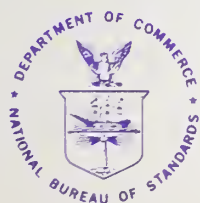COMPUTER SCIENCE & TECHNOLOGY:

FEATURES OF SEVEN AUDIT SOFTWARE PACKAGES— PRINCIPLES AND CAPABILITIES

NBS Special Publication 500-13
U.S. DEPARTMENT OF COMMERCE
National Bureau of Standards

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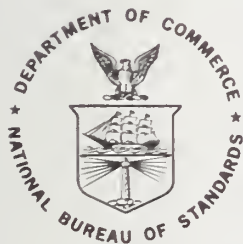[2] Located at Boulder, Colorado 80302.

COMPUTER SCIENCE & TECHNOLOGY:

Features of Seven Audit Software Packages—Principles and Capabilities

+ Special Publication # 500-13

Albrecht J. Neumann

Systems and Software Division
Institute for Computer Sciences and Technology
National Bureau of Standards
Washington, D.C. 20234

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FEATURES OF SEVEN AUDIT SOFTWARE PACKAGES--
PRINCIPLES AND CAPABILITIES

Albrecht J. Neumann

The objectives of the auditing process are illustrated by a review of auditing standards for external and internal auditors. Some basic concepts of auditing are defined. Methods for computerized internal control are outlined. Characteristics and features for seven major commercially available audit software packages are described under common headings dealing with the computer environment, input file characteristics, history, availability and cost, and general system characteristics. Basic functions and specialized audit functions of software packages such as numerical and logical operations, stratification and aging, selection, and summarization are described for the various packages.

Key words: Audit packages; audit routines; audit software; auditing; auditing standards; computer assisted auditing; computer auditing.

1. INTRODUCTION

The advent of digital computers has had considerable impact on the auditing profession. The computer as an auditor's tool provides a powerful extension of the auditor's capability, but the auditing of computerized organizations has placed new burdens on the auditing profession.

This study defines and clarifies some auditing terms and concepts, reviews some of the underlying principles of auditing, and then provides an overview of the features of generalized software tools which can be used by auditors.

This report primarily addresses the computer professional who is interested in auditing problems. To a lesser degree an auditor who is not familiar with computer techniques may find this report useful. Also managers, who are neither auditors nor computer specialists will find this report a source of information, that should help to stimulate new computer applications in the general area of computer auditing.

2. AUDIT, AUDITORS, and AUDITING

Since this report addresses a wide spectrum of readers with different backgrounds and interests, a review of basic terms may be helpful in reaching understanding of common areas of concern. Webster[1] gives three meanings for the term Audit:

1. A formal or official examination and verification of an account book,
2. A methodical examination and review,
3. The final report of an examination of books of account by auditors.

The dictionary definitions indicate two extreme viewpoints, a narrow one dealing only with the examination of account books, and a more broad one covering any methodical examination and review. An auditor is a person who performs an audit. In one sense, an auditor may be any person, who checks the correctness of a set of financial statements. An auditor often is a certified public accountant, a college trained, highly educated specialist with many years of professional experience. In another sense an auditor may be a computer or subject specialist with no particular training in accounting when non-financial auditing, such as quality audit, security audit, or computer performance audit are the objectives of examination and review. In the profession of auditing two major fields have emerged: those of external and internal auditing.

An external auditor is a member of a firm of Certified Public Accountants, who serves a client who requires auditing services. All public firms are required by law to undergo periodic external audits. Most often the external auditor is concerned with the examination of corporate balance sheets, and financial statements of a firm.

The internal auditor is an employee of the organization which is being audited. Internal auditing is also concerned with financial matters, but in addition may deal with efficient use of company resources, and the quality of the services or products of an organization.

Using the broader meaning of Webster, the term "auditing" is now often applied to the review of computer and communications systems. In that context Bjork[2] has defined auditing as "the act of monitoring the application for compliance with accounting rules and practices". He further states that "Auditing an application is essentially certifying the integrity of the system by verifying that rules and policies dictated by laws, business agreements,

etc. are being followed by the application". Bjork distinguishes four types of audit depending on whether the audit occurs during the computer process or after the process, and whether the auditing procedure is "transparent or non-transparent" to the process being audited, i.e. whether the process being audited is aware of the audit or not. Auditing in the latter context has become a function of a computer specialist, who is intimately familiar with the architecture, concepts and terminology of the hardware and software. The traditional internal or external auditor will have difficulty performing this kind of audit, and will need considerable specialized knowledge to achieve successful results.

Since both management and the auditor are vitally concerned with financial operations, efficient use of resources, and useful products, it is helpful to point out the distinction between the responsibilities of auditors and management.

The external auditor examines financial statements of a firm and expresses an opinion that the firm's financial position has been represented in a fair manner. In this opinion he exercises independent judgment.

The internal auditor however, acts as a management investigator, he has an interest in matters of organizational efficiency, proper use of resources, and effectiveness of organizational products. He reports on "what is done, who does it, where it is done, and how well it is done"[3].

Management, in contrast, is responsible for adoption of a sound accounting policy, for the maintenance of accounts, for the safeguarding of the company's assets, and for establishment and maintenance of internal controls.

Standards for external auditors have been documented over the years by the American Institute of Certified Public Accountants. The standards prescribe scope, duties, general and specific principles, and the form of reports to be prepared. They recently have been codified and collected in one volume[4]. Similarly guidelines and standards have been prepared for the internal auditor by the U.S. Comptroller General[5]. They are used widely both within and outside of the Government. The Institute of Internal Auditors presently is engaged in codification of standards for the internal auditing profession. The following sections summarize these auditing standards, which give the non-auditor a good perspective on auditing goals and objectives.

3. AUDITING STANDARDS

The GAO Auditing Standards deal with three major areas: General Standards, Examination and Evaluation Standards, and Reporting Standards. These standards are summarized in the following paragraphs and describe the general nature of the auditing process. The reader is cautioned not to interpret this report as an official standard or guideline. For specific wording the reader is referred to the original document which forms the basis for this report[5]. Although the GAO standards are prepared for governmental auditing, they are also used by non-governmental internal auditors, and there is considerable similarity between the external auditing standards and the GAO document. Most standards cited here have broad application for all kinds of audit.

3.1 General

There are four General Standards specified, which deal with the scope of audits, qualifications of auditors, independence of auditors, and the matter of "due professional care".

<u>3.1.1 Scope of Audit Work.</u> The first general standard for auditing is:

The full scope of an audit of a governmental program, function, activity, or organization should encompass:

1. An examination of financial transactions, accounts, and reports, including an evaluation of compliance with applicable laws and regulations.

2. A review of efficiency and economy in the use of resources.

3. A review to determine whether desired results are effectively achieved.

In determining the scope for a particular audit, responsible officials should give consideration to the needs of the potential users of the results of the audit.

These general objectives include analysis of financial
transactions, and compliance with applicable laws and
regulations to determine whether the audited organization is
maintaining effective control over revenues and
expenditures, assets and liabilities, whether there is
proper accounting for resources, liabilities and operations,
whether the financial reports are accurate, and contain
useful data fairly representing the financial state of the
organization, and whether applicable laws and regulations
are being followed. Included in an audit may be a review of
procedures, of possible duplication of effort, of
inefficient operations and faulty buying practices, and of
waste of materiel and personnel. Finally, the auditor will
consider results achieved, benefits obtained, and whether
objectives have been met.

3.1.2 Qualifications. The second General Standard for
auditing is:

> The auditors assigned to perform the audit must
> collectively possess adequate professional proficiency
> for the tasks required.

Audits vary in scope and depth. A team effort often is
required to provide the mix of financial expertise,
familiarity with laws and regulatory requirements, and
systems analysis required to assess operating efficiencies
and effectiveness of program results. Additional skills
required often are familiarity with statistical techniques,
computers and data processing, and various technical and
engineering specialties.

3.1.3 Independence. The Third General Standard for auditing
is:

> In all matters relating to the audit work, the audit
> organization and the individual auditors shall maintain
> an independent attitude.

This standard places upon the auditor, or the auditing
organization the responsibility for impartiality.
Independence must be maintained to produce unbiased
opinions, conclusions, and judgments. If this should be not
possible for personal, external, or organizational reasons
this must be prominently stated in the auditors report.

3.1.4 Due Professional Care. The fourth General Standard for
auditing is:

> Due professional care is to be used in conducting the
> audit and in preparing related reports.

This requires high professional standards to be exercised in all audit work. This standard implies some limited responsibility for disclosure of irregularities or non-compliance. The standard imposes on the auditor a requirement to be alert for situations that could indicate fraud, inefficiency, waste, improper use of resources, or lack of effectiveness. The audit process is not a substitute for internal control. Management is responsible for enforcement of adherence to policy, and for prevention of misuse of resources. The auditing process is a test of internal control, rather than a substitute for it.

Exercise of due professional care means use of good judgment in the choice of tests and procedures, doing a good job in applying them, and preparing of good reports. The auditor must consider the audit objectives, the relative materiality or importance of matters to which the procedures will apply, the effectiveness of internal controls, and costs in relation to derived benefits for the work being performed.

The quality of audit work depends upon the degree to which tests and procedures are competently applied, conclusions are based on pertinent and documented facts, conformance of the audit work to the evaluation standards and reporting standards outlined below, and on critical exercise of judgment in all phases of the audit process.

3.2   Examination and Evaluation Standards

Five standards deal with the details of examining and evaluating: covering areas of planning, proper supervision, compliance with legal and regulatory requirements, the evaluation of internal controls, and the matter of evidence.

3.2.1 Planning. The first examination and evaluation standard for auditing is:

Work is to be adequately planned.

Such planning is especially important if several organizations are involved in the audit, coordination between auditors is required, and division of assignments is required. It is often desirable to have one audit satisfy requirements of several levels of the organization, requiring different emphasis and viewpoints.

A written audit program or audit plan needs to be
prepared, which serves to communicate the audit objectives
to all concerned, and provides a vehicle of control during
the audit. Such a plan will contain purpose and scope,
objectives, background, definitions of terms, a description
of procedures to be used, and reporting requirements.
Planning also includes provisions for access to working
papers by other auditors at a later date, when required.

3.2.2 Supervision. The second examination and evaluation
standard for auditing is:

    Assistants are to be properly supervised.

This requires supervisory review during all phases of the
audit, both of the substance and the method of auditing.
Such review should ensure conformance to auditing standards,
adequate recording of adherence to the audit plan, adequate
documentation of findings and conclusions, and achievement
of audit objectives.

3.2.3 Legal and Regulatory Requirements. The third
examination and evaluation standard for auditing is:

    A review is to be made of compliance with legal and
    regulatory requirements.

Especially in governmental auditing compliance with laws and
regulations is important. Government activities are
creatures of law and detail pertaining to basic legislation,
hearing reports, legislative committee reports, court
decisions, state and local legislation must be considered
here. Other requirements include administrative memoranda,
guidelines and administrative regulations by all appropriate
levels of government.

    The nature and purpose of the review will vary
according to the emphasis of the audit, whether it focuses
on financial matters, economy and efficiency of operations,
or program results, or all three of these.

3.2.4 Internal Control. The fourth examination and
evaluation standard for auditing is:

    An evaluation is to be made of the system
    of internal control to assess the extent
    it can be relied upon to ensure accurate
    information, to insure compliance with
    laws and regulations, and to provide for
    efficient and effective operations.

This standard permits the auditor to determine how much

reliance can be placed on the internal controls of the audited organization. Internal control refers to the organization and methods which have been set up to safeguard assets, insure accuracy and reliability of accounting data, promote operational efficiency, and encourage adherence to established managerial policies. Concepts included here are separation of duties in critical areas, a system of authorization and record procedures providing effective control over assets, liabilities, revenues and expenses, and systems and procedures for personnel management and internal review.

Since it is difficult and expensive to completely evaluate all internal controls, judgment is required to select those aspects which are important to the issues being audited. Again the extent of controls may cover any one or all of financial areas, matters of efficiency and economy, or program results. The internal review provides a basis for application of further tests and use of auditing tools such as auditing software systems described later.

3.2.5 Evidence. The fifth examination and evaluation standard for auditing is:

> Sufficient, competent, and relevant evi-
> dence is to be obtained to afford a reasonable
> basis for the auditor's opinions, judgments,
> conclusions,and recommendations.

Evidence includes records of testimonials, documentary evidence such as letters, contracts, computer printouts, as well as analytical evidence secured by analysis of information the auditor has obtained. Regardless of the type of evidence, it must meet the basic tests of sufficiency, competence, and relevance. Details must be documented in the auditor's working papers, which must also include the methods used to obtain the data. "Sufficiency is the presence of enough factual, adequate and convincing evidence to lead a prudent person to the same conclusion as the auditor"[6]. Judgment is required here, and statistical methods may be employed to establish sufficiency, when appropriate. Competent evidence should be the best attainable through the use of reasonable audit methods. Relevance refers to the relationship of the information to its use.

Working papers are the link between the auditor's field work and the auditor's report. They contain the accumulated evidence in support of conclusions and recommendations in the report. Auditors need to adopt reasonable procedures to ensure safe custody and retention of their working papers to satisfy legal and administrative requirements. General

guidelines included in reference[5] include completeness and accuracy, clarity and understandability, legibility and neatness, and pertinence.

3.3 Reporting Standards

Four reporting standards are identified in the Comptroller General Report, dealing with form and distribution of reports, timeliness, content guidelines and financial reports. These standards are summarized in the following paragraphs.

3.3.1 Form and Distribution. The first reporting standard for auditing is:

Written audit reports are to be submitted
to the appropriate officials of the organizations
requiring or arranging for the audits. Copies of
the reports should be sent to other officials who
may be responsible for taking action on audit
findings and recommendations and to others
responsible or authorized to receive such reports.
Copies should also be made available for public
inspection.

Specific reasons for audit reports are stated: they should be widely communicated to responsible officials at all levels, they aid in avoiding misunderstandings, they permit public inspection of the auditor's findings, and they facilitate followup to determine whether the recommendations have been followed.

3.3.2 Timeliness. The second reporting standard is :

Reports are to be issued on or before the
dates specified by law, regulation, or
other arrangement and, in any event, as
promptly as possible so as to make the
information available for timely use by
management and by legislative officials.

Interim communication of results is encouraged, but is not a substitute for a final report.

3.3.3 Content. The third reporting standard enumerates content designators that should be included in the report. Topics mentioned are content, conciseness, accuracy, completeness, fairness, objectivity, adequate support, recommendations, constructiveness of tone, issues needing further study, recognition of noteworthy accomplishments,

views of responsible officials, scope and objectives of audit, and justification for omission of privileged information. For further detail the reader is referred to reference[4].

3.3.4 Financial Reports. The fourth reporting standard is:

Each Audit report containing financial information reports shall:

1. Contain an expression of the auditor's opinion as to whether the information in the financial reports is represented fairly in accordance with generally accepted accounting principles(or with other specified accounting principles applicable to the organization...audited),applied on a basis consistent with that of the preceding reporting period. If the auditor cannot express an opinion, the reasons therefor should be stated in the audit report.

2. Contain appropriate supplementary explanatory information about the contents of the financial reports as may be necessary for full and informative disclosure about the financial operations of the organization, program, function or activity audited. Violations of legal or other regulatory requirements, including instances of noncompliance, and material changes in accounting policies and procedures, along with their effect on the financial reports,shall be explained in the audit report.

In summary one may group these standards into two areas, those that deal with characteristics and qualities of the audit and the auditor, and those that are related to the object of the audit and the results desired. In the first area are standards dealing with the scope of the audit, qualifications of the auditors, matters of due professional care, independence, planning and supervision. In the second area are those dealing with review of internal control, use of judgment to develop proper tests, the producing of evidence to substantiate findings, and the generation of timely, relevant and useful reports.

It is in the second area that computers have made an impact. We will focus on these ideas in the next paragraph.

4. INTERNAL CONTROL, EVIDENCE AND REPORTING

In the early stages of accounting practice auditors periodically examined in great detail the manner in which individual transactions were handled by an organization. This independent, careful, professional assessment formed the basis for an opinion as to the accuracy and reliability of financial data of an organization. As organizations grew, the number of transactions grew correspondingly, and detailed auditing became time consuming, expensive and placed prohibitive burdens on management. Establishment by management of internal checks on the internal financial processes of an organization, has become an acceptable substitute for detailed auditing of each transaction.

The term internal control has been defined as: "the general methodology by which management is carried on within an organization; also any of the numerous devices for supervising and directing an operation or operations generally"[7]. Internal control acccomplishes three major objectives. First, the "methodology" is designed to insure that the accounting system provides accurate, complete, reliable and up-to-date information for making of management decisions. Second, it is intended to insure compliance with policy directives, and legal requirements. And finally, it protects the organization from carelessness, inefficiency and outright fraud.

With mechanization of accounting functions and the introduction of computers some of the methods of internal control have changed. New tools have become available, and some of the manual methods are no longer applicable. With advent of machines some functions previously performed by people, are now performed by machines. The basic principle of control of "division of duties and responsibilities" still remains, but a shift of duties from people to machines has eliminated the need for internal control over people, but has introduced the need to establish controls over machines.

Next there is the matter of audit evidence. Mautz[8] enumerates types of audit evidence. In addition to physical examination, statements by officers, employees, and third parties and documentation, he lists calculations by auditors, satisfactory internal control procedures, subsidiary records or detail records with no significant

indications of irregularity, and interrelationships within
the data examined. The last three types can be supported by
computer operations and specialized software which will be
discussed in the following sections.

And finally preparation of reports is subject to
support by computers. A major portion of computer aids
described in the following sections can be classified as
report generators.

5. COMPUTERS AND AUDITING

The advent of digital computers some thirty years ago
has introduced a new element into auditing activities. The
computer as part of the organization to be audited is
presenting some difficulties for the auditor. At the same
time the computer has become a valuable tool for the
auditor. Two auditing concepts that have been affected by
computerization are audit trails and internal control.

5.1 Audit Trail

As computers and computer related procedures have
become part of the accounting systems of organizations, new
complexities have confronted the auditor. One important
facet in accounting practice is the maintenance of an audit
trail, i.e. the capability to trace a sequence of
transactions from the source to the final result. In
manually maintained accounting books this is done through
auditor readable references from one entry to others in
other related documents. In accounts which are maintained
in form of machine readable records human tracing of audit
trails often is no longer possible. Auditors speak of
auditing "around the computer", and of auditing "through the
computer"[9]. In the first case inputs and outputs from the
computer are examined, but the internal processing of the
computer is not considered. In the latter case, the internal
operations of the computer are considered by the auditor as
well. In simple computer applications, where programs may
consist of several hundred instructions, it is possible to
examine a computer program line by line. In large
applications,involving multi-programming, where programs may
consist of many tens of thousands of instructions, this is
no longer possible and the auditor has lost the capability
to inspect and judge computer programs. Both the loss of
audit trails and the inability to assess computer program
quality have put a great burden on the auditor. The loss of

audit trails is being overcome by making special provisions
in software, which will be discussed under the topic of
automated internal controls. A third factor introduced by
computers is the dependence of the auditor on computer
specialists. This leads to loss of the auditor's
"independence", which may seriously affect the quality of
the audit.

Computers as an aid to the auditor have become an
important topic in the auditing profession, and continue to
attract the interest of auditors, accountants, and suppliers
of computer services and software.

5.2 Automated Internal Control

The ability of computers to perform many repetitive
operations at high rates of speed with great accuracy
provides new techniques for internal control. Some of the
applicable techniques are listed here.

5.2.1 Record Counts. Accuracy and reliability of results of
a financial system are impaired unless all contributing data
have actually been processed. Data may be lost in handling
of punched cards, or in transcription of data from one
medium to another. Automatic counting of records at various
stages in the processing, and comparison of record counts
provide assurance that no data have been lost.

5.2.2 Control Totals. An effective method of controlling
both the number of records processed, and the accuracy of
processing, involves the addition of specific data elements
taken from each record processed. These may be hash totals,
or totals of significant footings. Hash totals may be the
summation of stock numbers, account numbers, or work order
numbers; they only have control significance. Significant
control totals may be totals of dollar amounts or
quantities, and can be used for other useful purposes
besides control. Comparison of control totals from time to
time provide excellent means to detect errors.

5.2.3 Zero Balance Checks. A beginning balance is made from
existing data. As the data are processed, significant data
are accumulated, and at the end of the process the
accumulation is subtracted from the original balance. The
result should be zero.

5.2.4 Limit Checks. Predetermined upper and lower limits may
be established, and each record can be checked automatically
for being below, within or above the specified range. This
method can be used to flag unreasonable amounts, and
provides clues to the reasonableness of data.

5.2.5 Sequence Checks. The ability of comparing sequential control numbers, permits location of records that are out of sequence, gaps in files, and duplicate numbers.

5.2.6 Self Checking Numbers. Transmission accuracy or transcription accuracy of numbers can be verified by processing of check-digits, which are attached to the significant digits, and which serve to indicate error conditions.

5.2.7 Editing Routines. Editing routines are primarily used to test for data compatibility. They however do not assure that data are factual. A work order number may be matched against a number in a work order number table. This does not assure that the right work order number was used.

5.3 Audit Software

Computers permit the auditor to examine more material in shorter time, permit the gathering of evidence with the appropriate detail from a larger reservoir of resources, and permit professional documentation required by good auditing practice. Many of the available computer programs for routine data processing can be used for auditing purposes such as routines for sorting, merging, copying and comparing of large automated files.

Computer aided auditing is especially useful if there are large volumes of transactions, significant fragmentation of source data, or complicated segmentation by organization component or financial structure. It also is applicable if many records need to be segregated by audit categories such as vendor number, account number, project code etc.

Also programs developed for assistance to systems development often are useful to the auditor. Such programs may provide capabilities for editing, performance measurement, logging and journaling, simulation, testing, and documentation. Application of most of these programs do however require some knowledge of computer operations.

General purpose packages have been developed, which are based on simplified procedures and do not require special computer knowledge. These packages permit selection of records based on a variety of criteria, classification into categories determined by the auditor, and complex manipulations of records using arithmetic as well as relational and logical operations. Finally complex mathematical methods are available for statistical analysis, which help in determination of the reliability of data examined. Results of these "generalized audit packages" are

presented in a form which is most suitable to the auditor, in a format consistent with the accounting practices of the organization being audited, and in a form which facilitates analysis and exercise of judgment.

Use of these techniques varies in complexity. In the simplest case a few simple questions need to be answered by the auditor, on preprinted forms. The answers are translated into punched cards, which in combination with a prerecorded program on a computer readable medium provide the computer generated information needed by the auditor. In the most complex case the auditor will have some programming capability in a higher level language, and will be able to take existing program packages, select parts according to need, combine them with other ready made programs, write necessary modifications, and use the total program assembly for the specialized application. This requires special training in computer technology and experience in using computers. Computer audit specialists serve in this capability and a special branch of the auditing profession now is specializing in this field.

In the following pages features of a few "general audit packages" are described in some detail.

6. FEATURES OF AUDIT SOFTWARE PACKAGES

The following sections give an overview of a few selected audit software packages. There are a large number of packages available in an active and ever expanding software market. A survey by Adams and Mullarkey lists 17 packages [10]. The packages selected for this paper cover a few of the most popular ones, according to a recent study by the Institute of Internal Auditors [11]. Included are packages developed by external auditing firms, commercial software houses, and a government agency interested in internal auditing. Selection of packages for this study does not imply a rating of merit, and the arrangement in the text is alphabetical. The categorization of features attempts to bring all packages on a common denominator, but a detailed comparison of features cannot be made in any consistent manner because of the diversity of auditing viewpoints reflected in the packages. Technical details listed for the packages were obtained from documentation available at the time of writing and are given for illustrative purposes only. Draft copies were made available to the vendors whose products are described in this report, their comments were solicited, and were incorporated where feasible. Information presented here reflects the state of the systems described as of March 1977. Details should be verified with each individual supplier if the data are used for specification purposes. Any evaluation of particular merits or demerits of features or detail capabilities will need a detailed requirements analysis by the interested party, and an evaluation of features of a candidate system in relation to specified requirements. An overview of an evaluation methodology is outlined in a recent article by Knowlton [12].

The following summaries of features do however present an overview of capabilities, and should as such serve a useful purpose, listing general descriptions of seven typical packages, characteristics of input files required, some basic utility functions included, mathematical and logical capabilites, and specialized audit functions such as summarization, selection, classification, and report generation.

7. GENERAL DESCRIPTION OF PACKAGES

This section gives an overview of the history of the packages under consideration, and a brief system overview for each system. An address and phone number are given so that further information may be obtained easily. The hardware environment is discussed and modes of use of the system are described. Availability and cost of software packages are indicated.

7.1 System Identification

This section lists system name, system originator,address and a telephone number where further information may be obtained.

7.1.1 AUDITAPE.
HASKINS & SELLS
Certified Public Accountants
1114 Avenue of the Americas
New York, New York 10036
(212) 422-9600

7.1.2 DYL 260.
DYLAKOR Software Systems, Inc.
16255 Ventura Boulevard
Encino, California 91436
(213) 995-0151

7.1.3 EASYTRIEVE.
PANSOPHIC SYSTEMS INC.
709 Enterprise Drive
Oakbrook, Ill , 60521
(312) 986-6000
Arlington,Va. Office: (703) 821-8370

7.1.4 EDP-AUDITOR.
Cullinane Corporation
20 William Street
Wellesley, Mass. 02181
(617) 237-6601

7.1.5 HEWCAS.
Health,Education and Welfare Computer Audit System
Department of Health,Education and Welfare Audit Agency
Washington D.C.
Chief Advanced Techniques Staff,
(202) 755-8840

7.1.6 MARK IV/AUDITOR.
Informatics, Inc. System Products
21050 Vanowen Street
Canoga Park, CA 91304
(213) 887-9121

7.1.7 SCORE.
Programming Methods Company of
Informatics, Inc.
1301 Avenue of the Americas.
New York, N.Y. 10019
SCORE Product Manager
(212) 489-7200

7.2 Availability and Cost of Software

     Different software distribution plans exist. Software
to be installed at a customer´s site may be available for
purchase or lease. Software may also be available from
time-sharing service centers. The rental and purchase costs
for each of these systems were obtained from the GSA
schedule,where available, or from the software vendors. In
certain cases a discount is allowed if more than one copy of
the system is acquired within the same government agency.

7.2.1 AUDITAPE. The system is made available under a
licensing agreement that provides for an annual license fee.
The annual fee, which is based on actual usage, ranges from
a minimum of $ 100 to a maximum of $ 1200 per system.

7.2.2 DYL 260. Costs depend upon software modules and
supplies requested, and options of the lease or purchase
plan. Thirty day no cost trial available. Monthly rental is
$120 with sort module. Corresponding purchase cost is
$8450.No GSA contract. Small discount for multiple sites.

7.2.3 EASYTRIEVE. Available on perpetual license
basis,including first year maintenance, 1 day training, and
two sets of documentation. $ 12,500 + $ 750 /yr for
maintenance. Discount available for multiple systems within
one organization.

7.2.4 EDP-AUDITOR. EDP-AUDITOR can be purchased for $14,400
on the GSA schedule. Maintenance, new releases, and user´s
group membership are $2160 per year. EDP-AUDITOR can be
leased for $600 per month for a 24 month lease, and $180
per month after 24 months. The lease includes maintenance,
new releases, and user´s group membership. The lease is also
under the GSA schedule.

7.2.5 HEWCAS. The complete system is available for $ 800 on a reel of tape from the National Technical Information Service. This includes a complete set of system documentation. Also available to Government users of the INFONET timesharing service who have obtained permission from HEW. Cost of INFONET Service is applicable.

7.2.6 Mark IV/AUDITOR. Mark IV/Auditor consists of the Mark IV system plus a library of audit routines. Mark IV can be purchased or leased. Purchase prices depend on the particular model and range from $12,000 to $37,000. The audit routines alone cost $ 3,700. Over 20 special features are available at prices between $1100 and $13,000 per feature. Mark IV is available on the GSA schedule. The audit routines require a version of Mark IV to operate. Plans are being made by the vendor to have the audit routines added to the GSA schedule. Purchase price includes first year maintenance and support, training and installation. Discounts are available to multiple installations under purchase or lease plans.

7.2.7 SCORE. Can be purchased from Informatics,Inc. at about $18,000 for first installation. Additional installations can be obtained at half price. Lease/purchase plans are available.

7.3   History of Software Package.

Historical information on the implementation of the software package indicates the extent of development and field usage. The specific information concerns the date of first installation and the name of significant installations.

7.3.1 AUDITAPE. The system was originally developed in 1965 for internal use by the firm in its audit practice. Based on its own experience and comments from clients the system was adapted for external use and is offered to clients and other organizations. A variety of tapes are available geared to various makes of computers and to specific operating systems. There are approximately 600 users, including city, state and federal agencies.

7.3.2 DYL 260. System offered since 1973, over 600 installed. Listed in Datapro directory of commercial packages, won 1975 Datapro Award of Merit based upon satisfactory responses from user survey. Used by General Accounting Office and Veterans Administration.

7.3.3 EASYTRIEVE. Initially installed in 1969. Rights acquired by present vendor in 1973. Over 750 systems installed as of December 1975. Version 6 released December 1975. Listed in DATAPRO "Hall of Fame". Currently in use in US Department of Commerce, US Department of Agriculture, and other Government agencies.

7.3.4 EDP-AUDITOR. First installation was in 1970. Over 350 systems are installed in the U.S. and over 400 world-wide. Significant installations: Montgomery County Government, Rockville, Md., Federal Reserve Banks of Chicago, Dallas, Richmond, and San Francisco, Philadelphia, and Minneapolis, National Automobile Dealers Association, Mc Lean, Virginia.

7.3.5 HEWCAS. Software development started in 1972 at the HEW Audit Agency. Was first available in 1973. Released for general use 1 July 1974. Has been installed at US Civil Service Commission, HEW Audit agency, US Department of Labor, US Department of Commerce, and the US Government Printing Office.

7.3.6 Mark IV/AUDITOR. First delivery of Mark IV was in 1968. More than 1000 systems have been installed in the US and in other countries. AUDITOR is a special feature and was first introduced in 1976. Mark IV/AUDITOR has been installed at ERDA in Germantown,Md.

7.3.7 SCORE. First introduced in 1969. SCORE III in January 1970, SCORE IV March 1972. Over 400 systems installed. Some washington DC area installations include HUD, Maritime Administration, Department of Agriculture.

7.4 General Systems Characteristics

     The basic design of an auditing software package is important in analyzing the potential performance, flexibility, and transferability of the package. Other characteristics are the availability of separate functional components of the package, and the method of combining these components to generate data and information useful to the auditor. The language in which the package is written is of importance if changes have to be made to the program. Also of importance are the ability to link to other programs, and the ability to accommodate user generated routines, macros or programs.

7.4.1 AUDITAPE. Tapes have been prepared for several makes and types of machines, including sets of programs specially prepared and programs furnished by the manufacturers. Auditapes are in machine language. Three different types of programs convert client file records into a standard Auditape format. IBM 1400 and Honeywell 200 machines use the basic edit program, DOS uses the manufacturer's utility, and OS and DOS/VS use the expanded edit program. A set of specialized programs manipulate these standardized files and produce the desired output.

7.4.2 DYL 260. A report writer, data manipulator, and file utility program, written in assembly language, and meant to be cataloged and used on the host computer. Required processing is controlled by simple parameters input on cards.

7.4.3 EASYTRIEVE. The system is written in assembly language and produces an audit report. It is a load-and-go system, and does not require intermediate program production and compilation. Options are available for interfacing with data base systems such as IMS and TOTAL. A CALL command permits use of auditor-written higher level language subroutines. A macro processor command processor permits use of auditor-defined macro routines.

7.4.4 EDP-AUDITOR. EDP-AUDITOR is written in assembly language and produces an object code program which is executed to produce the audit listing. This type of system is a load-and-go type system. Up to 256 input files and 100 output files or reports can be specified. A library of routines is available supporting six auditing areas: file footing -control; exception analyses; summary analyses; special processing routines; confirmation of accounts; and selection and sampling. EDP-AUDITOR consists of the CULPRIT system plus the library of audit routines. Interfaces are available for data base management systems such as IDMS, IMS, DL1, TOTAL, DATACOM/DB etc. , as well as for the TSO, ROSCOE, and WYLBUR time sharing systems. There is a complete cataloging and macro facility and exits are provided to user written programs.

7.4.5 HEWCAS. HEWCAS is written in the BASIC programming language, and produces COBOL programs which can be compiled and executed on various machines. The user is prompted for the input specifications. Two simultaneous files can be handled on input, with any combination of media. Up to 91 simultaneous outputs are possible(one printer and 90 disk or tape files). No user written routines can be used, but produced COBOL programs can be saved. External program linkages are only possible by modification of the COBOL program.

7.4.6 MARK IV/AUDITOR. MARK IV/Auditor is written in assembly language and produces an assembly language program which is executed to produce results. The system can be considered a "load-and-go" system. It consists of the Mark IV system and the library of audit routines. Mark IV handles various data processing considerations in a manner transparent to the auditor. The auditor specifies the file characteristics and functions to be performed by filling out worksheets, which are translated into parameter cards. Standard file types and data bases are automatically supported, multiple files coordinated and up to 255 reports produced in one pass of the file. The auditor can sample, select, compute and report by specifying selection criteria and custom reports or by utilizing the library of audit routines. The library includes routines for aging, confirmation notices, random sampling, monetary sampling, stratification and grouping among others.

7.4.7 SCORE. The system is written in COBOL and generates COBOL programs as output. Program generation is governed by about thirty different keyword parameter cards,of which generally only a few are necessary for any given run. The vendor states that "no superfluous PROCEDURE DIVISION CODE is generated,so that programs are only as long as they need to be". The user can insert his own COBOL code at almost any point.

7.5 Modes of Use

     The operator interaction with the software package is described here. Various specifications must be supplied to an auditing package describing client's file characteristics, functions to be performed,and desired presentation of results. The object computer configuration, i.e. the configuration of the computer on which the audit package is run to produce audit results, must also be specified. These specifications can be communicated to the audit program in an interactive dialog from a terminal, or they may be entered by punched cards, requiring preparation of multiple choice forms, questionnaires, coding forms, or other written instructions. Number of forms, detail specified, ability to accommodate changes, affect ease of use of the package.

7.5.1 AUDITAPE. Specification sheets are filled out, and form the source for keypunched specification cards. The cards are read into storage, and combined with instructions from the Auditape system they complete the program for the particular process. Messages printed during processing, and computer operator documentation include explanations for operation of the equipment.

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7.5.2 DYL 260. Special layout sheets are provided to guide writing and subsequent keypunching of input parameters. Parameters grouped in these functional categories: program control, file control and definition, data selection and manipulation, report control header, report titles, report print line, job control. Certain processes can be done within these functional areas without inputting parameters in other groups.

7.5.3 EASYTRIEVE. Easytrieve is written in free form by selection from a set of English commands. No special specification sheets are required. Queries are entered via punched cards. As queries are read, an executable program is compiled and processed. File specifications are stored in a "library" from which they are available when needed. Selection criteria are specified with "IF" statements. Data movements are specified and a sort command is available. A controls command lists fields where breaks should occur, and a list statement specifies report items and their order.

7.5.4 EDP-AUDITOR. There are three pre-printed parameter forms--input definition, output definition, and process definition, which are translated into punched cards. These parameter forms are fixed in format, and prompt the user filling them in. An extra cost terminal-oriented version assists in free-form input. A free-form version is also available at no additional cost.

7.5.5 HEWCAS. Input is specified by answering of multiple choice questions. The system is interactive and specifications are entered from a terminal in a dialog manner.

7.5.6 MARKIV/AUDITOR. Files and tables, report types and formats, and selection methods are defined by coding forms, which are translated into punched cards. Prewritten routines are selected by the parameter cards, and routines written by the auditor can also be used. In addition Mark IV system routines are available. There are 11 basic forms in MARK IV, and about 11 specialized work sheets available for the specialized AUDITOR routines. Free-form and on-line query versions are available at extra cost.

7.5.7 SCORE. Data definitions are entered in COBOL. They can be also entered from a pre-existing library. Functions and output specifications are entered by filling out of pre-printed forms, which are translated into punched cards. The system is designed to operate in a batch mode; The vendor offers a user-written interactive prompting system (currently designed to run under IBM's TSO), but does not presently support it.

7.6 Computer Environment

The auditing software package may produce a program capable of running on a computer different from the one on which the initial parameters were specified. The computer on which the initial parameters were specified is called the source computer. The computer on which the auditing software executes the audit functions and derives audit data is called the object computer. The source computer could be a computer at the auditor's location, while the target computer may be a machine at the client's site. The source computer and the object computer could also be the same computer.

7.6.1 AUDITAPE. Three systems are available for IBM 360 and 370 series computers. DOS release 5.3 contains the manufacturer's operating system. OS and DOS/VS use the installation operating system and can be run in a multi programming environment. The OS Auditape does not include the operating system and can only be used by installations having the full IBM OS system. It can be run in a multi-programming environment. The IBM 1400 and Honeywell 200 Auditapes also contain their own operating systems, and require dedicated computer operation. For dedicated use at least 32 K bytes of storage are required. OS requires 80 K and DOS/VS requires 64 K of core partition. For IBM 1400 and Honeywell 200 machines at least 8K characters of storage are required.

7.6.2 DYL 260. Source and Object computers are the same: IBM 360 and 370 with minimum 65K bytes of core storage. Supported under most current versions of OS and DOS operating system software, including VS options.

7.6.3 EASYTRIEVE. Runs on all IBM 360 and 370 and UNIVAC Series 70 machines.

7.6.4 EDP-AUDITOR. Runs on IBM 360 and 370 under DOS,OS, and VS operating systems. For DOS 54K bytes is the minimum core and for OS 80K bytes of core. Also runs on UNIVAC series 70 DOS,TDOS, and VMOS with 70-80K bytes of core.

7.6.5 HEWCAS. UNIVAC 1108 source computer, operating under INFONET CSTS. Minimum of 100 K bytes of core is required. Mass storage device - disk needed to store program,card punch needed to prepare output deck. Object computers are IBM 360 or 370 ,CDC, BURROUGHS , and HONEYWELL machines, with COBOL compilers.

7.6.6 MARK IV/AUDITOR. Different versions have been designed
for a variety of machine configurations including IBM 360
and 370, UNIVAC Series 70 TDOS, UNIVAC 9400 or 9480 DOS, and
UNIVAC Series 90 OS/4 systems, and SIEMENS 4004 PBS systems.
In the system 360/370 environment the system operates under
DOS, DOS/VS, OS, OS/VS1 and OS/VS2. There are six major
versions available. The basic Mark IV package requires 36K
bytes of core. Most applications require between 80 and 120
K bytes of core. On-line operation under IBM TSO is also
available. MARK IV has optional interfaces for update and
retrieval from TOTAL, DOS/VS, DL/1, or IMS data bases.

7.6.7 SCORE. SCORE operates on many computers and a variety
of operating systems: IBM OS (88K) , DOS (52K) ; BURROUGHS
4700 and 6700/7700 (8K words); CDC 6000 (50K words), UNIVAC
9000/9400 (50K), UNIVAC 1108/1110 (27K words), HONEYWELL
2000/6000, RCA-Spectra, and NCR Century. All systems require
COBOL compilers.

8. INPUT CHARACTERISTICS

General purpose audit packages must accommodate a variety of file characteristics and data types which exist in various client's files. Characteristics which can be handled by the various systems are listed below.

8.1 Data Types

A variety of data types that exist in various client's files must be accommodated by general purpose audit packages. These data types are machine representations, but are dealt with by the auditing software in a logical way. Examples of data types which the vendors are supporting are numeric, numeric signed, alphanumeric, decimal, binary, floating point etc.

8.1.1 AUDITAPE. Character, zoned(unpacked) decimal, packed decimal, or binary data formats are accepted by the IBM OS, DOS and DOS/VS routines. Other routines accept IBM or HONEYWELL tape codes.

8.1.2 DYL 260. Zoned decimal, packed decimal, binary,character.

8.1.3 EASYTRIEVE. Binary, alphabetic, zoned numeric, packed decimal data can be defined in input.

8.1.4 EDP-AUDITOR. Alphanumeric, binary, decimal, packed decimal, unsigned packed decimal, and bit.

8.1.5 HEWCAS. Numeric - signed,unsigned , display, computational, decimal, fixed length alphanumeric,i.e. COBOL data types.

8.1.6 MARK IV/AUDITOR. The various versions are designed to handle access methods, data representations, and conversions automatically, transparent to the auditor.

8.1.7 SCORE. All data types acceptable to COBOL can be processed.

8.2 Input File Characteristics

A variety of files and file types are typically accessible. These files may be sequential, index sequential, or their organization may depend on a particular data base system. Record types may be of fixed length or of variable length. Records may be grouped in blocks or they may be unblocked. Files may have ANSI standard labels, industry standard labels, non-standard labels or no labels. A system may have to recognize various file marks such as "end of reel", "end of file", or "end of volume". In some applications, the auditor must specify detail in the client's files which is to be processed by the audit system. The files may be either processed directly, in which case complete specifications for all format detail must be stored in the object computer, or an intermediate file may be prepared, which is in a standardized format.

8.2.1 <u>AUDITAPE.</u> All punched card and fixed length magnetic tape records and many types of variable-length magnetic tape records can be processed. For IBM systems six different types of variable-length records can be processed. DOS/VS and OS systems can also accept disk files in sequential ISAM, and undefined formats. For Honeywell systems two types of variable-length records can be processed.(Bannered and unbannered records). An intermediate "Auditape" is always produced which is used as input to other routines.

8.2.2 <u>DYL 260.</u> Almost any IBM format can be handled: fixed and variable length, blocked, unblocked, sequential, indexed sequential files. Also accommodated can be Honeywell and Univac formats.

8.2.3 <u>EASYTRIEVE.</u> Fixed and variable length, blocked and unblocked records, sequential or indexed sequential records or input stream of cards or of card image records can be handled. Almost all IBM formats can be handled.

8.2.4 <u>EDP-AUDITOR.</u> Just about any type of file can be handled--sequential, index sequential, random, and data base (DL 1,DATACOM/DB,IMS,RDMS,TOTAL, and IDMS). The record formats supported are fixed, variable, and undefined. Label support is for standard, omitted, and user labels. Any block size compatible with the computer system can be used.

8.2.5 <u>HEWCAS.</u> Sequential, indexed sequential, random files can be handled. Fixed length, variable length record types. Any block size compatible with COBOL. COBOL standard labels or no labels can be handled.

8.2.6 Mark IV/AUDITOR. Different versions accommodate formats and file characteristics of different manufacturers. All data set organization can be utilized: sequential, indexed sequential, fixed length, variable length, and undefined data bases.

8.2.7 SCORE. Any type of file structure that can be accessed through COBOL can be handled by SCORE. (Sequential, indexed sequential, random, and all data bases.)

8.3 Media Characteristics

There exist a variety of media on which information can be recorded. This section summarizes media which can be handled by the various systems. Most systems provide flexibility for accepting files on cards, tapes, or disks. Similarly output can be provided on cards, tapes, or disks. Variations of media codes, such as tape codes of various manufacturers usually are handled by different versions of software packages.

8.3.1 AUDITAPE. Initial input records may be in punched card or magnetic tape form for the IBM 1400 and Honeywell 200 edit routine. The IBM DOS,TOS, and OS routines accept card, tape and disk inputs.

8.3.2 DYL 260. I/O devices supported include IBM 2311, 2314, 3330, and 3340 disk drives, plus the usual unit record peripherals.

8.3.3 EASYTRIEVE. Punched card, tape, or disk input are accepted.

8.3.4 EDP-AUDITOR. Tapes, punched cards, and IBM 2311,2314,3330, 3340, 3350 disk drives are supported.

8.3.5 HEWCAS. The system supports cards. tapes; and disks.

8.3.6 MARK IV/AUDITOR. The various versions support card, tape and disk input.

8.3.7 SCORE. The system handles whatever the host COBOL and operating system can handle; generally this includes all device/media combinations available on the object computer.

9. BASIC FUNCTIONS AND UTILITIES

This section furnishes an overview of some basic data processing functions,which permit the auditor to analyze client files, and to display client data in a form suitable for analysis by the auditor.

9.1 Copying

Although there usually are utility programs available at the clients site, some generalized audit packages provide for file copying capabilities. Detail on systems analyzed are given below. In some cases the copying function includes a selection capability.

9.1.1 AUDITAPE. All input file records can be translated into the standard Auditape format by means of the different input edit routines. No explicit copy routine is available.

9.1.2 DYL 260. Easily specified with a few parameters; provides control tables and options for diagnosing bad records or for reformatting.

9.1.3 EASYTRIEVE. Copy capability is available for file maintenance.

9.1.4 EDP-AUDITOR. Can take in any input file format and produce whatever output format file is desired, i.e. it can copy a file or only selected portions of a file.

9.1.5 HEWCAS. HEWCAS can take any type of input file and select all the records producing a disk or tape output file.

9.1.6 MARK IV/AUDITOR. No special provisions for copying available as part of the Auditor routines. Copying routines are available as part of the Mark IV capabilities.

9.1.7 SCORE. Records may be copied onto an output file from multiple input files, with records selected on logical comparisons and on whether or not the primary and secondary input files are matched. Up to 99 output files may be created from one pass of the input files with the optional MULTIPLE REPORT feature.

9.2 Sorting

Sorting refers to the arranging of a set of records in a specified order, according to sort keys. The order may be an alphabetic or numeric sequence. Ascending or descending sequences may be required. Several sort keys may be specified in some systems for one pass operation. In some system sorting is combined with other input, processing or output functions to speed up or to simplify the auditor's task.

9.2.1 AUDITAPE. Sort routines are available for IBM 360 and 370 DOS,TOS and OS systems. Several Auditape routines require input Auditape files to be in sequence based upon specified control fields. The sort routine or sort program arranges the Auditape file into sequence by the fields specified.

9.2.2 DYL 260. Has its own sort module, to sort during input, selection, or prior to printing or writing output file.

9.2.3 EASYTRIEVE. Sorting and calculations can be done in one step. Up to ten fields can be sorted in ascending or descending order.

9.2.4 EDP-AUDITOR. Has capability to sort with up to 20 sort key fields in any one report. Each sort field can be specified as ascending or descending. Sorting may also be performed on calculated values.

9.2.5 HEWCAS. Has no internal sort capability.

9.2.6 MARK IV/AUDITOR. Sorting sequence of reports can be specified independent of the sequence of the input file, as part of the report specification.

9.2.7 SCORE. Uses COBOL sort capability (SORT verb). The user specifies the sorting sequence desired, either Ascending or Descending for every item to be sorted. The sort limitation is identical to that of the operating system.

9.3 Multiple File Input

Ability to handle multiple files simultaneously on input improves flexibility of the package. This is useful for the comparison of files, for merging and matching operations. This capability requires the appropriate number of input equipments needed for simultaneous operation.

9.3.1 AUDITAPE. Two tapes can be handled simultaneously on input.

9.3.2 DYL 260. Four input and four output files can be handled simultaneously.

9.3.3 EASYTRIEVE. Up to two input files can be handled simultaneously.

9.3.4 EDP-AUDITOR. Up to 256 input files can be handled at one time.

9.3.5 HEWCAS. Two input files can be handled simultaneously.

9.3.6 MARK IV/AUDITOR. Information from up to eleven input files may be combined. This capability is available for use with any AUDITOR routine.

9.3.7 SCORE. Can handle a total of eight files, of which from one to six can be input or output depending on the user's need. With the MULTIPLE REPORT feature the system can generate more than 200 output files.

9.4 Merging

     This refers to the combining of records of two or more files, that are each in the same sort order, into one file, in that order. Merging is useful for making files more understandable to the auditor e.g. a vendor name file may be merged with a sales file to provide vendor names rather than vendor codes to the auditor.

9.4.1 AUDITAPE. A Match/Merge routine compares two separate files of Auditape records on as many as five control fields and writes an output file of records that match as to the control fields specified. The output file may contain records from either input file or from both input files, as specified.

9.4.2 DYL 260. Provided as specified by input parameters up to a 4 way merge.

9.4.3 EASYTRIEVE. Two files may be merged by keys.

9.4.4 EDP-AUDITOR. Merging is automatically accomplished with the file matching facility. Up to 4 different file match keys may be specified.

9.4.5 HEWCAS. No merge capability available.

9.4.6 MARK IV/AUDITOR. Up to eleven input files may be automatically combined by MARK IV/AUDITOR either sequentially or directly.

9.4.7 SCORE. Records can be selected from several files by means of boolean logic,"first-n records" criteria, etc. and the results can be merged onto a new file. No "built-in" merge parameter available, however.

9.5 File Validation

    File validation refers to the checking of data for correctness, or compliance with applicable standards, rules and conventions. Copies of files can be validated through bit-by-bit comparison with a master file. Discrepancies can be indicated and system reaction can be programmed.

9.5.1 AUDITAPE. The Match/Merge routine can be used for file validation. It can also check for duplicate records within the same file(control field data is equal). These duplicate records may be accepted or rejected for further processing and optional listing on the printer. Outputs also include record counts, net totals of quantitative data in fields 7 - 12, and positive and negative totals of quantitative data in field 9.

9.5.2 DYL 260. Provided as specified by input parameters. Input can be matched against 3 other files.

9.5.3 EASYTRIEVE. Input files can be matched, two at a time. If a data exception occurs, the error field is printed, along with the contents of all working storage fields.

9.5.4 EDP-AUDITOR. There are library routines for file footing allowing the user to determine if the appropriate number of records are present and if the data in those records are what is expected. In addition, a data exception analysis routine is available, where for example data defined as numeric, but actually alpha numeric, are flagged and dumped. When 30 data exceptions are encountered, the processing ceases. Fields and records containing data exceptions are displayed.

9.5.5 HEWCAS. Prints number of input records where a data field defined as numeric contains non-numeric data. Prints records where fields are defined as numeric but contain non-numeric data. Stops processing after 100 invalid records. Prints number of blocks with input/output errors (terminates after 200 errors). Finds duplicate fields in

one file and lists records. Finds duplicate fields in two files and lists records. Record layouts on the two files may be different,except for matching fields.

9.5.6 MARK IV/AUDITOR. The system checks automatically for arithmetic overflow, invalid operations(for instance, division by zero), and invalid data. Erroneous reports are highlighted without affecting any other reports, selection, or calculations in the run. Any numeric field can be examined to determine missing numbers, or to detect numbers appearing in more than one record on a file.

9.5.7 SCORE. No special file validation routine is provided, other than normal COBOL I/O diagnostics. Can match up to five data items per file in two files, to permit processing the two in parallel. Can not check for duplicates in one file, except through user's own code.

9.6 File Matching

     Matching of files permits the determination of identity of records or files. Duplicate records can be identified in one file, or by comparison of two files.

9.6.1 AUDITAPE. The Match/Merge routine compares two separate files of Auditape records on as many as five control fields and writes an output file of records that match as to the control fields specified. The output file may contain records from either input file or from both input files, as specified. Also duplicate records may be listed as cited above in 9.5.1.

9.6.2 DYL 260. Provided as programmed by input parameters.

9.6.3 EASYTRIEVE. Two input files may be matched by keys and merged in one step operation.

9.6.4 EDP-AUDITOR. Up to 256 input files can be matched and their information consolidated into one file.

9.6.5 HEWCAS. Duplicate fields can be found in one file, and the records are listed. Duplicate fields can be found in two files, and the duplicate records can be listed. Record layouts on the two files may be different, except for the matching fields.

9.6.6 MARK IV/AUDITOR. Two or more files representing similar data can be compared for exceptions.

9.6.7 SCORE. Matching is handled with a simple MATCH parameter. Matched records can be combined for printout, merging onto a new file, etc.

10. NUMERICAL AND LOGICAL OPERATIONS

Auditing software provides assistance to the auditor in the evidence gathering process. The auditor collects data from client's files, and puts these data in a form which permits analysis and auditing. Both during the collection process and during the analysis of the data numeric and logical processes are used to combine fields, to compare fields, and to summarize and select data. Arithmetic operations such as addition, subtraction, multiplication and division are available. Other capabilities are the counting of records, simple computation of percentages, and computation of standard deviations.Relational operations permit comparison of magnitudes of numeric fields on the basis of operators such as equal to, not equal to, greater than or less than and combinations of these. Logical capabilities include AND, OR, and NOT operations, and a conditional operation similar to IF... THEN.

10.1 Arithmetic Operations

Arithmetic operations such as addition, subtraction, multiplication and division are available.Other needed capabilities are the counting of records, simple computation of percentages, and computation of standard deviations.

10.1.1 AUDITAPE. A mathematical routine is provided, that performs addition, subtraction, multiplication or division of amounts in any two quantitative fields of an Auditape record, or of an amount in one field and a specified constant. The routine can perform 10 separate computations in each pass. For both input files and output files record counts, net totals and totals of positive and negative data are printed for some fields. The result of any computation can be used as an operand in a subsequent computation within the same pass.

10.1.2 DYL 260. Data in zoned decimal, packed or binary format can be added to, subtracted from, multiplied by, or divided by data of the same or of different format. Totalling and control breaks are automatic.

10.1.3 EASYTRIEVE. Totals can be calculated automatically on control break. A variety of numerical calculations can be specified by the user, such as percent of total, average, addition, subtraction. Calculations can be made in conjunction with merging and sorting in one step. All formats can be used together, and decimal alignment is done automatically.

10.1.4 EDP-AUDITOR. Any numeric field can be totaled. There can be 2Ø (standard) to 6Ø (optional) levels of totaling, with no system limits on the number of fields in any one level. Arithmetic capabilities present are addition, subtraction, multiplication, and division. There are library routines for statistical analysis. Temporary variables can be defined, tested, and printed.

10.1.5 HEWCAS. Totals can be reported on any numeric field. Totals can be reported by strata levels. No other explicit arithmetic functions are available.No temporary variables for testing are available.

10.1.6 MARK IV/AUDITOR. Addition, subtraction, multiplication, division and replacement may be applied to data fields or constant values. Conversions from one data type to another are handled automatically. Calculations may be specified on the calculations work sheet, on the selection work sheet or the information request work sheet and resultant values may be used for record selection, further processing, or reporting.

10.1.7 SCORE. Any COBOL computational capability can be specified, including addition, subtraction, division, multiplication, and exponentiation. Up to nine temporary variables are available automatically; an unlimited number may be submitted through user own code. Up to 12Ø totals may be specified automatically; an unlimited number may be specified with the optional MULTIPLE REPORT feature.

10.2 Relational Operations

Relational operations permit comparison of magnitudes of numeric fields on the basis of operators such as equal to, not equal to, greater than or less than and combinations of these.

10.2.1 AUDITAPE. The Include/Exclude and Subtotal routines provide for three types of comparisons of input records and specified codes: Greater than, equal to, and less than. For nonquantitative data comparison is based on the IBM collating sequence. The printed output will include for each output file record counts, net numeric totals, and totals of both positive and negative numbers for one field. Records meeting or not meeting the comparison criteria may be specified for output. If subtotal routine is specified subtotals for each specified code, record counts will be printed out. Four routines provide for subtotals, inclusion, inclusion and subtotals, and exclusion of records.

10.2.2 DYL 260. Tests include "equal to", "less than", "greater than", "less than or equal to", "greater than or equal to".

10.2.3 EASYTRIEVE. A complete set of relational operators (such as greater than, less than) are available in connection with the IF statement.

10.2.4 EDP-AUDITOR. Comparisons can be made on numeric and nonnumeric fields for equality, inequality, greater than or less than relationships.

10.2.5 HEWCAS. Comparisons are made for equality and range (low and high limits).

10.2.6 MARK IV/AUDITOR. Tests include greater than, less than, equal to, not equal to, and less or equal and greater than or equal. The data in the specified field may be compared to a field from the file, a character constant, or a decimal constant. Data in the specified field may also be compared to any temporary field.

10.2.7 SCORE. Has COBOL capability, which generally includes: EQUAL, NOT EQUAL, GREATER/LESS THAN, GREATER/LESS THAN OR EQUAL TO, test for numeric field, test for alpha field.

10.3 Logical Operations.

Logical capabilities include and, or, and not operations, and a conditional operation similar to IF... THEN.

10.3.1 AUDITAPE. The Match/Merge routine provides for printing of records that do or do not have a matching primary or secondary record. (The input files are designated as primary and secondary files). The expanded edit routine in the OS and DOS/VS systems contains capabilities for equal, greater than, and less than comparisons with true/false action paths.

10.3.2 DYL 260. Logical operations are not explicitly provided,but implicitly programmed through entry of parameter values and sequence of actions. Complete AND/OR logic and IF/THEN/ELSE logic permit formulation of complex requests.

10.3.3 EASYTRIEVE. AND/OR logic and IF/THEN/ELSE logic are available. Within each logical operation arithmetic calculations, data movements, tests, table lookups, and output operations can be performed.

10.3.4 EDP-AUDITOR. The logical operators AND, OR, NOT IF-THEN-ELSE are not explicitly used, however, these functions are implicitly available in the EDP-AUDITOR language via the placement of the conditional expressions.

10.3.5 HEWCAS. In the selection criteria the implicit AND operator is available.

10.3.6 MARK IV/AUDITOR. AND and OR connectors may be specified during record selection. More complex logic may be specified by means of level specification. Records NOT to be selected may be identified during the selection specification.

10.3.7 SCORE. Logical operations include IF, nested IF, ELSE, NOT, AND, OR, plus all other operations supported by COBOL. Match routines provide for printing of records that do or do not have a matching primary or secondary record.

11. CLASSIFICATION

Under this heading are grouped several functions which permit assignment of records into a set of predetermined classes. The two most common ways are stratification and aging. Classification permits the auditor to separate records or information into sets which then can be examined according to different criteria. It may be required to examine all disbursements above a certain dollar amount, but to only sample those below that amount.

11.1 Stratification

Stratification is defined here as the separation of records into sets of classes. Stratification may be based on dollar amounts, or dollar ranges, in which case these ranges must be specified by the auditor. Often the system provides a set of ranges as a default capability. Stratification may also be based on account classifications, or other criteria.

11.1.1 AUDITAPE. The subtotal option in the Include/Exclude routine provides stratification as a result. Control totals of the number and monetary amount of items in the population and in the sample are printed out. These totals are classified into two or three strata, top and bottom, or top, middle, and bottom strata as specified.

11.1.2 DYL 260. Stratification can be implicitly programmed through entry of parameter values and a sequence of actions.

11.1.3 EASYTRIEVE. Stratification can be specified including record count, money amounts, percentage and average calculations.

11.1.4 EDP-AUDITOR. There are pre-written stratification routines called Stratified Random Selections which perform automatic stratification into 6 strata. The user can specify the ranges. If more strata are required, the user has the capability to specify any number of strata in the EDP-AUDITOR language.

11.1.5 HEWCAS. Selection and stratification processes are combined in HEWCAS. Maximum number of strata that can be specified is 30(option 1), and 90 (suboption 2).

11.1.6 MARK IV/AUDITOR. Records may be automatically stratified, based on ranges of values. Up to 20 different strata may be specified in a "stratification table", and three stratification tables can be used. Each stratum is assigned a group code, which then may be used for record

selection, reporting, control breaks, sorting, and
conditional calculations or other processing.

11.1.7 SCORE. No special provision is made for
stratification. The user can specify stratification by
first sorting, then specifying a control break for each
interval desired.

11.2   Aging

        Aging refers to the placing of records into ranges
based on time based criteria. As an example all records may
be classified into those from 0 to 3 months old, 3 to 6
months old, and older than 6 months.

11.2.1 AUDITAPE. Aging may be performed by use of the
subtotal option in the Include/Exclude routine.

11.2.2 DYL 260. Provided as programmed by input parameters.

11.2.3 EASYTRIEVE. Aged analysis reports can be prepared.

11.2.4 EDP-AUDITOR. There are library routines in the
summary analysis which perform an aging summary
automatically.

11.2.5 HEWCAS. No provision for aging.

11.2.6 MARK IV/AUDITOR. An aging worksheet provides for five
types of date format, and four types of aging analysis.
Columnar aging provides detail within each account number.
Summary aging provides aged summaries for each account
number, i.e. one line per account number. In category aging
each detail record within each age group is shown or the
report may show each detail record within each age group
within each account number.

11.2.7 SCORE. No special provision for aging is offered.
The user can specify aging by first sorting the file, then
specifying a control break for each interval desired.

12.   SELECTION

The auditor selects those records from client files, which are of special interest to him. Selection may be based on record attributes, such as account number, vendor number, plant location etc., or it may be based on dollar range or account ranges, as defined during the classification process. Selection may also occur by means of sampling. Sampling may be done on a periodic basis, i.e. every tenth record may be selected, or it may be done on a random basis. Selection criteria may be combined by means of logical or relational operators. Selection may also occur on a temporary variable(a field produced as a result of an arithmetic calculation).

12.1.1 AUDITAPE. The Estimation Sample Design, Selection and Evaluation routines will design, select, and evaluate a sample as a stratified regression estimate on a separate or combined basis. Mean, ration, and unstratified estimates may also be obtained as special cases of a regression estimate.

12.1.2 DYL 260. Fields may be tested with complex selection logic set by parameter values and sequences. Random sampling requires exit to a special routine for random numbers.

12.1.3 EASYTRIEVE. Selection of records is made with the IF statement and a listing of logical and/or statements. Also many special tests can be made to select records that are blank, alphabetic, numeric, negative, hexadecimal, changed since "last record in", sorted etc.

12.1.4 EDP-AUDITOR. In addition to the standard selection capability of testing for equality, inequality, greater than, and less than relationships, there is a library of selection and sampling programs including a random number table, simple random selection, stratified random selection, and 6 different statistical sampling techniques. The 6 additional sampling techniques are discovery, stop-or-go, attributes, variables estimation, numerical, and proportional sampling. Selection can also occur on a temporary variable.

12.1.5 HEWCAS. Interval sampling with random start is possible. Other selection criteria are matching for equality, and matching for within range, high and low limits. No logical limit on number of fields that can be tested. Number of fields limited by printer width. No selection is possible on temporary variables. Item sampling,and dollar unit sampling are available, both also

with interval sampling.

12.1.6 MARK IV/AUDITOR. Selection may be based on sampling, range selection, additional criteria specified before or after sampling, logical criteria, or computation. A variety of sampling routines are available, such as interval sampling, interval sampling with multiple random starts, random sampling, cumulative monetary amount sampling, limit number selected, and stratified monetary sampling. Records not to be selected may be also specified.

12.1.7 SCORE. Complex record selection criteria may be specified by the user. No logical limit on the number of fields that may be tested. Selection may be based on temporary variables. Every n-th record read, or every n-th record selected may be processed through the use of a control card. An optional RANDOM NUMBER GENERATOR may be used to randomly select records for processing.

13. SUMMARIZATION

Summarization refers to the summing of numeric totals, or subtotals, for items with common attributes, such as account number, vendor number etc. For purposes of internal control it is necessary to count and report total number of records. Summarization is used by the auditor to consolidate information of interest, which is fragmented in different files and records.

13.1.1 AUDITAPE. For each numeric field summarized the output provides the number of items summarized, positive, negative, and net totals before and after summarization. Out-of-sequence records can be identified. Any contiguous positions in the Auditape record may be specified as control field for summarization.

13.1.2 DYL 260. All detail records in a file can be combined based on a key field to produce a total record for further processing. There is no limit on the number of fields that can be totalled by appropriate input parameters.

13.1.3 EASYTRIEVE. Summarization reports can be specified.

13.1.4 EDP-AUDITOR. Any numeric field is totalled automatically. There can be 20 (standard) to 60 (optional) levels of totaling (control breaks). There are library routines for file footing and summary analyses.

13.1.5 HEWCAS. Totalling is available on any numeric field. The number of fields that can be totalled and printed at one time is a function of the printer width. No other arithmetic functions are available. No temporary variables are available.

13.1.6 MARK IV/AUDITOR. Summarization capability exists as part of the aging specification and the report specification. Summaries may be produced on a control break, and up to 9 levels of control breaks may be specified. Additional processes may be invoked automatically such as printing of subtitles, page eject, or cumulative totaling.

13.1.7 SCORE. Any computation possible with COBOL may be specified. Up to nine temporary variables are possible automatically; an unlimited number may be submitted by the user through own code. Up to 120 totals are possible automatically. An unlimited number of totals are available with the optional MULTIPLE REPORT feature.

14.   DIAGNOSTIC AND CONTROL CAPABILITY

In this section the basic diagnostic capability of the software package is discussed. Certain controls need to be exercised as part of an audit to assure integrity, and to maintain accuracy of the data.   This pertains to the physical tape, the processing and the records resulting from the processing.

14.1.1 AUDITAPE. Control totals and record counts are provided automatically.   Internal file labelling is used for all files created by the Auditape system. Some Auditapes, especially those used in multiprogramming environments, contain new features, which are subject to change. To avoid use of outdated tapes, each of these tapes will function only until a self-contained expiration date is reached. Each Auditape contains a unique control code keyed to the control number of the Auditape reel. This code is printed on printouts and with certain console messages. These control codes are maintained on a confidential basis and help assure system integrity.   On some tapes independent control totaling is available as an optional feature.

14.1.2 DYL 260. Seven levels of control break are available. At the end of a run a complete set of file counts and diagnostics are printed out.   Diagnostics are in form of error messages, indicating code errors, incorrect data field sizes,discrepancies between specified data types and data types in records,invalid characters,etc.

14.1.3 EASYTRIEVE. Nine levels of control breaks are available.   Record counts are documented automatically.

14.1.4 EDP-AUDITOR. The EDP-AUDITOR specifications are checked for accuracy, and error diagnostics are printed out prior to the extraction of input data.

14.1.5 HEWCAS. Because HEWCAS prompts the user for the input specifications, the user can correct input errors immediately without waiting for a batch summary error listing.

14.1.6 MARK IV/AUDITOR. The control break, statistical, and footing capability of the reporting routines which may be specified by the auditor, provide control capability. Statistics capability includes totals, subtotals, averages, counts, cumulative totals, maximum and minimum values, percent, and ratios, which may be specified at any control break. All Mark IV/Auditor specifications are automatically validated, and error diagnostic messages are printed.

14.1.7 SCORE. Provides a thorough edit check of SCORE parameter statements. An extensive list of error messages describes any detected specification errors. SCORE-generated COBOL code is error free. User submitted COBOL errors are diagnosed by the COBOL compiler.

15.   REPORT PREPARATION CAPABILITY

For many routine applications standard report formats
are practical, and require only a minimum of specification.
For ad-hoc reports, or one-time applications, report formats
must however be flexible and must be easy to adjust.   Points
to be considered are number and widths of columns in
reports,number of lines, heading and footing formats.
Automatic editing capability with regard to dollar signs,
commas and decimal points, zero suppression,etc.   is
required.   Functions which are necessary for internal
control and maintenance of an audit trail are automatic line
numbering, page numbering, record numbering, the counting of
records, and the provision of control totals as required by
the auditor.   Another feature often provided is the ability
to generate confirmation notices. Often provision for
printing of mailing labels is also provided.

15.1.1 AUDITAPE. The Print/Punch routine takes standard
Auditape inputs, and provides printed or punched card output
or both. The printed output includes listing of all records
in input file, with either one or two printed lines per
record, depending on number of fields specified.   Fields may
be printed in any sequence. Optional column headings may be
specified. Listings also contain a record sequence number, a
random item number for selection routine output, a count of
items summarized for summarization routine output. The most
commonly used specifications are assumed, and entries are
needed only for those specifications that differ from the
assumed ones.   Additionally the Print Confirmation routine
may be used to generate confirmation notices on a full file
basis or with output from the Audit Sample routine.   Text
generated is the standard AICPA text, or optionally user
generated text. Addresses fit standard window envelopes,
thus avoiding need for mailing labels.

15.1.2 DYL 260. Automatic composition or user specified
columns can be used. Page format can be specified in terms
of lines per page, characters per line,column spacing, line
spacing, and control breaks.   Report titles can be specified
with up to nine lines, headings and footings, spacing, and
centering. Report lines can be specified to relate to input
file specifications, several types of editing, rounding,
justification, and printing of totals at control breaks.
Column headings may contain text or formulas.

15.1.3 EASYTRIEVE. Automatic page numbering,date insertion,
centering for titles and column headings is available. Paper
size options are 8 1/2 x 11, and 8 1/2 x 14. Automatic page
ejection is available. A PRINT command is used for text
generation. Ten sort fields, 9 levels of control breaks, 25

fields maximum on one line, four title lines which may include variable information. Format controls may be overridden to create special non-standard formats.

15.1.4 EDP-AUDITOR. The output formats are completely flexible. The user can specify horizontal and vertical placement; multiple header lines, total lines and detail lines; single, double, triple spacing; page length, page numbering, output editing such as decimal point placement, asterisk or comma fill, number of digits printed, etc. These functions can be specified for each report and up to 100 separate reports can be printed at one time. Defaults are available for automatic report formatting and header generation, floating dollar sign, filling, totaling, page numbering, dating etc.. Library routines are provided for confirmation and label printing.

15.1.5 HEWCAS. Spacing between vertical columns can be specified. Title and footing cannot be modified except by COBOL program modification. Automatic zero suppression and comma insertion for numeric fields is available. Line spacing is fixed. No automatic page numbering is available. Up to 90 separate extracted files can be produced from one input file. The formats of the output files must be the same.

15.1.6 MARK IV/AUDITOR. In addition to fixed format reports there is flexibility to design one-time "ad-hoc" reports. The MARK IV capability is available, which provides for output editing, specification of as many title lines as desired, specification of a preface to be printed before the report, entering of comments, and specification of free-form page formatting. Page width and height are adjustable, number of detail page images is flexible(such as mailing labels), column heading positions , date position, page number position, and page numbering are flexible. Confirmation notices may be automatically prepared on a sampling basis, letters or preprinted forms may be used, and confirmation notice reconciliation and optional second notice generation are available. Mailing labels can be generated automatically for confirmation notices.

15.1.7 SCORE. Report format may be specified in terms of lines per page, characters per line, column control, page ejection, page numbering and date insertion. Page width and depth are completely flexible. Automatic or user controlled editing for rounding, decimal point location, leading zero suppression, floating dollar sign and asterisk check protection. Mailing labels and audit confirmation may be printed automatically. All print lines may contain variable information and up to 9 lines may be spaced after each print function. Up to 9 heading and 5 footing lines are available

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per page. Up to 5 uniquely formatted detail lines may be
printed on each read cycle. Up to 9 differently formatted
summary lines may be printed on up to 6 control breaks.
Data may be extracted automatically from up to 9 different
tables, with the optional TABLE LOOKUP feature. Up to 99
different reports, each in a different sorting sequence, and
each with all the above features, may be printed from one
pass of the input files with the optional MULTIPLE REPORT
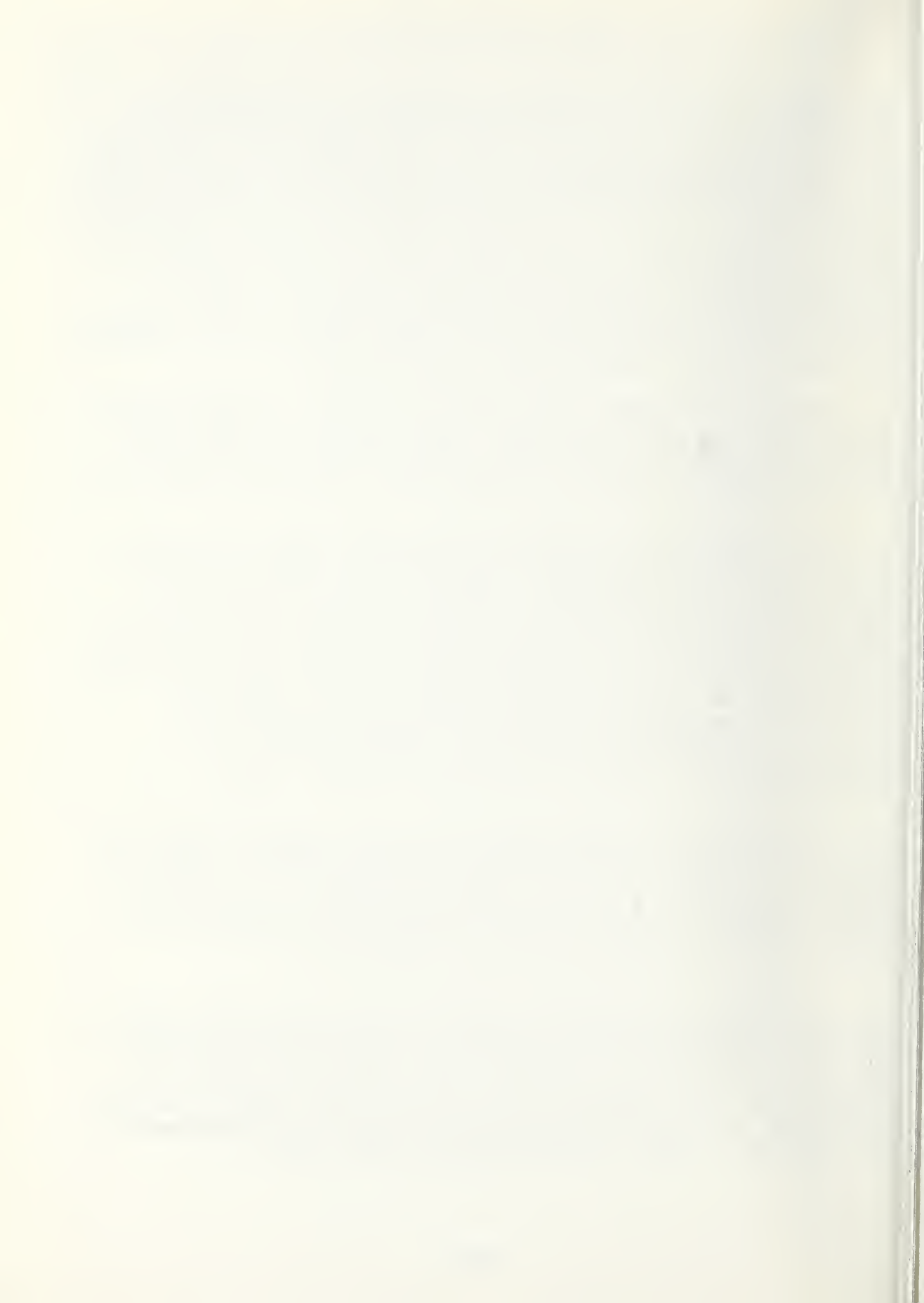feature.

16. CONCLUSIONS

This overview of auditing software in the context of the overall auditing process illustrates the complexities both of auditing and of the audit software field. Auditing as a profession is changing. Internal auditing is expanding with the expanding scope of organizations. Electronic funds transfer and automated information systems of trans national corporations, are but two examples where expanded scope of auditing techniques is required. The increasing emphasis on data security and privacy is adding a new dimension to systems planning and auditing and is becoming a fertile field for the auditor and for software applications. At the same time EDP professionals are joining auditors in auditing of large, complex computerized organizations.

Use of the terms "audit" and "auditing" in the broader sense, meaning system analysis with respect to efficiency, quality of results, relevance, and accuracy is increasing, and the internal auditor is expanding activities beyond the financial area.

The term audit software covers only a small part of existing computer programs which could be used in auditing processes. Data management systems could be applied to audit planning, statistical analysis packages are being applied to the determination of accuracy and reliability of numerical tests, and information retrieval systems could be applied to the collection of evidence useful not only in the assessment of financial information, but in resource utilization and assessment of utility of products and services. Management information systems should be available to the auditor and should provide useful information.

The relatively small sample of seven systems discussed here illustrates the difficulty of description of a set of systems in common terms. It would be desirable to develop common denominators for features of systems, which could be used as design criteria, and as evaluation guideposts for independent evaluation and system comparison.

Although some software vendors claim that their audit software packages can be used by non computer-specialists, there is considerable discussion on this point among users of audit software. It appears that much can be done in simplifying audit applications, which would reduce training costs and operating expenses and provide the independence for auditors, which is required for their work.

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16. ABSTRACT *(A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here.)*

The objectives of the auditing process are illustrated by a review of auditing standards for external and internal auditors. Some basic concepts of auditing are defined. Methods for computerized internal control are outlined. Characteristics and features for seven major commercially available audit software packages are described under common headings dealing with the computer environment, input file characteristics, history, availability and cost, and general system characteristics. Basic functions and specialized audit functions of software packages such as numerical and logical operations, stratification and aging, selection, and summarization are described for the various packages.

17. KEY WORDS *(six to twelve entries; alphabetical order; capitalize only the first letter of the first key word unless a proper name; separated by semicolons)*

Audit packages; audit routines; audit software; auditing; auditing standards; computer assisted auditing; computer auditing.

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