidence.' In the CICA Handbook, the concept that

21 CICA Handbook, Section 3860 "Financial Instruments"

22 AAA, pg. 17

computerized systems are now the norm is not effectively recognized (EDP Auditing Guidelines, themselves outdated, are contained in separate part of the Handbook). Also, the International Federation of Accountants (IFAC) has identified as a high priority auditing issue the need for standards to discuss the level of IT knowledge for 'general auditors,' the need for the profession to establish a clear definition of the minimum levels of competency required in IT (taking into account the various fields in which accountants practice) and the need to undertake an aggressive campaign to ensure practitioners gain the minimum level of IT competency through a more systematic approach to continuing professional education.[23]

Need for specialization and new competencies

The IFAC also recognizes the need to create specialist designations and related education programs for IT specialists, who would be publicly recognized as having the competence to perform assurance services related to data integrity and system security for highly complex state-of-the-art IT.[24]

In addition, the performance of a wide variety of assurance services will require auditors to acquire new competencies beyond the traditional accounting and finance expertise. The CICA Vision Task Force also recognizes the need to develop a certification process for specialists within the public accounting profession (typically based on knowledge of a particular industry and/or a particular function).

The involvement of persons possessing specialized knowledge is discussed in the CICA ED *Standards for Assurance Services.* It states that the practitioner and any other persons performing the assurance engagement should collectively possess adequate knowledge of the subject matter. Accordingly, it is recognized that an individual practitioner is not expected to possess all the expert knowledge needed to perform an assurance engagement, which may involve, for example, expertise in fields such as engineering, statistical analysis, human resource management and economics. However, the question arises as to what should be the expected nature and extent of the contribution to the engagement of a generalist practitioner. The ED takes the position that when a specialist is involved, the practitioner should consider whether the practitioner's involvement in the engagement and knowledge of the subject matter elements involving the specialist is sufficient to enable the practitioner to discharge his or her responsibilities.

A CICA auditing standards task force (which will report to the Auditing Standards Board) will soon start a project to update and expand standards on the assurer's use of the work of a specialist. This project will address issues such as: the nature and extent of the procedures expected to be performed by the practitioner to gain a knowledge of the methods, assumptions and source data used by a specialist and the extent of the knowledge of the subject matter and the methods and assumptions employed by the specialist that the practitioner should have in order to meaningfully carry out an assurance engagement. Based on its discussion paper *The Auditor and the Environment* it would seem that the International Auditing Practices Committee (IAPC) believes that when an assurance engagement involves the work of a specialist, there would be separate reporting. That is, the specialist would report on the specific work he or she performed and the practitioner would report only on the 'non-specialist' aspects of the engagement. But such an approach is unlikely to be acceptable to most users of assurance services who will, and should, expect someone to take overall responsibility for the assurance being provided. In our view, a practitioner should be prohibited from undertaking an assurance engagement when the specialist would be performing virtually all of

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23 International Federation of Accountants Information Technology Committee, "Action Plan", May 1995

24 Ibid.

the work, since the practitioner would not be in a position to provide any significant value to the user.

Process for developing standards

Dissatisfaction has been expressed regarding the processes presently used to develop standards for assurance services. There are concerns, for example, about the lack of speed with which standards are developed in most jurisdictions and the duplication of effort that seems to take place when standard setting bodies in various jurisdictions separately develop guidance on the same topic. The bodies responsible for setting assurance standards in various jurisdictions need to reassess when, how, where and by whom such standards should be developed and promulgated. These questions are all interrelated.

Time taken to develop and issue standards

In a high-tech environment, change occurs rapidly. Users expect the elapsed time for developing standards and related guidance to be shortened considerably. If traditional methods are used to attempt to develop standards and related guidance for assurance services related to new types of IT that evolve, the services may be out of date by the time the standards are issued.

However, there are at least three significant issues to consider. The first is whether standards should follow or lead best practice. For example, at the Canadian Institute of Actuaries, some actuaries feel that the Institute was moving too quickly in promulgating standards of practice for life insurance when there may not have been sufficient evidence that these standards were acceptable to a broad majority of the practitioners in this area.[25] However, there is a danger that if a standard setter does not provide leadership, the result may be the entrenchment of poor practices or, at best, the development of a number of inconsistent approaches to providing a service which may be difficult to resolve at a later date. At a minimum, standard setters should set up the mechanisms, and spend the time needed, to monitor matters such as the development of new financial and non-financial performance measures and related assurance services so that continuous assessments can be made of what, if any, action is needed regarding setting standards or related guidance and project priorities. The Elliott Committee and its Canadian equivalent, the Thesberg Committee, are developing means for performing these functions.

The second is whether standards are really necessary to address each new service. It would seem that a better approach would be to develop more general, but fundamental, standards that practitioners can apply to most new types of service. More detailed, but not necessarily authoritative, guidance could be issued in forms such as interest group newsletters.

The third is the limited availability of volunteer time. Standard setting bodies are typically composed of volunteers who have only a limited amount of time to devote to the process. For standards to be effective, there must be buy-in by practitioners and other affected parties. Therefore, it would not be acceptable for standards to be developed solely by full time staff, despite the reduction in development time which might result.

Standards boards, do however, have to come up with ways to improve the process for issuing standards on a more timely basis. In Canada, standard setting boards now make exposure drafts available on the Internet (a copy is also distributed in CAmagazine which arrives a month later.) The payback may not be large at present (since not all practitioners are on the Net), and deadlines for responding to EDs, while shortened, still allow time for a paper-based approach. As more

25 CIA *Bulletin*, October 1995

practitioners connect to the Net, it may be possible to quicken the pace of the due process of getting consensus on proposed new standards.

More radical approaches to standard setting also could be tried. For example, instead of going through an extensive due process before releasing a standard, a proposed standard could be developed with minimal consultation and issued for a 'trial period' to see if works effectively in practice. However, such an approach could be confusing (i.e., is a trial period standard really a standard?) especially when accounting and auditing standards are often recognized in statutes. Also, the time to finalize standards could actually be longer than for the approach currently followed in most jurisdictions.

A CICA Task Force, composed of volunteers with various interests and expertise, has just started a project to review all aspects of the process for developing Canadian standards and guidance. As part of its mandate, the Task Force will consider :

- whether the standard-setting Boards are strategically positioned to meet the new thrusts of developing non-financial and broader financial performance measures and the expansion of assurance services; and
- whether current structures provide the most appropriate framework to meet evolving needs.

Need for intra-jurisdictional cooperation and coordination

The development of new accounting standards, auditing standards and standards in other matters such as control need to be complementary. For example, the CICA's Accounting Standards Board is planning to continue to expand GAAP beyond the traditional historical cost model to include more 'soft' information. This raises significant issues regarding the auditability of soft information and whether auditors need more guidance on auditing such information. Also the CICA's Criteria of Control Board (CoCo) has issued its first volume of Guidance on Control. This guidance is already being used by entities in Canada, the U.S.A. and the U.K. Auditors likely will use guidance published by CoCo as criteria by which the effectiveness of controls should be evaluated. Accordingly, in Canada (and likely most other jurisdictions), closer working relationships are needed between those developing standards on the preparation and presentation of information and those developing standards for providing assurance on such information.

Need for international cooperation and coordination

Developments in IT enable an increasing number of businesses to operate multinationally. Electronic communications cross borders very easily. In a high-tech multinational environment, intercorporate arrangements, strategic alliances and other business practices are more becoming complex. This makes it difficult for assurers to function effectively when there is no general acceptance by all jurisdictions of uniform sets of accounting and auditing standards.

There are frequent calls in Canada to make more use of international and U.S. standards. The CICA's Auditing Standards Board is planning to identify specific areas where it feels joint projects should be undertaken with standard setters in other jurisdictions and promote the need for more joint efforts. With issues of concern to the AuSB being increasingly similar to those of other standards setters around the world, there would seem to be less justification for homegrown standards. However, it may be difficult for a standard setter in any jurisdiction to rely heavily on work done by others for reasons such as the following.

- International standard setting activities are typically not well-funded. In developing international auditing standards, the IAPC relies heavily on work already done in Canada and the United States and other jurisdictions. The IAPC does not have the personnel or financial resources to fund development of standards from scratch.

- Simple adoption of standards developed in another jurisdiction, without review and change, seldom seems to work. Invariably, standards are significantly influenced by legal, political, social and business environment factors that continue to be significantly different among jurisdictions (even among countries with cultures as similar as those of Canada and the United States).

Nevertheless, there are many opportunities for effective collaboration. For example, the IAPC anticipates issuing an Exposure Draft on Assurance Standards in late 1996 or early 1997. This should provide many countries with a useful basis for developing specific assurance standards. Also, the AICPA and CICA have recently released the joint Audit Procedure Study *Audit Implications of EDI* and the AICPA has kindly allowed Canadian participation in the Elliott Committee. Further, a meeting of the volunteers and staff of Auditing Standards Boards of AICPA and the CICA is planned for June 1996. The CICA's AuSB will continue to actively participate in IAPC standard setting activities and to monitor the activities of standards setters in countries such as the Netherlands, the U.K. and Australia to identify areas of mutual concern and interest.

Leading edge issues - the need for input from academics

There is need for standard setters to obtain much more input from academics. In a high-tech environment, there are more leading-edge issues about which relatively little is known and which accordingly require a significant amount of research by experts in particular fields.

Such research must be designed to provide a sound basis on which to develop practical guidance. For example, the CICA's Auditing Standards Board is sponsoring a research project on audit inquiry as a form of audit evidence. Because IT is causing the disappearance of traditional forms of audit evidence (e.g., documentation, confirmation), there is a need to consider means of obtaining sufficient appropriate audit evidence which may be effective alternatives (or complements) to computer-based audit strategies. The terms of reference for the project (being conducted by two Ph.D.'s who report to a steering committee chaired by a volunteer CA) are:

- to examine the existing theory of audit evidence to see whether it provides a broad enough base from which to expand the reliability of inquiry methods;

- to investigate current best practices and skills that are now being used within the auditing profession, to determine how best to describe them so that the means now used by expert auditors may become generally available;

- to examine and describe methods and standards used by other professionals (such as psychiatrists, police officers, lawyers) that appear to be relevant to the current needs of the auditing profession and suggest how they might be adapted most effectively;

- to describe other initiatives that are considered relevant to the conduct of inquiry and suggest how they can be adapted to an auditing context; and

- to suggest extensions that need to be made to the theory of audit evidence to accommodate these new analytical skills.

Such research provides a useful mix of theory and practicality.

As another example, the CICA's Criteria of Control Board has identified as a high priority the need to develop guidance on the effect of IT on control. This is a very broad and complex subject area. Assistance will not doubt be needed from academics having expertise not only in the mechanics of IT but also in the psychological and sociological effects of the use of IT to identify significant issues that should be addressed and perform the required research.

It will be necessary for standard setters to establish closer links with the academic community, keep up to date on relevant research and identify those who may best be able to provide the assistance needed to address leading-edge issues.

CONCLUSION

Assurers can still 'add value' in a high-tech environment. The real-time availability of limitless sources of information provides many opportunities for assurers to help users make better decisions and thereby improve organizational performance. But while the traditional audit role has been effectively sheltered from competition by regulatory requirements, public accountants are likely to face stiff competition in obtaining and holding a significant share of the market for new assurance services. Success will depend on the willingness and ability of public accountants to acquire the new skills required by the high-tech environment and of the profession to continue to develop the standards which users recognize and use as the basis for assessing the quality of service provided.

Technological Change - A Glass Half Empty or a Glass Half Full: Discussion of "Meeting the Challenge of Technological Change," and "Business and Auditing Impacts of New Technologies"

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Will there still be work for auditors in the year 2016? This is the question James Sylph and Gregory Shields initially posed in their paper "Meeting the Challenge of Technological Change - A Standard Setter's Perspective." It is also the question addressed, albeit more implicitly, in the paper by Charles Le Grand, "Business and Auditing Impacts of New Technology." While both papers agree that technological change will have a dramatic impact on the auditing profession over the next 20 years, their perspectives are quite different. Whereas the Sylph and Shields see technological change as "a glass half empty," Le Grand views technological change "as a glass half full" in terms of opportunities for the auditing profession.

The difference in these views comes from how each defines auditing. Sylph and Shields take what I will call the "attestation perspective," going back to the 1973 ASOBAC (A Statement of Basic Auditing Concepts) and its framework for conditions which create demand for auditing. Le Grand, on the other hand, takes what I will call the "assurance perspective" with an emphasis on reliability of systems and improvement in their performance. While these perspectives both describe the traditional external audit of the financial statements, different attributes of the product of the audit process are emphasized.

Attestation versus Assurance

The definition of auditing presented in ASOBAC, and subsequently in the majority of auditing textbooks, is as follows:

> Auditing is a systematic process of objectively obtaining and evaluating evidence regarding assertions about economic actions and events to ascertain the degree of correspondence between those assertions and established criteria and communicating the results to interested users. (American Accounting Association, 1973).

ASOBAC further qualifies the definition of "auditing" by adding the restriction that "quantifiability is an attribute which subject matter must possess to be auditable." In this view the product of the audit process is a statement about the quality of the information contained in the assertions (i.e., the information presented in the financial statements either meets or does not meet some quality criteria). Indeed, this definition characterizes quite well the external auditing of financial statements, particularly as practiced in the 1970s, as well as the activity that today we would call "attestation."

However, the ASOBAC definition is less than satisfying when one moves from the case of the external audit of financial statements to other activities which most would regard as also properly being classified as "auditing." One need only consider the layman's image of the auditor as the IRS agent examining a tax return, the person introduced at the Academy Award ceremony, or the one standing by as the balls are selected during the weekly state lottery drawing, to see the limited nature of the ASOBAC definition.

In seeking a definition that would encompass not only these cases, but cases such as internal, value-for-money, management and quality auditing Schandl, in his *Theory of Auditing*, proposed the following simple definition:

> Auditing is an evaluation process to establish the adherence to certain norms, resulting in an opinion or judgment. (1978, p. 4)

Schandl notes that while the underlying audit process is the same, these various cases of audit activity do differ as to their purpose. He identifies three general purposes (goals) audit activities may have:

- attention-directing,
- attestation, and
- decision (1978, pp. 81-82).

This recognition that it is the goal rather than the process that distinguishes the various cases of audit activities is important. If, like Sylph and Shields, we are attempting to assess the demand for auditing in the new high-tech environment, we must also consider that there may be a shift among the goals (for example, less demand for attestation audits and more demand for attention-directing and decision audits[1]).

A similar notion of the need to expand auditing from the limited attestation perspective is found in the definition of assurance developed at the 1993 AICPA's Santa Fe Audit/Assurance Conference. Assurance (the new word for "audit") is defined as the expression of a conclusion on the reliability and/or relevance of information and/or information systems (Elliott, 1994, p. 120). This definition has been further modified by the AICPA's Assurance Audit Services Committee to be:

> Assurance services are independently performed services that improve the quality of information or its context for decision making. (Lea, 1996)

Attestation versus Assurance - What do the customers want?

In their analysis of the demand for auditors, Sylph and Shields note that technology has changed what the users of financial information (traditionally, the users of the audited financial statements) want and need. Specifically, they argue that technology has led to an increase in the amount and kind of information that might be available for evaluation of organizational success, a shortened time-frame for decisions making by these users, and an increased difficulty in assessing the quality of the information. Such changes have lead many to conclude that the traditional financial statements and the auditor's certification of them are becoming irrelevant or, at least, rapidly diminishing in importance. However, as Sylph and Shields point out in their analysis, there is certainly no lessening of the demand for quality information. What has potentially changed, I would maintain, is the auditor's traditional role.

Technology has changed the auditor's role in two basic respects. First, the auditors (and here I am thinking primarily of the external auditors) have lost their monopoly rights as certifiers of information quality. When the annual financial statements were the primary source of information for evaluating organizations, it was only the external audit to whom one could turn. However, as improvements in information technology have lowered the cost of additional sources of information,

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[1] Decision audits is an ambiguous term. Schandl goes on to define it as evaluative activities to ensure that the process itself will operate with the least possibility of errors or mistakes. This might also be though of as a "systems" audit.

people such as Robert Elliott have predicted that new players will enter the game, often blurring the distinction between information producer, certifier of information quality, and interpreter (Elliott 1994, p. 108). Already, there are certainly many non-CPA firms that provide a number of attestation services. To see the potential competition one need only consider the numerous consulting and engineering firms, as well as divisions of large publicly traded companies, which offer certification for ISO 9000 and for environmental compliance.

Second, as the advancement of information technology has led to a shortened time-frame for decision making by information users, what may be of more value to users is certification of the quality of the system producing the information rather than the certification of the information itself. In today's fast-paced world, can users wait 30 days before acting on a company's earnings numbers while the auditor goes about collecting evidence to certify the numbers' quality? Wouldn't the users' preference be for immediate assurance about the numbers as soon as the system can generate them?

Will there still be work for auditors in the year 2016? Maybe not for the traditional financial statement auditor, but for those able to audit for system reliability and for performance improvement there should be great demand. The opportunities for the latter type of audit services come through clearly in the second paper of this session which is authored by Charles Le Grand. However, as Le Grand makes clear, while these new technologies create opportunities they also require the auditor to develop new tools and skills.

"Oh Brave New World...."

Le Grand takes us into a world of LANs, VANs, WANs,...AI, ES, EDI; a world of open systems, object technology, WEBs, and CD-ROM... a world of fuzzy thinking and alphabet soup. Does this brave new world need auditors? I certainly would argue that it needs good systems of internal control.

The new information technology has not solved the problem of control. One only has to consider some recent examples to see that the need for a good system of internal control is as great, or greater, in our technologically advanced world as it ever was. Consider the recent Wall Street Journal article on Exide Corp. - "Bilked of Batteries Exide Corp. Says It'll Take a Charge." (Henderson, 1996). The article begins:

> Some one stole more than 112,000 car batteries from Exide Corp., one of the world's largest battery makers, and the company said it will take a pretax charge of as much as $3.5 million to cover the loss. The situation has gotten Exide clobbered on Wall Street. Friday, Exide shares tumbled $4.25 to a 12-month low....

This is not the type of incident that makes one in the auditing profession fear there will be no work. For the problem at Exide is not just that the batteries were gone; but that the company was unaware for some time that the batteries were missing.

A second example comes from a 1995 report by the Office of the Texas State Auditor on Texas A&M University. The State Auditor's cover letter for the report starts:

> At Texas A&M University, management's override of policies and procedures, laws, and channels of communication have eroded the effectiveness of control systems designed to protect resources from misuse and safeguard assets. This breakdown in controls has contributed to poor

> decision making, ineffective use of resources, weak oversight of operations, unlawful activities by some members of executive management, increased risks and liabilities associated with the System and University operations and negative publicity....Much of the responsibility for University administrative operations (personnel, purchasing, contracting, etc.) has been delegated to the departments, but management has not held them accountable for the operations.....

The report goes on to give a number of examples of control breakdowns with significant consequences (e.g., a $120 million co-generation power plant which would be terminated prior to completion, consultant services of $1 million being received without contracts in place, inefficiencies from duplicate data entry into administrative systems estimated to be costing the University over $1 million per year). Again, this report is unlikely to compel one to conclude that audits with the goals of attention-direction or decisions are not needed. Internal control remains an issue.

A final example of how the need for assurance about internal control creates additional demand for audits is the area of outsourcing and third party contracting. Whether the increase we see in organizations' outsourcing of internal services is driven by the change in information technology or by other economic factors is not the issue. (Although I do believe there is an association between outsourcing and the rapidly changing information technology environment.) The issue is that such third party contracting requires a significant increase in auditing activity, both in terms of examining the system of controls designed into these arrangements and in terms of being an actual control for monitoring the performance of contracted parties.

In addition to the question of internal control, there is the issue of the actual performance of the new technologies. It is by no means clear that these new technologies significantly increase operational effectiveness and efficiency, at least, not to a point where attention-direction and decision auditing cannot add value. As evidence of this I collected some examples from the class projects completed by my management auditing class this past semester:

- The accounting system of the City of Austin was not able to report cost by programs, but was able to report it only by departments.
- In working with one Texas State agency the students found two payroll accounting systems were being kept because the new Statewide payroll system was unable to provide wage costs information by department.
- In another state agency fixed assets records in the Statewide system were found to be inaccurate (in a very small sample of 15 the error was over $325,000).
- Another group worked in a very fast growing new company on improving a billing system with a current 20% rework rate.
- In another large organization students found a case where the purchasing clerk could initiate purchases without authorization.

Each of the above cases took place in environments that were relatively sophisticated in terms of information technology, but clearly were not in a world ready to dispense with auditors.

Nor are the above particularly isolated cases. A recent survey conducted by Deloitte & Touche of CIOs (Bodnar 1996), concerning the expected versus actual benefit of new information technology, found that often the results were disappointing. First it is clear that in many organizations the world describe by Le Grand has yet to arrive. The CIOs who responded to this survey still classified 77 percent of their mission-critical applications as legacy systems, systems that use outdated techniques and technology. Over a third reported that they were dissatisfied with the performance of these

systems. However, the new technology does not fare much better. For instance, in the case of one "new technology," client/server architecture, only 33 percent of respondents reported significant actual benefit to these tools. Fifty-seven percent of the respondents expected enhanced system quality; 32 percent actually got it. Forty-six percent expected reduced maintenance costs; only 19 percent got it. Twenty-seven percent expected better documentation; only 15 percent got it.

The Promise

While the new information technologies often fail to meet expectations, there are success stories. Consider the results achieved in the retail industry by firms such as JC Penney and WalMart from their investment in information technology. In the case of one large retailer, the improvements in information technology have allowed the sales return process to be simplified by eliminating the need for segregation of duties. Now, rather than requiring the sales clerk to get approval from a manager for a return, and requiring the customer to provide documentation of the initial sale, the clerk is authorized to credit the customer's credit card account directly for the amount of the return. This increases the efficiency of such transactions as well as significantly increasing customer satisfaction. Control over these transactions is achieved through the computer continuously monitoring credits to accounts and alerting company personnel when unusual activity is encountered. Such CCM and CPAS techniques, to use the Le Grand terminology, clearly are changing the way control is achieved. Yet, as Le Grand points out, it is not clear that these advances lessen the need for auditors.

Surprisingly, the Le Grand paper does not discuss one of the most widespread changes we see taking place in information technology, the implementation SAP R/3 and other integrated systems. Thousands of companies such as Dow, Exxon, IBM, Intel, Dell and Texas Instruments are in the process of investing hundreds of millions of dollars in SAP or similar systems. SAP is a system with a high level of data integration. As data are only entered into the system once and maintained in only one data base, users have an increased responsibility to control and guarantee the integrity of the system. While this shifts the role of central accounting from data capturing to a planning and control function, it does not eliminate the need for auditors. If anything, SAP implementation seems to be increasing the need for auditors as organizations struggle with redesigning their work process to fit SAP and to build in appropriate controls.

The New Auditor

I agree with Le Grand that a new type of auditor will be needed for this brave new world that advancement in information technology is creating. Clearly this auditor will need a much greater understanding of information technology than in the past. An idea of what skills this new auditor need possess can be found in the IIA's "Model Curriculum of Information Systems Auditing," discussed by Le Grand, or the recent guidelines issued by the Education Committee of the International Federation of Accountants (IFAC) - "Information Technology in the Accounting Curriculum." In the IFAC model information technology becomes one of the core competencies of professional accountants. The accountant is viewed as a user, manager, designer and evaluator of information systems. Even a cursory review of the suggested knowledge and skills that the new auditor should acquire in his or her formal education and on-the-job-training reveals a radical change from what one finds in today's graduates of accounting programs or successful CPA exam candidate. Whether these new auditors will be the products of today's academic accounting departments is probably much more in doubt than the existence of work for auditors twenty years from now.

Conclusion

Changes in information technology have decreased, and will continue to decrease, the significance of traditional financial statements and their audits as Sylph and Shields compellingly argue in their paper. In addition these changes in technology have a significant impact on internal control - changing the risks, increasing the importance of internal control and requiring new mechanisms to achieve control objectives. Will there still be work for auditors in the year 2016? Yes, more than enough, provided that there are changes in auditing standards to allow external auditors to provide assurance on "reliability of systems," and that there is a different educational curriculum for the auditor of 2016 whether they be internal or external.

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A Model of Errors and Irregularities as a General Framework for Risk-Based Audit Planning

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INTRODUCTION

Auditing standards define the objective of an audit as providing assurance that financial statements are presented fairly in accordance with generally accepted accounting principles (GAAP). Exactly how this should be achieved has been a subject of much interest in recent years. Now, because of SAS 58, the term "presented fairly" requires that the auditor must obtain reasonable assurance that the financial statements are free of material misstatements. This is in addition to the historical role of gathering positive evidence to support the assertion that the financial statements conform to GAAP, as applied on a consistent basis.[1]

SAS 53, issued at the same time as SAS 58, provides some guidance with respect to the auditor's evaluation of whether the financial statements are free of material misstatements (hereafter called errors and irregularities). For example SAS 53, paragraph 6, states:

> The auditor should assess the risks that errors and irregularities may cause financial statements to contain material misstatements. Based on that assessment, the auditor should design the audit to provide reasonable assurance of detecting errors and irregularities that are material to the financial statements. The auditor's assessment of the material misstatement of financial statements requires the auditor to understand the characteristics of errors and irregularities... Based on that understanding, the auditor develops and performs appropriate audit procedures and evaluates the results.

Of particular importance are the last two sentences which require the auditor to understand the "characteristics" of errors and irregularities, and based on that "understanding" to develop appropriate audit procedures.

In line with SAS 53, the purpose of our paper is facilitate the auditor's understanding of the characteristics of errors and irregularities. This is a necessary first step to fully implement the kind of risk-based auditing articulated in SASs 53 and 58. We do this by developing a model of financial statement errors and irregularities that can be used to assist in the process of risk-based audit planning.[2] The objective of the model, to echo SAS 53, is to better understand the "characteristics of errors and irregularities" with a goal of planning "appropriate audit procedures" in order for the auditor to have "reasonable assurance of detecting errors and irregularities."

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[1] The scope paragraph of the standard audit report as required by SAS 58 makes this responsibility explicit.

[2] We do not claim that ours is the only analysis of errors and irregularities. For example Mautz and Sharaf (1961, Chapter 6) evaluate sources of financial statement misstatements and how the auditor may detect them.

There are several reasons for developing such a model. First, and most obvious, existing audit standards do not provide the kind of detailed guidance necessary to implement SAS 53 and SAS 58.[3] Second, the academic research that has modeled errors and/or irregularities has been at an abstract level that cannot provide detailed guidance in the field.[4] Third, field auditors appear to have rather limited personal experience in discovering errors and irregularities due to low occurrence rates [e.g., Kreutzfeldt and Wallace 1986, Loebbecke et al. 1989, Willingham and Wright, 1985]. This lack of experience hinders the development of both an underlying knowledge base as well as the cognitive structures required for organizing knowledge of misstatements into the "procedural knowledge" necessary for the development of problem solving expertise.[5] Thus, besides providing a framework for assisting the auditor in audit planning, a model of errors and irregularities also provides more general benefits to auditors and students in learning, elaborating, and evaluating risk-based auditing.

The remainder of the paper is organized as follows. The next section defines the two basic elements of the model: (1) sources of errors and irregularities and (2) types of financial statement transactions. The model is then formally developed and presented in section three. The model shows how specific sources of errors/irregularities logically align with particular types of transactions. This leads to propositions about (1) the presence of specific sources of risk in particular components of the financial statements and (2) the risk-based audit planning implications. The analysis concludes by examining audit testing strategies in terms of the broad choice between internal control testing (and reliance) and substantive tests.

The model serves as a general framework for risk-based audit planning in the following manner. First it guides the auditor in identifying which particular populations of transactions/balances to test (in terms of the underlying risk of misstatements) and specifies the audit testing objectives (based on the nature of possible misstatements). Second it further guides the planning process by carefully delineating the roles of internal control testing and substantive testing for particular populations of transactions and account balances. In sum, with a model of errors and irregularities it is possible to plan and design appropriate audit tests in terms of *what* to audit and *why*, with respect to specific sources of errors and irregularities in the financial statements.

A preliminary caveat is in order with respect to the model. The model developed here is generic in the sense that it would be universally applicable to all engagements. However, it is not meant to be a complete, all-inclusive planning framework. The model would necessarily have to be supplemented by

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[3] Nor to the best of our knowledge have accounting firms developed anything comparable to the model of errors and irregularities we present in this paper. Readers are referred to disclosures by several of the major accounting firms of their proprietary auditing methodologies [e.g., Elliott (1983), Felix et al. (1990), Grobstein and Craig (1984), Leslie et al. (1986), Mullarkey (1984), Sullivan (1984), Walker and Pierce (1988)]. See also Kneer (1984) for a summary of the (then) Deloitte Haskins & Sells approach (which was also disseminated in the early 1980s at DH&S Auditscope seminars held around the country). In related work, Cushing and Loebbecke (1983) surveyed accounting firms' approaches to assessing audit risk.

[4] Audit testing models have generally drawn on either Bayesian decision theory (Bailey 1981, Kinney 1975, Srivastava and Shafer 1992) or game theory (Fellingham and Newman 1985, Matsumura and Tucker 1992, Morton 1993). These models are not operational nor are they necessarily intended to be. Rather, they are fairly abstract and stylized models designed to elucidate and better understand salient features of the global audit testing process.

[5] For general discussions of the cognitive development of auditor expertise see Bonner and Pennington (1991), Gibbins (1988), and Waller and Felix (1984). See also Ashton (1991) for an experimental study which underscores the critical role played by the auditor's knowledge of errors and irregularities in problem solving and the development of expertise, and the possible limits to expertise due to the auditor's limited experience with misstatements.

special engagement-specific audit risk concerns identified by the auditor. In addition, materiality decisions might either override or emphasize particular planning implications of the model. Finally, even though this study develops a formal model of errors and irregularities, the study is actually an example of applied auditing research and represents a response to recent calls for research into audit approaches (Akresh et al. 1988); for more realistic modeling in audit research (Solomon and Krogstad 1988, p. 10); for studying auditing in context and as a field of research in its own right (Johnson et al. 1989); and for greater relevance of academic research to the problems of accounting practice (Black et al. 1990).

DEFINITIONS OF ELEMENTS USED IN THE MODEL

The model of errors and irregularities that is developed in the next section is based on the interaction of two elements: (1) sources of misstatements in financial statements and (2) what the auditor audits, i.e., the types of transactions in financial statements. Specifically, the model analyzes interactions between three general sources of financial statement misstatements (random error, asset misappropriation, and financial statement manipulation) and two general types of financial statement transactions, completed and incomplete, with a further distinction between internally- and externally-generated transaction recognition.

Before defining these two elements of the model some brief observations on the relationship between transactions and financial statements are helpful. Auditors express an opinion on financial statements taken as a whole. However, financial statements are, by definition, the summarization of transaction recognition and valuation that has occurred in accounting journals. This means that the risk of a financial statement misstatement is really the risk that individual transactions have not been properly recognized and/or valued. Thus in auditing financial statements the auditor is ultimately expressing an opinion on whether or not the underlying transactions (that constitute the financial statements) are materially misstated. For this reason it is logical to model errors and irregularities in financial statements in terms of the underlying transactions that constitute the financial statements.

The two basic elements of the model are now discussed. First, sources of financial misstatements are presented based on definitions and categories in SAS 53. Then types of transactions are presented. This material is more complex and is a unique aspect of the study. It builds on two key ideas: (1) the notion of the completeness or incompleteness of transactions and (2) whether transaction recognition originates internally or externally.

Sources of Financial Statement Misstatements

Based on definitions in SAS 53, material misstatements may occur from either (1) *errors* which are "unintentional" in origin or (2) *irregularities* which are "intentional" misstatements (see paragraphs 2-3 of SAS 53). Errors occur from mistakes in underlying data, from incorrect accounting estimates, and from mistakes in applying generally accepted accounting principles. Hereafter, errors will be referred to as *random errors* to delineate them from irregularities and to emphasize the underlying risk (i.e., randomness). By contrast, irregularities are intentional in origin. SAS 53 further subdivides irregularities into (a) the misappropriation of assets and concealment in accounting records (also called defalcations), (b) outright theft of assets (misappropriation *without* concealment in accounting records) and (c) fraudulent manipulation of the financial statements (also called management fraud). No further consideration is given in this paper to item (b), outright asset theft, because the auditee's physical controls over assets and other asset accountability procedures (e.g., bank reconciliations, physical inventories) are assumed to normally prevent or detect such theft.[6]

[6] Even if these internal controls are not adequate, the audit tests suggested by the model should also detect outright asset theft (see audit planning implications P4 and P6).

Types of Transactions: Completed and Incomplete, and Internal Versus External

For simplicity we initially characterize accounting transactions as originating from a bilateral economic exchange between the auditee and another party. While this represents the majority of accounting transactions, we later relax this definition to deal with what we term unilateral or internally-generated recognition by an auditee. An economic exchange can be temporally classified as initially *incomplete* and then being subsequently *completed.* The exchange remains incomplete until all of the underlying economic activity required by the auditee and the other party to the exchange is fully completed by *both* parties. For example, a credit sale is initially "incomplete" and remains so until payment is received from the debtor. At this later date the credit sale, which was originally incomplete, becomes completed.[7] Similarly, a credit purchase is initially incomplete and then becomes "completed" when cash is disbursed or the account payable is otherwise debited (e.g., purchase returns).

Some exchanges are more complex, such as sales with right of return or with warranties. Nevertheless, they can be classified as completed or incomplete by decomposing the exchanges into their constituent components. For example, a sale with warranty can be analyzed as having a conventional sale component which is completed when cash is received and a warranty component which remains incomplete (warranty liability) until the warranty period expires.

The completion of purchases is also more complex than suggested above. For purchases a distinction must be made between the acquisition of goods and services and their subsequent use if the use extends beyond the current fiscal year.[8] For example, the acquisition of inventory is completed when payment is made to vendors. However, the inventory account balance represents incomplete use of the inventory by the auditee. Inventory becomes used or completed when the goods are subsequently sold to customers (i.e., the completion of an economic exchange of inventory between the auditee and customer).[9] Similarly, the purchase of fixed assets is completed when cash is disbursed to vendors, whereas the use of fixed assets is economically completed when the assets are retired and written off (i.e., fully used up in production for the generation of revenues).[10]

Completed and Incomplete Transactions. The preceding discussion about completed and incomplete economic exchanges is mirrored in the accounting transactions that are recognized in the financial

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[7] A credit sale may be completed other than by cash collection: (1) if the account receivable is written off as uncollectible or (2) if a contra-sale occurs, i.e., sales return or sales discount. The point here is that all of these are mechanisms through which the account receivable is credited, and the outstanding debit amount removed (completed) from the account balance.

[8] Purchase transactions that represent periodic operating expenses (i.e., selling, general, and administrative expenses) are "completed" when cash is paid. Since these transactions are periodic expenses it is not necessary to make a distinction between acquisition and use, that is, acquisition and use take place in the same accounting period except for year-end accruals.

[9] Since the manufacturing of goods and the placing of them in finished goods inventory only leads to internal accounting transfers, the acquisition of inventory (and its conversion to finished goods) is completed when the final product is sold to an external party. The intermediate accounting consists only of internal cost transfers from one inventory account to another.

[10] It can be argued that partial completion occurs each year through periodic recognition of depreciation expense. However, as will be seen it is more useful to define completion as total (100%) completion. This means that a fixed asset remains incomplete until retirement, and depreciation expense is a periodic valuation adjustment to the asset.

statements. This is the basis for the two kinds of accounting transactions in the model. *Incomplete accounting transactions* represent those economic exchanges that remain incomplete at the end of the fiscal period. *Completed accounting transactions*, by contrast, represent those economic exchanges that have been completed during a fiscal period. Thus economic exchanges lead to two distinct types of accounting transactions: (1) the initial recognition of an incomplete exchange (e.g., credit sale) and (2) the subsequent recognition of the completion of the exchange (e.g., cash receipt).

Internal Versus External Recognition. A further distinction is made between (1) transaction recognition originating in direct response to a bilateral exchange with an external party, i.e., externally-generated recognition and (2) transaction recognition that unilaterally results from the auditee's own internal accounting procedures, i.e., internally-generated recognition. The majority of accounting transactions (both completed and incomplete) are external and the preceding examples implicitly assumed this to be the case. For example, credit sales and credit purchases, and the subsequent cash receipts and disbursements are recognized in direct response to billings, and to subsequent cash outflows or inflows with the other party to the economic exchange. These kinds of externally-generated bilateral transactions are normally supported by source documents to/from external parties, have a visible audit trail, are high volume in nature, and are recorded in specialized accounting journals such as sales, purchases, payroll, cash receipts and cash disbursements.

While the majority of transactions are external in the sense described above there are also a number of important internally-generated transactions. Internally-generated recognition of *completed transactions* pertain to asset write-offs. Specific examples of asset write-offs include: asset retirements (internal completion of fixed assets), write-offs of accounts receivable as bad debts (internal completion of sales), and write-offs of other assets whose value is totally impaired (internal completion of other assets). In all of these cases, the auditee unilaterally completes the underlying economic exchange through the action of writing off the asset as having completed its economic value to the firm. These transactions are low volume in nature and would normally be recorded in the general journal.

Internally-generated recognition of *incomplete transactions* include routine year-end accruals and adjusting entries, the recognition of self-constructed assets, and internal inventory transfers from raw material to work-in-process to finished goods.[11] Another common type of internally-generated *incomplete transaction* is the end-of-period asset valuation adjustment. Examples include valuation adjustments to accounts receivable for doubtful accounts, to inventories for cost of goods sold and asset write-downs (i.e., lower-of-cost-or-market), to prepaid expenses for periodic amortization, to investments for investment loss write-downs, and to fixed assets for periodic depreciation expense or for asset impairments. Again, because these transactions are low volume in nature they would normally be recorded in the general journal.

Table 1 summarizes examples of the four types of transactions that have been discussed throughout this section, classifying the transactions into the completed and incomplete categories, and further subdividing them into internally- and externally-generated recognition. As will be illustrated in the next section of the paper, the usefulness of these transaction categories lies in how they logically map to particular sources of misstatements and hence lead to an identification of *where* the auditor should audit (i.e., which accounting population) and for *what* type of risk (i.e., source of misstatement).

[11] While recognition is internally-generated by the auditee's own accounting procedures (rather than a direct response to an external party to the exchange), the original notion of an economic exchange being incomplete or completed still holds. For example, year-end accruals are "completed" when cash is received or disbursed in the next period, self-constructed assets are "completed" when fully depreciated and retired, and inventories are "completed" when finished goods are ultimately sold to external parties.

Table 1
Examples of the Transaction Types

Transactions Representing a Completed Transaction		Transactions Representing an Incomplete Transaction*	
Examples of Internally Completed Transactions:	Examples of Externally Completed Transactions:	Examples of Internally Incomplete Transactions:	Examples of Externally Incomplete Transactions:
Asset Write-offs: Asset Retirements Bad Debt Write-offs Other Asset Write-offs	Cash Receipts from Sales Cash Disbursements Sales Returns & Allowances	Year-end Accruals and Adjusting Entries Year-end Asset Valuation: Ending Inventory Amortization of Prepayments Receivables Allowance Depreciation Investment Write-downs Other Asset Impairments	Sales on Credit Purchases on Credit Prepayments

* Transactions that are initially incomplete become subsequently completed by either by an "internal" or "external" completed transaction.

A MODEL OF ERRORS AND IRREGULARITIES

The model which is developed in this section formulates a systematic relation between type of transaction and source of misstatement. Table 2 summarizes these results as (1) risk propositions and (2) preliminary audit planning corollaries and testing implications. Each risk proposition is for a specific category or population of transactions and is derived from an analysis of the interaction between (1) the presence or absence of specific sources of errors and irregularities (random error, asset misappropriation, or financial statement manipulation) and (2) a specific category of transactions (completed or incomplete). Each proposition leads to one or more corollaries with respect to preliminary audit planning implications. These planning implications focus on the resulting need (or lack of need) for audit testing.

As seen from Table 2, the model's predictions about the risk of errors and irregularities and the resulting audit planning implications can be summarized by the following duality. First, because there is very little risk of either random error or financial statement manipulation in completed transactions, *completed transactions* normally need only be tested for risk of asset misappropriation. Second, because there is a risk of both random error and financial statement manipulation (but no risk of asset misappropriation), *incomplete transactions* normally need to be jointly tested for random error and financial statement manipulation.

Thus the model provides a framework for preliminary audit planning based on the specific populations of transactions that are (or are not) normally in need of testing for specific sources of misstatement. In keeping with the generalized nature of the planning framework, the model does not initially specify how the actual audit testing would be done, e.g., control versus substantive tests, or specific types of substantive tests (e.g., analytical procedures versus tests of details). However, these broader questions of audit testing strategy are reconsidered later in the paper.

The model is now formally developed beginning with an analysis of completed transactions and each of the three sources of misstatements. The same analysis is then undertaken for incomplete transactions.

Analysis of Completed Transactions

Risk of Random Errors in Completed Transactions. Random errors in completed transactions can occur if transactions are initially recognized and then subsequently completed at an erroneously over - or understated monetary amount. However, the probability of this is very low. Completed transactions are normally subjected to the joint effects of the internal control systems of the two parties to the transaction (e.g., the firm and its customers or vendors, or employees in the case of payroll). That is, the two internal control systems provide independent checks on the transaction processing and are likely to prevent such errors from occurring in the first place, or to correct such errors before the transaction is completed.[12]

By contrast, completed transactions resulting from internally-generated recognition (see Table 1) do not receive the scrutiny of these two internal control systems and consequently random errors could go undetected. However, as will be discussed below, internally-completed transactions are directly tested for misstatement from asset misappropriation (fraudulent asset write-offs) and hence are subjected to audit testing albeit for a different audit objective. Thus because they are subject to testing for asset

[12] If by chance random errors go undetected by both parties' internal control systems, it is not clear that the monetary amount of errors in these completed transactions are recoverable or that the financial statements need correcting. It can be argued that *caveat emptor* applies and that there is no financial statement error, per se, if these transactions have been voluntarily completed by both parties to the transaction.

Table 2

Risk Propositions (R) and Audit Planning Corollaries (P)

Source of Misstatement	Completed Transactions		Incomplete Transactions	
Random Error	R1:	There is little risk of financial statement misstatement from random error in completed transactions.	R4:	There is a risk of financial statement misstatement from random error in *all* incomplete transactions, but especially in internally-generated transactions.
	P1:	Because of the low risk there is no compelling reason to plan audit tests of completed transactions for risk of random error.	P4:	There are compelling reasons to test *all* incomplete transactions (and especially internally-generated transactions) for misstatement from random error.
Asset Misappropriation	R2:	There is a risk of financial statement misstatement from asset misappropriation in certain populations of completed transactions.	R5:	There is no risk of financial statement misstatement from asset misappropriation in incomplete transactions.
	P2a:	Noncash completion of sales, and cash disbursements, should both be tested for the risk of *cash* misappropriation and concealment.	P5:	There is no logical reason to plan audit tests of incomplete transactions for the risk of misstatement from asset misappropriation.
	P2b:	Internally-generated asset write-offs should be tested for the risk of *noncash* asset misappropriation and concealment.		
Financial Statement Manipulation	R3:	There is little risk of financial statement misstatement from financial statement manipulation in completed transactions, assuming routine tests of ending cash balances are performed.	R6:	There is a risk of financial statement misstatement from financial statement manipulation in *all* incomplete transactions (and especially internally-generated transaction recognition).
	P3:	Because of the low risk there is no compelling reason to plan audit tests of completed transactions for the risk of financial statement manipulation, beyond routine tests of ending cash balances.	P6:	There are compelling reasons to test *all* incomplete transactions (and especially internally-generated ones) for the risk of financial statement manipulation.

misappropriation, special audit tests are not necessary for random error in internally-generated completed transactions.

In sum, random errors in externally-generated completed transactions are unlikely. While this is not the case for internally-generated completed transactions, they are directly tested elsewhere (see planning implication P2b below) and thus do not need to be specially tested for random error. Consequently, given the low risk there normally is no reason to test completed transactions, either internally- or externally-generated, for random error.[13] Formally stated the risk proposition (R1) and preliminary audit planning implication (P1) are:

R1: There is little risk of financial statement misstatement from random error in completed transactions.

P1: Because of the low risk there is no compelling reason to plan audit tests of completed transactions for risk of random error.

Risk of Asset Misappropriation in Completed Transactions. Two types of assets may be misappropriated (and concealed): cash and noncash assets. Cash misappropriation is examined first.

Misappropriation (and concealment) of cash means that transactions have been "fraudulently completed" to conceal the misappropriation. The model provides a basis for analyzing which particular completed transactions are at risk of being fraudulently completed in order to conceal cash misappropriation. Cash misappropriation could occur in either of two ways: (1) through underreporting of cash receipts from credit sales (fraudulent completion of sales)[14] or (2) through unauthorized disbursement of cash (fraudulent completion of purchases or other disbursements). In either case there is an understatement of the "true" or non-fraudulent cash balance, and a corresponding understatement of net income as a result of the fraudulent completion of the transaction. Each of these is now discussed.

First, consider the fraudulent completion of sales. Misappropriation of cash receipts from credit sales can be concealed by fraudulently "completing" sales in a noncash manner. This can occur through actions such as bogus sales returns or bogus cash discounts, or through the fraudulent write-off of an account as uncollectible. The implication is that *noncash* completions of credit sales are at risk and warrant testing.

Second, consider fraudulent cash disbursements for purchases. Fraudulent cash disbursements can occur through bogus vendor invoices, or from fraudulently overstated dollar amounts on otherwise valid purchases. The same is true of cash disbursements for payroll and other disbursements in general.

[13] A random error in completed transactions that could potentially occur and go uncorrected in accounting systems is the misclassification of transactions (including the misapplication of GAAP to transactions). If misclassification errors exist, and are material, preliminary analytical review may indicate their presence through the identification of unusual fluctuations in account balances. Also, to the extent certain populations of completed transactions are tested for asset misappropriation (see P2a and P2b in the next section) there is a joint test for random error due to misclassification. In particular P2a specifies the testing of cash disbursements which is where misclassification errors may be most likely to occur (i.e., a misclassification of expenditures such as capitalizing rather than expensing or vice-versa). Misclassification errors could also exist in incomplete transactions. However, the testing identified in audit planning corollaries P4 and P6 would fully test for this.

[14] If cash is taken before sales are recorded then this is outright theft rather than misappropriation and concealment in the accounting records. The omitted recording of sales is more difficult to audit (the completeness assertion) and the auditor normally relies on tests of the client's internal control system and on analytical procedures.

For example, fraudulent disbursement can occur from payroll ghosting (fictitious employees) or from the overstatement of hours and/or pay rates on an otherwise valid payroll payee. The overall implication is that all cash disbursements are at risk and warrant testing.

Noncash asset misappropriation and concealment is now examined for several types of noncash assets (accounts receivable was treated as "cash" and evaluated above). First, the theft marketable securities can be concealed through a fraudulent asset write-off for impaired value. Second, the misappropriation of inventory can occur through a fraudulent completion related to improper inventory write-offs for asset impairments. Third, the misappropriation of long-term or fixed assets can be concealed through bogus retirement or write-off of the misappropriated assets. In each of these cases, the misappropriation of noncash assets is concealed through an internally-generated fraudulent completion. Such asset write-offs are visible, are normally recorded in the general journal, and should be tested to determine the transaction's validity.

In sum, there is a risk of asset misappropriation in completed transactions. Formally stated the risk proposition (R2) and preliminary audit planning implications (P2a and P2b) are:

R2: There is a risk of financial statement misstatement from asset misappropriation in certain populations of completed transactions.

P2a: Noncash completion of sales, and cash disbursements, should both be tested for the risk of *cash* misappropriation and concealment.

P2b: Internally-generated asset write-offs should be tested for the risk of *noncash* asset misappropriation and concealment.

Risk of Financial Statement Manipulation in Completed Transactions. The fraudulent manipulation of financial statements in completed transactions is highly unlikely. Such manipulations would be readily detected through routine testing for discrepancies in the ending cash balance.[15] Consequently, special audit procedures (beyond tests of cash) are normally not required to test for financial statement manipulation in completed transactions.

Formally stated the risk proposition (R3) and preliminary audit planning implication (P3) are:

R3: There is little risk of financial statement misstatement from financial statement manipulation in completed transactions, assuming routine tests of ending cash balances are performed.

P3: Because of the low risk there is no compelling reason to plan audit tests of completed transactions for the risk of financial statement manipulation, beyond routine tests of ending cash balances.

[15] To illustrate, if "completed" sales are overstated by bogus (fraudulent) transactions then the cash account, because of double-entry accounting, must show a corresponding increase (since the transaction is completed) and must also be overstated. This fraudulent overstatement of cash would be detected through the auditor's routine test of the ending cash balance (e.g., bank confirmation and cutoff statement to test the year-end bank reconciliation). Similarly, if recorded "completed" purchases are understated (relative to actual cash disbursements) in order to fraudulently overstate income, then the ending balance of cash would show a discrepancy between cash per bank and cash per books.

Analysis of Incomplete Transactions

Sources of risk in incomplete transactions are now analyzed. Random errors are evaluated first followed by an analysis of asset misappropriation and financial statement manipulation.

Risk of Random Errors in Incomplete Transactions. For completed transactions it was argued that random errors are unlikely to occur (see R1 and P1). In contrast, for incomplete transactions such errors could exist because the transactions have not yet been fully screened by both parties' internal control systems. By virtue of being incomplete, these random errors can be corrected and the transaction can be subsequently completed at the corrected amount. The detection of these random errors would result in an adjustment to the financial statements (if material). Random error could exist in any population of incomplete transactions (see Table 1). However, there is a special risk of random errors with internally-generated recognition such as year-end accruals because such transactions do not go through the same kind of rigorous internal control system as is used for routine, repetitive, high-volume, externally-generated transactions.

In sum, there is risk of random error in all populations of incomplete transactions. Formally stated the risk proposition (R4) and preliminary planning implication (P4) are:

> R4: There is a risk of financial statement misstatement from random error in *all* incomplete transactions, and especially in internally-generated transaction recognition.
>
> P4: There are compelling reasons to test *all* incomplete transactions (and especially internally-generated transactions) for misstatement from random error.

Risk of Asset Misappropriation in Incomplete Transactions. Recall that the concealment of misappropriated assets can only occur in completed transactions (see R2, P2a and P2b). By definition, then, there is no risk of asset misappropriation (and concealment) in incomplete transactions and hence no logical reason to test for such risk.[16] Formally stated the risk proposition (R5) and preliminary audit planning implication (P5) are:

> R5: There is no risk of financial statement misstatement from asset misappropriation in incomplete transactions.
>
> P5: There is no logical reason to plan audit tests of incomplete transactions for the risk of misstatement from asset misappropriation.

Risk of Financial Statement Manipulation in Incomplete Transactions. The fraudulent misstatement of assets and income can be concealed, at least temporarily, in incomplete transactions such as accounts receivable or inventory. More subtle manipulation could also occur through end-of-period valuation adjustments to asset accounts, for example, the deliberate underestimation of the allowance for uncollectible accounts receivable. Internally-generated transactions involving year-end accruals and adjustments, and end-of-period asset valuation adjustments are particularly vulnerable because they are not subject to the same kind of internal control systems that apply to routine, high-volume, externally-generated transactions.

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[16] Outright theft of assets (i.e., unconcealed asset misappropriation) will by definition occur in incomplete transactions. However, as discussed in footnote 6 such thefts should either be detectable by the auditee's internal control system, or, failing that, by the auditor's tests of incomplete transactions for random errors or financial statement manipulation. Therefore, no special audit tests beyond those suggested by P4 above (and P6 below) are necessary.

Thus there are compelling reasons to test all types of incomplete transactions for financial statement manipulation. Formally stated the risk proposition (R6) and preliminary audit planning implication (P6) are:

R6: There is a risk of financial statement misstatement from financial statement manipulation in *all* incomplete transactions (and especially internally-generated transaction recognition).

P6: There are compelling reasons to test *all* incomplete transactions (and especially internally-generated ones) for the risk of misstatement from financial statement manipulation.

RELATION OF THE MODEL TO SAS 31 ASSERTIONS

Further insights can be gained by considering the model in terms of the SAS 31 assertions (existence, completeness, rights and obligations, valuation, presentation). These assertions can be thought of as the "properties" that make the financial statements presented fairly. In and of themselves, however, the assertions are not particularly instructive for audit planning. They do not specifically identify what should be audited, or why, from a risk perspective.

The assertions are, however, very useful for clarifying the scope of audit testing objectives once an area for testing has been identified through risk-based audit planning. Our model of error and irregularities provides this by analyzing which populations of transaction are at risk and should be tested. The model's risk propositions R1-R3 and preliminary planning implications P1-P3 can then be related to SAS 31 assertions in the following specific manner:

1. for the risk of asset misappropriation in *completed transactions* (R2), the primary assertion being tested (P2a and P2b) is existence or the validity of transactions that could conceal asset misappropriations (or relatedly the validity of the underlying control system that generates the transactions).

2. for the risk of random error and/or financial statement manipulation (R4 and R6) in *externally-generated incomplete transactions*, the primary assertions being tested (P4 and P6) are the existence and completeness of incomplete transactions with respect to proper year-end recognition and cutoff.

3. for the risk of random error and/or financial statement manipulation (R4 and R6) in *internally-generated incomplete transactions*, the primary assertions being tested (P4 and P6) are (a) existence, completeness and valuation of year-end accruals and adjusting entries and (b) the proper valuation of assets (i.e., end-of-period asset valuation adjustments).

In sum, the model's preliminary audit planning implications (P2a, P2b, P4, and P6), clarify and provide guidance as to which assertions (i.e., "properties" of correctness) are relevant to which class of transactions.[17]

[17] We have not discussed the "disclosure" and "rights and obligations" assertions. In our view, the "rights and obligations" assertion can be interpreted as an elaboration of the existence and completeness assertions. That is, asset recognition has validity only if rights to the asset actually exist (existence). Similarly, liability recognition is complete only if all obligations are recognized that should be recognized (completeness). Therefore we do not treat it as a separate assertion with additional testing requirements.

AUDIT STRATEGIES FOR CONTROL AND SUBSTANTIVE TESTS

The audit planning corollaries (P1-P6) of the model are quite specific and can be used as a general guide to preliminary audit planning. In particular, planning corollaries P2(a,b), P4 and P6 identify those specific populations of accounting transactions or account balances where some form of testing is normally appropriate, and P1, P3 and P5 identify situations where testing is not normally warranted. We now show that these results also lead to a systematic framework for assisting auditors in their strategic choice of (1) internal control system compliance tests or (2) substantive tests of transactions and account balances.[18] Thus our model of errors and irregularities also provides a preliminary planning framework for identifying where control versus substantive testing is normally appropriate. As noted before, though, exactly how control and substantive testing is carried out (e.g., analytical procedures versus tests of details) is beyond the scope of the study's analysis.

The analysis in this section uses the transaction categories developed for the model of errors and irregularities: completed-incomplete and internal-external. With these characterizations it is easy to assess the use of control versus substantive tests for the accounting populations specified by planning corollaries P2(a,b), P4 and P6. The analysis proceeds as follows. Completed transactions are analyzed first with a further distinction between internal and external. Incomplete transactions are then analyzed, again with a further distinction between internal and external. Results of the analysis are summarized in Table 3.

Completed Transactions (Planning Corollary P2(a,b): Asset Misappropriation and Concealment)

The model of errors and irregularities in Table 2 identifies specific populations of completed transactions that can be used to conceal asset misappropriation (see audit planning corollaries P2a and P2b). Two testing approaches are possible for these completed populations. In the first approach the auditor could test the underlying internal control system to determine that proper authorization procedures exist to assure the validity of these completed transactions. Alternatively, since the model identifies specific transactions in which concealment is possible, direct substantive tests of these transactions could be performed to determine the validity of the transactions and that they have not been used to conceal asset misappropriations.[19] It will now be shown that this trade-off between control and substantive testing for asset misappropriation in completed transactions normally hinges on the internal versus external nature of transaction completion.

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[18] Audit standards clearly demarcate these two categories of tests, for example, SAS 47 and SAS 55. In addition, the audit risk model establishes an inverse relationship between reliance on controls and reliance on evidence from substantive tests.

[19] By contrast control system tests are only *indirect* tests of underlying transactions based on an assessment of the quality of the control system. As discussed in SAS 47 good (bad) control systems are presumed to be correlated with a lower (higher) likelihood of material financial statement misstatements. Nevertheless, empirical studies have generally failed to support the proposition that good internal control systems lead to fewer financial statement misstatements (e.g., see Kreutzfeldt and Wallace 1990, Waller 1993, Willingham and Wright 1985). The reason for this may be that internal control systems are effective in controlling transaction-level processing of routine, high volume, externally-generated transactions, whereas misstatements (random and nonrandom) are more likely to occur in lower volume, internally-generated transactions that do not lend themselves to the same degree of process control. Thus one could observe strong internal controls over routine transactions, but if misstatements are primarily in internally-generated transactions (as the data by Kreutzfeldt and Wallace 1986 suggest) then there would be no correlation between the control system and the incidence of misstatements.

Table 3
Implications for Control Versus Substantive Tests

Transaction Type	Model's Control Tests	Substantive Tests	Planning Corollaries	Audit Concerns
Completed:			P2(a,b)	Misappropriation & Concealment
Internal	No	Yes		
External	Yes -Trade-offs-	Yes		
Incomplete:			P4, P6	Random Error & Financial Statement Manipulation
Internal	No	Yes		
External	Yes -Trade-offs-	Yes		

Internally-Recognized Completed Transactions.

Asset misappropriations in completed transactions can occur through certain internally-generated and low-volume transactions that are recorded in the general journal such as the noncash completion of sales through bad debt write-offs or through other asset write-offs. These types of transactions do not lend themselves to the same degree of internal processing controls as do externally-generated high-volume transactions. For this reason it normally would be more appropriate for the auditor to rely on direct substantive tests of these transactions. In other words it would not be necessary to perform control tests relating to these particular populations of transactions since they can be directly tested through substantive tests.

Externally-Recognized Completed Transactions. Control tests (and hence internal control reliance) for asset misappropriation in completed transactions may be efficient and effective for populations of externally completed transactions. These completions are typically high volume in nature and are recorded in special journals. For example, high-volume externally completed purchase transactions (see testing corollary P2a) might be efficiently and effectively audited via control tests (rather than direct substantive transaction tests). The same may also be true of the external completion of sales through high-volume returns and allowances.

Finally, it is possible that the optimal audit strategy would be a mix of control tests and substantive tests of transactions. However, the nature of these trade-offs is beyond the scope of this study.[20]

[20] There has been some prior research on combining evidence from control tests and substantive tests (e.g., Bailey 1981, Grimlund 1982, Kinney 1975, Smieliauskas 1985), but little formal modelling of the trade-offs in deriving an optimal audit strategy. Our approach to this question identifies where control tests logically make sense and where they do not. Only where control tests are logical is there a need for further analysis of what the optimal trade-off is regarding the amount of evidence from control tests and substantive tests, and the development of algorithms for combining such evidence.

Incomplete Transactions (Planning Corollaries P4 and P6: Misstatements from Random Error & Financial Statement Manipulation)

The model of errors and irregularities (summarized in Table 2) has two auditing planning corollaries with respect to incomplete transactions, P4 concerning the risk of random errors and P6 concerning the risk of financial statement manipulation. The analysis again shows that the choice of control versus substantive test hinges on whether the recognition is internally or externally generated.

Internally-Recognized Incomplete Transactions. Internally-generated incomplete transactions are year-end accruals and adjusting entries, self-constructed assets, internal inventory transfers, and end-of-period asset valuation adjustments. With the possible exception of inventory transfers, these are normally low-volume transactions that are recorded in the general journal. These transactions are not therefore effectively controlled by processing-oriented transaction-level control systems.

By definition, then, internal transactions are judgmental items, non-routine (low volume) in nature, and recorded in the general journal rather than high-volume special journals. As a result, internal control system reliability (control risk) is unlikely to be an effective audit approach. Instead, audit testing must necessarily rely on (1) substantive tests of transactions (in the case of year-end accruals and adjusting entries) and (2) substantive tests of asset balances (in the case of self-constructed assets, internal inventory transfers, and end-of-period asset valuation adjustments).

Externally-Recognized Incomplete Transactions. The primary source of misstatement in externally-generated incomplete transactions is improper recognition and cutoff at year end. The particular risks are:

1. the "existence" assertion, or whether the assets/revenues that were recognized should have been recognized.

2. the "completeness" assertion, or whether all liabilities/expenses that should have been recognized were in fact recognized.

These types of transactions are normally recorded in high-volume special journals and may be effectively controlled by well-defined processing-level transaction control systems identified by the auditor's preliminary review of controls. In such cases, control system reliance and testing may be efficient and effective in evaluating the likelihood of either random errors or financial statement manipulation.

Thus there is a potentially strong role for control testing with a resultant cutback in substantive testing in these externally-recognized incomplete transactions. Again, though, the optimal strategy may be a mix of both control and substantive tests and the precise nature of these trade-offs is beyond the scope of this study.

SUMMARY AND IMPLICATIONS

This study has developed a transaction-based model of financial statement misstatements to aid in risk-based planning of audit tests. The model analyzes the risk of misstatements from random error, asset misappropriation, or financial statement manipulation in the specific populations of accounting transactions and account balances that constitute the financial statements. The results of our model identify which transactions should be tested for particular sources of misstatements.

Two broad audit testing objectives are delineated. First, populations of *completed transactions* are tested for the risk of asset misappropriation. Second, populations of *incomplete transactions* are tested jointly for the risk of random error and financial statement manipulation. Insights from the model are then used to consider the overall audit strategy suggested by the audit risk model in SAS 47. Specifically, our analysis helps to clarify the respective roles of control tests versus substantive tests from an audit planning perspective.

It has been seen that our model of errors and irregularities identifies well defined classes of populations for which some form of testing is normally appropriate. This result is summarized in Table 2. The distinctive feature of the model (i.e., incomplete/complete and internal/external transactions) has then proven useful in further classifying the general form of testing (i.e., control/substantive). Table 3 summarizes this analysis.

The study has a number of implications for the potential improvement of audit practice. First, the model of errors and irregularities could be used as a general training tool for understanding inherent risk of misstatements. Second, it might potentially improve audit effectiveness when formally used as a decision aid for audit planning in the design of appropriate (relevant) tests. Third, audit planning based on the study's model might improve audit efficiency because the model demarcates what needs to be tested and, by implication, what need not be tested. Fourth, the model aids in evaluating how testing should be efficiently and effectively undertaken with regard to control tests or substantive tests or a combination of both.

As teachers of auditing we also believe our model of errors and irregularities has positive pedagogical implications for three difficult topics in auditing: the SAS 31 assertions, the SAS 47 audit risk model, and internal control evaluation and SASs 55 and 78. Our experience is that students normally have some problems in understanding the assertions in SAS 31 because of their abstractness and generality. The model of errors and irregularities developed in this study overcomes this pedagogical problem by applying the assertions to context-specific situations and logically relating specific assertions to particular sources of misstatements in specific populations of transactions.

With regard to SAS 47, the basic logic of the audit risk model is easily grasped. However, students struggle to understand the wider implications of the model for audit planning and testing. Our model of errors and irregularities helps by clarifying the strategic role of control tests and substantive tests (and their trade-offs) in testing those populations of accounting transactions and account balances identified in the model.

Internal control evaluation is another difficult aspect of an auditing course. Our model facilitates this by identifying more specifically where internal control reliance matters and should normally be tested (and why). The internal control insights from our model are also consistent with the recommended methodology for auditing internal control (see SAS 55). The essential first step in that process is to identify what misstatements can occur (and why) which is exactly what our model does.

The model of errors and irregularities developed in this study also suggests a number of issues for follow-up evaluation and/or empirical testing. We simply present these in the form of questions. First, can the model be used as an effective pedagogical and training tool for understanding the risk of misstatements and for risk-based audit planning? Second, can the model be operationalized for use in the field as a decision aid for risk-based planning of audit tests and for making strategic choices between control and substantive tests? Third, would the audit testing suggested by the model lead to more efficient auditing (by identifying what should be audited and why)? Fourth, are there currently routine audit tests being performed that are inconsistent with the predictions of our model and which therefore might be unnecessary?

We believe our model of errors and irregularities has a rich potential for the auditing discipline in each of the above areas. The logical and structured understanding it brings to risk analysis, and the role it plays in risk-based preliminary audit planning, are foundational issues that have not been rigorously investigated in the auditing literature. A better understanding of these foundational issues is essential for the further development of risk-based auditing.

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Discussion of "A Model of Errors and Irregularities as a General Framework for Risk-Based Audit Planning"

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Francis and Grimlund (henceforth F&G) develop a simple taxonomy of financial statement transactions and evaluate classes of transactions in terms of their susceptibility to error, misappropriation, and fraudulent misrepresentation. The paper provides insightful discussions about the ways errors and irregularities can happen and "what to audit and why." I begin my discussion by providing a brief summary of the risk-based audit planning model presented in the paper. I then compare the F&G model to the approach outlined in Houghton and Fogarty [1991] and attempt to reconcile any apparent differences between these two approaches. Remaining remarks focus on what I believe are key audit planning issues not discussed in the paper, and current trends within the auditing profession that indicate a movement away from a transactions orientation for audit planning and toward a more holistic business orientation.

The F&G Risk-Based Audit Planning Model

In order to better understand the susceptibility of "accounting populations" to errors and irregularities, F&G subdivide transactions into distinct groups based on the *timing* of the recording of the underlying economic events, and the circumstances that *trigger* the recording of transactions. An accounting transaction is categorized by F&G as "incomplete" if, at the end of the accounting period, an account balance related to the transaction will remain on the books, and one can reasonably expect at least one additional accounting transaction will be recorded in any future accounting period related to the same underlying event.[1] All other accounting transactions are defined as "completed." For example, a credit sale (purchase) is an incomplete transaction prior to collection (payment) of the related receivable (payable). The transaction is completed when cash is collected or paid. F&G's audit planning model is based, in part, on the assumption that incomplete and completed transactions have different propensities for errors and irregularities.

The recording of accounting transactions is sometimes — but not always — triggered by the occurrence of external events. F&G subdivide completed and incomplete transactions based on the triggering event — external event was, or was not, the trigger. The F&G audit planning model is also based on the assumption that transactions for which recording is triggered by external events have different propensities for errors and irregularities than those for which recording is not triggered by external events.

Table 1 summarizes the audit planning implications that fall out of their analysis of propensity for errors and irregularities for each of these classes of transactions.

According to F&G, externally-triggered completed transactions have a low risk of random error or fraud because of the confluence of the control systems of all involved parties over the recording process. F&G suggest that completed transactions for which recording is not triggered by external events should be tested for asset misappropriation and random error because they are not subjected to the same degree of control. However, they suggest the risk of fraudulent account balance manipulations is very low in all completed transactions because they would normally be detected by routine testing of the ending cash balance. Finally, F&G suggest that all incomplete transactions should be tested for random errors and fraud, but not for asset misappropriation with concealment,

[1] F&G define "incomplete" transactions as "those economic exchanges that remain incomplete at the end of the fiscal period." This is my attempt to make the definition more precise.

Table 1: The F&G Risk-Based Audit Planning Model

- **Rely on Controls for Assurance on *Completed* Transactions Where Recording is Triggered by *External* Events**

- **Test *Completed* Transactions for Misappropriation and Concealment When Recording is *Not* Triggered by *External* Events**

    - Non-Cash Completion of Sales
        - Bogus sales returns
        - Bogus cash discounts
        - Fraudulent write-offs of accounts receivable as uncollectible
    - All Cash Disbursements
        - Bogus vendor invoices
        - Overstated dollar amounts
        - Payroll ghosting
        - Overstatement of hours or pay rates
    - Internally-Generated Asset Write-Offs
        - Fraudulent write-offs of marketable securities
        - Fraudulent write-offs of inventory
        - Bogus retirement or fraudulent write-off of long term and fixed assets

- **Test *All Incomplete* Transactions for Random Error and Fraud**

    - Accruals (Especially Internally-Generated)
    - Valuation Adjustments

because they, too, are not subjected to the same degree of control. Incomplete transactions have no risk of asset misappropriation because, by definition, an asset cannot be *misappropriated with concealment* if it is the subject of an incomplete accounting transaction that evidences its continued existence on the books.[2]

Although the apparent focus of the F&G audit planning model is on the "nature of transactions," in effect the underlying rationale about propensities for errors and irregularities is based on the authors' expectations about the *extent of control system effectiveness* over the transactions. For example, they assert that risk of random error for completed transactions is low because "completed transactions are normally subjected to the joint effects of the internal control systems of the two parties to the transaction." Also, they suggest that non-cash completion of sales, all cash disbursements, and internally-generated asset write-offs are higher risk transactions because "these types of transactions do not lend themselves to the same degree of internal processing controls as do externally-generated high-volume transactions."

[2] F&G consider only misappropriation *with concealment*. Their model ignores outright theft (misappropriation without concealment) because they believe for most clients the control system can be relied upon to detect these events.

Alternative audit planning models that incorporate characteristics of errors and irregularities have been reported in the literature. One such model was reported in Houghton and Fogarty [1991] (henceforth H&F). In the next section, I discuss the H&F audit planning model and attempt to reconcile it with the F&G model.

The Houghton and Fogarty [1991] Audit Planning Model

H&F surveyed 480 audit engagements conducted by Deloitte Haskins & Sells, International to determine the characteristics of auditor-detected errors [3] and whether areas in which errors occur could be identified during the audit planning process. Their results indicate that non-systematically processed transactions have a significantly disproportionately higher likelihood of error than systematically processed transactions. H&F separate non-systematically processed transactions into those that are recurring and normal, such as year-end accruals, and those that are unusual such as the recording of a finance lease transaction, the acquisition or sale of an affiliate, installment sales of real estate, etc.

The results of the H&F study were incorporated into a revised audit approach used by DH&S at the time of publication of the study. The revised audit approach involved placing greater reliance on audit planning, and in particular on the assessment of inherent risk, to determine the extent of audit testing. Key aspects of the revised audit approach are presented in Table 2.

Similar to F&G, H&F (p. 18) conclude that "internal accounting control procedures are effective controls over the recording of exchanges with outside parties. Such controls relate to the movement of assets, and most asset movements are systematically recorded."
H&F go on to state that "traditional controls are not as applicable to transactions that do not involve exchanges. Most non-systematically processed transactions are not exchanges, and many involve client judgment. Such transactions include changes in asset and liability valuations, cut-offs that are not systematically determined, or unusual transactions that require special processing."

The H&F planning model is simpler than the F&G model. It identifies only two broad classes of transactions: transactions for which processing is systematic and those for which processing is non-systematic. The underlying client characteristic that heightens or lessens risk is the same as that discussed in F&G; that is, internal accounting control is usually effective for systematic processing, and less effective or non-existent for non-systematic processing.

An attempt to reconcile these two audit planning models led me to the following observations. First, systematically processed transactions can be both complete or incomplete, and in both cases these transactions are probably low risk. In the recent past, several studies have documented the effectiveness of accounting systems at processing routine transactions originating from exchanges with outside parties.[4] The evidence shows the risk for incomplete routine transactions that are systematically processed is typically not heightened. After all, management must rely on information from these systems to manage their businesses.

Second, H&F observed that routine bookkeeping adjustments were the most frequent cause of error. These adjustments are usually internally-generated incomplete transactions, so H&F's data support F&G's risk propositions.

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[3] H&F do not differentiate between errors, misappropriations, and fraudulent financial statement manipulations. Presumably, their definition of "error" encompasses all three possibilities.

[4] For example, see *Systems Audibility and Control*, Institute of Internal Auditors [1992].

Table 2: The H&F Audit Planning Model

- **Non-Systematically Processed Transactions are Generally Designated as High Inherent Risk and Are Subjected to Focused Testing to Address the Specific Identified Risk**

- **If the Answer to Any of the Questions Given Below is "Yes," an Inherent Risk Has Been Identified and the Individual Transaction or Class of Transactions to Which the Risk Applies Will Be Addressed in the Design and Execution of Specific Audit Procedures:**

    - Does the account contain entries that are non-systematically processed?
    - Does the account contain any unusual transactions?
    - Does the account have a history of audit error?
    - Does the account represent a particular industry risk for the client?
    - Does the account contain amounts that, based on existing knowledge of the client's business or other knowledge, represent a greater than normal risk of error?

- **If the Answer to Each of These Questions is "No," Inherent Risk is considered "Low" for the account or class of transactions and Audit Procedures are Extended Only if an Internal Control Weakness Has Been Identified**

Third, consistent with other studies[5], H&F report that judgment and GAAP errors, while fewer in number than routine bookkeeping errors, were significantly larger in size. These findings imply that certain internally-generated incomplete transactions represent a higher risk than others. If this is true, it would be useful to divide this class of transactions into subclasses with different grades of risk, e.g., where valuations and complex transactions requiring significant judgment represent the subclass of internally-generated incomplete transactions with the highest risk of a material misstatement, and routine bookkeeping adjustments represent a lower risk subclass.

I believe the strength of the F&G paper lies in its challenge to the reader to think through the risk and control implications inherent in certain classes of transactions. Although these implications will likely come as no surprise to the typical field auditor, too often they are ignored or forgotten by the professional in the field who views his job as maximizing the efficiency of the audit production process.

Other Risk Considerations

The F&G and H&F audit planning models provide valuable insights about the relative vulnerabilities of different classes of transactions to random errors, concealment of asset misappropriations, and fraudulent financial statement manipulations. However, it is important to note that other risk considerations can — and perhaps should — influence audit planning. Some of these risks are presented in Table 3.

[5] See, for example, Hylas and Ashton [1982] and Bell and Knechel [1994].

Table 3: Other Important Risk Considerations for Audit Planning

- Client business risks
  - Strategic risks
  - Process-level risks
  - Industry competition
  - Product/service obsolescence
  - Technology risks
  - Strategic alliances among competitors within the industry
- Risks related to organizational culture and management integrity
  - Constrained internal communication
  - Past irregularities
  - Management evasiveness
  - Corporate values and social responsibility
  - Incentive compensation schemes and degree of management tolerance for sub-goal performance
- Compliance risks
  - Federal sentencing guidelines
  - Extent of industry regulation
  - Compliance risk management practices and quality of the compliance system

It is impossible to prioritize and effectively address these other risks without first obtaining a thorough understanding of the client and the environment in which it operates. I suggest that if these risks do exist for a given audit client, they will likely provide a greater impact to audit planning than the risks outlined by F&G related to the nature of transactions.

As we approach the beginning of the 21st century, emerging technology is enabling the establishment of a new economic order. The economic world is poised for yet another wave of "complexification," or "the third wave" as Toffler refers to it. Business organizations, governments, indeed, all forms of working, living institutions are metamorphosing by shedding less-productive parts and processes and by connecting to other organizations in new and innovative ways via advanced communications technology, thereby establishing new niches.

In this rapidly evolving economic climate, auditors face the difficult challenge of evaluating the implications of quick and dramatic economic and technological changes on financial statement assertions. Do new alliances among a client's competitors render accounting choices and asset valuations obsolete? What is the impact on the client's asset values when business process advantages are enjoyed by competitors? Is the client's industry highly regulated, and if so, what is the level of exposure to compliance risks? What is the appropriate level of disclosure about these business, organizational, and compliance risks? In the current litigious environment, what is the level of auditor business risk arising from association with the client? Do bottlenecks in internal information flows heighten the risk of material misstatements in the financial statements?

The auditing profession is currently inventing new auditing methodologies that address these important risks. Risk assessment methods confined to evaluating the nature of transactions are viewed by today's auditors as outdated and ineffective. My remaining remarks will focus on the current trend within the auditing profession to reinvent auditing methodology and shift the audit planning focus from a transactions orientation to a holistic business orientation.

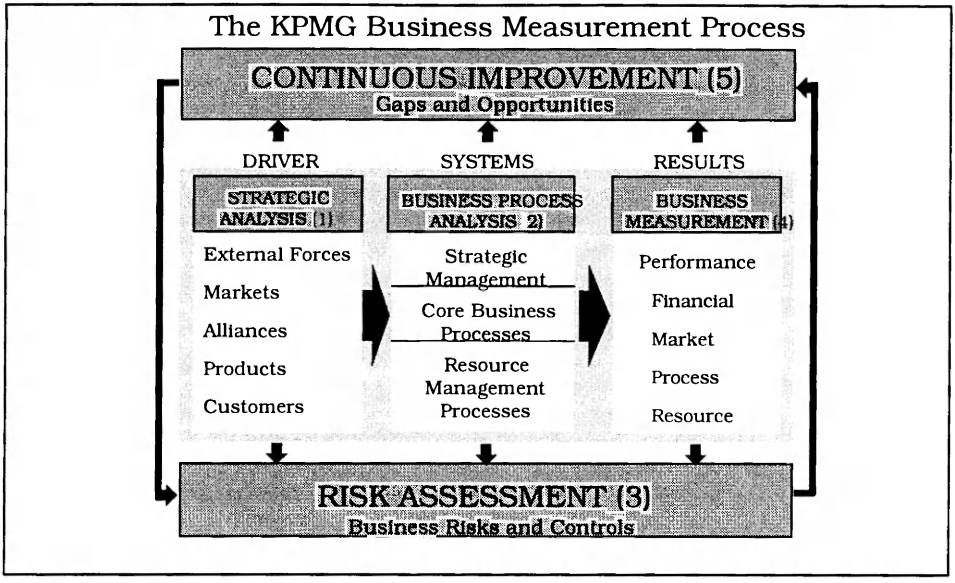
The KPMG Business Measurement Process

Today many parties related to the client seek assurance from the auditor about business process performance, compliance with laws and regulations, and other forms of business assurance that go beyond the traditional assurance about complete and accurate recording and reporting of business transactions in compliance with generally accepted accounting principles. These parties include capital suppliers, resource and raw materials suppliers, customers, regulators, business partners, other outside constituents, and client management themselves. Unprecedented innovations within information technology present the possibility of rendering obsolete any job, business, or market whose primary function is information intermediation. On the flip side, opportunities abound for business organizations with the foresight and agility to adapt effectively in this new environment. The accounting profession is not immune to the radical changes currently impacting the global business environment. KPMG has developed a new audit approach, called the Business Measurement Process (BMP), as the first phase of its long term strategy to adapt to this changing business environment.

BMP shifts the risk assessment focus from a bottom up transactions risk orientation to a top down business risk orientation. The new process requires the auditor to make judgments about the potential impacts of rapid changes in technology, competition, and regulations on the client's current and prospective performance and whether these impacts affect key assertions contained in the financial statements.

We believe a top down risk assessment focus will improve the auditor's judgment and decision making ability. Under the old transactions risk orientation, risk assessments were anchored to a preliminary version of the very assertions being audited — the account balances. Research in audit judgment and decision making has documented the potential for bias in the direction of cognitive anchors. Under the new business risk orientation, auditors anchor to a fundamental understanding of the business; its strategy; business risks that threaten the achievement of its business objectives; the efficiency, effectiveness, and proper alignment of its core business processes; and financial and non-financial indicators of current process and business-wide performance. Financial statement assertions are evaluated against well-conceived expectations of overall business performance and business process performance formed from knowledge of productive capacity; current industry trends; potential technology impacts; the probability of product, service, and process obsolescence; measures of customer satisfaction; and other key performance indicators. Transactions-based auditing procedures are applied principally to non-routine transactions and non-routine and highly judgmental accounting estimates.

BMP requires the application of five monitoring and measurement principles. Each principle guides the auditor's evaluation of the client's business risks and related audit risks. The five principles are: (1) strategic analysis, (2) business process analysis, (3) risk assessment, (4) business measurement, and (5) continuous improvement. The five principles, and their interrelationships, are depicted in the accompanying illustration.



Using BMP, risk assessment begins with a strategic analysis of the client. The auditor analyzes the industry within which the client is operating, the client's strategy to achieve a sustainable competitive advantage within this industry context, the business risks that threaten the success of this strategy, and the client's responses to these risks. During strategic analysis the auditor makes judgments about whether the client has a comparative advantage for occupying its current niche, whether external forces threaten the sustainability of this niche, and whether accounting choices are appropriate in light of the client's strategic choices.

The 1990's has seen a surge in efforts to redesign core business processes and outsource non-core processes as organizations attempt to achieve "process advantage." Management has traditionally focused on business inputs and outputs, leaving the detailed operations of core business processes to lower level operations personnel. Today, we see a shift toward process-driven competition, and top management have turned their attention to creating process advantage. Similar to species in living nature, organizations that achieve process advantage are in a position to survive and prosper, whereas organizations stuck at lower levels of process performance risk extinction. In this regard, Keen and Knapp [1996, p. 4] state the following:

> Study after study reveals far more differences in firms' economic performance as measured by long-term return on assets *within* an industry than across industries and relates those differences directly to business processes.

BMP requires the auditor to analyze the core business processes of the client organization in order to develop an understanding of how these processes work, the significant process risks and how are they being controlled, and the critical performance-related issues confronting the client. Measurements of process performance are taken in the business measurement phase of BMP to identify performance gaps between client processes and analogous processes of direct competitors demonstrating consistent process advantage.

Having obtained an understanding of the client's strategy and the workings of its core business processes, the auditor is in a position to begin the risk assessment phase of audit planning. During this phase, the auditor observes the client's own risk management process to understand the extent to which the client is monitoring external and internal risks[6] that threaten the achievement of its overall business objectives and its business process objectives. If the client's risk management process is adequate, the auditor can rely on its outputs to form a preliminary list of high priority business risks.

An adequate risk management process will include sub-processes at the strategic level and the business process level, with an effective management control process to integrate and coordinate the monitoring and control activities occurring at both levels. Strategic business risks threaten the overall success of the entity's business strategy, while process business risks threaten the achievement of specific process objectives. The primary role of management control is to ensure that risk monitoring and control activities are aligned properly with overall strategic objectives.

Once the auditor gains an understanding of management's process for identifying and controlling business risks, and management's perceptions, assumptions, and judgments about business risks, he can then assess the business risk implications, both for the client's business and for the audit approach. Particular attention is paid to the adequacy of the risk management process and includes considerations such as whether the list of identified business risks is complete, business risks have been prioritized accurately, existing controls reduce these risks to acceptable levels, and accounting choices and financial disclosures properly reflect uncontrolled risks.

During the business measurement phase of the BMP audit, the auditor measures the processes and variables that have the greatest impact on the business. He also analyzes interrelated performance measures (financial and non-financial) both over time and relative to those of similar organizations. Transactions-based auditing procedures are applied to non-routine transactions and non-routine and highly judgmental accounting estimates. Computer assisted auditing techniques might also be applied to populations of routine transactions to filter those that are unusual in nature.[7] Additional audit test work is performed when interrelated financial and non-financial performance measures are inconsistent, and when key financial statement assertions are not consistent with the auditor's understanding of the organization's strategy and process performance.

The BMP audit positions the auditor to provide assurance not just to outside capital suppliers, but also to inside process owners, board members, and top management. During the continuous improvement phase of the audit, the auditor prepares and reports process performance and financial performance gap analyses using measures from competitors demonstrating consistent process advantage. In addition, the auditor identifies and reports on the process areas that can be addressed to generate improvement opportunities and achieve the "process advantages" the client seeks. These new types of diagnostic business assurance are designed to deliver more value to the client than the outdated management letter whose contents, historically, have been limited to issues dealing with the quality of accounting systems.

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[6] *External risks*, including operational, financial, and compliance risks, arise from the complex relationships between the organization and its external environment. *Internal risks* arise from characteristics of the organization's management, strategy, structure, culture, and business processes.

[7] Transactions that fail to pass through screening filters are subjected to further testing. Client analyses and internal audit results are relied upon where appropriate.

Summary

F&G separate accounting populations into classes of transactions with differing propensities for material misstatement based on differing degrees of underlying control system effectiveness over the recording of the transactions. Their transactions-based risk assessment approach provides useful guidance to auditors about what to audit and why, and, in my opinion, auditors would be well served by thinking through the nature of these subclasses of transactions and their inherent vulnerabilities to misstatement. The current trend within the auditing profession is to assess client and auditor business risk from a more holistic business orientation. I have provided a description of KPMG's Business Measurement Process as an example of one firm's efforts to infuse its audit process with holistic business risk assessment methods and procedures. Competitive pressures within the auditing profession continue to intensify, and clients expect auditors to understand the workings of their businesses and business processes better than they have in the past, and to provide more informative and valuable feedback about relative process performance and performance improvement opportunities. KPMG believes that an audit planning model that couples the holistic BMP business risk assessment approach with a fundamental understanding of the vulnerability of classes of transactions to misstatements will result in an efficient and effective audit and will at the same time empower auditors to provide more valuable business diagnoses to their clients.

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7

Framing Effects and Output Interference in a Concurring Partner Review Context: Theory and Exploratory Analysis

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INTRODUCTION

A quality control procedure mandatory for audit firms in the SEC practice section is concurring partner review. The specific actions taken by the concurring partner in conducting the review, however, vary across audit firms. Some firms encourage a consultative role where the concurring partner and the engagement partner routinely interact to discuss the major decisions involved in the planning, conduct, and final review of the audit (Jamal et al. 1995). Other firms advocate an advisory role in which the concurring partner explores key judgments made by the engagement partner and verifies that no oversights or errors have been made (Jamal et al. 1995). Still other firms advocate an investigative role in which the concurring partner has no input in the planning or conduct of the audit and serves only to "ensure that auditing standards and SEC requirements have been fulfilled and that the audit report is appropriate in the circumstances" (Johnson et al. 1991, p. 80).

The key factor that differentiates each of these roles is the type of interaction that takes place between the engagement partner and the concurring partner. When assuming a consultative role, the engagement partner and concurring partner engage in a significant amount of interactive problem solving and decision making. In assuming an advisory role, the concurring partner reviews the most difficult audit issues in a relatively independent fashion and interacts with the engagement partner on only a limited basis. The investigative role implies almost no decision making or problem solving interaction between the engagement partner and the concurring partner. In fact, "the SEC has interpreted the role of a concurring partner as being independent and almost *adversarial* (emphasis added) with respect to the engagement partner" (Jamal et al. 1995, p. 6). It is unclear whether the alternative levels of interaction evidenced across concurring partner review roles will impact decision making, problem solving, and the outcome of the concurring partner review process.

For example, consider a case where an audit client has a material and unusual source of revenue and the appropriate revenue recognition process is not clear. The concurring partner, whether assuming a consultative, advisory, or investigative role, must aid in the resolution and/or evaluate the solution ultimately chosen. To be successful, the concurring partner must generate possible solutions that are acceptable under GAAP and acceptable to the client. To generate such solutions the concurring partner must access considerable technical knowledge and must engage in appropriate creative thinking.

There are many possible impediments to the effective performance of the concurring partner in this case. For example, the creativity of a concurring partner may be inhibited by the revenue recognition solution already suggested by the engagement partner. The inability to generate creative solutions in this situation is related to a psychological phenomenon, output interference, which has been the subject of considerable research in both psychology and auditing. "Output interference is a psychological concept that implies that whatever is thought about first interferes with, and thus inhibits, later thoughts about an issue" (Moser 1989, p. 433). This paper explores the notion that the level and type of interaction between the engagement partner and the concurring partner may impact

both the decision making process and the final decision made by the concurring partner. One purpose of this paper is to review the literature on output interference in order to draw implications for the practice of concurring partner review and to suggest future research.

Another possible complicating factor in the process of concurring partner review is the client-auditor relationship. Findings from the "framing effects" literature provide insight regarding the impact that alternative client-auditor relationships may have on the process of concurring partner review. A framing effect "is the induction of differential response through the use of particular forms of a given question or issue" (Bedard and Graham 1994, p. 79). The client-auditor relationship may be perceived in a variety of ways by the concurring partner. For example, an audit client may possess one of a variety of "red flags" (e.g., a risky industry, declining liquidity, a management team that is uncooperative with the audit firm) that cause the concurring partner to view the client in a negative light. Alternatively, the client may be viewed in a positive light due to a variety of other factors. The framing effects literature suggests that the concurring partner may approach the review process differently depending on whether the client is viewed in a positive or a negative light. A second purpose of this paper is to review the framing effects literature in order to provide implications for practice and to suggest avenues for future research in the area of concurring partner review.

A third purpose of the paper is to explore the possible interactive effects of output interference and framing effects for situations in which they might jointly occur. For example, there could be an interactive effect between the engagement partner-concurring partner relationship and the nature of the client-auditor relationship. These interactive effects could mitigate or compound the impact of one or both of the effects. However, no research exists that addresses these possible interactive effects. Thus, this paper provides direction for future research.

The remainder of this paper is organized as follows. The next section describes a variety of research questions and related background literature. A third section describes an exploratory study using verbal protocol analysis that illustrates the issues discussed in the second section. A final section concludes the paper and proposes possible extensions.

RESEARCH QUESTIONS AND BACKGROUND LITERATURE

Output Interference Research

Research Question 1: Will the concurring partner's knowledge of the engagement partner's proposed solution induce output interference as evidenced by a reduced number of alternative solutions proposed by the concurring partner?

In an auditing context, output interference can occur as the engagement partner and concurring partner interact to propose possible accounting treatments for complex revenue recognition or inventory valuation issues. A plausible solution for the issue suggested by the engagement partner may limit additional independent thoughts by the concurring partner, especially in the current audit environment that stresses engagement efficiency.

Slamecka (1968) first reported output interference in a study utilizing part-list cueing. Participants who received a subset of cue words from a previously viewed list were able to recall significantly fewer critical items (items on the original list that were not used as cues) than those participants who were not given the subset of cue words. Slamecka (1968) found that cue words interfered with the ability of participants to recall critical items from the original list.

Raaijmakers and Shiffrin (1981) further explored output interference using the part-list cueing methodology and have proposed the Search of Associative Memory theory (SAM) to explain the cognitive processes underlying output interference. SAM predicts that retrieval from memory is achieved through associations between images stored in memory. Inferior performance by the cued participants is predicted by SAM because cued participants are forced (via the cues) to consider the randomly selected cue words as they sample the associated images in memory. As such, SAM predicts that they will recall/retrieve more items associated with the random list and fewer critical items (Raaijmakers and Shiffrin 1981).

To relate the predictions of SAM to the concurring partner review process, consider the following example. An engagement partner encounters a complex inventory valuation issue and, after careful consideration, reaches a tentative but plausible conclusion as to the manner in which the issue might be accounted for. The engagement partner then consults with the concurring partner[1] and informs him of the issue and the proposed treatment (the introduction of the part-list cueing effect)[2]. According to SAM, the concurring partner will evaluate the proposed treatment by activating images in memory that are associated with the type of treatment that the engagement partner suggested. That is, the SAM model assumes that the probability of retrieving associated memory images is increased and the probability of retrieving less directly associated images is simultaneously decreased. Accordingly, images of alternative accounting treatments for the revenue recognition issue may be neglected.

Two outcomes are possible in light of the existence of output interference. First, the solution/cue suggested by the engagement partner might be the "right" revenue recognition treatment, one that is theoretically sound and is deemed to be an "acceptable" solution to the problem. If the engagement partner provides the "right" accounting treatment, the concurring partner is expected, according to SAM, to concentrate on that treatment and to neglect the consideration of other treatments. If this situation were to occur, output interference would enable the audit services to be equally effective and more efficient than if no output interference had occurred.

However, in practice, a variety of solutions may be acceptable. As such, another view of effectiveness may be that of the ability to creatively generate a variety of possible solutions. In a

[1] This scenario assumes a consultative or advisory role, rather than an investigative role, for the concurring partner.

[2] While this cue is, admittedly, not randomly selected it is an approximation of the assumptions of the part-list cueing paradigm.

competitive audit environment, an effective auditing firm will offer services that enable a client to achieve the accounting treatment that they desire while still adhering to GAAP. For instance, a revenue recognition issue may have a different potential solution if some part of the sales contract is modified slightly. An effective audit service would provide advice to the client concerning acceptable means to achieve their financial reporting objectives. If this definition of effectiveness is accepted, then output interference may be viewed as decreasing audit effectiveness even if the engagement partner suggests the "right" solution. Efficiency would be gained in the scenario where the critical cue and the cue provided are equivalent because the concurring partner would have achieved the correct solution with a minimum of cognitive effort/time expended.

The second outcome that may occur due to output interference is that the engagement partner may not suggest the "right" accounting treatment. In this scenario, the solution/cue provided by the engagement partner is anticipated to cause the concurring partner to concentrate on that solution and to neglect consideration of other alternatives. In this case, output interference would cause the audit services provided to be ineffective, but the service may still be evaluated as superficially efficient. The decision process may be viewed by the auditors as efficient because the engagement partner's suggestion saved time for the concurring partner. The decision process is really only superficially efficient because the sub optimal decision may cause later repercussions such as the loss of the client. The effects of this superficial efficiency may be downplayed by auditors due to the low level of feedback commonly found in auditing settings.

Several studies have examined output interference in accounting contexts (cf. Anderson et al. 1992; Church and Schneider 1993; Frederick 1991; and Moser 1989). Frederick (1991) studied output interference by utilizing both free recall and part-list cueing methodologies. Participants were provided a list of internal controls that they later recalled. Consistent with output interference, Frederick (1991) found that "providing subjects with a portion of the controls was detrimental to the recall of the remaining controls" (p. 241).

Anderson et al. (1992) and Moser (1989) initiated output interference by requesting participants to list hypotheses for an event in a specific order. For example, in Moser (1989), participants generated supporting or opposing reasons that a company might attain a pre-specified earnings level. In Anderson et al. (1992), participants generated error or non-error explanations for a ratio change in analytical review. Output interference was demonstrated by the finding that the order in which the participants listed the hypotheses affected their ability to list items in the other category.

Church and Schneider (1993) presented participants with one of two possible inherited hypotheses regarding the cause of a fluctuation in a client's gross margin ratio; they inherited either a sales error or a purchases error hypothesis. Then, the participants were requested to identify potential causes for the change in the gross margin ratio. The findings demonstrated the impact of output interference since "auditors who inherited a superior's suggestion from a particular transaction cycle generated fewer additional hypotheses from the same transaction cycle than did auditors who were not provided with a superior's suggestion" (Church and Schneider 1993, p. 345).

Research Question 2: Will the alternative levels of engagement partner-concurring partner interaction evidenced across concurring partner review roles (e.g., consultative, advisory, investigative) impact the process and effectiveness of concurring partner review?

The following examples will serve to illustrate Research Question 2. Imagine that you are a concurring partner and that your firm advocates a consultative concurring partner review role. As such, you are actively involved with the engagement partner in the planning, conduct, and review of the audit engagement. Imagine further that the client has a complex revenue recognition issue that must be resolved. When discussing the issue with you, the engagement partner may adopt one of two approaches. First, the engagement partner may present the facts of the case and provide his opinion of how the issue should be addressed. Alternatively, the engagement partner may present the facts of the case and ask that you consider the issue independently before reaching a conclusion.

In the first case knowledge of the engagement partner's solution could interfere with your ability to think of alternatives, especially if the solution proposed seems reasonable. In the second case the opportunity for the engagement partner's solution to interfere with your ability to retrieve alternatives does not exist, making it more likely that you would propose a solution that the engagement partner had not previously considered.

Now imagine that your firm advocates an investigative concurring partner review role. This implies that you, the concurring partner, are to be independent and almost adversarial with respect to the engagement partner[3]. As such, you are to actively challenge and critically evaluate the revenue recognition issue decision made by the engagement partner. You have two choices in this situation. First, you could follow SEC recommendations and do a "cold" review whereby you reconstruct the decision alternatives considered by the engagement partner as documented in the workpapers. Second, the engagement partner could brief you on the alternatives considered and you could then evaluate the merits of the course of action chosen. In either situation, however, the information that you will receive is a description of the decision that has already been made by the engagement partner. As such, your ability to independently evaluate the solution chosen or to creatively generate alternative solutions may be diminished.

The examples above illustrate the potential interdependency that exists between the engagement partner and the concurring partner. Only in the consultative review case where the engagement partner chose not to immediately disclose his opinion was this interdependency in decision making eliminated[4]. Given the findings of this research, what types of answers might be anticipated for Research Questions 1 and 2? It appears that the interaction between the engagement partner and the concurring partner, whether this interaction occurs through joint problem solving or through indirect interaction via workpaper documentation, has the potential to significantly impact the process and outcome of concurring partner review.

The findings of the output interference literature suggest that the creative ability to generate additional solutions to complex audit issues may be impeded when a plausible solution to the issue is proposed before the decision maker has the opportunity to independently evaluate the issue. It is possible that since highly experienced partners are involved in the process they would not be subject to output interference. However, these effects have not been well documented in the concurring partner review setting.

Framing Effects Research

In addition to the potential difficulties imposed through the interaction of the engagement partner and the concurring partner, another complexity that may arise during the concurring partner review process is a consideration of factors related to the client-auditor relationship. For example, in resolving a complex audit issue, the client-auditor relationship may be one in which the client is amenable to suggestions made by the firm. Alternatively, a client may possess very strong opinions regarding the resolution of the issue. The process and outcome of the concurring partner review process may be impacted by these factors.

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[3] In fact, "the SEC has sanctioned concurring partners for relying on conversations with the engagement partner as to the adequacy of work performed (ASR #285) (and for) not examining audit working papers in detail (AAER #118)" (Jamal et al. 1995, p. 6).

[4] Note that this situation could also occur when the concurring partner assumes an advisory role. Since the advisory role is intermediate between the consultative and investigative roles, no example of it is provided.

Research Question 3: Will framing effects induced by differences in the client-auditor relationship impact the process and effectiveness of concurring partner review?

Suppose that you serve as the concurring partner for two audit clients that are relatively similar except in one respect. One client generally reacts positively to the firm's recommendations for resolving complex revenue recognition issues and is generally agreeable to suggestions for conservative financial treatments of such issues. The other client generally reacts negatively to the firm's recommendations and is not agreeable to suggestions for conservative financial treatments of such issues. This scenario suggests two additional related questions:

Research Question 3a: Will framing effects induced by differences in the client-auditor relationship impact the manner in which the financial statement analysis portion of concurring partner review is conducted?

Research Question 3b: Will framing effects induced by differences in the client-auditor relationship impact the proposed solutions that the concurring partner suggests to the client?

The example provided above is meant to illustrate the impact that perceived "red flags" or client risk factors may have on concurring partner review. The important point to note, however, is that although a client may be generally disagreeable to suggestions for conservative revenue recognition solutions, or may possess other risk factors, it does not necessarily follow that the client is, in fact, a client that may exhibit fraudulent financial reporting or is a client that should be approached any differently in terms of concurring partner review. The following research provides the theoretical linkages between perceived positive/negative connotations about the audit client and the behavior by the concurring partner.

Framing effects have traditionally been initiated by introducing a situation in either a positive or a negative light (Tversky and Kahneman 1981). In conducting analytical procedures, for example, an auditor may interpret financial signals differently for a client that routinely accepts the audit firm's suggestions for conservative accounting treatments (a positively framed client) than for a client that routinely rejects such treatments (a negatively framed client).

Tversky and Kahneman (1981) first demonstrated that the inclusion of seemingly insignificant wording changes with either a positive or negative connotation significantly impacts decision making. Decision makers react more strongly to negatively framed situations than to positively framed situations (Bedard and Graham 1994; Kida 1984; Levin et al. 1986; Trotman and Sng 1989; Tversky and Kahneman 1981). This property may be particularly salient in the auditing arena due to the high costs associated with rendering an inaccurate audit opinion (e.g., legal liability, decline in professional reputation) or of providing sub optimal advice to a client (e.g., client dissatisfaction or loss of the client). Frisch (1993) found that subjects who compared versions of an alternatively framed problem "believe that changing the 'frame' *significantly alters the situation* (emphasis added), and therefore that it is reasonable to make different choices in different frames" (Frisch 1993, p. 422). This finding has important implications for concurring partner review because it demonstrates that framing may influence the auditors' perceptions of the facts in an audit service engagement.

Kida (1984) and Trotman and Sng (1989) examined framing effects in the going-concern decision. Following a review of company information, participants listed and ranked information relevant to whether the firm would fail (the failure group) or remain viable (the viability group). In both studies, negative information was recalled to a greater extent than was positive information for both treatment groups. In addition, participants in the failure treatment groups recalled a greater percentage of negative information.

Bedard and Graham (1994) described framing effects that were detected during the development of Risk Advisor[sm]. The development of Risk Advisor[sm] involved the collection of data from auditors regarding their knowledge of the assessment of audit risk. To elicit this

knowledge from the auditors, the same questions were worded in a positive manner, in a negative manner, and in a combination of positive and negative wording to determine the most effective knowledge elicitation method. "Negative wording of the questions evoked a better recall of negative aspects (risks) of the client than did positive or neutral wording. Overall, the development team observed an improvement in the identification and integration of issues when the statement was negatively worded" (Bedard and Graham 1994, p. 79).

Johnson et al. (1991) explored the cognitive representations employed in a concurring partner review task with embedded framing effects. This study did not utilize the traditional positive/negative framing manipulation. Instead, participants analyzed cases in which a financial statement error was either intentional or unintentional on the part of management. The framing effect was created by the communication of management in the management representation letter. In the intentional error case, for example, management framed the description of the company as a "growth" company when the company was in fact engaged in fraudulent manipulation of the financial statements. Participants that detected the error developed a problem representation different from the representation that was initially suggested by the facts of the case and related the implications of each of the cues in combination.

The preceding studies indicate differential response due to alternatively framed information. However, these studies provide little evidence regarding the cognitive processes underlying the framing effect. Dunegan (1993) provides evidence regarding these processes. Dunegan (1993) examined the notion of framing in the context of capital expenditure decisions and found that negatively framed information induces "controlled cognitive processing" while positively framed information induces "automatic cognitive processing." Information processing occurs along a continuum of depth of cognitive processing ranging from automatic to controlled processing (Gioia and Poole 1984). Controlled cognitive processing is evidenced by detailed and comprehensive information processing and the utilization of information cues in combination. Automatic cognitive processing is less detailed and comprehensive and involves reduced utilization of information cues in combination (Dunegan 1993; Gioia and Poole 1984; Shiffrin and Schneider 1977a, b; and Wofford and Goodwin 1990).

The above discussion indicates that framing effects are likely to have some impact on concurring partner review. In addition, research findings in other decision contexts suggest that such framing effects will result in process and outcome differences in concurring partner review. More specifically, aspects of the client-auditor relationship that induce framing effects could result in different amounts of automatic or controlled processing. These processing differences could, in turn, affect the outcome of the concurring partner review process. On the other hand, the expertise of the partners involved in the process might mitigate these potential effects. Auditing firms need to be aware of these effects and research is needed to resolve the existence and/or extent of such effects.

A Comparison of Framing Effects Research and Output Interference Research

The research questions and related background literature addressed up to this point have explored the independent impact that the engagement partner-concurring partner relationship and the client-auditor relationship may have on concurring partner review. However, these relationships may have an interactive effect. The following section explores this possibility.

Research Question 4: What is the interactive nature of the engagement partner-concurring partner relationship and the client-auditor relationship?

Suppose that you are a concurring partner and that your firm advocates an investigative concurring partner review role. As demonstrated by the discussion of Research Question 1, you may be subject to output interference since the input to your decision process is determined by the opinions and actions of the engagement partner. Now consider the following two alternatives: (1) no "red flags" exist regarding this client or (2) one or more "red flags" exist. Might you, as a result

of the controlled cognitive processing initiated by negatively framed information in the "red flags" exist case, be better able to overcome the output interference associated with the engagement partner's conclusions regarding the client in general or the revenue recognition issue specifically? Stated more formally:

Research Question 4a: Will a negatively framed client-auditor relationship mitigate the potentially detrimental impact of the output interference initiated by the interaction of the engagement partner and concurring partner?

Framing effects and output interference share several similarities and differences. To understand the similarity between the two effects, consider the following definitions: (1) the interference effect "implies that whatever is thought about first interferes with, and thus inhibits, later thoughts about an issue" (Moser 1989, p. 433), and (2) framing effects occur in situations "in which seemingly inconsequential changes in the formulation of choice problems cause significant shifts of preference" (Tversky and Kahneman 1981, p. 457). For both cognitive factors, then, the initial problem representation is an important determinant of the subsequent cognitive reaction to that problem. In this sense, framing effects and output interference are quite similar.

The impact of these effects, however, differs. The results of output interference studies indicate that output interference results in the *inhibition* of certain thoughts. For example, by providing participants with a partial listing of internal controls, the recall of additional controls was inhibited in Frederick (1991).

The results of framing effect studies, however, report changes in the *emphasis* of thought due to the effect (positive or negative) that has been introduced. In Kida (1984), for example, participants were asked to decide if a company would ultimately fail (negative frame) or would ultimately remain viable (positive frame). Participants that received the negative frame recalled fewer positive facts about the client than did participants in the positive frame, but participants in both treatment groups recalled the same number of negative facts about the client. Thus, participants in the negative frame placed greater emphasis on the negative information and less emphasis on the positive information.

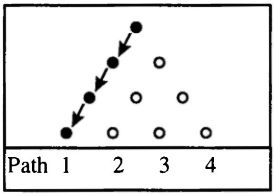
To illustrate the difference between the inhibition of thought due to output interference and the change in emphasis in thought due to framing effects, consider the following example. Suppose an auditor is conducting analytical procedures and notices unusual fluctuations in some accounts. A variety of interpretations of the financial cues are possible and alternative levels of analysis may be conducted to assess the fluctuations depending on a variety of client-specific characteristics.

Output interference implies that suggestions from other audit team members or management will inhibit the auditor from entertaining other explanations for the fluctuations (cf. Bedard et al. 1993; Libby 1985). As such, alternative lines of reasoning that might be indicated by the fluctuations may not be explored due to output interference. The framing effects literature indicates that positive or negative characteristics of the audit client will impact the emphasis of thought related to the fluctuations. The findings of Dunegan (1993) suggest that negatively framed information will cause the auditor to engage in relatively controlled processing with respect to the fluctuations while positively framed information will initiate relatively automatic processing.

Figure 1 provides a description of the independent and interactive impact of output interference and framing effects. The inhibition of thought due to output interference is portrayed by depicting a financial statement "fluctuation" knowledge representation where one line of reasoning is highlighted while other possible explanations for the fluctuation are inhibited due to the presence of output interference. The change in emphasis of thought due to framing effects is depicted using the same "fluctuation" knowledge representation. Here, the automatic cognitive processing induced by positively framed client information leads to a less than complete utilization of the "fluctuation" knowledge. The controlled cognitive processing induced by negatively framed client information, however, leads to a more thorough utilization of the "fluctuation" knowledge. A depiction of four possible interactive effects of output interference and framing effects are also provided in Figure 1.

Figure 1
The Interaction of Framing Effects and Output Interference

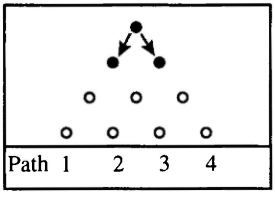
The Inhibition of Thought Due To Output Interference



Consideration of paths 2, 3 and 4 is inhibited.

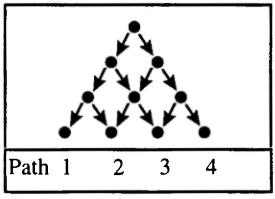
The Change in Emphasis of Thought Due To Framing Effects

Positive Frame



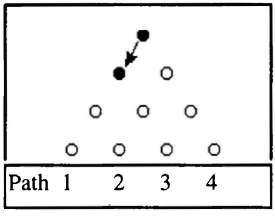
Less emphasis due to positive frame

Negative Frame

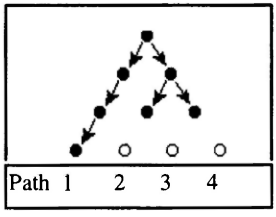


More emphasis due to negative frame

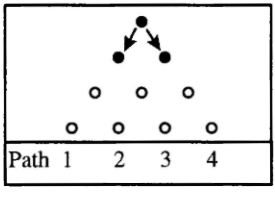
The Interaction of Framing Effects and Output Interference



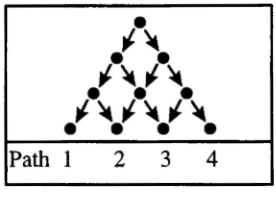
Positive Frame, Interference Present



Negative Frame, Interference Present



Positive Frame, Interference Absent



Negative Frame, Interference Absent

While no research yet exists to provide a definitive answer to Research Question 4, the implications of Figure 1 would indicate that affirmative answers to these questions may be supported by subsequent research. By initiating a deeper thought process that encompasses a broader range of lines of reasoning, (negative frame, interference absent diagram in Figure 1) a negatively framed client-auditor relationship may indeed mitigate the potentially detrimental impact of output interference.

VERBAL PROTOCOL ANALYSIS OF CONCURRING PARTNER REVIEW

Goals

The purpose of this section is to provide a preliminary application of the theories outlined above. The analysis described below addresses the research questions in the following manner. A scenario involving investigative concurring partner review was given to audit partners and their decision processes were analyzed according to the theory. Research Question 1 (regarding output interference) is addressed through the presence or absence of a solution proposed by the engagement partner. Because an investigative concurring partner review is used, Research Question 2 is not directly addressed but is left for future research. Research Question 3 (regarding framing effects) is addressed through manipulation of the client-auditor relationship. Research Question 4 (concerning the interactive effects of output interference and framing) is explored by examining the differential effects of framing in the presence of output interference.

Method

Experimental Task

Each participant performed a concurring partner review on one of four versions of a pre-tested case[5] that contained background information about a continuing audit client, comparative financial statements and selected ratios, and a description of a revenue recognition issue relating to a government contract. The experiment consisted of five phases. First, the framing effect manipulation was embedded within the introductory portion of the case. As such, all subsequent tasks in the experiment are presumed to be subject to the impact of framing effects. Second, all participants were told that the client in the case resolved the revenue recognition issue using a "straight-line" methodology. However, the specifics of the calculation were not disclosed.

[5] The case was developed from an actual audit client of a Big Six firm. The revenue recognition issue involved in the case was chosen because it was sufficiently complex to have warranted national consulting level analysis. The case was developed in conjunction with a partner of the firm and was pretested with two audit seniors and two doctoral students with prior public accounting experience.

Figure 2
Experimental Procedures

Stage	Description
1. Introduction/Framing Effect Manipulation	A description of the client was provided within an audit planning document required on all engagements at this particular firm. The framing manipulation was introduced at the beginning of this description as follows: "When complex accounting issues have arisen in the past, management has generally reacted positively (negatively) to our recommendations for resolving those issues. In addition, management has been (has not been) agreeable to our suggestions for conservative financial treatments of complex accounting issues".
2. Client Proposed Revenue Recognition Solution Presented	Still within the audit planning document, all partners were told that the client had tentatively recognized revenue related to the revenue recognition issue based on a "straight line" methodology. However, no numerical calculations were provided.
3. Financial Statement Analysis Task	A balance sheet, income statement, and selected financial ratios were presented next. Data from the two preceding years, as well as the projected and unaudited figures for the current year were provided. Partners were requested to respond to the following question: "What observations did you make and what questions did you raise during your review of Diamond's financial statements?". The same seeded error as that used in Bedard and Biggs (1991) was introduced into the data, as well as indications of an accounts receivable valuation problem.
4. Revenue Recognition Issue Description/ Output Interference Manipulation	Next, the revenue recognition issue was presented. All partners received contractual, firm-specific, and industry revenue and cost data. One-half of the partners received an inherited solution to the issue that was suggested by the engagement partner. The partners were asked to respond to the following question, "The engagement partner is considering alternative accounting treatments to determine the amount of revenue that should be recognized pursuant to this contract for the year ended December 31, 1994. We are interested in knowing how you think this issue could be handled. Please describe the plausible solutions that you have considered. Include numerical calculations".
5. Debriefing Task	Finally, several questions related to the task and the experience level of the partners were completed.

Figure 3
Experimental Design

Output Interference Manipulation:	Framing Effect Manipulation: Positive Frame	Framing Effect Manipulation: Negative Frame
Output Interference Present	Partner 1	Partner 3
Output Interference Absent	Partner 2	Partner 4

Third, participants reviewed financial statements and financial ratios. Fourth, participants completed the revenue recognition task. The output interference manipulation was embedded within this task. The manipulation was achieved by describing an inherited solution advocated by the engagement partner. As such, the impact of output interference can only be observed in the revenue recognition task. Finally, a debriefing questionnaire was completed. Figure 2 provides a summary of the experimental procedures.

Participants and Data Collection

Four audit partners from a Big Six firm, ranging in experience from 13 to 30 years, completed the case. All had acted as consultants on more than three complex revenue recognition issues in the past three years. Only one partner routinely dealt with audit clients with governmental contracts. That partner (Partner 2) estimated that 15% of his time was spent on such engagements. The experimental sessions were completed in a conference room or office at the participant's workplace and lasted approximately 60 - 90 minutes. Each partner's discussion of the case was collected in the form of think-aloud verbal protocols, adhering to the procedures recommended by Ericsson and Simon (1984).

Experimental Design

The experiment employed a 2 X 2 design. The two independent between-subjects variables were: inherited revenue recognition solution (*present, absent*) and client-auditor relationship (*positive, negative*). The dependent variables were performance on the financial analysis task and performance on the revenue recognition task. Figure 3 summarizes the experimental design.

Procedures

Analysis of protocols involved three stages. The first stage involved transcription of the taped verbalizations. The resulting verbal protocols were then analyzed in the second stage to identify episode abstracts. Episode abstracts summarize the verbal protocols into sequences of goal directed decision processes (Newell and Simon 1972). Two of the authors independently coded the protocols for the episode abstracts, achieving a coding agreement of 84 percent. All differences were reconciled and the resulting episode abstracts are included in Appendix A. The reconciled episode abstracts provide data with a measured amount of reliability which serve as the basis for the third stage of analysis. The third stage of analysis involved the classification of decision process types used and issues identified. The results of this analysis will be presented around the two tasks in the study, financial statement analysis and revenue recognition.

Results

The purpose of this section is to describe the results of an exploratory analysis of output interference and framing effects in the concurring partner review task. The research involved a verbal protocol analysis of the decision processes of four partners. Since the research involved a limited number of auditors, it is not intended to be a test of these theories. Rather, it is intended to be a detailed description of auditor decision processes and as a result provides insight into both the independent and interactive impact of output interference and framing effects in concurring partner review.

Financial Statement Analysis Task

The financial statement analysis task involved only framing effects (see Figure 2, Experimental Procedures). Specifically, those partners in the negative frame conditions (Partners 3 and 4) were expected to exhibit a higher degree of controlled processing than the partners in the positive frame conditions (Partners 1 and 2). To explore this prediction, the partners' episode abstracts were analyzed to identify the types of decision processes used and the cues examined related to critical issues in the case.

Types of Decision Processes. Based on Wofford and Goodwin (1990), three types of decision processes were identified. These included evaluation, causal and strategy processing. The Wofford and Goodwin theory suggests that these processes will be present to varying degrees depending on the level controlled processing induced by the framing effect. Evaluation processes were indicated by a judgmental statement about the case (e.g., "COGS is up" see Partner 4, Episode 3.2.). Causal processes were evidenced by the presence of an attribution (e.g., "COGS is up, **probably due to inflation**" see Partner 4, Episode 3.2.1). Strategy processes were indicated by statements about future occurrences or audit implications of some aspect of the case (e.g. "Net income is high, **Risky because of public offering**" see Partner 3, Episode 1.1.1.). The absolute number of each of these processes, as well as their relative percentages, are shown Table 1. Two of the authors independently coded the protocols for the types of processing and achieved a coding agreement of 87 percent.

Table 1
Financial Statement Analysis Task - Summary of Process Results

Type of Processing	Partner 1* (Positive Frame)		Partner 2 (Positive Frame)		Partner 3 (Negative Frame)		Partner 4 (Negative Frame)	
Evaluation Statements	18	74%	38	68%	15	54%	26	57%
Causal Statements	3	13%	9	16%	2	7%	3	7%
Strategy Statements	3	13%	9	16%	11	39%	17	36%
Total Statements	24	100%	56	100%	28	100%	46	100%

*Results are reported as the raw number and as the percentage of the total number of processing items.

Strategy, causal and evaluation processing occur along a continuum ranging from higher to lower levels of controlled processing. The results are consistent with the theory. Partners 3 and 4 (negative frame) exhibited relatively higher levels of strategy processing, 36-39 percent of the total decision processes compared to 13-16 percent of the decision processes of Partners 1 and 2 (positive frame).

Cues Used During Issue Identification. There were three significant issues in the case: (1) a misallocation between SGA and inventory, (2) an accounts receivable valuation issue, and (3) an overall evaluation of the company's financial health. The episode abstracts were coded to determine the extent to which cues related to these financial statement issues were examined by each partner. Results of this analysis are shown in Table 2. As seen in the table, all four partners used some cues related to the three significant issues. This suggests that all partners had some minimal awareness of the three important issues. Moreover, there is no discernible difference in cue usage between partners in the positive and negative frames.

While overall cue usage did not differ between the positive and negative frames, it is possible that cue usage related to particular types of processing was different. The framing theory suggests that negatively framed partners should better identify the seeded error and should simultaneously engage in more controlled processing (i.e., strategy processing). Since Table 1 illustrated that partners in the negative frame proposed a greater percentage of strategy statements, the episode abstracts were analyzed further to identify the use of cues related to the seeded error within strategy processing episodes. Cues used within strategy processing episodes are depicted as check marks in Table 3. Because a single use of a cue is the critical determinant for issue identification, multiple uses of a single cue may distort the analysis. Thus, even though a cue may have been mentioned several times, it is simply denoted as a single check mark.

Table 2
Financial Statement Analysis Task - Summary of Issue Identification Results

Issue 1: Seeded Error	Partner 1* (Positive Frame)	Partner 2 (Positive Frame)	Partner 3 (Negative Frame)	Partner 4 (Negative Frame)
Account Name:				
Sales	3	5	1	1
COGS	1		2	2
Gross Margin		1		1
SGA	1	5	3	3
Income Before Tax		1		
Net Income	1		1	1
Inventory	1	3	1	2
Gross Margin%	1			
IBT/Sales				1
NI/Sales			1	1
Inv. Turnover	1	2	1	1
Total	9	17	10	13
Issue 2: Accounts Receivable Valuation				
Account Name:				
A/R	7	3	2	3
Allowance	1	1	2	2
A/R Turnover	1	1		1
Total	9	5	4	6
Issue 3: General Evaluation				
Liquidity:				
Cash		2	1	1
Current Ratio	1	2		1
Quick Ratio	1			
Capital Structure:		1		
Current Liab.				1
LT Debt			2	1
Equity		1		
Total	2	6	3	4

*Results are reported as the raw number of times an account name was mentioned by the auditor.

Table 3
Seeded Error Cues Used During Strategy Processing

Issue 1: Seeded Error Cue	Partner 1* (Positive Frame)	Partner 2 (Positive Frame)	Partner 3 (Negative Frame)	Partner 4 (Negative Frame)
Account Name:				
Sales	√	√	√	√
COGS			√	√
Gross Margin		√		√
SGA		√	√	√
Income Before Tax				
Net Income			√	√
Inventory		√	√	√
Gross Margin%				
IBT/Sales				√
NI/Sales				√
Inv. Turnover		√	√	√
Total	1	5	6	9

Several conclusions may be drawn from Table 3. Both negatively framed partners (Partners 3 and 4) exhibited the most controlled processing as evidenced by the number of cues used during the strategy episodes. Partner 3 used fewer cues in strategy processing than Partner 4, but the effects of the negative frame are illustrated best by analyzing the content of the episodes. Particularly, it is interesting to contrast Partner 3 and Partner 1 in this regard, using Table 3 and the episode abstracts in Appendix A. Partner 3 immediately recognized a potentially overstated net income and sought to evaluate its possible causes (see Partner 3, Episode 1). This partner's analysis seemed to be driven by a realization of increased risk from the impending public offering. The analysis was quite detailed and resulted in the conclusion that the primary cause of income overstatement was an understated SGA expense. On the other hand, Partner 1 (who used one seeded error cue in strategy statements) had a very superficial analysis of the seeded error and did not mention the increased risk of overstated income associated with an impending public offering. In fact, the understated SGA expense was only identified at the very end of the decision process of Partner 1 (see Partner 1, Episode 3.4.1.).

The other partner in the positive frame, Partner 2, did not use any net income cues in strategy processing. About half way through the decision process, Partner 2 (Episode 2.4.) mentioned that income had increased, but tied that increase to the possible curtailing of discretionary expenditures by the client rather than relating the changes in income to risk factors as did Partner 3. Thus, while these results need to be corroborated by further research, the decision processes of these four partners suggests that negative framing affects the conduct of financial statement analysis.

Revenue Recognition Task

The revenue recognition task involved both framing effects and output interference (see Figure 3, Experimental Design). Specifically, those partners who received the output interference manipulation (Partners 1 and 3) were expected to generate fewer independent solutions to the revenue recognition issue than those partners who did not receive the output interference manipulation (Partners 2 and 4). In addition, the impact of framing effects (via enhanced levels of controlled processing) was expected to mitigate output interference. As such, Partner 3 was expected to generate more independent solutions than Partner 1. To explore these predictions, the

partners' episode abstracts were analyzed to identify the major decision episodes and to determine the number of solutions generated by each partner.

Decision Episodes. Each partner began the revenue recognition task by evaluating the contract details. Next, the partners engaged in one or more of the following behaviors: (1) the generation of an independent solution, (2) an evaluation of the client's proposed solution, (3) an evaluation of the engagement partner's solution for partners in the output interference present conditions, (4) the comparison of alternative solutions, and (5) the rejection of the client's proposed solution. Flowcharts showing the major decision episodes are shown in Figure 4.

The major observation related to Figure 4 involves the fact that the two positively framed partners (Partners 1 and 2) did not reject the client proposed solution whereas the two negatively framed partners (Partners 3 and 4) did reject that solution. It is interesting to note that Partners 3 and 4 both rejected the client's straight-line method based on concerns about the matching of revenue and expenses. This concern about overstatement of income may reflect the more critical analysis associated with controlled, strategy processing.

Decision Outcome. In addition to analyzing the variations in decision processing, a determination was made regarding the number of solutions generated by each partner. Comparing the numerical outcomes in such a small sample study is intended only to provide exploratory descriptive evidence of the independent and interactive impact of framing and output interference. Credit was given for independently generated solutions as well as for the numerical calculation of the solution proposed by the client. Recall that a qualitative description of the client's proposed "straight-line" approach was provided to all partners. However, Partner 1 did not attempt to review the client's suggestion or to calculate the numerical implications of such a solution. As such, Partners 2, 3, and 4 received credit for making such an analysis.

As seen in Figure 4, Partner 1 (positive frame, output interference present) generated only one solution. Partners 2 (positive frame, output interference absent) and 3 (negative frame, output interference present) each generated two solutions. Partner 4 (negative frame, output interference absent) generated three solutions. These outcomes are supportive of the predictions of framing effects and output interference theories.

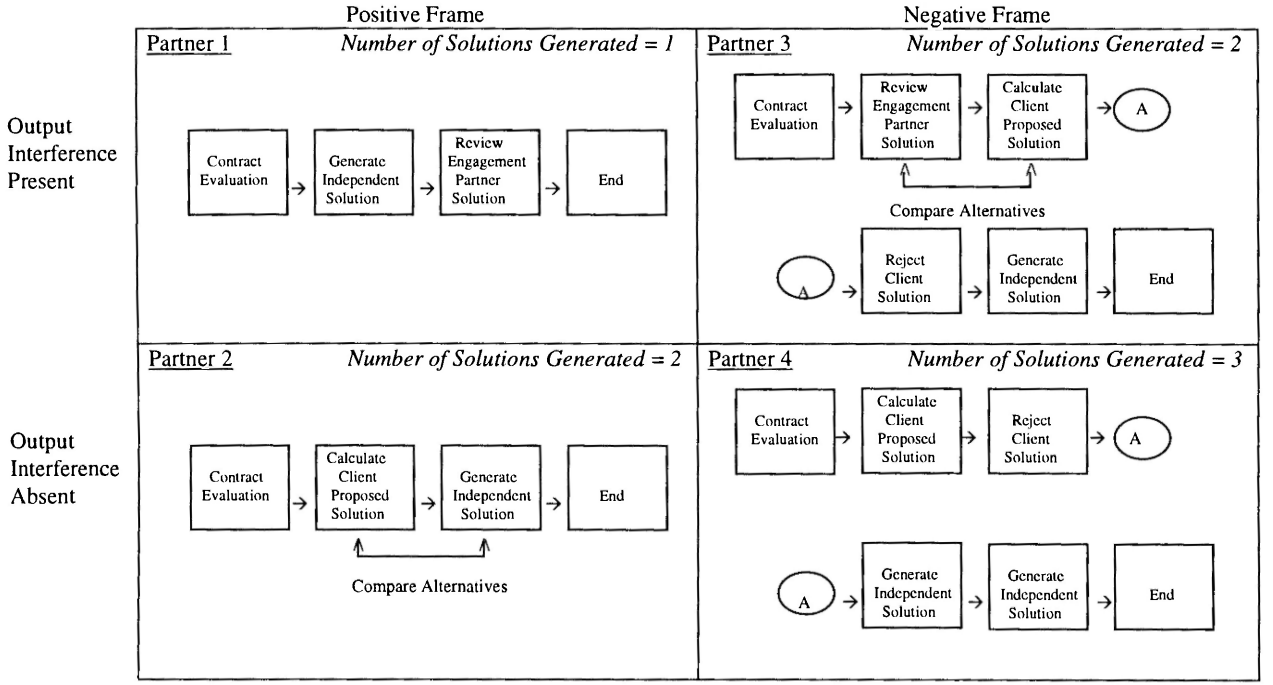
The impact of output interference may be judged by comparing the combined outcomes of Partners 1 and 3 versus Partners 2 and 4. Partners 1 and 3 combined generated three solutions whereas Partners 2 and 4 combined generated five solutions. As such, partners receiving the output interference manipulation generated fewer additional independent solutions. The mitigating impact of framing effects is demonstrated by comparing the performance of Partners 1 and 3, since they both received the output interference manipulation but they differed in terms of the framing manipulation. Partner 3 generated one more solution than Partner 1, providing support for the proposed interactive impact of framing effects and output interference.

CONCLUSIONS AND FUTURE RESEARCH

The purpose of this study is to initiate discussion regarding the cognitive factors that may impact the process and performance of concurring partner review. Specifically, research questions are posited that relate to the impact of framing effects, output interference, and the interactive impact of these two judgment effects in a concurring partner review context. An exploratory verbal protocol analysis was conducted to illustrate these effects.

By understanding the impact of framing effects and output interference, implications for the practice of concurring partner review may be drawn. First, there is currently uncertainty in audit practice regarding the "level of responsibility and scope of the work to be performed by the concurring partner" (Jamal et al. 1995, p. 1). The findings of this paper provide input to the resolution of this uncertainty. For example, the output interference literature predicts, and our results suggest, that concurring partners who receive an inherited solution to a revenue recognition issue generate fewer additional independent solutions to that issue. Thus, the availability of potential

Figure 4
Revenue Recognition Task - Summary of Results



solutions from engagement partners may inhibit full consideration of alternatives during concurring partner review.

Second, in cases where the concurring partner assumes a consultative role, the close working relationship between the engagement partner and the concurring partner may cause output interference to be particularly difficult to avoid. While the current study did not directly address this issue, it may be a fruitful avenue for future research.

Third, this paper proposes and examines process effects related to framing. Findings indicate that negative framing induces controlled processing, particularly with respect to the proposal of strategy statements and the utilization of cues within those statements. The initiation of a negative frame could be accomplished in audit practice by keeping knowledge regarding the client-auditor relationship from the concurring partner. While "no knowledge" is certainly not as negative as "negative knowledge", it may be sufficient to engender enough uncertainty in the mind of the concurring partner to attain some of the benefits associated with decision processing in negatively framed situations. Since concurring partners at local offices will have knowledge of the client-auditor relationship, the use of national consulting advice in the resolution of some concurring partner review issues may be appropriate.

Fourth, a previously unexplored avenue for future research relates to the potential interactive impact of framing and output interference. Since negatively framed information appears to evoke better recall of the risk factors of a client and improve the identification and integration of audit issues (Bedard and Graham 1994) through the initiation of more intensive levels of controlled cognitive processing (Dunegan 1993), this paper explores whether a decline in the impact of output interference may be predicted in situations where the client-auditor relationship is framed negatively. Some evidence supportive of an interactive effect was found. By exploring methods to initiate a negative frame for the concurring partner in actual audit practice, audit firms may mitigate the potential for the detrimental impact of output interference in situations where intensive engagement partner-concurring partner interaction is unavoidable.

Implications for practice are suggested based on literature related to output interference and framing. While most auditing research is conducted by academics, it is also possible for firms to conduct research into the effectiveness of various approaches to concurring partner reviews and other audit issues. For example, firms could experiment with the idea of output interference by allowing some concurring partners to be aware of suggested solutions proposed by engagement partners while in other situations the concurring partner would not be aware of such suggested solutions. In this way firms could begin to understand which situations lead to more or less effective concurring partner reviews. Similar research in audit practice is reported in Bedard and Graham (1994). On the other hand, the research questions posed in this paper could also lead to additional research conducted in academic settings. For example, see Johnstone et al. 1997).

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Appendix A
Episode Abstracts

Episode Analysis Partner 1: Financial Analysis Task

1. Information Acquisition and Problem Recognition: Balance Sheet and Income Statement
   - 1.1. How is the revenue recognition issue (Navy Contract) represented on the balance sheet?
     - 1.1.1. Reviews contract information in planning memo
     - 1.1.2. No important changes in assets except receivables
     - 1.1.3. Either it is not reflected in balance sheet or it is in receivables.
   - 1.2. Steady profitability
   - 1.3. Inventory is high in relation to COGS
   - 1.4. Receivables are out of line in relation to sales.
     - 1.4.1. We need to look at the revenue recognition policies
     - 1.4.2. Need to evaluate the collectibility of receivables
2. Information Acquisition and Problem Recognition: Ratio Analysis
   - 2.1. Current ratio is improving
     - 2.1.1 Probably due to increase in receivables
   - 2.2. Quick ratio is improving
     - 2.2.1 Probably due to increase in receivables
   - 2.3. Gross margin is steady
   - 2.4. There is a deterioration in receivable turnover
     - 2.4.1. Indicates a change in the relationship between receivables and sales
     - 2.4.2. Appears that some change in the business has occurred
3. Summary of Significant Observations and Issues
   - 3.1. A/Rec. out of line with sales
     - 3.1.1. Appears to be a significant deterioration in collections
     - 3.1.2. Aging has deteriorated but there hasn't been a change in the allowance
   - 3.2. Inventory turnover is a problem
   - 3.3. Accounting for Navy contract is an issue
   - 3.4. Review of Income Statement
     - 3.4.1. Significant decrease in SGA in terms of both historical and projected figures
     - 3.4.2. Interest expense is right on, as expected
     - 3.4.3. Provision for income tax is higher

Episode Analysis Partner 1: Revenue Recognition Task

4. Contract Evaluation
    - 4.1. Need to make sure contract is not in a loss situation
        - 4.1.1. Are historical numbers applicable to the present
            - 4.1.1.1. Need to look at current year costs
            - 4.1.1.2. Can't rely on past costs
            - 4.1.1.3. Need to determine if there are any unusual costs associated with the contract
                - 4.1.1.3.1 If so need to relate them to the contract
    - 4.2. Need information about contract payments
        - 4.2.1. Is there any uncertainty about collectibility
5. Mentions Cost Recovery Method as a Potential Solution
6. Review Underlying Assumptions of Engagement Partner's Approach
    - 6.1. Current approach uses historical costs and assumes a steady state
    - 6.2. An appropriate alternative should consider actual costs to date
    - 6.3. An assurance about contract profitability is needed
        - 6.3.1. Margins should be similar to historical margins
    - 6.4. If the margins are similar then current approach is acceptable
    - 6.5. If margins are not similar, a new method must be adopted.
7. Summary of Alternative Solutions
    - 7.1 Cost recovery method
        - 7.1.1. This method is appropriate if there is uncertainty about contract profitability (error - contract guarantees at least break even)
    - 7.2. Alternative Gross Margin Approach
        - 7.2.1. Base gross margin on actual 1994 costs and projected 1995 costs
    - 7.3. Percentage of Completion Method (using cost-to-cost approach)

Episode Analysis Partner 2: Financial Analysis Task

1. Information Acquisition and Problem Recognition: Balance Sheet
   - 1.1. A lot of cash on hand now and historically
   - 1.2. Receivables have grown from year to year
   - 1.3. Allowance seems reasonable.
   - 1.4. Inventory has gone up
   - 1.5. There is a lot of PPE
     - 1.5.1. It is a capital intensive business
     - 1.5.2. $27 out of $38 million of assets is PPE
     - 1.5.3. Need to understand that
     - 1.5.4. But, it seems like a normal progression
   - 1.6. There is a reasonable amount of equity
     - 1.6.1. 30% equity
     - 1.6.2. Equity base is not made up of intangibles
     - 1.6.3. No imminent capital structure problems
   - 1.7. Balance sheet summary
     - 1.7.1. Relatively solid company
     - 1.7.2. They have working capital
     - 1.7.3. They have positive cash
     - 1.7.4. They have positive current ratio
2. Information Acquisition and Problem Recognition: Income Statement and Ratios
   - 2.1. Sales have not changed much
     - 2.1.1. That causes concern, given the increase in receivables
       - 2.1.1.1. Are there collectibility issues?
     - 2.1.2 Inventory didn't go up much
       - 2.1.2.1. There could be valuation issues
       - 2.1.2.2. They lost some on the margin but not too much
   - 2.2. Cut back on R&D expenses compared to projections
     - 2.2.1. It must have occurred during the fourth quarter
   - 2.3. Cut back on SGA also
   - 2.4. Looks like they are curtailing discretionary expenditures toward the end of the year.
     - 2.4.1. That is how they achieved the increase in IBT
   - 2.5. Calculate current and prior effective tax rates
     - 2.5.1. It went down a little from prior years
       - 2.5.1.1. Find out why it went down
       - 2.5.1.2. But, 40% is not too unreasonable.
   - 2.6. Inventory Turnover decreased
     - 2.6.1. Inventory up and sales are stable
   - 2.7. Receivable turnover had a significant decrease
     - 2.7.1. Valuation seems to be a concern
   - 2.8. SGA/Sales has gone down compared to last year
   - 2.9. R&D/Sales is also down from projected, but similar to prior years
   - 2.10. Hard to understand why SGA is down so much
3. Summary of Significant Observations and Issues
   - 3.1. Receivables
     - 3.1.1. Growth of receivables on flat sales
     - 3.1.2. May be a valuation problem
   - 3.2. Inventory
     - 3.2.1. Inventory turnover is down
     - 3.2.2. May be a valuation problem
   - 3.3. Discretionary spending
     - 3.3.1. Find out from management why projected from actual is so far off
   - 3.4. Tax rate is down
     - 3.4.1. 40% is not unusual
     - 3.4.2. but, they might be a bit aggressive on their effective rate this year

Episode Analysis Partner 2: Revenue Recognition Task

4. Contract Evaluation
   - 4.1. How does the average rate ($1,993) relate to the flight rate ($2,274) and ferry rate ($1,423)?
     - 4.1.1. It is not a direct average
   - 4.2. Minimum contract cost is about $800,000
   - 4.3. Evaluation of rental rate per hour
     - 4.3.1. The rental rate must cover all costs
     - 4.3.2. I don't see a profit element (error)
     - 4.3.3. I don't understand that
   - 4.4. At year end have used 144 hours of the 400 minimum contract hours
     - 4.4.1. That means they are 36% complete
   - 4.5. Gross margin evaluation
     - 4.5.1. They have earned a 42% gross margin on past contracts
     - 4.5.2. Revenue is $1,993/ hour and standard costs is $631/hour
     - 4.5.3. So there is a substantial profit in the contract (correction of error)
   - 4.6. Revisits question in Part 4.1. above
     - 4.6.1. The contract is weighted toward flight time since the average price ($1,993) is closer to the $2,274
   - 4.7. Revisits question in Part 4.3. above
     - 4.7.1. Does the rental rate per hour cover all costs?
       - 4.7.1.1. Isn't price significantly above costs?
       - 4.7.1.2. So, a loss contract is not an issue

5. Review of Client-Proposed Solution (Straight Line)
   - 5.1. Calculated as $800,000 divided by 12 months and multiply by 8 months for the current year
     - 5.1.1. Why didn't they just use the rate per hour in the contractual agreement?

6. Generate Alternative Solution Based on Contractual Rates
   - 6.1. 78 flight hours x $2,274/ hour = $177,000
   - 6.2. 66 ferry hours x $1,423/ hour = $94,000
   - 6.3. That gives $271,000 of revenue

7. Compare Solution Based on Contractual Rates versus Client Proposed Solution (straight line)
   - 7.1. The client would recognize $533,000 versus the $271,000 based on my method
   - 7.2. We need to discuss an adjustment or better understand the $262,000 difference between the methods

8. Evaluation of Client's Possible Rationale For Use of Straight Line Method
   - 8.1. The Navy will pay for not less than 400 hours
   - 8.2. Would like to see a budget for the hours expected on the project
     - 8.2.1. Was a budget made for the expected contracted hours?
       - 8.2.1.1. If yes, the client proposed straight line method is unacceptable because it does not match revenues and effort
     - 8.2.2. Perhaps there was no budget for expected contract hours made
       - 8.2.2.1. I'm still not sure that the straight line method best matches revenues and costs
   - 8.3. Is this contract like a take-or-pay contract?
     - 8.3.1. If all 400 hours are not used, the Navy still has to pay
       - 8.3.1.1. The minimum 400 hours is probably something anticipated to be easily attained and therefore should not come into play
   - 8.4. How does the ultimate cash payment come into play?
     - 8.4.1. The client gets payment at the end of the contract
     - 8.4.2. When should the difference between the revenue recognized and the cash payment be recognized
       - 8.4.2.1. Is it more acceptable to recognize it at the end?
       - 8.4.2.2. Or is it more acceptable to amortize it on a continuous basis over the 12 months of the contract?
       - 8.4.2.3. I don't know the answer to that

Episode Analysis Partner 3: Financial Analysis Task

1. Information Acquisition and Problem Recognition: Income Statement
   - 1.1. Net income is high
     - 1.1.1. Risky because of Public Offering
     - 1.1.2. Sales trend stable
     - 1.1.3. COGS under (error)
     - 1.1.4. SGA under
     - 1.1.5. Income taxes OK
     - 1.1.6. Review and understanding of high net income
       - 1.1.6.1. Any staff explanations?
         - 1.1.6.1.1. NO
       - 1.1.6.2. Ratio analysis
         - 1.1.6.2.1. NI/Sales is High
       - 1.1.6.3. Return to Income Statement
         - 1.1.6.3.1. Revenue recognition issues?
           - 1.1.6.3.1.1. Revenues stable
           - 1.1.6.3.1.2. Rev. rec. not problem
         - 1.1.6.3.2. Expenditures
           - 1.1.6.3.2.1. COGS is actually up (Corrects earlier error)
           - 1.1.6.3.2.2. So it is SGA
2. Information Acquisition and Problem Recognition: Balance Sheet
   - 2.1. Cash no problem
   - 2.2. Receivable allowance is low
     - 2.2.1. Allowance not keeping up with receivable growth
     - 2.2.2. Need to review aging
     - 2.2.3. Need to test receivables
   - 2.3. Inventory is high
     - 2.3.1. Inventory turnover has dropped
     - 2.3.2. Obsolescence problems?
     - 2.3.3. May simply be a timing problem.
   - 2.4. Evaluate remaining balance sheet items
     - 2.4.1. Examine restructured debt impact
     - 2.4.2. Examine income tax liability.
3. Summary of Significant Observations and Issues
   - 3.1. Investigate Receivable/Allowance Issue
   - 3.2. Investigate high inventory
   - 3.3. Investigate debt restructuring
   - 3.4 Investigate low SGA expense.

Episode Analysis Partner 3: Revenue Recognition Task

4. Contract Evaluation
    - 4.1. Flight operations and ferry time rates
    - 4.2. Minimum contract usage is 400 hours.
    - 4.3. What is the rental rate per hour?
        - 4.3.1. Rate must cover fixed and variable costs
            - 4.3.1.1. So it is a cost-plus contract.
    - 4.4. Time and usage
        - 4.4.1. Eight out of twelve months have past
        - 4.4.2. 144 out of 400 hours have been used
            - 4.4.2.1. But, they are guaranteed 400 hours
5. Review and Evaluate Engagement Partner Proposed Solution
    - 5.1. Review of numerical calculations and underlying assumptions
        - 5.1.1. use standard costs to determine gross margin
        - 5.1.2. use gross margin to determine revenue ($263,800)
    - 5.2. Evaluation of proposed solution
        - 5.2.1. Why use standard costs when we could be using actual costs?
6. Review of Client Proposed Solution
    - 6.1. How does the client propose to recognize revenue?
        - 6.1.1. Client proposes straight-line method.
        - 6.1.2. Numerical calculation of straight-line method ($531,000)
7. Compare Client and Partner Proposed Solutions
    - 7.1. Evaluation of standard cost assumptions of partner's proposed solution.
        - 7.1.1. Why not use actual costs?
        - 7.1.2. Actual costs could exceed revenue.
            - 7.1.2.1. Could be a net realizable value problem
            - 7.1.2.2. But, no indication of that here.
    - 7.2. Evaluation of revenue recognized under client's proposed solution
        - 7.2.1. There may a cost/revenue matching problem
            - 7.2.1.1. May cause overstatement of revenue in current year
8. Attempt to Generate Alternative Solutions
    - 8.1. Percentage of completion is mentioned, but is abandoned without further calculation
    - 8.2. Restates cost concerns
    - 8.3. Restates matching concerns
    - 8.4. Suggests that a compromise between client and partner solutions be adopted

Episode Analysis Partner 4: Financial Analysis Task

1. Information Acquisition and Problem Recognition: Balance Sheet
   - 1.1. Cash is down from prior years and projected
   - 1.2. Receivables are up
     - 1.2.1 See what explanation we have for that
   - 1.3. Allowance is almost flat only slightly higher than last year
     - 1.3.1. Although receivables are up about 30%
     - 1.3.2. Need to investigate why allowance isn't greater
   - 1.4. Inventories are up over prior years and projected
   - 1.5. Other current assets do not seem to be that significant
   - 1.6. PPE up over prior year but below projections
     - 1.6.1. Need to find about additions to PPE
     - 1.6.2. Not too concerned though
   - 1.7. Other assets are close to projections but below last year
   - 1.8. A/Pay. down from prior year but close to projection
     - 1.8.1. Seems to be in line.
   - 1.9. LTD is up
2. Information Acquisition and Problem Recognition: Ratio Analysis
   - 2.1. Current ratio is better than prior year and even with projections
     - 2.1.1. That is good
   - 2.2. Gross margins are down
     - 2.2.1. Have to find out what caused that
   - 2.3. IBT/S is up considerably from projected and last year.
     - 2.3.1. I'd like to find out what caused that
   - 2.4. NI/S is up from last year
     - 2.4.1. I'd like to find out what caused that
   - 2.5. Inventory Turnover is down
     - 2.5.1. Are there issues of slow moving or obsolete inventory.
   - 2.6. Receivable turnover has improved from projection but is down from last year.
     - 2.6.1. Doesn't make sense
     - 2.6.2. Have to look at that in terms of aging.
3. Information Acquisition and Problem Recognition: Income Statement
   - 3.1. Sales are flat with last year and even with projections
     - 3.1.1. Doesn't seem consistent with increase in inventory and receivables
     - 3.1.2. Have to look into that further
   - 3.2. COGS is up
     - 3.2.1. Probably due to inflation
     - 3.2.2. Have to look into that
   - 3.3. SGA is down considerably from projections and down from last year.
     - 3.3.1. Have to find out what caused that
   - 3.4. Interest expense
     - 3.4.1. Can easily investigate that because the rates didn't change much
   - 3.5. NI is up from projected and last year
     - 3.5.1. Probably due to SGA
     - 3.5.2. Have to find out what caused that
4. Summary of significant observations and issues
   - 4.1. Follow up on inventory
   - 4.2. Follow up on receivables and allowance
   - 4.3. Do more probing of SGA
   - 4.4. Do more probing of COGS

Episode Analysis Partner 4: Revenue Recognition Task

5. Contract Evaluation
   - 5.1. Contract total is $797,000
   - 5.2. Calculate implied gross margin
     - 5.2.1. Average rate ($1,993/hr.) less standard cost ($630/hr.) equals a gross margin of about $1,400.
     - 5.2.2. That is a significantly higher margin than for last year
6. Review of Client-Proposed Solution (Straight Line)
   - 6.1. Determines that straight line implies taking 2/3 of revenue this year.
     - 6.1.1. Could they recognize revenue even if flight time were zero?
     - 6.1.2. Straight line is not acceptable in terms of matching.
7. Generate Alternative Solution Based on Hourly Usage
   - 7.1. Actual hours x average rate (144 hours x $1,993/hour)
8. Generate Alternative Solution Based on Contractual Rates
   - 8.1. (78 flight hours x $2,274/ hour) + (66 ferry hours x $1,423/ hour)
   - 8.2. This method would more closely match revenues and expenses
   - 8.3. But, need to determine if the 78 hour and 66 hour relationship is valid for all 400 hours.
9. Review of Alternative Solutions
   - 9.1. Use of solution based on hourly usage (144 hours x $1,993) would probably be most appropriate

Discussant's comments on "Framing Effects and Output Interference in a Concurring Partner Review Context: Theory and Exploratory Analysis"

David Plumlee
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I find the paper to be an interesting look at a practice-relevant audit task: concurring partner review. The authors use a research method that I believe to be very appropriate to examine the concurring partner review. In addition, they combine two streams of judgment and decision-making research to provide a framework from which they predict partners' behavior in a review task The framework the authors develop combines research that deals with (1) decision framing, which examines the effects of how problems are posed to decision makers on the decision reached, and (2) research on the effects of a decision-maker being given a possible problem solution on his/her ability to retrieve other possible solutions from his/her memory.

This study is preliminary and exploratory. There are only four subjects; one in each of four experimental conditions. Thus, I do not comment on the results because there is not sufficient data on which to base any conclusions. Instead, I focus on the appropriateness of the framework and on how the constructs are operationalized in the study.

Importance of Describing Audit Practice

Audit research is, by its very nature, applied research. I believe strongly that good auditing research must examine issues that practicing auditors find relevant to what they do every day. Audit research and audit practice form a partnership where the practitioners face problems and dilemmas for which audit researchers can provide structure and fundamental understanding. Both parties must benefit from this partnership in order for it to survive.

An important role for audit researchers is to develop meaningful structures for problems found in practice. By carefully observing events in practice researchers can infer the existence of certain constructs and relationships that can serve as theory in predicting behavior or outcomes in new situations. Theories of auditing phenomena provide explanations that practicing auditors can use to solve practical problems. Thus, I feel that research like the authors' is essential for audit research to maintain its viability.

I think that a good model for this partnership exits between physicians and medical researchers. Physicians document the problems they face, and researchers bring to the partnership training in science and research methods that are beyond those of the typical physician. Certainly the analogy between medicine and auditing is not perfect. For example, audit researchers' lack of access to actual work papers has no parallel in medicine. Nonetheless, I find research into the task of concurring partner review certainly to be in the spirit of doing practice relevant research in auditing.

Is this Framing?

One stream of research that the authors integrate into their theoretical framework is known as "framing." The authors rely on a definition from Bedard and Graham (1994) which defines framing as "the induction of differential response through use of particular forms of a given question or issue." While the authors' operationalization of the framing construct is consistent with this definition, I do not believe it is consistent with the construct's origin in normative decision theory. Furthermore, I believe that the authors' framing manipulation confuses differential responses to

what are different problems with different responses to what is essentially the same problem. The latter is the definition that originators of the construct intended. I see the framing manipulation in this study as inducing different problems that differ not only psychologically, but, more importantly, economically.

Framing, as originally envisioned (Kahneman and Tversky, 1979; Tversky and Kahneman, 1986), occurs when positive and negative versions of the same decision problem, in terms of its probabilities and payoffs associated with different outcomes, induce decision makers to make different choices. Framing effects are violations of normative decision-making rules. For example, assume a decision maker faces the choice between $400 for sure and an even chance of winning either $500 or $300. Phrasing the decision as a potential loss results in a strong preference for the risky choice, while phrasing it as a potential gain results in an equally strong preference for the certain act. This phenomenon violates any rational choice model and its explanation constitutes part of an alternative, non-normative decision theory known as prospect theory (Kahneman and Tversky, 1979).

The two conditions in this study essentially present two different problems. The authors' "framing" manipulation incorporated statements in the case reviewed by the subjects about whether the management of the client firm "generally reacted positively (negatively) to our recommendations" and "has been (has not been) agreeable to our suggestions." I do not see this as the same decision problem simply couched in either positive or negative terms. Instead, the problem of an agreeable client who reacts positively to the auditor's suggestions is very different from the problem of a client who disagrees and reacts negatively to suggestions. Having different responses to different problems is not framing as Kahneman and Tversky envision it.

The important consequence of creating different problems through the authors' framing manipulation yet only viewing the problems as differing in their orientation (positive versus negative) is that important cognitive and economic differences between the problems (clients) are ignored. To predict how a partner's cognitive processing would be impacted by differently framed problems, the authors rely heavily on a study by Dunegan (1993). Dunegan includes as part of decision makers' cognitive processing their cognitive representation of the task environment. As I point out, the positive versus negative dimension is only one of the dimensions on which the authors' task conditions differ. In terms of cognitive processing, the mental representations of the auditors in the two conditions were likely to involve substantially different episodic and semantic elements. I suspect that referring to the manipulation only in terms of the positive and negative aspects masks a number of aspects of the partners' mental representations that would be very relevant to our understanding of the concurring partner review.

The differences in the economic nature of the two problems would certainly include the perceived risk and all the associated audit implications, such as the nature and amount of audit procedures required. Auditors' level of skepticism is heightened when the veracity of management's responses to auditors' inquiries is in doubt. Thus, I believe that the authors' framing manipulation actually induces two problem representations that differ on a rich set of dimensions rather than simply the same decision problem viewed as either positive or negative. Ignoring these other dimensions keeps us from seeing differences in problem representations that the manipulation actually induced.

It is not the case that I find the authors' framing manipulation uninteresting. My concern is that calling it framing implies a research motivation based on comparisons with normative theory, which is simply not the one incorporated in this study. In addition, this framing manipulation connects this study to a research literature that has little or nothing to do with what was done.

What is the Concurring Partner's Motivation?

The authors' second experimental manipulation involves providing the review partner with a solution to a revenue recognition problem proposed by the engagement partner. The proposed solution was intended to trigger output interference. Output interference is a result of one's inability to retrieve from memory items (alternative solutions) related to the item provided (proposed solution). In previous experiments where output interference was demonstrated (e.g., Moser, 1989) the subjects were instructed by the researchers to try to recall the related items. In this study, the subjects were not told to generate all the alternatives that they could, only to "describe the plausible solutions" that they had considered in response to the revenue recognition problem. So, we do not know whether they could have generated more alternative solutions. Thus, we cannot know whether output interference was induced by the proposed solutions.

I do not believe that the authors' manipulation produced output interference, nor can a very plausible alternative explanation for the results be refuted. While the two subjects who received the proposed solution from the engagement partner produced fewer alternative solutions, there is a very plausible alternative explanation for this result, which does not involve output interference. Instead, the subjects are likely to have performed as they would in practice where partners face enormous demands on their time. As a consequence of their limited time, partners work to be as efficient as possible. Thus, during a concurring partner review, partners react to the real economic incentives inherent in their environment and only pursue questions or solve problems that warrant the cost and effort. It is reasonable to ask what motivates a partner to question the engagement partner when there seems to be no reason to do so. Figure 4 of the authors' paper shows that all of the subjects generated independent solutions and a review of the episode abstracts in Appendix A shows that one of the subjects indicated that they could not think of alternatives. It seems that the uncooperative client scenario produced more processing, rather than output interference occurring.

Oversimplified Communication

The authors conclude that "the availability of potential solutions from engagement partners may inhibit full consideration of alternatives during concurring partner review." Yet their manipulation was a solution proposed by the engagement partner included in work papers reviewed by two of the four subjects. I think this oversimplifies the communication between engagement and concurring partners. There are many relevant issues that must be considered in any audit engagement, but only a few are critical to the ultimate conclusion reflected in the opinion. I suspect that the communication regarding those critical issues would be an involved dialog that might extend beyond the two partners. It seem likely that the issue in this case of the client's revenue recognition would have been sufficiently critical that a dialog would have occurred. And, that the discussion would have resulted in a number of alternatives being considered and examined. Research on group decision-making has shown that groups tend to generate more alternatives and that the correct answer is included in the set more often than when individuals consider the same problem. Given the oversimplified communication setting in this study, I think that it is inappropriate to conclude anything about how the communication between an engagement and a review partner should be altered.

Things Done Right!

As I said when I began my discussion of this study, it is the kind of study that audit researchers should conduct. It has some strengths that I encourage more audit researchers to employ in their research. Most importantly it begins with a question closely related to practice. By beginning with the task of concurring partner review, the research focus is on the practice of auditing and the tasks relevant to practice. Not only are relevant tasks important, so is the context in

which the task occurs in practice. While the authors only suggest researchable facets of the review context, such as the nature of the relationship between an engagement and a review partner, a fairly realistic context was provided for the review task. I believe that context is as important as the task in auditing research, and that the task/context interface should be the focus of future auditing research. One final aspect of the authors' research method that I commend is their use of subjects appropriate for the task. It is critical that the knowledge and experience of the subjects match the task they are given in order for the results to have any meaningful interpretation.

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Implementation and Acceptance of Expert Systems by Auditors

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OVERVIEW

Remarkably powerful computers are now widely available at a cost that enables auditors, in principle, to achieve increased efficiency and effectiveness in their work. It is certainly true that auditors can benefit from the same generic software tools as every other professional -- they can take advantage of any of several "office" suites consisting of word processing, spreadsheet, databases, presentation software, electronic mail, and so forth. The addition of a commercial package for flowcharting might well round out an adequate set of tools for auditors. Of course, mere *adequacy* is an uninteresting aspiration. What additional kinds of tools could provide additional leverage for the auditor? What impact will such tools have on the audit practice?

Technology tools can have wide ranging impacts on an organization, its staff, the work that they do, and how they do it. The benefits promised by the tools can be lost if the behavioral impacts resulting from the use of the software are ignored. Many theories exist relating to sources of resistance and implementation strategies to minimize resistance. McGowan (1986) catalogued many of these theories and discussed their application to audit technology.

This paper describes two tools developed at the Price Waterhouse World Firm Technology Centre in Menlo Park, California and their current and predicted impact on the audit practice. These tools are:

- Planet: an expert system for assessing risk and selecting audit procedures; and
- Comet: a model-based system for identifying key internal controls, documenting weaknesses, and making internal control recommendations.

Planet

Background

Planet is an expert system for audit planning: in particular, for risk identification and audit procedure selection. Based on an auditor's answers to a series of questions, it makes risk assessments for the particular audit engagement and automatically chooses a set of audit procedures to satisfy the identified risks. Planet provides detailed explanations using a graphical display for all conclusions reached. Planet also has user-friendly tools for reviewing and editing the audit plan so that any member of the audit team can understand why each procedure has been included in the audit plan.

The Planet Knowledge Base

Planet is an expert system in the traditional sense: it captures the accumulated knowledge of human experts in a narrow domain. Its knowledge base was built using input from the audit partners and managers on a wide variety of engagements from around the world. The knowledge is represented by over 5000 logical axioms which are similar to if-then rules. These rules represent the

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relationships among risks, errors that could occur and procedures to gain assurance that errors have not occurred.

PWWF chose this style of expert system because audit planning is a highly studied task for which a relatively clear articulation of the problem already existed. The procedure selection problem had already been studied extensively by PWWF during the development of the software product, APEX 2.0 (Audit Planning Expediter). During the development of APEX 2.0, the relationships between standard types of audit procedures and the financial statement assertions (or their inverse -- errors) were assigned scores. Further, generalized rules were developed to score non-standard procedures. These generalized rules were used in the development of the Planet knowledge base and, in fact, are used by Planet when the auditor adds custom procedures.

Before developing Planet, it was necessary to determine whether a similar scoring process could be used for the risk side of the equation. Boritz and Wensley (1990) described a knowledge based system for audit planning which suggested that an expert system was well suited to the inherent risk assessment task. While the final structure of Planet's knowledge differs from the structure they describe, their work facilitated the early stages of the project.

Representing the risk assessment knowledge proved to be somewhat more complex than the procedure selection knowledge; however, a similar set of rules emerged for quantifying the relationships between risks and financial statement errors. This knowledge was acquired through an interactive prototyping process where auditors, under the observation of a knowledge engineer who had a thorough understanding of both auditing and the prototype, used a succession of prototypes to plan real audit engagements.

A Planet Session

During a Planet session, the auditor is asked a number of questions about the client under consideration. Which questions are asked varies dynamically, depending on the answers given to previous questions. The questions serve two basic purposes in Planet. The first, and main, role for the questions is to identify risk factors. Based on the answers to the questions, Planet identifies risk factors and considers the impact of the risk factors on the errors which could occur in the financial statements. Planet then accumulates these findings and infers an assessment of the risk that each of the relevant error types will occur. The secondary role that the questions play is to rule in, or rule out, certain error types, audit procedures and other questions from further consideration. In this way, we show the auditor only that information which directly relates to specific situations at his or her client.

Explanation Functions

A clear explanation trail is crucial for any expert system. This is particularly true for an expert system used in a highly judgmental domain such as auditing. The auditor can review Planet's risk assessments in detail at any point during or after the question and answer process. To facilitate this review, we show the risk assessments to the auditor using bar graphs. The size of the bar reflects the relative importance of each risk factor for each error type. To obtain additional information about why a particular risk is present, the auditor can "drill down" through the detail by clicking a mouse on the relevant error type, risk category, risk factor, or question in which he/she is interested. In this way, the auditor can see the logic behind every conclusion reached by Planet.

Procedure Selection

Once the auditor is satisfied that the risk assessments are complete and appropriate, he/she asks Planet to generate an audit plan. In a matter of seconds, Planet selects a set of audit procedures which will satisfy the risks identified during the question and answer portion of Planet. The algorithm uses a number of rules and heuristics to ensure that no error types are left with risk which is not satisfied by a procedure, and that each procedure in the plan is necessary. By "necessary" we mean that no procedure could be removed from the plan without exposing a risk. The auditor

reviews the plan and can question why each procedure has been included in the plan. In addition, the auditor can add and remove procedures from the plan and immediately see the effects of those changes.

These review tools are graphical in nature, and are also based on bar graphs. If the auditor clicks on a procedure he/she immediately sees a list of all the error types for which the procedure is providing assurance, and a "what if" analysis showing which error types would have exposed risk if he/she removed the procedure from the plan. Alternatively, the auditor can view a list of all the procedures which are providing assurance for any particular error type.

Following is an example of a "What If" screen from Planet. The auditor asked, "What if I removed the procedure 'Explain movements in monthly expense purchases' from the audit plan?" The left-hand side of the screen shows a list of all the errors for which this procedure provides assurance. Across from each error are bar graphs showing the risk, the assurance provided by the current plan and the assurance which will be provided if the procedure under consideration is removed. The gauges provide an additional visual cue to help the auditor pinpoint the most important effects.

Benefits

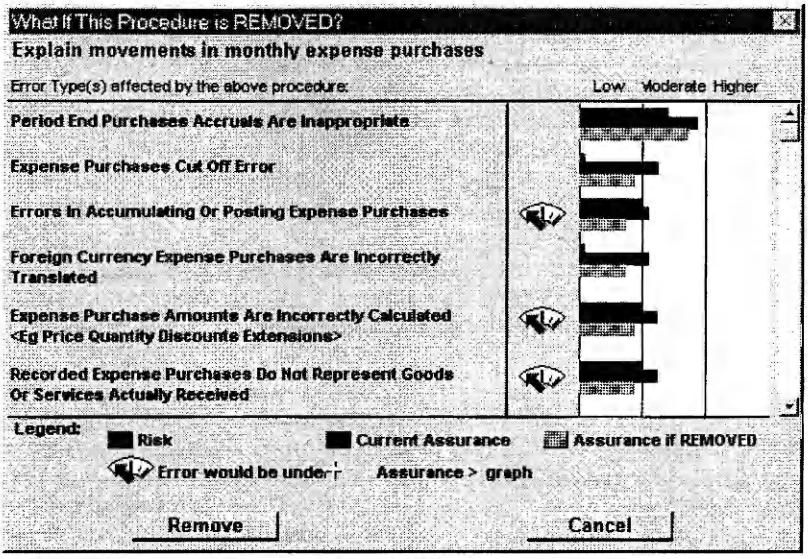
The potential benefits of Planet, *if* it is well accepted by the general population of Price Waterhouse auditors, are believed to be substantial. The auditor is efficiently guided through a comprehensive set of audit considerations and each element of the resulting plan represents the best practice as agreed upon by experts from Price Waterhouse firms worldwide.

Planet will keep track of the daunting level of detail that auditors might otherwise be able to consider only implicitly. Because of this added detail, the auditor can ensure each audit procedure is closely related to the identified risks. This will result in a more efficient and focused audit plan. Related to the increased detail is the ability to explicitly show the interrelationships between the assurance gained across the various components. With the ability to show the effects of this "cross-component satisfaction," the auditor can get the advantages of breaking the audit down into small manageable pieces, without losing the overall picture. In the course of extensive testing around the world, Planet has been documented as having achieved up to twenty-five percent reduction in audit hours without sacrificing effectiveness.

Besides the substantial benefit of increasing the efficiency of the audit plans, Planet also increases the efficiency of the audit planning process itself, because the procedure selection process has been automated. In addition, Planet provides better documentation of the planning process. Because audit planning is complex and judgmental, planning documentation typically contains only the results of decisions made and rarely includes evidence of the thought process behind those decisions. With Planet, all the relevant facts behind the planning decision are captured. This will aid in communicating the objectives of the audit plan to other members of the audit team.

Figure 1

Example of What if? screen in Planet



Impact and Acceptance

The benefits of new technology tools will not be realized to their fullest if the implementation of the tools is met with resistance. To minimize the risk that resistance would negate the benefits of this software, careful consideration was given to the effects that Planet might have on the firm's partners and staff. Following are some of the issues considered in this process.

Knowledge Rationalization and Amplification

Hirschhorn and Farquhar (1985) suggest that professionals (lawyers) will resist automation tools that rationalize knowledge, unless those tools also amplify knowledge and/or reduce the professional's need to rely on support staff. That is, they will resist something that makes their decision making more explicit, without either improving the quality of the decisions they make or the speed at which they can make them.

Planet does somewhat rationalize knowledge by making the decision making process more consistent and more explicit. However, we believe that Planet also amplifies the decision making process by enabling the auditor to plan the audit at a more detailed level, thereby freeing his/her time to focus on the most complex and important issues facing his/her client. In addition, Planet reduces the audit planner's need to rely on support staff. Because it is a very user-friendly system, and because an audit plan can be produced in a relatively short time (average 2 hours) there is a reduced need for word processors (secretaries) and paraprofessionals to prepare audit plans and programs.

Our belief that Planet will amplify the knowledge of the audit planner suggests, under the theories put forth by Hirschhorn and Farquhar, that the risk of user resistance is lowered. Nonetheless, it would be foolish not to take further steps to encourage acceptance. Because resistance to knowledge rationalization could mitigate the potential benefits of Planet, features were included to

help ensure the auditor will feel in control of the process. For example, although Planet has a standard order for the question and answer dialog, the auditor can alter the order in which the questions are asked. In addition, the auditor is given the opportunity to add "custom" risks and procedures to Planet which helps increase the auditor's feeling of ownership of the audit plan. Finally, because of the nature of auditing -- which many say is more of an art than a science -- the auditor must exercise his/her professional judgment simply to answer the questions. In other words, the rationalization has not been taken so far as to make the audit planning process a mundane or unskilled task.

Cultural Values

Auditing decisions are based largely on professional judgment. Even though guided by their education and training within the firm, auditors develop unique decision making styles. In addition, even if decisions are subsequently reviewed, auditors are accustomed to making relatively autonomous decisions. Since Planet rationalizes and amplifies this decision making process, it could potentially conflict with the traditional cultural values of the firm.

The structure of the knowledge in Planet, and the explanation trails available, were designed to minimize the risk of violating the cultural values of the firm. For example, the audit risk model is traditionally represented in multiplicative form. That is, AR = IR * CR * DR (audit risk equals inherent risk times control risk times detection risk), with each of the elements of this equation represented by percentages. It is extremely difficult to multiply several percentages together without an electronic aid (or at least a pencil and paper!). Thus, rather than show the risks as percentages, we express the risks as integers that are the logarithm to the base 0.9. As a result, the scores appear additive to the auditor, rather than multiplicative, and the auditors can easily understand and even verify the mathematics being performed by the system.

In addition to the features built into the system, the training and manuals which accompany Planet further enforce the idea that Planet is a tool -- not a replacement -- for the auditor. Great emphasis is placed on the judgments exercised by the auditor to use the tool well. This message is important, not only because it is true, but also because it re-enforces the cultural values intrinsic to the firm and the profession.

Job Content

Before the introduction of Planet, audit planning at Price Waterhouse was carried out as a two-step process: Strategic Planning and Detailed Planning. Strategic Planning, performed with the involvement of the audit partner, included risk assessment and a development of a high level expected audit approach for each major financial statement component. Detailed Planning, traditionally performed by audit seniors (sometimes with the assistance of more junior staff), included the selection of audit procedures within the guidelines specified by the Strategic Plan. The partner and manager then reviewed and approved the detailed plan before the commencement of the audit work.

Planet, in contrast, provides a "one-pass" audit planning process, eliminating the need for intermediate reviews. Thus, the job content of most levels of audit staff will be affected to some extent. These changes are congruent with other behavioral changes that are currently being implemented in the firm, notably an increased emphasis on team work. The one-pass planning aspect of Planet, as well as the interactive nature of the question and answer process, is conducive to this behavioral change. The early implementers of Planet have been encouraged to answer the questions in Planet as a team -- involving at least the audit manager, and preferably the partner as well.

Thus, in terms of job content, the technology is not the primary driver of the changes, but does complement the desired behavior. Change integration techniques are being used to ease the introduction of these new working arrangements.

Skills and Training

One possible outcome of the implementation of an expert system is the de-skilling of a process. Some have hypothesized that the introduction of expert systems will hamper learning because the "computer does it for you." Although this is a recognized risk, we believe that the opposite will be the true for Planet. Because of the knowledge rationalization, the planning decision processes will be more explicit. In this way, we believe that Planet will help rather than hamper the development of good audit judgment. In fact, it is envisioned that Planet will be used to teach auditing to new auditors.

Many of the early implementers of Planet have made comments such as, "It made me think about my client in more detail" and "It helped me understand how the entire plan fits together." Comments such as these are taken as encouragement that Planet will enhance auditors' understanding of the audit process -- rather than remove their need to understand it at all.

Current Status

Version 1.0 of Planet is being used by Price Waterhouse auditors in several countries around the world, largely in Australia and Europe. Version 1.2 will be released for broader use in May 1996.

Early users were not selected based on any particular affinity for technology or for a perceived receptivity toward new ideas. Nevertheless, they have been very enthusiastic about the system. When the pilot testing was conducted in 1994, 97% of the pilot testers were supportive of the software. This is perhaps the most enthusiastic response we have ever had to a new audit tool. This leads us to believe that our efforts to overcome the resistance problems have been successful.

COMET

Background

The evaluation of internal control systems is a very complex process. Control weaknesses often arise from interactions among many details which, when taken individually, are very simple. However, in modern accounting systems, determining the interactions between all the simple details can be complicated. To handle the complexity, auditors and others use a variety of tools such as flowcharts, verbal descriptions of systems, and/or checklists describing "typical" controls in a "typical" system. However, even given those tools, it is up to the human to mentally extract all the important results and recognize the weaknesses and redundancies in the system.

Comet is a model-based analysis tool for analyzing business processes and internal control systems. Potential applications of this technology include not only internal controls evaluation, but also re-engineering, systems development and audit planning. Potential users include internal and external auditors as well as designers of new business systems. Comet provides Price Waterhouse and its clients with a facility to build hierarchical, structured, textually annotated models of a system and to analyze the system based on that model. While the model building facilities alone are superior to the flowcharting tools presently available to the auditor, the real power of Comet is that it automatically provides the user with an evaluation of the system and its internal controls.

Model-Based Approach

Comet uses a branch of artificial intelligence called model-based reasoning for its analysis. A model, in this context, refers to a structured representation of a specific business system.

Model-based analysis has traditionally been applied largely in engineering, rather than financial, domains. The original premise for Comet was based on the notion that a computer information system (CIS), like any other process, can produce failures for which hypotheses can be constructed to suggest the cause of the failures. In fact, this is one strategy that auditors already use

to investigate errors discovered in financial systems -- formulating and testing various hypotheses about the cause of errors. Walter Hamscher, the lead researcher on Comet, had previously done work on model-based systems diagnosing faults in electronic circuit boards. He suggested that these same principles could be used to cover other types of complex systems, such as accounting systems.

A model-based approach was considered a good match to the problem of internal controls evaluation because the number of combinations of "typical" controls which might be present in a complex CIS is so large that any attempt to create a generic yet robust listing of the possible combinations quickly becomes ineffective. Comet assists auditors in answering questions like, "How many controls are adequate?", "Which controls are crucial?" and "Are any controls redundant?". While methodologies exist (both within the firm and in the profession at large) to answer questions like this in abstract terms, the application of these methodologies becomes highly subjective when applied to a specific system. As a result, the expertise required to analyze a complex accounting system is considerable and the quality of the outcome is highly variable. Comet's aim is to enhance the decision making ability of the experts and introduce some level of consistency in the decision making process.

Development of Comet

Accounting systems process accounting data through activities that create, use, alter, and store that data. While the variety of processes to perform these activities is perhaps infinite, each process can be broken down into a set of primitive processes or verbs. Comet's model building tools include a set of verbs which can be used describe how the data is created, used, altered and stored.

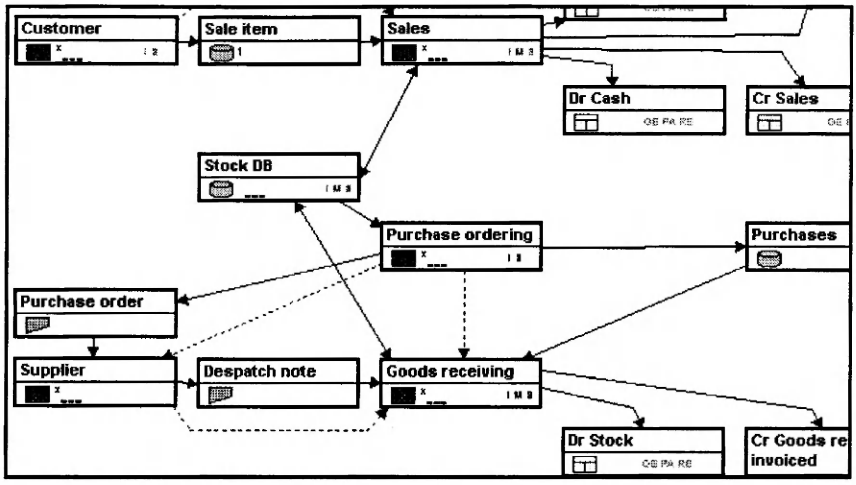
Planet and Comet exploit artificial intelligence techniques in very different ways. In Planet, most of the intelligence is hard-coded into the knowledge base and the "inference engine" (that is, how the system reaches decisions) is fairly simple. In contrast, the intelligence of Comet is incumbent on having a robust list of primitives which the auditor can use to accurately describe an accounting system, and the inference engine is quite complex. Thus, Comet's development was somewhat less dependent on knowledge acquisition and more dependent on building a user interface which could convey the results of the complex reasoning process in a way in which the auditors could understand.

Because of its reduced emphasis on knowledge acquisition, an early prototype of Comet was developed with little input from domain experts. Once this prototype was used to prove the concept, a partner and senior manager who are experts in analyzing complex computer systems were asked to use the prototype on some of their engagements. Their involvement resulted in a great expansion of the list of primitive verbs, common activities, and controls included in Comet. They, and other members of the Information Systems Risk Management (ISRM) practice used a succession of Comet prototypes on a wide variety of engagements ranging from relatively simple systems to highly complex ones in the financial services industry. The models created by these early implementers were sent back to the developers and used to refine and improve the modeling and analysis process.

The Modeling Process

Auditors can use traditional off-the-shelf flowcharting software to document the activities included in an accounting system. At first glance, Comet resembles off-the-shelf flowcharting software. There is a crucial difference, however, between traditional flowcharting software and Comet. Traditional flowcharting software produces only a picture. The documentation, if any, of what happens inside each activity is just text. It is up to the person examining the diagram to interpret the significance of how records are processed and to make conclusions about weaknesses in the system. In contrast, Comet uses the description of the processing steps to perform the analysis without further human intervention.

Figure 2
Section of a Comet model



To build a Comet model, the user begins by drawing a diagram of the various business activities in the system and the relationships between them -- much like traditional flowcharting. While diagramming the activities in Comet, the user describes the each process using a pre-defined set of verbs such as *transfer, copy, create, merge, find, compare, compute,* and *assign.* To facilitate the modeling of complex accounting systems, some common activities such as *maintain standing data,* and *data entry,* have been pre-defined for inclusion in a model. The user also includes controls in the descriptions of the activities. Again, these controls are described using a set of pre-defined verbs such as *authorize*, *match* and *reconcile.* The user can further describe each control by answering a set of three to seven yes/no questions about it. The answers to these questions help to assess the relative effectiveness of the controls.

Above is a snapshot of a portion of a Comet model. Processes are shown by rectangles. The dashed lines beside the rectangles indicate that the process can be expanded into further levels of detail.

There are many review and syntax checking tools included in Comet. These help to ensure that the model of the system is accurate and complete. For example, there are checks to ensure that every output described is created by a process in the model. In addition, the system checks that the types of inputs and outputs from a given process are consistent with the activity or verb used to describe the process.

Analysis of a Model

Once the system is described, Comet automatically determines a complete list of everything which could go wrong. Thus, the auditor need not hypothesize about possible problems -- Comet does that for him/her. Things that could go wrong are referred to as *failures.* The list of all failures is further refined to show only those failures which are significant. In the current version of Comet, which is being used by CIS auditors in an external audit context, a failure is considered significant if its downstream effects could cause an error in the financial statements. The system can also detect failures that generate operational type errors for an internal audit context.

Comet continues its analysis by determining the probability that each of the failures will be detected by the controls in the system. The auditor can input an allowable risk level to which the

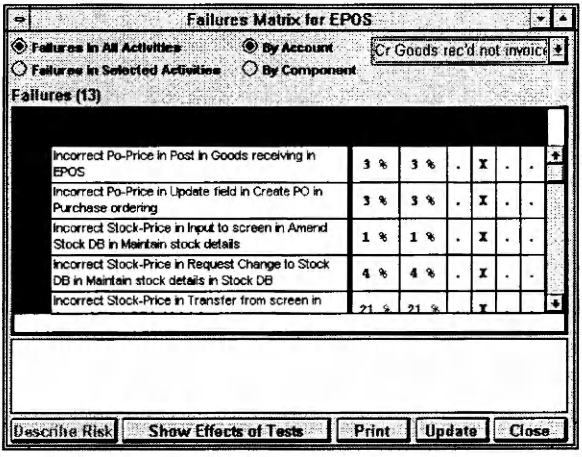
probability of detection is compared. Once the analysis is complete, the user can review, for each significant failure, a list of the controls that could detect it. Conversely, the auditor can, for each control, see a list of all the failures that it detects. Comet also produces, for each control, a list of all the failures that could defeat it (render it ineffective). For example, failures in the activities that relate to maintaining a password file can defeat any controls that rely on the integrity of the password file.

Having produced these lists, Comet can analyze the overall control system in a variety of ways:

- It can find the critical controls -- those controls most capable of detecting some significant failure, or the only ones capable of detecting a failure that defeats other critical controls.
- It can find control weaknesses -- any significant failure that is not detected by any strong control. For example, assume that a purchases and payables system does not compare the amount specified on a purchase order with the amount appearing on the invoice. A consequence of this weakness is that mistakes in computing the amount on the invoice would not be detected.
- It can find redundant controls -- controls, which, if not performed, would not significantly change the set of failures and their effects.
- It can generate a list of incompatible activities to support segregation of duties evaluations, based on the notion that the same person must not be allowed to perform both an action and the control that is supposed to detect failures in that action.

Below is an example of one of the results of a Comet analysis -- the Failures Matrix. This shows a list of failures that affect the account chosen at the top right-hand corner of the screen. For each of the failures, the analysis indicates whether the risk of the failure occurring has been sufficiently reduced given the controls described in the model. In addition, the impact of each failure on the financial statement assertions is shown -- e.g., Genuine, Proper Amount, Recorded, and Operational.

Figure 3
Failure Matrix from Comet



Benefits

The analysis performed by Comet can be extremely powerful. Many system control weaknesses are difficult for a human to recognize as they arise from the interaction of numerous individually simple details. Some CIS may be too complex for a single human to mentally extract all the important results. It would be a rare human indeed who could provide anything like the guarantee of logical correctness that Comet provides.

The main effect of a model-based approach to evaluating controls is that it can reduce uncertainties associated with relying on controls. These uncertainties can lead to either over-auditing or under-auditing. Comet and its associated methodology have the potential to favorably impact the audit practice in terms of audit efficiency, effectiveness, and client service. As is the case with Planet, though, the benefits of Comet will only be realized if the tool is broadly accepted within our practice.

Impact and Acceptance

Knowledge Rationalization and Amplification

The use of Comet will undoubtedly rationalize the internal control evaluation process. In fact, it will make the process explicit to a level not previously thought possible. Thus, unless the auditors using it believe that it considerably amplifies their knowledge, it may meet with resistance. To date, none of the potential resistance surfaced. In fact, quite the opposite has occurred. Early users are emphatic about their support for the software. Some initially disliked the rigor required to break each process down into primitive verb sets, but they eventually came to prefer the Comet approach because the act of building the model contributed to their understanding of the CIS. This fits in with Hirschhorn and Farquhar's theories. While Comet rationalizes the decision making process, it also greatly amplifies it, thereby making the decision makers more confident in their decisions.

While we have yet to prove with certainty that Comet helps auditors make decisions more quickly (because a considerable investment is required in order to build a Comet model), it seems clear that the decisions made are much better reasoned and supported than those which can be made without the aid of the tool. Because internal control evaluations often result in making recommendations for change, having a detailed rationale, or "proof' for the necessity of the change greatly increases the credibility of these recommendations. This, too, can be seen as an amplification of knowledge.

Cultural Values and Job Content

Peer reviews of our (and other firms') audit work frequently suggest that CIS auditing is underutilized. Despite numerous academic theories and research which show that reliance on systems of internal controls is an effective and efficient means of providing audit assurance, it appears that many practitioners still believe that substantive testing and analytical review techniques are better. Some auditors claim that their clients place little value on recommendations to improve CIS controls when their own eyes and business acumen (i.e., management and independent controls) suggest that system outputs are correct. As CIS become increasingly complex, it may also be the case that financial auditors do not completely understand the work performed by their computer audit counterparts and are uncomfortable relying on that work. Because Comet will greatly rationalize the internal control evaluation process, it should make it easier for computer auditors to explain results to general auditors and clients. This may raise the perceived value of their work and facilitate greater acceptance of CIS auditing.

Skills and Training

The skills required to analyze a complex CIS without Comet are considerable. The introduction of the software has not changed this. Early implementers of Comet required significant

training, as the quality of the analysis performed by the software is dependent on the accuracy and quality of the model the auditor has described. We expect that the amount of training required to use Comet will ultimately be the same as or less than the training required by ISRM auditors not using the tool. However, the focus will shift more toward accurately describing systems, less toward analyzing them for weaknesses or redundancies in controls..

This raises another important issue. Widespread use of Comet by ISRM staff may change the desired skill set of individuals recruited into and attracted to this area of the practice. There may be a greater need for logical and systematic thinkers, rather than on traditionally trained auditors. This change in skill sets, and in the type of individual attracted to this area, is congruent with other changes being made in Price Waterhouse -- particularly in the European firm, where Comet is most widely used. In the European practice, a clear separation of career paths is being defined between Systems Assurance (SA) auditors and Business Analysis (BA) auditors. SA auditors need not be professional accountants, and need not be on an "up or out" career path toward partnership. Thus, new recruits into the ISRM practice will more often have a background in computer science than accounting or auditing. This is congruent with the skill set required to use Comet effectively.

Current Status

To date, nearly half of the staff of the European ISRM practice has been trained in the use of Comet and are using it on dozens of client engagements. The remainder of the European ISRM practice will be trained in 1996. Comet is also being evaluated for use by the other large Price Waterhouse firms around the world.

SUMMARY

Planet and Comet represent a new generation of audit tools that leverage advanced technology and focus on audit-specific issues. They hold out the promise for dramatic increases in both auditor effectiveness and efficiency. Because these tools affect the way in which our professional staff make decisions, careful consideration of the behavioral impacts has been made. By recognizing and managing these risks, we believe that we have minimized resistance to the tools, thereby maximizing the benefits.

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