June 1983

76

Report of the Technical Committee of the Audit Section

of the American Accounting Association

THE USAGE OF COMPUTERS IN AUDITING

TEACHING AND RESEARCH

Miklos A. Vasarhelyi, Chairman
Columbia University

Andrew Bailey
University of Minnesota

James C. Lampe
University of Missouri-Columbia

W.Thomas Lin
University of Southern California

Walter D.Pugh
Price Waterhouse

Joseph E. Camardese, Jr.
Arthur Young & Co.

S. Michael Groomer
Indiana University

I. I

American Account: Section cr

the needs

om the impact of . on auditing.

. us

.nd

redesigning the audit practice.

The second part of the report describes some software currently used in audit education. The third part of the report discusses the impact of technology on auditing and, in particular, the effects of database management and data communication advances. The fourth part examines current efforts in the analysis and representation of internal controls in a computer supported environment. The fifth part discusses EDP instruction in auditing in both professional and in university settings. The final part suggests potential application areas and makes several specific recommendations for future efforts.

II. IMPACT OF INFORMATION TECHNOLOGY

This section deals with two of the many areas of information technology:

1. Data communications

2. Database management systems

This section attempts to assess the impact of these two areas on auditing education in the academic environment.

Cost trends of data processing equipment indicate expected cost reductions at the rate of twenty percent per year over the next decade. This estimate is based on actual product development and research work performed by such major suppliers as IBM, Wang and Hewlett-Packard. The forecast is not a simple extrapolation of the past ten years results. Computer capabilities that cost one million dollars in 1958, cost about $36 in 1980, and will cost about $1.14 in 1990. Computers will be cheaper, faster, and smaller in the future which logically leads to their increasing proliferation. This proliferation is likely to lead to greater use of powerful stand alone, single user computers. The impact on the business environment will be immense and, this in turn, will affect auditing -- in practice and in theory.

The cost reduction in the data communications area, although not as spectacular, will probably result in a greater geographical dispersion of users and equipment. This will

communication link, the U.S. Postal l be used to the output tapes to the various users.

In the future, we can expect a substantial redu cost of dat :ommunications. With some allo ased system (itibility, the near future should bring Lete access t ograms, data and output, subject only to security concerns osts may be sufficently low as to make it cost/effective to process different simulations for the various users to match their requirements. Costs will be substantially affected by the use of common carrier communication and the rapid popularization of ple user d. etworks.

; noted, security issues ma become the primary issue--how to keep students accessing the full simulation. Those who have read New York [ol case, where high school stude cessed a ng network in Canada, are conscious e problem. As data communication's capabilities a nced and become less expensive, a new oblems . Nevertheless, the academic and audi ional will see a much greater use of data communicati r problem is to study both the enhancements and difficulties that come with an expanded communications network.

Databases provide an effe storing data. latab prevalent in th :

incorporate the database control language into their operating systems. Generally, from a programming point of view, the database system facilitates program change and maintenance. This is possibly due to data independence and data sharing characteristics of data base systems. Programs and other data can be changed without affecting all data or all programs.

The communication database concepts will affect the academic community in at least two areas: First, in most instances, the computer system and the data stored on that system will be available to even unsophisticated users in a transparent manner. Very powerful analysis tools will be made available to the general user: auditors, students and academics. Second, the database and data communications environments will require a different approach to control. Accounting as well as computer controls will change. Such changes will be identifed, studied, accommodated and communicated to users via manuals, texts, etc. In fact, they could be communicated via a computer learning network.

A committee of the Institute of Internal Auditors, the Canadian Institute of Chartered Accountants and the AICPA are looking into the audit implications of database systems (AICPA, 1982). Additionally, the committee is examining database administrative and security problems from an audit point of view.

The next section introduces data processing as a tool for audit research. It illustrates the valuable contributions that data processing can make to audit research with specific emphasis on internal control.

III. RESEARCH ON INTERNAL CONTROL EVALUATION

This section describes work involving formalized internal control description, design, analyses, and evaluation, with special emphasis will be on the TICOM system. TICOM (The Internal Control Model) combines the areas of internal control and mathematical symbolic languages. TICOM is basically a computer language used to describe a firm's internal control representation. TICOM makes use of database management concepts since once developed the model will be stored in [illegible] e n [illegible] atabase [illegible] [illegible] pabil [illegible] refl [illegible] nction that aid the use [illegible] in a [illegible] the ch [illegible] erist [illegible] f the described inte [illegible] ncepts developed throug [illegible] timately contribute [illegible] esign [illegible] us [illegible] OIS) [illegible]

system. To synthesize the modular model components into a global model, software is needed and is based on the language commands identified with the transfer and wait procedures in the ICDL.

2 - TICOM includes an internal representation process based on a precedence network graphics model and mathematical logic. As a part of the mapping of the ICDL to the internal representation, tests of system completeness consistency will be performed making use of the precendence and mathematical characteristics of the TICOM model. This level of analysis capability is unique to TICOM.

3 - TICOM has a query system whereby the user can question the internal control system description as to its control characteristics. The query system basically takes advantage of two mathematically based principles, contraction and simplification. Contraction can reduce a component of the internal control system description to a "smaller" component of the system, while maintaining the essential system control characteristics, i.e. it reduces the system in such a way as to maintain the viability of the control relationships between the other components of the system. It is similar to the current audit environment where the elements of an audit are compartmentalized so that they can be reduced to a manageable size. The TICOM compartmentalization maintains the relationship between the other system components; those not under immediate consideration are identified by the conditions

auditors.

IV.

lit

educ in

uni to.

ill

ond part of the ... ilar

problems as illus d by instructi sity.

These two examples are the educational approaches and

difficulties of the pr l auditing

sectors.

A. In the Profession

The first part

approaches

auditors.

us in

ina ithe

is some instruction on aud EDP systems. In

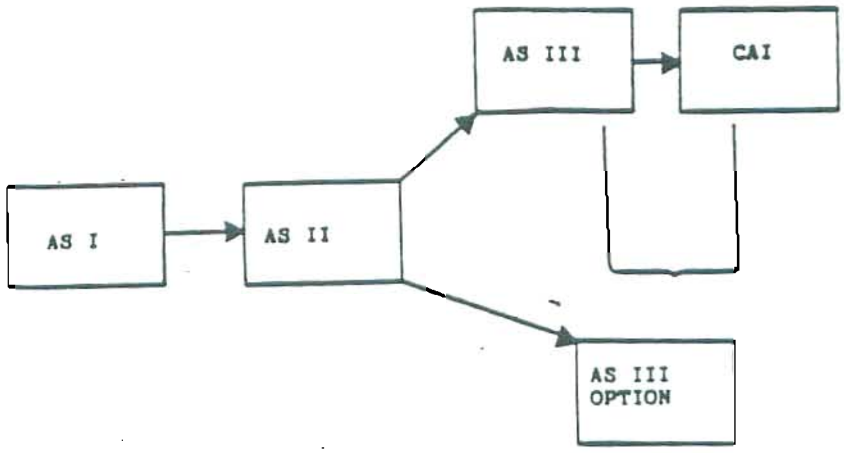
... the fi el auditing course, Audit Seminar #1,

is the starting point. Overall,

Figure 1

AUDIT STAFF TRAINING - 1981

Computer Audit Topic	I/O Controls	SAS #3, Application Controls & CAAP's	EDP System Review & Testing	Detail Coverage of EDP Controls & CAAP's



Estimated Credit Hours	10	8	8	40

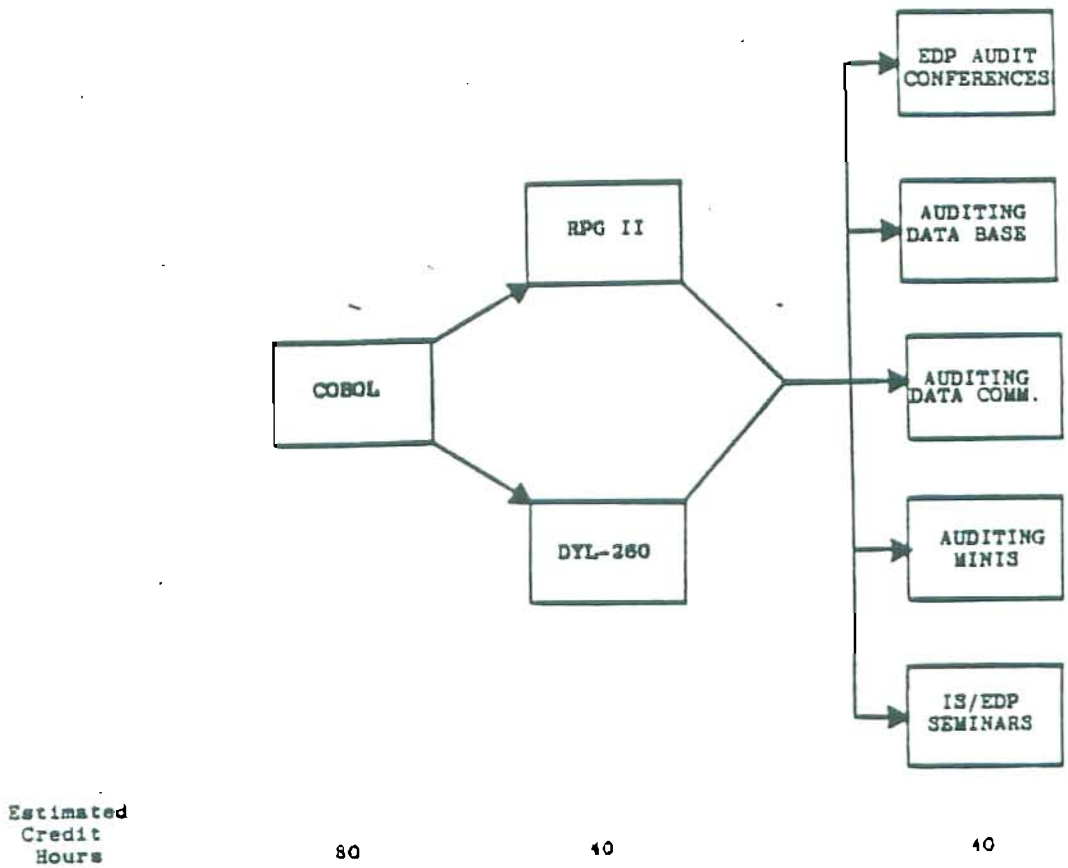
this seminar covers basic audit techniques. Ten hours are spent discussing EDP concepts with primary emphasis on input and output controls in an EDP environment. This gives auditors a sense of EDP effects on the evaluation of internal control.

In the next level of staff training the program emphasizes advanced auditing techniques that are needed to supervise audit assignments. The EDP audit training is considerably expanded at this point because of the increased responsibility on the job. The training focuses on SAS #3, application controls, and CAAPs. CAAP is the acronym used for Computer Assisted Audit Procedure and describes audit testing utilizing the computer. Training consists of case studies of the review and evaluation of internal controls in an automated system, awareness building of application controls and their impact on the overall audit engagement, and background information on CAAPs and techniques to interact with a computer auditor when a CAAP is used on the job.

In the third year with the firm, the staff auditor has a choice in his training program. First, he can attend a one week Audit Seminar III containing a very brief look at EDP review and testing. This is followed by another course, Computer Audit Introduction. This full, one week seminar consists of a detailed coverage of EDP controls, both general and their application, and a detailed examination of CAAPs. Or, he can attend a two week seminar focusing on EDP auditing,

Figure 2

COMPUTER AUDITOR TRAINING - 1981



Arthur Young is contemplating three new computer audit training programs for 1982. The first is auditing distributed networks. The second new program relates to the recent announcement of the AUDITCOMPUTER™ by Arthur Young & Company. The AUDITCOMPUTER™, which is described later in the text, is a fully integrated microcomputer to be used in performing computer assisted audit procedures. It will enable each office to have its own microcomputer which can access client data files and audit such files within the confines of the auditor's office. The seminar will introduce all firm personnel to the AUDITCOMPUTER™ and its use. The third new seminar to be instituted is Computer Assisted Auditing Using PASCAL. This will enable computer auditors to develop and use customized programs in PASCAL on the AUDITCOMPUTER™. In addition, the seminar will train computer auditors in the use of Arthur Young's software which has been developed for use on the AUDITCOMPUTER™.

The heart of the AUDITCOMPUTER™ system is an Apple III microcomputer, configured at 256K. Peripheral equipment includes the two floppy disc drives attached to the Apple III a sixty lines per minute ANADEX printer, and a Winchester type mass storage unit that holds about 20 megabytes of data. The system also has archival capabilities using videotape. A Z-80 based microcomputer system is used in conjunction with the AUDITCOMPUTER™ as a remote data capture unit. It can be used to retrieve data directly from a mainframe for processing on the AUDITCOMPUTER™. In addition, data can also be retrieved

the future, the Touche ss Statistical Sampling (TROSS ich supports Dollar unit sa ing methodology.

The results of a c puter system instruction exp ent performed at Indiana that involved the utilization of PLATO for tutorial purposes in introductory accounting in Groomer (1981). Indiana is a medium size use system. The PLATO system, based in Illinois, is institutions in the United States (Florida State well. The study involved the use of PLATO a device but not necessarily as an instructi introductory accounting.

Computer assisted instruction is an uncha audit education. Considerable work is nece assessment as a desirable educational tool. PLA stable environment in the world for co instruction and an extremely powerful tool for The student contact hourly cost for the usa about $2.50. Additionally, PLATO interfaces friendly language which enables the student lessons called TUTOR. Accounting, auditing courses in the PLATO environment could be poten available. For example, statistical sampling m be performed on CAI oriented on PLATO. In addi assisted instruction may serve as the medium topics such as principles of data processing, i auditing, professional statements, etc.

Universities, with scarce audit faculty resources, and rich in data processing support may seriously consider furthering their audit curriculum with self-paced, self-administered audit instruction modules.

V. EDUCATIONAL SOFTWARES

1. The MARS System

The MARS system is a small, simplified, educational audit retrieval system developed at the University of Missouri by Professor J. Lampe. It is used to teach EDP Audit concepts in the introductory auditing and the systems accounting courses at the University of Missouri. The system, about 8000 instructions long, fits onto most computers, and is available in both COBOL and PL1. The design is purposely kept simple in order to provide an easily learned and used system for students. Experience has shown that a student can learn the operations of the system in about fifteen minutes by reading the manual and by following the professor's instructions. The simplicity of MARS is a major advantage to students.

The MARS system is educationally oriented and uses cases to illustrate an audit and retrieval system. Some of the files have been constructed from real data and range from 200 to 2000 records. The files include two inventory files, two

tisti

utes

dicat

samples.

)onds for simple means per unit and

variable sampling methods.

MARS system will include a dollar unit

ıen it has been fully tested. The package

The University of Missouri allocates two weeks in the introductory audit course for auditing EDP based system and statistical sampling topics. These skills are developed early in the course and are utilized throughout the rest of the course. In the two week section, students run two routines, a SUMRY and a MANIP routine, perform an audit and familiarize themselves with the package. Later, during the study of the sales-receivable-collectables cycle, students gain further familiarity with the package as they study inventory cycles and fixed assets. The package can be run in conjunction with the area cycle being taught and/or taught as a separate unit.

From the students' perspective, MARS is intended to encourage an appreciation of what using an audit retrieval system entails. The parameters of each routine are input by means of cards. Special forms are provided to each student for each routine. The students complete these forms before punching any cards. A minimum of three and a maximum of twenty to thiry cards need punching depending on the complexity of the problem. In the past, however, students have made a large number of punching errors.

2. The TREAT System

The TREAT system is an educationally oriented, generalized audit software. It is designed to emulate the main features and utilize the same forms as Touche Ross' STRATA system. Touche Ross' STRATA is a batch system, whereas, TREAT is an online, interactive system. The TREAT system may be used within an audit course for something as simple as performing an inventory audit walkthrough example. It illustrates the main features of generalized audit softwares including setting up audit objectives, specifying program code, filling out coding sheets and defining output reports. The system may also be used within an advanced audit or computer course. The students obtain "hands on" experience using four different cases (and data files): inventory, property plant and equipment, and two accounts receivable settings.

The TREAT system can be obtained, free of charge by universities, for educational and teaching purposes. About twenty universities are using TREAT software in different stages of implementation. Among these are the University of Southern California, the University of South Carolina, the

it's online, conversational
age commands. Error detection
built in. In terms of
more fully identify errors and
large program which needs both
use.

3. The ACL (Audit Command Language) System

ACL (Audit Command Language) has been developed by Professor H. Will at the University of British Columbia in several versions with the help of several generations of students over the last ten years. The idea behind its design is the consolidation of as many machine-supportable accounting and audit tasks as possible. Thus, ACL is an accounting and audit data management system as well as a decision support system for accountants and auditors. It is also a working paper generator which documents the user dialogue in a file that can be printed or edited further.

The ACL user can perform his tasks interactively or in or adjustment to different physical file environments.

The audit commands refer to single and multiple files and include the data processing functions as well as histographs, random number generation, regression, sample evaluation, selection and size determination, statistics, stratification and verification of data types.

ACL is written in IBM Assembler and runs currently under the Michigan Terminal System (MTS) operating system at the University of British Columbia and at the University of Michigan. A version under the Siemens BS 2000 operating system has been implemented at the University of Saarbrucken in Germany and is used there for teaching, research and audit practice. Several other transfers and implementations are planned on main frame and microprocessor systems. The language is used not only in educational contexts (accounting, MIS, computer auditing) but in <u>practice</u>, research and teaching.

ACL is <u>embedded</u> in a supervisory system, ACL SUPERVISOR which can be monitored by means of the ACL MONITOR system for managerial and research purposes.

ACL is a "generalized audit software system" as well as an "individualized computer audit package" (directory features) with <u>immense</u> computational power at the fingertips of a sophisticated user. As a language, it "lives" and can mirror the computational sophistication of its user; it is

VI. CONCLUSIONS AND RECOMMENDATIONS

Some examples of potential technologies to be incorporated in auditing practice and education are:

Practice

1 - Online auditing.

2 - Automated working papers.

3 - Automated scheduling of staff.

4

5

integration and quality control).

6 - Using pre-diagnostic algorithms.

7 - Auditing decision support systems.

8 - Developing basic definition of EDP control

9 - Expert systems as decision support aids

Education

1 - Incorporating the computer as an integrated tool.

2 - Training on a wide range of technologies, e.g., personal processes, etc.

3 - Computer Assisted Instruction (CAI)

4 - Remote question answering

In Research

1 - Analytical formulation of internal control schemi systems and controls.

2 - Define control and control mechanisms.

3 - Access to working paper databases.

4 - Develop knowledge base to support artificial intelligence research.

5 - Usage of optical scanning to develop research databases.

6 - Develop technology for onsite continuous monitoring and auditing of internal control systems.

7 - Usage of computer communications to facilitate research work.

8 - How will office information systems be audited?

These and numerous other topics are areas ripe for exploration and research by academics and practitioners. We are only at the dawn of the era for systems and audit automation. This report has illustrated certain audit practices, education, tools and research ideas in auditing. A few careful recommendations may be drawn from this discussion.

The first involves the use of educational software. These softwares are deemed of great value and should be supported by academic administration and practice. They allow for technological development, experimentation and student training in an environment less threatening than the field. Existing softwares are still few and inadequate, but are growing in sophistication and may serve as the leading edge of software development. In the past, little theory preceded these developments, as they were mainly a result of immediate needs. Hopefully, future research will more effectively contribute to their design and implementation.

The second recommendation suggest an increase of more analytical and theoretical research in areas related to technology and auditing. In the future efforts such as TICOM may precede rather than follow practical software development efforts.

Y

Adams, D.L. and Mullarkey, J.F. "A Survey of Audit Software," The Journal of Accountancy, September 1972.

AICPA, "The Effects of EDP on the Auditor's Study and Evaluation of Internal Control," Statement of Auditing Standards No. 3, New York, December 1973.

AICPA, "Tentative Draft of the Committee on Database Audit," Walter D. Pugh, Chairman, NY, 1982.

Balachandran, K.R. and Steuer, R.E. "An Interactive Model for the CPA Firm Audit Staff Planning Problem with Multiple Objectives," The Accounting Review, January 1982.

). and Whinston, A.B. "A Survey
ng EDP-Based Accounting Information
view, October 1977.

ion Research Laboratory (CERL),
omatic Teaching Operations (PLATO),

lls. AUDITSCOPE Manual, 1978.

Ernst & Whinney. Audit Sampling, Cleveland, 1974.

Ernst & Whinney. Sigma Users Guide, Cleveland, 1976.

Groomer, S.M., "An Experiment in Computer-Assisted Instruction for Introductory Accounting," The Accounting Review, October 1981.

Haskins and Sells. Auditape Systems Manual, New York,

E.G. and Lilly, F.L. "SAS No.3 and the
Internal Control, The Journal of Accountancy,

.C., Missouri Audit/Retrieval
Missouri-Columbia, 1980.

V.F. and Hansen, J.V. "Decisi
' Under review at The commu

. "Expe
Internat
l. II, N

Sardinas, J. "EDP Audit Curricula," University of Massachusetts, Amherst, 1979.

Stern, M., Wayne Audit Software Package (WASP), Wayne State University, 1980.

Stringer, K.W. "A Statistical Technique for Analytical Review" Proceedings of the Conference on Statistical Methodology in Auditing at the Graduate School of Business at the University of Chicago, 1975.

Summers, E.L. The Audit Staff Assignment Problem: A Linear Programming Analysis, Accounting Review, July 1972, pp.443-453.

Touche Ross & Co., STRATA: User's Reference Manual, 1973.

Vasarhelyi, M.A. "A Framework for Audit Automation: Online Technology and the Audit Process" Working Paper, Columbia University, 1983.

Vasarhelyi, M.A. and Lin, W.T. TREAT: Terminal Related Educational Audit Tool, Report to the Touche Ross Foundation No.1, System Design, April 1978.

Vasarhelyi, M.A., and Pabst, C.A. Practices, Standards Involvement, and the Usage of the Computer in EDP Audit: A Survey," The EDP Auditor, Summer 1981.

Vasarhelyi, M.A., Pabst, C.A. and Daley, I. "Organizational and Career Aspects of the EDP Audit Function: A Survey" accepted for publication, The EDP Auditor, Spring 1981.

___ and ___, Educational Research in Computer Auditing: Computer Audit Package Simulation, A Proposal to the Touche Ross Foundation, September 1977.

Will, H.J., "Computer Based Auditing," Canadian Chartered Accountant, March 1972 (Part 1).

____, ACL (Audit Command Language): User Manual, University of British Columbia, 1981.

Yasaki, E.K. "Who is the DP Auditor?" Datamation, August 1977.