

**A Framework For Audit Automation:
Online Technology and the
Audit Process**

by

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Abstract

This paper discusses the impact of technology upon the audit process as well as the potential tasks in audit automation.

The auditing profession has been substantially affected by automation in corporate information processing. It must now introduce these same tools into its procedures to facilitate and make the process more economic. These imply in the use of tools such as computers, management science, online technology, communication networks and microcomputers. The use of automation tools leads to automation tasks such as standardized documentation, comparative analysis, scheduling automation, embedded audit routines, etc.

The audit *process* will be affected to the extent that location, timing, access, procedure, and working papers, among others, will be different. These will be influenced by introducing into the six major steps of the audit process revised processes of contract preparation, client investigation, analytical review, personnel scheduling, ICQ utilization, internal control evaluation, source document retrieval, etc.

Substantial investment and research on these issues is necessary over the next five years. Its performance (or lack thereof) will substantially shape the future corporate environment and the role of the auditor in society.

Introduction

This article looks at today's technology within the audit process. Initially it examines the state-of-the-art in auditing and its potential for automation. Additionally, audit tools and tasks are introduced and interrelated.

The second part examines the impact of automation upon the audit process. Different steps of the audit process are examined vis-a-vis online auditing and the automation of this task.

The conclusion proposes a series of research and implementation priorities to be considered and adapted by audit researchers and practitioners.

State-of-the-Art Auditing

The audit process is highly manual and labor intensive. Many procedures are ad-hoc based. Auditors often find themselves using manual methods to examine and comprehend highly technological accounting systems. This technological limitation of the audit process is a natural consequence of existing methods that survived experimental testing, legal testing and an environment highly resistant to change. Currently, computer audit techniques tend to be simply the computerization of manual audit methods instead of the product of a reanalysis and redesign of the entire audit process. In a few instances, however, new methods (e.g., embedded audit routines) have been implemented.

Designers of accounting systems, on the other hand, have used technology extensively to improve the reporting function. A large portion of the major US organizations use databases to store substantial amounts of accounting data. Accountants are concerned about the increasing use of data bases to the extent that they have set up a task force to examine its impact upon the audit process (AICPA, 1982). Another major development in the accounting environment is the advent of micro and minicomputers. The use of these computers decreases the potential of general controls and places greater emphasis on application-specific controls determining an environment diametrically opposed to the database. Finally, networks and communication links bring these two audit problems together into a more complex and exposure-rich environment.

The Need for Audit Automation

Manual audit processes cannot cope well within this increasingly complex environment. The AICPA recognized this fact, as the use of computer systems increased, requiring the SAS No. 3 preliminary review (AICPA, 1982). This review assesses the impact of computerization of the firm's systems and prescribes the necessary extent of audit review.

Secondly, cost escalation compounds the problems faced by auditors. The intrinsic profit margin of audit activities is decreasing due to the competitive environment in the profession.

Finally, advanced information systems require auditors to integrate technology into the audit process. For example, automatic cash tellers do not require the creation of a source document (to which auditors are accustomed). Auditors, therefore, tend to require the generation of a source document equivalent to captured data for audit trail purposes.

Some Potential Automation Tools

After many of the major audit firms experimented with application of specific softwares the development and use of generalized audit tools evolved. (See Will, 1972; Adams and Mullarkey, 1972). The integration of some audit sampling plans into these generalized softwares or the development of independent softwares for sampling purposes followed. These applications, despite being less widespread in accounting firms, are currently of common usage in many corporations.

In addition, some general descriptive statistics features are commonly part of these softwares. Typically these provide counts, means, standard deviations and strata of distinct population samples.

The third major audit aid is the use of regression analysis in the analytical review process. Delloite Haskins and Sells has recently publicized its STAR package which performs these functions.

A series of additional Operations Research/Management Science techniques exhibit potential for use in the audit process as well as in the management of the audit process. Dynamic programming was proposed for audit use. Linear programming can be used in the optimal engagement staffing (Summers, 1972; Balachandran and Steuer, 1982). Other operations research methods may be applied in various steps of the audit process.

Office automation techniques or automatic document retrieval may help alleviate the problems of document organization storage and retrieval. Recent working papers can be stored in an orderly fashion, while older documents can be microfiched and magnetically encoded for later retrieval. These systems permit entire sets of working papers to be cross-tabulated and integrated into master catalogs of audit data, precedents, industry comparisons and auditor tendencies.

Databases and database retrieval may serve as tools for analytical review. Auditors are able to examine, division by division, historical ratios that may not be available for examination in manual or file systems. In addition, auditors may develop audit sub-schema more directly connected to the attestation process.

Furthermore, substantial potential exists for the integration of interactive (online) technology into the audit process. The possibility of interactive audit program development, testing and implementation, as well as potential online data queries may be considered valuable ancillary audit tools.

Some Potential Automation Tasks, and Techniques

Preparation of Standardized Documents

Word processors compatible with mass storage devices exhibit increasing potential in the preparation of semi-repetitive type documents. A substantial part of the documents is repeated or selected from a finite set of paragraphs (wording). Such situations may occur in the preparation of audit bid proposals, engagement letters, contracts and confirmations. Internal audit departments may repeat similar audit workpapers for successive years or different areas using the same magnetically recorded working paper "skeleton" modules.

Comparative Analysis

In the analytical review process, the need to compare the organization with other firms and its industry may arise. This analysis can be facilitated by using financial accounting databases (e.g., COMPUSTAT or Value Line) as sources of comparative analysis. The scope may then expand from linear to multiple regression. The same data can also be used with financial ratio calculation or n cluster analysis.

Audit Scheduling Automation

One key problem area in the managing of large audit practices remains the assignment of staff (Vasarhelyi, 1981) to audit engagements. Typically this problem has two dimensions: (1) a long term assignment plan and, (2) a short

term engagement management plan. Intrinsic to the process is unplanned rescheduling (i.e. to increase or decrease the size of the audit staff in a particular engagement or to replace a particular staff member due to illness, incompatibility, turnover, etc.). The long term problem can be managed by corporate policies coupled with linear programming (Summers, 1972). The optimal staff can be assigned on a minicomputer using spread sheet software. The short term engagement management plan can be devised using the query/update mode of the same data base.

Internal Control Evaluation Automation

The evaluation of internal control design and compliance is manually performed by a set of Internal Control Questionnaires (ICQs). The system is evaluated in terms of the importance of internal control procedures and their combinations (see Vasarhelyi, 1981). The combination of procedures may assume a large number of variations which are better evaluated by electronic data processing. Once the adequacy of the internal control system is assessed, the issue of evaluating compliance arises. The assessment of compliance adequacy must be tied to the sampling process. This leads to the adoption of larger or smaller substantive samples.

Audit Planning Automation

Associated with the task of long (and short) term staff assignment is the evaluation of audit risk, analytical review, choice of audit effort assignment, timing of the audit and level of interim and year-end effort. Data processing integrates these processes into a homogeneous and court-defensible program. Once the prescribed steps are followed (and documented) through an interactive design of an audit plan, the plan follows the general firm guidelines, thus limiting discrepancies in audit quality.

In an internal audit practice, audit planning automation poses a different set of problems. The emphasis will be shifted from materiality subject examination of financial statements to reliance and quality of data at the diverse levels of search for evidence. Planning will be strongly associated to corporate growth and management strategy.

Self-Starting Audit Algorithms

The audit of online systems poses a new range of problems to the auditor which include: (1) operations with system-generated (as opposed to user-generated) source documents, (2) transactions flowing through highly integrated systems, (3) data stored and accessed in multiple data storage media, and (4) multiple simultaneous access by users. In the future these requirements may lead to substantially different audit procedures. They include passive devices that examine the flow of automated transactions and are ac-

tivated (self-started) by the event of a particular state-of-the-world (which may be the parameter(s) of a transaction(s), a random choice, or a systematic data collection heuristic).

The adoption of such a technique requires substantial changes in existing softwares and/or the integration in the data flow of audit/monitoring devices (hardware, software or firmware).

The automation tasks are restricted by the limitations of the individual auditor as an information processor. The audit process is often too detailed and complex for assimilation by an auditor. The multiple interrelationships are not entirely known. Many consequences of these interrelationships are counterintuitive and difficult to ascertain. In addition, the auditor must make a series of judgments concerning the adequacy of evidential matter that may exceed his/her human information processing capabilities (Libby, 1982).

The next section examines some of these issues and tasks in relation to changes to be effected on the audit process.

Automation and Audit Process Change

We shall assume that the objectives of auditing are fivefold:

- (1) To perform the attestation function.
- (2) To decrease the number of discrepancies between accounting records and real events.
- (3) To decrease the most of accounting operations through the benefits of control and scrutiny.
- (4) To increase the reliability of organizational controls.
- (5) To evaluate and improve the effectiveness of certain organizational sectors through operational auditing.

Intrinsic to the adoption of radically different technologies are modifications in the process of the activity being changed. We shall now examine some of the potential changes in the *process of an audit* that may ensue from online auditing. Studies in the integration of technology into management processes clearly indicate that, unless processes are changed, the full impact of technological change is not absorbed.

—Physical location of the auditor

The auditor, particularly in an EDP audit situation, will not be performing

work at the client's EDP site, but at the site of the client system (e.g. accounting), where source documents or their equivalents can be directly accessed. This will substantially increase auditor visibility and accountability as well as decrease communication and transportation delays.

—Time Required to Access Data

Auditors will be able to use random number generators when choosing the source documents to be examined and record the result of this access immediately. These results can be entered into a spread sheet working paper and algorithms can be run on the desirability and location of the additional sample. Online auditing and recording allows for the subsampling of different populations, and potentially, identifies sources of systematic discrepancies.

The use of an optical scanning device to read source documents can substantially reduce information recording and examination time. The use of voice recognition devices may further enhance this process.

—Audit Timing Issues

Currently, audits are planned at discrete time intervals and usually at announced dates. This results mainly from the problems of scheduling and logistics, with limited, if any, deterrent value. If client source documents are kept in computer readable code, discrete availability of time by auditors (such as a day) may be used for unannounced audits at the compliance and substantive levels.

—Treatment of Working Papers

Working papers currently follow general firm guidelines but vary substantially from office to office, engagement to engagement and year to year. These discrepancies increase the difficulties in peer review, staff integration and recall of events in a particular situation. The development of event databases to facilitate research (and to avoid rediscovering solutions) within firms is made very difficult by working paper variability.

Online technology will likely imply standardized work paper formatting and substantially increased indexing. Additionally, word processing softwares will be used for preparation and spelling checks as well as for standardized footnote comments; and, arithmetical and mathematical aids will ease footing and subtotalling tasks.

It is somewhat more difficult to assess changes in working paper techniques per se. However, a trend toward more voluminous documentation is expected. This would imply more extensive support of evidential matter and additional supporting schedules.

Cross-indexing (tying) of numbers in schedules will be substantially aided by computer-based search procedures that allow for finding relationships without considerable page flipping, colored pencils and various symbols. Of course, current technology also allows for multicolored displays and symbols but, most likely, the complexity and cost introduced by using these media will not compensate for its advantages.

Internal audit departments benefit from substantially less variability in working paper standards within the firm. On the other hand, substantial differences can be found from firm to firm. This may result in difficulties for the development of standardized working paper management systems. In consequence, for internal audit departments, working paper management systems should be highly modular and flexible allowing both corporate definition of working paper formats and easy interface with corporate databases and communication systems.

—Technological Dependence

Auditors currently depend on client computer availability for part of their audit work. However, they are mainly self-reliant and use manual methods. The evolution towards more advanced forms of audit will be dependent upon: (1) audit aid access, (2) communication lines, (3) database access and, above all, (4) technical competence.

The fourth issue principally may cause substantial change in the process (or particularly the career) of auditors. Studies (e.g., Vasarhelyi and Pabst, 1981), indicate that EDP auditors are on average more experienced and more trained than their traditional counterparts. This finding can be easily supported by the argument that EDP training and experience is harder to come by and EDP auditors take longer to be proficient and useful in audit engagements. Consequently, to enable audit staffs to groom proficient, technologically aided auditors, current career paths must be adjusted. Furthermore, alterations to the present curricula for college accounting training would be required.

Technologically Aided Auditing and the Audit Process

This section will summarize technologically aided audit procedures related to each step in the audit process.

We shall examine the audit process vis-a-vis automation considering its main elements:

- (1) Engagement Definition
- (2) Engagement Planning
- (3) Internal Control Evaluation
- (4) Compliance Testing
- (5) Substantive Testing
- (6) Attestation

Each of these elements will be examined vis-a-vis some potential automation tasks and/ impacts.

(1) Engagement Definition

a. Contract Preparation

Large law firms engaging in repetitive types of contract preparation have set up contract clause databases in word processors. The actual contract preparation usually entails paragraph selection, but seldom are paragraphs actually rewritten.

The same concept can easily be extended to audit contracts, engagement letters and other engagement definition documents.

b. Client Investigation (analytical review, database queries)

A substantial number of databases are currently available for the examination of financial statements (e.g., NAARS), stock prices (e.g., CRSP), legal precedents and rulings (LEXIS) and other issues. These can be used for analytical review both in a time-series mode as well as in cross-sectional inter- and intra-industry analysis. Database availability results in a wider scope of analytical reviews.

(2) Engagement Planning

a. Analytical Review

The same questions raised above in client investigation are the basis for a more in-depth year-to-year analysis of the evolution of accounting numbers of a particular auditee.

b. Risk Assessment

A series of different methodologies have been proposed for the assessment of audit risk. Automation would permit the usage of simulation, "what if . . ." models and sensitivity analysis in risk assessment.

c. Planning Matrix (work sheet software utilization)

Work sheet software (e.g., VisiCalc) may be used to plan and schedule engagement planning. In addition, these plans may be incorporated into actual budgets and serve as audit control mechanisms.

d. Personnel Scheduling

Linear programming techniques can improve short term personnel usage management. Online reservation systems developed the art of resource utilization management. Stochastic techniques may be used for personnel "overbooking" and task completion estimation.

e. Multi-Year Engagement Planning

Multi-year models can be used in personnel scheduling endeavors to improve audit management and decrease multi-year risk. The yearly choice of areas to be audited should be part of this risk minimization process.

(3) Internal Control Evaluation

a. Computerized ICQs

Internal controls are complex and interlinked. The automation of ICQ's may provide a basis for "tailored" ICQs based on industry, company size and error experience.

b. Automated Flowcharting

ICQ flowcharts may be designed from the above and describe document flow and control points. These may be examined in relation to actual values to evaluate system integrity.

c. Critical Control Combinations Analysis

The above two steps can be overlapped or an "optimal set" or a critical set of controls.

d. Audit Trail Sampling

SAS No. 3 requires a preliminary review of EDP based systems that identify document flows. Tagging and tracking techniques may serve to automate this process.

(4) Compliance Testing

a. Multiple Sampling Plans

Computationally complex sampling plans become menial computation tasks when used with state-of-the-art data processing. They can be directly linked to both the internal control compliance testing and the substantive sample selection processes.

b. "Over the Shoulder" Supervision of Compliance

Most interactive systems of today provide the option of an operator (or someone with high priority) to visibly or invisibly link with another terminal and see the user/system interaction being performed. This feature can be used for the audit of the alertness of users in interactive systems as well as their compliance to internal control rules.

(5) Substantive testing

a. Preparation of Confirmations

The combination of word processing, client files and sampling plans will generate economies in the audit. This traditional computer usage step can still be substantially perfected to gather further evidential matter at an improved cost benefit.

b. Random Number Generation

Techniques such as the adoption of multiple sampling methods, revised sampling schedules and verifiable sample plans may make extensive use of computers. This will expand the scope of audits while at the same time help to document audit costs and to increase audit reliability.

c. Source Document Retrieval Automation

Modern storage technologies may lead to a substantially increased level of source document storage in data processable media. Software can be designed to retrieve automatically on a sample basis, within a sampling plan, part of this data. This software may also be used to automatically generate tables with document availability, content, location and update data.

(6) Attestation

a. Evaluation of Audit Evidence (integration algorithms)

Expert systems (Messier and Hansen, 1982) may be used to supplement audit judgement. Knowledge bases and policy based heuristics may be regularly used to help in judgment and to force/reminc the consideration of particular issues.

b. Issuance of Opinions

Dictionaries of types of opinions, caveats, qualifications, restrictions of scope, etc. may be used to decrease the legal expense of creating new wording on an ad hoc basis or of searching for similar precedents and established disclosure wordings.

c. Issuance of Management Letters

The same technique described in item b above may also be used in management letters.

The above changes in the audit process lead to a series of educational and cost-benefit implications. These needs include: increased hands-on skills, mixed backgrounds in accounting and computer science, substantially improved technological backgrounds, increased hardware requirements (and costs), simple and multiple-purposed languages.

Conclusions

The audit process encompasses: (1) economic events, (2) captured economic evidence, (3) an accounting system structure, (4) the activity of search for evidence, (5) audit personnel, (6) audit agents and, (7) a set of statutory requirements.

These seven elements are affected by automation and open multiple roads of research inquiry. These multiple roads are illustrated by the parable that follows.

Economic events are captured in different ways and with a substantially lower level of error in automated systems.

Direct generation of source records poses a wide set of research questions such as level of detail frequency, reliability, centralization and decentralization, level of editing, etc.

Data capture generates questions regarding frequency of collection, selection, aggregation, log records, database centralization and acceptable error rates.

Structure questions of automated accounting systems relate to the substantially changed environment and control requirement of a computerized system. Controls, tags, accounting records, control combinations and structure documentation pose major challenges to practitioners and researchers.

The search for evidence activity now may be extended to the search through entire populations for algebraic validity and discretionary transactions. It also requires the search for discrepancies of every different nature and a major increase of exposure due to systematic processing and increased distance between the auditor and data.

Audit and client personnel may change substantially, as will interaction patterns. Behavioral factors will differ, reflecting many of the psychological defenses that people present in the presence of computers (Argyris, 1971).

Finally, statutes, particularly audit standards, must evolve to adapt to different exposures, cost-benefit tradeoffs, alternative audit tools, and others. In addition, technology will undoubtedly have an effect upon reporting requirements by facilitating disgregation, disclosure and information preparation through media.

This paper examined the introduction of automation to the audit process. It discussed audit tools and tasks and related these to the various steps of the audit process. It examined the impact that procedural and process changes will have on the audit practice. In conclusion, it raised a series of questions to challenge researchers and practitioners in the search of better quality auditing.

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