CAATTs History

Computers are not new to us. From microwave ovens to DVDs, everywhere around us we see and feel the effect of the microchip. But, too often, we have either not applied these new technologies to our everyday work activities, or we have only succeeded in automating the functions we used to do manually. "Things are working fine the way they are" or "I'm not an IS auditor" are just two of the many excuses we hear for not capitalizing on the power of the computer. However, we cannot afford to ignore the productivity gains that can be achieved through the proper use of information technology. The use of automation in the audit function—whether it is for the administration of the audit organization or tools employed during the conduct of comprehensive audits—has become a requirement, not a luxury. In today's technologically complex world, where change is commonplace, auditors can no longer rely on manual techniques, even if they are tried and true. Auditors must move forward with the technology, as intelligent users of the new tools. The vision of the auditor, sleeves rolled up, calculator in hand, poring over mountains of paper, is no longer a realistic picture. Automation has found its way into our homes, schools, and the workplace—now is the time to welcome it into the audit organization.

This book discusses microcomputer-based audit software, but the techniques and concepts are equally applicable to mainframe and minicomputer environments. Examples of software packages are provided, but the focus is on the discussion of an approach to using automation to assist in performing various audit tasks rather than the identification of specific audit software packages.

Throughout this book, Computer-Assisted Audit Tools and Techniques (CAATTs) and audit automation are meant to include the use of any computerized tool or technique that increases the efficiency and effectiveness of the audit function. These include tools ranging from basic word processing to expert systems, and techniques as simple as listing the data to matching files on multiple key fields.

The chapters:

- Define audit software tools
- Introduce relevant data processing concepts
- Discuss the implementation and benefits of information technology in auditing
- Describe the issues of data access, support to the audit function, and information technology training

This book was written as a guide to auditors who are interested in improving the effectiveness of their individual audits or the complete audit function through the application of computer-based audit tools and techniques. It does not cover technology audits, the audit of computer systems, or systems under development. However, the ideas and concepts are valid for IS auditors and non-IS auditors alike. The topics presented are particularly relevant to:

- Auditors with a requirement to access and use data from client systems in support of comprehensive or operational audits
- Audit managers looking for ways to capitalize on the potential productivity increases available through the adoption and use of CAATTs in the administration of the audit organization and in audit planning and conduct
- IS auditors wishing to expand their knowledge of newer tools and approaches, particularly in the microcomputer environment
- Persons with responsibility to implement automated tools and techniques within their operations

This book is designed to lead auditors through the steps that will allow them to embrace audit automation. It is written to help the audit manager improve the functioning of the audit organization by illustrating ways to improve the planning and management of audits. It is also written with the individual auditor in mind by presenting case studies on how automation can be used in a variety of settings.

It is hoped that this book will encourage auditors to look at audit objectives with a view to utilizing computer-assisted techniques. More than ever, auditors must increase their capability to make a contribution to the organization. The computer provides tools to help auditors critically examine information to arrive at meaningful and value-added recommendations.

The New Audit Environment

These are exciting times for internal auditors, especially those who see themselves as agents of change within their organization. The drive to do

more with less, to do the right thing, or to reengineer the organization and the way it does business is creating an environment of introspection and change. Change is occurring at a faster rate than ever, and this change is being driven by technological advances. Companies wishing to survive in these times must strive to exploit new technologies in order to achieve a competitive advantage. Today's business environment is rapidly and constantly changing, and technology is one of the key factors that are forcing auditors to reassess their approach to auditing. Other factors are the evolving regulations and audit standards calling for auditors to make better use of technology. These forces are creating a new audit environment, and audit professionals who understand how to evaluate and use the potential of emerging technologies can be invaluable to their organizations. New possibilities exist for auditors who can tie software tools into their organizations' existing systems (Baker [2005]).

The Age of Information Technology

In the last 20 years, we have progressed from Electronic Data Processing (EDP) to Enterprise-wide Information Management (EIM). We have gone from a time when hardware drove the programming logic and the software selection to a time when the knowledge requirements are driving business activities. As little as 15 years ago, information was almost a mere by-product of the technology; the selected hardware platform determined the software, which would likewise be a determining factor of each application. Today, the technology, the hardware and software, are merely delivery mechanisms, not the determining factors behind either information technology purchases or systems development activities. One of the main tenets of EIM is that the information is a key resource to be managed and used effectively by every successful organization. Data holdings are driving business processes, not the reverse, and there has been an increased treatment of information as a strategic resource of the business. From an audit perspective, this means that data and information are equally important. First, to analyze the current state of the business critically; and second, to help determine where the business is going or should go.

Decentralization of Technology

We are seeing a greater reliance on computers in every aspect of our world. Data processing is no longer confined to programmers or to the mainframe systems. We have seen the emergence of enterprise-wide systems in all business/operational areas in many organizations. In some, the separate information processing by specialized applications is a thing of the past. Enterprise-wide systems are changing the notion of traditionally centralized data and applications. Application programmers have been transferred

to business areas to support and encourage use of enterprise technology. Today, one can find business applications where a purchase order transaction is initiated in England, modified in the United States, and then sent to a processing plant in Mexico. All of this occurs in minutes—or even seconds—across time zones and continents. The modules or components are fully integrated with the business processes and occur without a paper trail. These types of applications make traditional manual audit approaches useless and impossible to apply. Auditors must learn how to access and analyze electronic information sources if they want to make a meaningful contribution to their organizations' bottom line.

Absence of the Paper Trail

While a "less paper" rather than a "paperless" office is the best we may be able to achieve in the near future, we have already seen the disappearance of paper in many areas as a result of information systems and technology such as enterprise system, Electronic Data Interchange (EDI), Electronic Commerce (EC), and Electronic Funds Transfer (EFT). The audit trail is electronic and is therefore no longer visible and more difficult to trace. The volume of data and its complexity is increasing at a rapid rate because of the requirement to quickly focus company resources on emerging problems or potential opportunities. To some, this lack of transparency is a problem; to the more enlightened auditor, this is an opportunity.

Do More with Less

There is increasing pressure to do more with less. Over the last 200 years, most of the productivity gains have occurred within the areas of production, inventory, and distribution, but little gain has occurred within the administrative functions. The automation of production plants saw reductions in the number of production workers within a plant, going from 200 people on the assembly line with five managers to 50 people on the assembly line and five managers. With productivity increases in the traditional, blue-collar areas becoming harder to achieve, there is increasing pressure to make improvements in the white-collar areas. Reducing overhead, doing more with less, and rightsizing all circumscribe efforts to make productivity gains in the management areas of administration. Given the unfortunately still widely held view that audit is overhead, internal audit must not only become more efficient in delivering its products and services but often must also pay its own way and become more effective in order to succeed.

As might well be expected, the factors driving business organizations also drive the audit function. In order to better serve the increasingly complex needs of their clients, auditors must provide a better service, while

being increasingly aware of the costs. To this end, auditors are looking for computer-based tools and techniques.

Definition of CAATTs

Many audit organizations have looked to the microcomputer as the new audit tool, a tool that can be used not only by IS auditors, but by all auditors. This book highlights the benefits of Computer-Assisted Audit Tools and Techniques (CAATTs) and outlines a methodology for developing and using CAATTs in the audit organization. Today's auditors must become more highly trained, with new skills and areas of expertise in order to be more useful and productive. Increasingly, auditors will be required to use computer-assisted techniques to audit electronic transactions and application controls. Laws like the U.S. Sarbanes-Oxley Act of 2002 are pushing audit departments to find new ways to link specialty tools into the complex business systems (Baker [2005]). By harnessing the power of the computer, auditors can improve their ability to critically review data and information and manage their own activities more rationally. Due to the critical shortage of these skills and talents, they will become even more valuable and marketable.

CAATTs are defined as computer-based tools and techniques that permit auditors to increase their personal productivity as well as that of the audit function. CAATTs can significantly improve audit effectiveness and efficiency during the planning, conduct, reporting, and follow-up phases of the audit, as well as improving the overall management of the audit function. In many cases, the use of the computer can enable auditors to perform tasks that would be impossible or extremely time-consuming to perform manually. The computer is the ideal tool for sorting, searching, matching, and performing various types of tests and mathematical calculations on data. Automated tools can also remove the restrictions of following rigid manual audit programs as a series of steps that must be performed. CAATTs allow auditors to probe data and information interactively and to react immediately to the findings by modifying and enhancing the initial audit approach.

In today's age of automated information and decentralized decision-making, auditors have little choice concerning whether or not to make use of computer-based tools and techniques. It is more a question of whether the use of CAATTs will be sufficiently effective, and whether implementation will be managed and rationally controlled or remain merely haphazard. Many organizations have tried to implement CAATTs but have failed. By understanding the proper use and power of computer-based tools and techniques, auditors can perform their function more effectively. This

understanding begins with knowledge of CAATTs, including their beginnings, current and potential uses, and limitations and pitfalls.

Evolution of CAATTs

Today's microcomputer-based audit tools and techniques have their roots in mainframe Computer Assisted Audit Tools (CAATs), which in turn are surprisingly rooted in manual audit tools and techniques. These mainframe-based tools were primarily used to verify whether or not the controls for an application or computer system were working as intended. In the 1970s, a second type of CAAT evolved, which sought to improve the functionality and efficiency of the individual auditor. These CAATs provided auditors with the capability to extract and analyze data in order to conduct audits of organizational entities rather than simply review the controls of an application. A third type of CAAT, and a more recent use of automated audit tools, focuses on the audit function and consists of tools and techniques aimed at improving the effectiveness of the audit organization as a whole. But, for a moment, let's step back in time to the late 1970s, as illustrated in Exhibit 1.1.

Books written on computer controls and audit in the 1970s did not include sections on end user computing or, at best, mentioned audit software only in passing. In fact, for the most part, auditors avoided dealing with the computer and treated it as the black box. Audit methodologies discussed the input and output controls, but largely ignored the processing controls of the system. The methodology employed was one of auditing around the computer. The main audit tools included questionnaires, control flowcharts, and application control matrices. Audit software was specifically written in general-purpose programming languages, was used primarily to verify controls, and parallel simulation was only beginning to gain ground. Audit software packages were considered as specialized programming languages to meet the needs of the auditor and required a great deal of programming expertise. The packages were mainframe-family dependent and consequently were limited in data access flexibility and completely batch-oriented.

By the 1980s, some of the more commonly used tools to verify an application system were test decks, Integrated Test Facilities (ITF), System Control Audit Review File (SCARF), and Sample Audit Review File (SARF) (Mair, Wood, and Davis [1978]). Other techniques included parallel simulations, reasonableness tests and exception reports, and systematic transaction samples. Some organizations were still achieving very effective results with these types of audit tools in the 1990s. In fact, according to a 1991 Institute of Internal Auditors' Systems Auditability and Control (SAC) study, 22 percent of the respondents were still using test decks, 11 percent were still using

EXHIBIT 1.1 Audit Tools and Techniques (Computer System Audit)

1970s	1980s	1990s	2000s
Programming Language Applications	3rd-Generation Programming Language Applications	4th-Generation Programming Language Applications	Web-enabled Software (XBRL)
1st-Generation Audit Software (Batch)	2nd-Generation Audit Software (Interactive and batch)	3rd-Generation Audit Software (PC-based interactive and batch)	Continuous Auditing
Simple Parallel Simulations	Extensive Parallel Simulations	Comprehensive Data Analysis and Testing	Digital Analysis
Test Decks/ Integrated Test Facilities (ITF)	Test Decks/ITF		
Input/Output Testing	SCARF/SARF (Definition in text)	Audit Software	Audit Assurance Software
Internal Control Review (ICR)	Automated ICR Questionnaires	Integrated ICR Questionnaires	Control Self Assessment
Questionnaires Control Flowcharts	Program Flowcharting	Process Flows Emphasis on Data Auditing	Visualization Software
1st Computer-based Monetary Unit Sampling	More Developed Dollar-Unit Sampling	Diverse Sampling Options including Stratified	Less Emphasis on Sampling
Control Matrices	Improved Control	Expert Systems	Neural Networks and Artificial Intelligence Matrices

ITF, and 11 percent were still using embedded audit modules (Institute of Internal Auditor's Research Foundation [1991]).

Audit Software Developments

The first audit software package, the Auditape System, which implemented Stringer's audit sampling plan (Tucker [1994]), already provided limited

capabilities for parallel simulation. The system facilitated limited recomputation of data processing results based on only a few data fields. In response to the Auditape System, many accounting, auditing, and software firms developed audit software packages that supported parallel simulation within computer families and against limited file and data types.

This proliferation of audit software and the overwhelming variety of data and file types to be audited led to the design of a generalized Audit Command Language (ACL), the implementation of several prototypes, and repeated calls for joint implementation efforts by all concerned.

In the late 1980s and early 1990s, the advent and proliferation of end user computing and the birth of the microcomputer became a major driving force in the computing world. These factors created the conditions within which audit software research results could be transferred into audit practice (Will [1980]). It became easy and economical to use the microcomputer to assess the controls over input data, over the processing of the actual data, and over the validity of the information generated as output. In fact, practically all electronic data has now become accessible to auditors anywhere and at any time.

Historical CAATTs

It is useful to review the various CAATTs briefly, in order to develop a common body of knowledge from which to judge the currently available audit technology and to assess its impact on audit practice.

Test Decks

Test decks are sets of input data created by the auditor to cover and test all types of possible transactions and scenarios. The name test deck comes from a time when transactions and even commands were entered into the computer via a stack (deck) of punched cards. The test data are input in the computer system and verified through the actual processing of the test transactions. These decks are used to test for incorrect processing of transactions by the application. The technique can be used to verify that edit checks and application controls are working. The main condition for the proper use of test decks is that the auditor must have an excellent knowledge of the system in order to generate a test deck that presents every possible combination of invalid transactions that may be encountered by the system. Of course, the auditor also has to be able to determine what the valid inputs and outputs are—or should be—in order to compare these with the actual processing results based on the test deck.

Obviously, errors and omissions can occur with test decks. The first type of error is the failure to include certain types of transactions that would have been incorrectly processed. These errors will not be identified because the transactions that should cause errors, are not part of the test deck. The second type of error is the failure to notice that data were incorrectly processed (i.e., transactions were entered and resulted in invalid processing, but the auditor failed to notice the errors that occurred).

Integrated Test Facility (ITF)

The Integrated Test Facility (ITF) is an improvement on the test deck. The ITF involves the entry of selected test items into a system, as if they are live data. The transactions are traced through various functions in the system and compared with predetermined results. Usually the ITF involves the creation of dummy accounts or organizational entities and departments, against which transactions are applied. For example, a fictitious division might be established with personnel and pay data entered for fictitious employees of that division. The results produced by the application are compared with the expected results, as determined by the auditor.

One of the main sources of problems with ITF lies in the requirement to remove the effects of the dummy transactions. If the test data or dummy accounts are not removed from the system, they may be inappropriately included in the live data and affect the processing results.

System Control Audit Review File (SCARF)

The System Control Audit Review File (SCARF) approach requires the auditor to develop detective tests. Auditor-determined reasonableness tests are coded in the normal processing programs and all transactions entered into the system are checked for reasonableness. If a transaction falls outside of the expected range, it will be flagged and an exception report produced. The results of these tests are then retained in a file for review by the auditors. SCARF, or a variation thereof, has seen a resurgence in use as companies search for responses to the requirements of legislation, such as Sarbanes-Oxley.

Sample Audit Review File (SARF)

The Sample Audit Review File (SARF) is similar to the SCARF, except that it uses randomly selected transactions rather than flagging transactions that failed the reasonableness tests. The random selection of transactions is retained as representative sample of transactions for audit review. The main drawbacks to the implementation of ITF, SCARF, and SARF are the requirement to involve the system development team and to identify the audit's

requirements during the user specification phase of the system development. In many cases, the priority afforded audit's requirements—when most development projects are running late and over budget—can easily be reduced or overlooked entirely. Often the audit modules are developed as add-ons after the system has been completed. Further, as modifications are made to the application, these audit modules and the test data may not be kept up-to-date. Before long, the embedded audit modules will not work properly. Often, as a result of the lack of management support required to maintain these tools, the use of these techniques decreases and auditors look to other approaches.

Sampling

Sampling as an audit technique has been around for many years. The American Institute of Accountants (the predecessor of the American Institute of Certified Public Accountants, AICPA) made an official statement on statistical sampling in 1962 (Ratliff, Wallace, Loebbecke and McFarland [1988]). Sampling techniques are used to generate statistically valid samples that can be reviewed by the auditors. Sampling was born out of the reality that auditors could not examine every single transaction using the methods at the time.

Statistical sampling has traditionally been an effective technique for testing the controls and other characteristics of computer systems. And with the advent of computer-generated samples, it became an even more effective approach. Audit software supported random, interval, and stratified sampling. In addition, new sampling methods, such as Dollar Unit Sampling, were developed to improve the utility of the results and reduce the sample sizes. Stratified sampling techniques and Dollar Unit Sampling became an accepted part of auditing in the 1990s, saving audit organizations many days of work while remaining an effective audit tool.

More recently, there has been a move away from sampling because of failures to identify significant misstatements and other irregularities. Today's audit technology allows auditors to review 100 percent of transactions, using embedded audit modules or advance analysis techniques (see the sections on continuous auditing and digital analysis techniques in Chapter 2). It should be noted, however, that while a number of audit organizations are performing continuous auditing of all the transactions, sampling techniques still offer a significant level of reliability when correctly applied and interpreted.

Parallel Simulation

Parallel simulation is a technique that involves duplicating a portion or module of the automated system either with a program written in a

general-purpose programming language or with audit software. Ideally, parallel simulation makes use of the same input data as the application system and produces results that are then electronically compared with the output produced by the actual system.

Initially, the problem with parallel simulation was the requirement to write mainframe programs to duplicate portions of the application's code. This usually involved programmers and required a lot of time, and as a result, was often not a viable option for a one-time audit.

Today, modern audit software and powerful microcomputer packages are much easier to use than mainframe programming languages and are equally powerful. Now, auditors can perform parallel simulation tests on the microcomputer, using data downloaded from the mainframe system, in a fraction of the time and without the involvement of the mainframe application programmers. The user-friendliness of modern audit software—its flexibility, power, speed, and ability to handle legacy data—allows auditors to design, implement, and execute their own comprehensive tests independently and in an unrestricted fashion.

In the 1990s, object-oriented programming languages allowed for rapid program development and the reusability of code for other audits. This sped up the development of the required programs for parallel simulation and allowed the code to be reused in other similar audits. However, the techniques of object-oriented programming may be beyond the capabilities of most auditors and will therefore require the involvement of computer specialists.

Reasonableness Tests and Exception Reporting

Current audit software allows auditors to perform reasonableness checks and exception reporting without the use of test decks, ITF, SCARF, or SARF. The entire transaction file can be directly accessed from, or downloaded to, the auditor's microcomputer and all transactions reviewed for edit checks, reasonableness, invalid data, and more. Rather than using test decks to see if specific edit checks are working properly, the auditor can review every transaction to identify all instances of erroneous, invalid, or unreasonable transactions. However, auditors recognize that the absence of invalid transactions does not mean that the system has edit checks to prevent the user from entering incorrect data—only that none was found. As a result, the audit emphasis has shifted and continues to shift. Not only the traditional meaning of CAATTs, but also the traditional audit paradigm, has been called into question (Will [1995]). Let us first consider the traditional approaches to computer-based auditing.

Traditional Approaches to Computer-Based Auditing

Computer-based auditing has traditionally been considered from two perspectives: a systems-based approach and a data-based approach.

Systems-Based Approach

A systems-based approach can be used to test the application's controls to determine if the system is performing as intended. In other words, the audit object is the whole information system in general and the various programs used to process the data in particular. Some approaches to internal control reviews are primarily based on a review of the application system in terms of input-output relationships and program reviews.

Test decks, IFT, SCARF, and so on are all forms of system-based audit techniques. But the design of audit software has eliminated the need for these approaches by including commands to assess the values of a field with the defined field type, or to summarize all transactions based on the value of the specified field.

Case Study 1 is an example of how a system-based approach can be used to test the controls of an application system. In this case study, the auditor was examining the controls over the supplier table as part of a larger audit of the financial controls.

Case Study 1: Financial Controls over the Supplier List

As part of the evaluation of the effectiveness of the financial controls, the auditors reviewed the supplier list. The financial system requires that all suppliers, from which the company bought goods or services, be on the supplier list. During a manual review of the financial controls, the auditors determined that many people could add a supplier's name to the list. The auditors decided to analyze the list, and a download of all suppliers was obtained. The file contained detailed information for 82,000 suppliers including name, supplier code, and address. The first test involved sorting the file and checking for duplicates. This revealed that, because of variations in the spelling, a supplier could have many different supplier codes. For example, the system treated XYZ Corporation, XYZ Corp, and XYZ Corp. as different suppliers, each with their own supplier code.

A second test was performed to identify cases where the same supplier had different addresses or different suppliers had the same

address. Finally, because of the risk over the ability of all staff to add suppliers to the list, the auditors performed two additional tests: one to match the supplier addresses with employee addresses and one to match supplier name and employee name.

The results of the match on names are shown in the table below.

Match Employee File with Vendor File

Vendor Name	Employee Name	Payment
T. SCARBARELLI CONSULTING	SCARBARELLI	6,976.67
CODERRE DAVE	CODERRE	3,765.32
CODERRE D	CODERRE	3,342.36
D CODERRE	CODERRE	3,168.97
CONSULTING - CODERRE	CODERRE	3,358.34
TILBURN BENEFIT FUND	TILBURN	985.50
CODERRE DAVE	CODERRE	3,217.17
CODERRE DAVE	CODERRE	2,930.19
LAEYER, CHRISTIAN	LAEYER	634.05
THE MATERIAL MANAGEMENT LTD	RIAL	700.00
SWIFT MESSENGER SVC	SWIFT	24.00
SWIFT MESSENGER SVC	SWIFT	11.04
PERRY JOHNSON, INC.	JOHNSON	2,003.30
C JAMES GIFT FUND	JAMES	748.35
BEALL INSTITUTE	BEALL	280.00
PERRY JOHNSON, INC.	JOHNSON	2,003.30

The automated analysis easily confirmed the control weaknesses with the supplier list and showed how these weaknesses presented opportunities for fraud. As a result of the audit, the controls over the supplier list were tightened and reports were produced to identify suppliers added to or deleted from the list, or when supplier addresses were changed.

Obviously, as illustrated in Case Study 1, the ultimate solution to the systems-based approach would be program verification, preferably automated; however, program verification is next to impossible and impractical. Only extensive testing of the systems is feasible and methodologically sound, and one can never be absolutely sure about the performance of computer systems.

Today, system-based approaches are not just used to test system edit checks. The approaches are often used in the planning phase of the audit to obtain an overview of the audit entity during the analytical review rather

than to test the application's controls. As such, they provide auditors with an historical perspective of the entity, for example, summary information concerning the business and activities of the entity and discernible trends over several years.

Case Study 2: Review of Employees and Salary Costs

The following table, Employees and Salary Costs by Department, is an example of a system-based CAATT, providing an historical view of the number of employees and associated salary costs for a branch office over three years.

Employees and Salary Costs by Department

Department	# Emp	CYR-2	# Emp	CYR-1	# Emp	CYR
Production	976	$39M	952	$40M	963	$41M
Personnel	210	$15M	252	$16M	216	$10M
Finance	132	$7M	132	$8M	125	$8M
Marketing	10	$1M	15	$2M	20	$3M
Total:	**1,328**	**$62M**	**1,351**	**$66M**	**1,324**	**$62M**

This type of high-level summary, across several years, gives the auditor an understanding of the employment trends of the business. The comparative picture of the audit entity, over years, helps to identify trends that would not be visible by examining the detailed transactions or by considering only one year of data. For instance, it is relatively easy to see that the average salary cost per person in the personnel department has decreased over the past three years, while the average salary cost per employee in the marketing department has increased significantly. A report of this type would also highlight any anomalies, such as an invalid department, or unreasonable conditions, such as unexplained, overly large increases from one year to the next for a given department.

While the presentation of the data contained in Case Study 2 may be considerably refined and even displayed in graphical form with modern microcomputer software, auditors must still be able to delve deeper into the data and information to identify causes and effects. The analysis shows you where to look, but it does not identify the reasons why.

Data-Based Approach

The second view of computer-assisted auditing focuses on the data and is commonly called transaction- or data-based auditing. This approach is primarily used during the conduct phase, providing the auditor with increasingly more detailed information about the audit entity. Often this technique is used to verify the accuracy, completeness, integrity, reasonableness, and timeliness of the data. It is also often used to address Sarbanes-Oxley compliance requirements. However, thanks to the increased power and functionality of audit software, transaction-based techniques are being employed in the planning phase as well. During the planning phase, transaction-based CAATTs can be used to assess risk and materiality issues, to identify specific lines of inquiry, or to develop the audit organization's annual plan. This helps ensure that audit resources are applied effectively in areas where audit will have a positive impact.

Case Study 3: Telephone Charges

As a result of the increased use of fax machines, personal computers with modems, and Internet accounts, telecommunication charges were increasing steadily. When the telecommunications budget more than doubled in three years, the vice president of Informatics asked the internal audit department to identify inefficiencies and areas for cost savings.

During the planning phase of the audit, an Internet search of audit programs found two telecommunications audit programs. The first audit program was more technical than the audit director desired, but the second proved to be very useful. Many of its lines of inquiry and audit steps were extracted and copied into the audit program.

The first part of the audit focused on possible abuses of long-distance privileges. Since headquarters was responsible for a significant portion of the billing increases, the audit team obtained detailed information for all calls made from headquarters. The data received from the telephone company included the originating telephone number, telephone number called, date and time of call, length of call in minutes, and cost. The auditors ran several reports, the first of which identified all long-distance calls longer than three hours. The auditors were quite surprised to discover a number of calls which were exactly 999 minutes (over 16 hours) in length.

Analysis of Telecommunications Bill
March Billing—Calls 999 Minutes in Length

Phone No.	Date	Start	End	Time
555-1234	18/03	08:32	01:11	999
555-1256	18/03	09:17	01:56	999
555-1385	19/03	12:08	04:47	999
555-2341	17/03	14:51	07:30	999
555-2348	26/03	16:04	08:43	999
. . . . . .				
555-9745	06/03	12:42	05:21	999
555-9897	01/03	01:17	17:56	999

Note: Time can be calculated by using start and end dates and times (hours and minutes) as follows: $(((24^*(END\_DATE-START\_DATE) + END\_HR)^*60 + END\_MIN) - (START\_HR^*60 + START\_MIN))$

By performing a detailed review of the activity on these telephone lines, the auditors found that other telephone calls had been made from the same telephone line during the same time period as the 999-minute call. None of the telephones in headquarters had a feature that would allow the caller to make two calls at the same time. The auditor checked with the telephone company and determined that a faulty communication switch had remained open after these persons had hung up the telephone, effectively failing to register the completion of the call, resulting in an erroneous long-distance charge. The telephone company's system had a maximum call length of 999 minutes; otherwise, the call lengths would have been even higher. All charges related to the 999-minute calls were reversed by the telephone company.

In some of the cases where the calls were longer than 180 minutes, the auditors determined that large data transfers were being performed between two sites. The auditors summarized the detailed billing information where data transfers were being conducted and identified instances where the usage was high enough to justify leasing a dedicated line, reducing the overall cost of the file transfers and improving the reliability and speed of the transmission.

The next test identified all long-distance calls made after regular working hours or during holiday periods. The auditor recommended controls over the ability to dial outside of the local area code after 6:00 P.M. and on weekends and holidays. Another test identified calls to long-distance exchanges for pay-per-minute numbers (1-900, 1-976, etc.). Despite no serious evidence of abuse, the auditors recommended a simple change to the company's telecommunication software switch, which blocked all access to the pay-per-minute exchanges.

The audit also reviewed the accuracy of the telephone bill and the efficiency and effectiveness of the use of leased lines. The audit team used the current month's bills for leased long-distance lines (dedicated lines) from all branch offices for review. Using the computer, they automatically generated confirmation letters, which were sent to the appropriate branch offices. The letter asked the branch managers to verify the accuracy of the charges and, in particular, to ensure that the line was still connected. The managers were also asked to review the justification for the use of a dedicated line. In close to 10 percent of the cases, the lines were no longer required, but the service had never been canceled. In a further 5 percent of the cases, the lines were not even physically connected to a telephone. For example, because of office space redesigns, some telephone lines terminated in closets or were enclosed within the new walls. In other cases, dedicated lines purchased to support data transfer requirements were no longer connected to computer terminals or branch offices had closed, but the service had not been discontinued.

The use of the computer to generate confirmation letters, to analyze thousands of lines of detailed calling information, and to highlight anomalies or potential abuses greatly improved the effectiveness of the audit. The overall result was a 17 percent reduction in the telecommunications bill.

Other examples of transaction-based CAATTs include refined data analyses, statistical and judgmental sampling, searching for particular attributes, testing the validity and reasonableness of transactions, and determining the impact and significance of a finding.

The real power of the data-based approach lies in the auditors' ability to examine the data easily, flexibly, independently, and interactively. The auditor can formulate hypotheses based on conjectures and imagination and test them immediately. "What-if" scenarios can be developed, with the results often examined in real time. The ability to review data comprehensively and down to every minute detail enhances the creativity of auditors and allows them to adjust their critical inquiries immediately as they gain new relevant insights into the data.

Case Study 4: Audit Planning

As part of the planning phase in the example of Case Study 2: Review of Employees and Salary Costs, the auditor decided to look closer at the salary costs for the marketing department. The following table, Salary

Details—Marketing Department, provides detailed salary information, by employee, for the past two years.

Salary Details—Marketing Department (in 000s)

Name	Base Salary		Bonus		Total	
	CYR-1	CYR	CYR-1	CYR	CYR-1	CYR
Brown	50	50	20	30	70	80
Smith		50		80		130
Jones	50	50	15	52	65	102
Rogers		50		26		76
......						
Black	50		12		62	
Stevens	50	50	26	48	76	98
Total:	200	250	73	236	273	486

The analysis shows that the base salary remained fairly constant over the last two years, at $50,000; however, the amount paid in bonuses has more than tripled, from $73,000 to $236,000. The information led the auditor to expand the original scope of the audit to include a review of sales data for the last two years. The review showed that, while the sales volume had increased, the increase was not sufficient to justify the large increase in the bonuses. Following up, the auditor learned that a new compensation system was introduced early in the current year, and the bonus schedule was revised. A review of the individual bonus payments discovered an error in the program used to calculate the bonuses.

This specific line of inquiry had not been included in the original audit scope, but with a minimal investment of time, the issue was raised early in the planning phase and was added to the scope of the audit. The addition of this line of inquiry resulted in a significant audit result.

Case Study 4 is an example of how the application of CAATTs can improve audit planning by allowing the auditor to capitalize on risks identified early in the planning phase and adjust the original audit plan. In the example, the audit had not called for a review of the bonus payments, but the auditor was not constrained by a rigid audit plan. Critical thinking and audit judgment was demanded and supported by the power of the software. It has therefore been suggested to change the traditional meaning of CAATs from Computer-Assisted Audit Techniques to Computer-Aided Audit Thought Support (Will [1995]), and to distinguish between audit thinking in discovery mode and audit reasoning in judgment mode in line with modern philosophy of science and technology (Fetzer [1996]).

EXHIBIT 1.2   Tools for Administration and Planning of the Audit Function

Administration	Planning
Budgeting	Audit Universe
Client Billing	Risk Identification and Assessment
Time Tracking (Staff and Projects)	Audit Assurance
E-mail	Continuous Auditing
Project Management	Issue and Finding/Tracking
(Resource and Schedules)	Follow-Up Tracking

Audit Management and Administrative Support

A variety of microcomputer-based audit tools exists and has already had a significant impact on the audit function. They include spreadsheets, presentation graphics, databases, and more. Further opportunities for computer-based support lie in the support to the management of the audit function. This area has seen a rapid increase in the use of microcomputer tools. More audit organizations are employing software packages to develop and maintain their audit universe, to conduct risk assessment when planning audit coverage, to schedule and manage audit resources, and to improve the ability of all auditors to use and share information. Further, automated tools are being used to track audit issues and monitor follow-up on audit recommendations. Exhibit 1.2 illustrates areas where computerized tools could assist in the administration and planning of audits.

The list and types of CAATTs continues to grow in number, complexity, and utility. These types of tools include a variety of software packages and programs designed to help auditors perform the audit and report the results of their work, not just perform data analysis. They include software for text search and retrieval, flowcharting, database creation and manipulation, telecommunications, and electronic working papers. More advanced CAATTs such as expert- or knowledge-based systems, self-auditing, continuous auditing, and neural networks are also available. (These tools are discussed in more detail in Chapter 2, Audit Technology.)

However, the tools are not effective without the application of a sound audit mentality. Auditors must adopt innovative approaches to using the computer as an effective and efficient audit tool in areas where these tools can be applied. Audit professionals who are critical and understand the potential of these new technologies can bring about significant productivity increases. Properly applied, CAATTs can reduce costs, improve the reliability of audit work, and allow auditors to examine areas that are not easily examined using manual methods.

Roadblocks to CAATT Implementation

Audit software has been available for a number of years. Still, in many organizations, only the IS auditors have attempted to introduce CAATTs into their audits and, even then, only to a limited degree—for very specific tests or under rigid circumstances. Too few auditors and audit organizations have invested much thought and resources into computer-based tools and techniques, let alone information technology.

Before examining the roadblocks to the implementation of CAATTs, please review Case Study 5.

Case Study 5: Review of Overtime Expenditures

Two audit teams were sent out to review the management and use of overtime at two branch offices (one on the West coast, the other on the East). During the planning phase, the first team conducted a detailed review of collective bargaining agreements, company policies, and procedures with respect to overtime. They estimated that the review would involve air travel and take five people ten days.

The second team performed a similar review of the relevant policies, procedures, and agreements; however, prior to leaving headquarters, they also obtained detailed pay records for all employees of the branch. Using data analysis software, they identified all employees with overtime payments and selected a statistical sample from this group. The team leader spent one day playing with the data file. By producing different stratifications of the data along various lines, the team leader discovered that certain individuals had received more than twice their salary in overtime payments. The team leader further determined that certain job classes, as a group, consistently earned a lot of overtime. In particular, the janitorial services group was collecting large amounts of overtime. The team leader added a new line of inquiry, a review of overtime payments by job classification, and selected a directed sample consisting of all employees who had received more than one-and-a-half times their regular salary in overtime.

The first team arrived at the branch office and proceeded to select a sample of employees and pull their pay files. After eight days of review, the team leader determined that they would have to expand their sample, since less than 10 percent of the employees in the sample had worked any overtime. This added four extra days to the audit.

The second team faxed the list of selected employees, all of whom had received overtime pay, to the branch's personnel office, requesting

that all the pay files be pulled. When the team arrived on-site, they were able to start their review immediately.

In addition, the second team reviewed the current situation regarding the janitorial services group. They found that last year management decided to reduce the number of cleaners by 10 percent and to only pick up the garbage every second day. This led to numerous complaints and a health and safety complaint. Management quickly decided to provide the same level of service as before, but did not hire any additional staff. The projected savings from the 10 percent cut in janitorial staff was eroded by the remaining cleaners working overtime, resulting in an 18 percent increase in the total cost of janitorial services.

With the audit of overtime, Case Study 5 demonstrates the power and utility of automated tools in audit. The ability to review thousands of transactions during the planning phase and the utility of sorted/summarized data, statistical sampling, and other techniques can revolutionize an audit. So, why is it that when the utility of CAATTs has been demonstrated time and time again, many auditors fail to make use of them? The reasons for the reluctance to embrace the automated tools are linked to the past and mired in myths or assertions that are no longer valid. (For similar observations, see also Will and Brodie [1991] and the Canadian Institute of Chartered Accountants [1994]).

These myths remain powerful even in the 21st century:

- Hardware and software are too costly to purchase and expensive to maintain.
- Logic or tests must be hard-coded into the application during the system development phase, and the programming is technically complex and requires the involvement of mainframe programmers.
- Automated tools and techniques can only be used by IS auditors because general auditors lack the necessary training or computer literacy required to benefit from the use of automated tools.
- Auditors must maintain a hands-on approach by performing physical/manual reviews of all relevant information.
- Client systems and data will be compromised by the use of audit software.

While there was an element of truth to some of these statements 15 or 20 years ago, to a large degree this is no longer the case. The power of the microcomputer, the knowledge level of all auditors, and the ease of use of various tools has increased dramatically. To further dispel these

myths, each is discussed as follows from the perspective of the newer tools available employing microcomputer technology.

MYTH 1: TOO COSTLY TO PURCHASE AND MAINTAIN   Some audit organizations believe that audit software is costly and cannot be proven to be cost-effective. Early audit software only ran on mainframe computers and often required site licenses and expensive maintenance contracts. Embedded audit modules had to be written during the development of the application and were expensive to program and had to be maintained when the application was modified. Often the audit organization was billed for the time the mainframe was used and had to request special runs or to create copies of the production databases. Also, the output was usually paper-based and had to be reviewed manually. Moreover, audit organizations had to deal with different software for each application. To make matters worse, depending on the cycle time for the audits, the software may not have been used more than once every two or three years. This often meant that no one had sufficient expertise with the software to make effective use of the tool. Under these conditions, the cost/benefits of maintaining the audit software would obviously be questioned, and often a decision would be made to suspend its use and to develop more robust controls and manual audit procedures.

The belief that computer-assisted tools and techniques are too expensive stems from experiences of ten or more years ago. Today, audit software offers more choices, and the costs have decreased dramatically. Modern audit software is more flexible and can be used to analyze data from a variety of applications on various computer platforms.

Typically, audit software supports access to various databases and file formats and data types, including DB2, IDMS, IMS, Microsoft Access, AccPac, dBASE, Excel files, and other esoteric data types. So there is no need to purchase and maintain a variety of tools.

Today, microcomputer packages are affordable, not only by the smallest of audit organizations, but also by intelligent sole practitioners who can amplify their power and potential enormously without becoming dependent on "Big Brother organizations."

MYTH 2: TOO TECHNICAL AND COMPLEX FOR NON-IS AUDITORS   Once again, this false belief stems from the historical usage patterns of audit software. The mainframe audit modules/packages had to be developed and maintained by a programmer. Traditionally, programming departments were under considerable pressure and had backlogs of up to several years. The priority given to developing audit modules for new applications was not always as high as audit would have liked. Little time was spent developing user-friendly, menu-driven interfaces, and documentation was likely to be absent or not very useful. To add to the problem, the programmer did not usually have

any audit expertise. Consequently, the audit routines were often difficult to use, and the results did not exactly meet audit's requirements. Also, all requests would have to be made through the programming area, adding delays and raising questions of auditor independence. After several attempts at developing and using audit software, many audit organizations abandoned this approach.

Today's audit software does not have the same limitations. Software vendors have developed audit-specific packages with excellent user interfaces. These packages can easily be used by auditors and often do not require the services of the programmers. Further, it has become much easier to extract and transfer data from one application or computer system to another. Data stored in complex databases can also be extracted using structured query language (SQL) packages. The results can be accessed directly by audit software and used by practically all auditors. Further, the auditors can do most of their analysis on their own microcomputers, and the communication and download facilities are supported by most systems. For large files, many audit organizations have powerful microcomputer audit workstations that support CD-ROM, optical disks, and other facilities to handle large volumes of data. Now, mainframe files, which are hundreds of megabytes in size, are easily processed using microcomputer audit software. In addition, audit software is available in client-server versions, providing auditors with the ease of use of the microcomputer and the storage and processing capacity of the mainframe.

MYTH 3: ONLY FOR USE BY IS AUDITORS More and more auditors are joining the workforce with some level of computer expertise, have taken programming courses in school, and have personal computers at home. The workplace requires most auditors to use computers in one way or another, even if it is only word processing or e-mail. With graphical user interfaces and application portability, the complexity of the audit software and the problems surrounding access to data are not what they used to be. An auditor with a basic understanding of computers and knowledge of data concepts (such as fields, records, files, and databases) can use today's audit tools effectively because programming, as a logical exercise in itself, is no longer required. Modern audit software makes it easy for auditors to develop their own analysis plans and to execute them with limited involvement and dependence on technical experts. There is also an increased understanding among audit managers that staff must be provided with sufficient computer training to keep abreast with technology. Since the audit software is more standardized, there is little need for training on your company's proprietary software package. Self-directed learning, computer-based training, Web-based training, and a variety of seminar and instructor-led courses are readily available. In fact, some of today's general field auditors have more practical technical

skills and a higher level of computer familiarity and expertise than did the IS auditors of 10 to 15 years ago.

MYTH 4: HANDS-ON APPROACH TO AUDITING REQUIRED The feeling that auditors must conduct the review manually—physically touching and reviewing files and reports—is more of a myth than a reality. Of course, automated techniques do not eliminate the need to conduct a manual file review, but the automated tools will help to focus the auditor's attention for physical review. Instead of having to examine 100,000 pay statements, the audit software might highlight the 100 that are of critical interest for one reason or another. So, the auditor only needs to perform a manual review of a small subset of transactions. In addition, the interactive nature of audit tools also provides a high degree of hands-on analysis. Using transaction data, the auditor can pose what-if questions and test out various scenarios. The ability to query the data, to run a variety of tests, and to get immediate responses to specific questions provides the auditor with a hands-on capability that is not available when dealing strictly with the physical files. Audit software allows the auditor to perform tests of 100 percent of the transactions, regardless of whether there are 10,000 or 10 million transactions.

MYTH 5: CLIENT SYSTEMS AND DATA COMPROMISED Previously, mainframe audit software had to be loaded on the client's computer system, modified for the particular installation, and run. The only alternative was to obtain a tape containing the client's database and process the information on the audit organization's computer. Neither alternative was considered to be completely secure. Clients were reluctant to allow unknown software on their mainframe and did not want to release data to the auditors. Some of these concerns still exist today, but auditors have more options. In particular, the auditor can download the data to a microcomputer and analyze it at the client's site. Thus, software is not being loaded onto the client's system, and the data does not physically have to be removed from the premises. For large data files, even portable laptop computers come equipped with CD-ROM drives, which are capable of holding millions of bytes of data, and external hard drives can hold hundreds of gigabytes of data.

Summary and Conclusions

Modern audit technology has freed auditors to use their judgment and all of their critical faculties rather than be limited by physical reviews, rigid audit programs, and information systems and technology that do not support audit. While some barriers to the use of CAATTs still exist, advances in hardware and software have reduced negative attitudes significantly, so

much so that you do not have to be a member of a large audit organization with sophisticated mainframe software to make effective use of CAATTs. The processing power and storage capabilities of the microcomputer continue to improve, while the hardware costs continue to decrease—making microcomputer-based tools increasingly viable.

Modern audit software is more powerful and much easier to use than the mainframe software of ten years ago. As a result, auditors can make effective use of these tools with a limited investment in training. It is possible to equip a stand-alone microcomputer with audit software for under $2,000, and the required hardware and additional useful software for between $2,000 and $3,000. Clearly, if you are considering the cost and benefits of automated audit tools, you should examine the latest options and alternatives. Historical comparisons and performance measures are no longer valid. However, the road to automation is still lined with potential pitfalls.

The main elements of strategy to ensure effective use of computer technology in the audit function must be delineated and clearly understood by all participants. An effective plan to implement and support the use of CAATTs must be developed to ensure that the tools and techniques are properly understood and used by all.