1983

An Integrated Approach to the Audit of OIS'S

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ABSTRACT

Accounting systems are by their very nature fundamental components of an Office Information System (OIS). As a requirement for conducting business, these systems need to satisfy accounting and auditing requirements. Though the "state-of-the-art" in EDP auditing has made major advancements in recent years, many of the computer controls and EDP auditing techniques currently employed are unusuable or inadequate in an OIS environment. The accountability of an OIS poses many new challenges. The answers to these questions must be found in the same technology that presents them.

In partial fulfillment of these needs, a general design of an audit system suitable for OIS's is presented in this article. The audit system constitutes a unified and integrated audit approach that includes internal control documentation and review, office compliance, real-time office control, and substantive testing. The real-time control of an OIS requires the development of matching OIS hardware controls and operating system controls for tracing, scheduling, and monitoring office activity. Further development of this work and integration of the audit system in an OIS would virtually result in a continuous audit.

INTRODUCTION

Current research in the area of automated Office Information Systems (OIS's) projects a shadowy image of the future office environment (Bailey, Gerlach, McAfee and Whinston, 1982; Ellis and Nutt, 1980.) Electronic mail, teleconferencing, and other forms of telecommunications promise to improve office communications. Word processors and filing systems have already made a significant impact upon clerical work. Besides automating office devices, research into OIS's is striving to automate office procedures as well (Zisman, 1977 and 1978). Most of this work focuses on document handling. OIS languages such as IBM's Office Procedures by Example (OBE)

language incorporate word processing, electronic mail, and database capabilities that enable office workers to construct automated office procedures (Zloff, 1981). These procedures map data items between data bases and forms. Edit checks ensure that the forms are properly completed and numerical functions can be used to calculate data dependent fields such as subtotals. Prospective uses of this new computing environment includes the automation of accounting office systems.

As an OIS, accounting office systems are interesting to consider for several reasons. The foremost is that an organization spends a great deal of effort collecting information and processing documents for the purpose of recording business events. The accounting system is by its nature a fundamental component of most, if not all, OIS environments. Common examples of accounting office systems found in organizations include purchasing, sales, cash disbursements, accounts receivable, and payroll systems. Therefore, by addressing the implementation of accounting office systems, the automation of a significant sector of office work common to all organizations is considered. In addition, many businesses are subject to financial audits by law and as a requirement for conducting business.

Since accountants and auditors have long been concerned with satisfactory accountability, accounting office systems have been investigated in detail and are better understood than many other types of office systems. Accounting principles and standards are reasonably well-defined and supported by professional accounting organizations, government agencies and various sectors of industry, education and banking. As a result, these office systems are based on formal information flow structures that are adequate for processing routine business transactions. Exceptional transactions for which the accounting office system is not designed to handle are dealt with individually, requiring intervention and decision-making. The formal stucture of accounting systems facilitates OIS design and implementation while the dynamic aspect, so typical of office systems, challenges OIS designers and implementors. It is reasonable to assume that if accounting office systems cannot be adequately supported within an OIS environment, then many other office systems are doomed to fail also.

ACCOUNTABILITY OF OIS'S

Accounting information systems are required to produce relevant information that is accurate and reliable on a timely basis and safeguard assets from theft, misuse and fraud. In order to ensure that these objectives are being met, the systems are periodically subjected to review and analysis by external auditors. Satisfactory accountability is achieved when the system's database accurately describes the full economic status of the firm. Since it is not possible to verify every database entry or even a large proportion of them, the auditor is concerned that the processes that generated the information are valid and the controls that regulate system operations are adequate.

The advanced computing environment provided by an OIS poses many new challenges for accountants and auditors. The decentralization of the data processing function renders modern computer auditing techniques useless by drastically changing the problem of adequately controlling, securing, and validating system operations. Furthermore, as accounting information systems become too expansive or complex for a detailed review, greater reliance will have to be placed upon the system's control structure. This makes

the imposition of adequate access and processing controls even more critical in an OIS.

Security and Control Problems

The OIS environment eliminates many controls present in the traditional manual office, even one using extensive computer capability. Locked doors and drawers, walls, geographic displacement from restricted information, and high visibility of the office worker are done away with in the ultimate OIS. In an uncontrolled OIS environment, the office worker has access to accounting information for preparation and dissemination at electronic speeds with little to no visibility. If not adequately controlled, an OIS will actually facilitate irregularities, fraud, and theft by giving the workstation operator easy access to accounting information and documents. A wealth of experience in computer crimes has more than adequately demonstrated this fact (Parker, 1976). In addition, data redundancy serves as a control in that data may be verified against its redundant counterpart. The reduction of data redundancy in an OIS reduces this control. The loss of control over these activities needs to be compensated for with adequate computing and security controls. Balance will be necessary in that while an uncontrolled OIS is chaotic, an overly restrictive OIS is not economically functional.

Assessment of EDP Auditing Techniques

Even though the current "state-of-the-art" in auditing the Electronic Data Processing (EDP) environment is much advanced over that of the late 1960's and continues to improve rapidly, substantial room for improvement still exists for auditing conventional EDP accounting systems. Most current EDP auditing techniques do not fully exploit the computing environment in order to perform control and analytic functions (Cash, Bailey and Whinston, 1977). Even though these methods require the auditor to understand the basic system functions and interrelationships, they do not require the auditor to analyze the actual system. Furthermore, adequate controls safeguarding system operations do not yet exist as evidenced by large numbers of computer crimes that are being accidentally detected (Parker, 1976) and the auditor's deep concern over loosely controlled access by EDP staff to system operations (AICPA, 1977).

The audit of more advanced systems such as large-scale, complex OIS's is only in its formative stages. Many of the EDP auditing techniques currently employed are unusable in an OIS environment. The few that are applicable, first require modifications. The unsuitability of current EDP auditing techniques is a direct result of the new computing environment provided by an OIS. Primarily, because of the extensive distributed processing environment, the partial automation of office procedures, and the continuously changing office system most current EDP auditing techniques are not suited for auditing an OIS.

For example, the test data technique attempts to certify the correctness of a module by running the module on sample data and comparing the results of the run with the expected results. Using this method to examine online processing may be difficult since many of the operations associated with processing a transaction may happen internally with no immediate visual indications of the complete results. This technique also requires the module under examination to be fully automatic. Office procedures may be fully automated, but many will be interactive giving the office worker flexibility in processing the transaction. Also, since the development and maintenance of the procedure will be

under the control of the worker, procedure modifications may be expected frequently. Thus, the auditor may be faced with testing several generations of a procedure. This added complexity renders this approach useless. For similar reasons, other EDP auditing techniques like controlled processing or reprocessing, parallel simulation, mapping and custom-designed computer programs are not considered to be viable EDP auditing techniques in an OIS environment.

The most applicable of the currently available techniques are the integrated test facility, concurrent processing, tagging and tracing, and data base management systems. Formal procedure verification techniques may have limited use for reviewing office procedures. They may be used to mechanically assist the review of office procedures and determine the effects of procedure modifications.

Current techniques for controlling information access in online business systems achieve various levels of success. As online systems become more sophisticated, simple computer access and processing controls will become steadily less effective. Present research in OIS's suggests that control will be implemented on a component basis. That is, each OIS component (including documents) will be equipped with its own system of simplistic safeguards which will regulate access on an object-agent basis. What is required is a system of controls that regulates office activity on a functional basis. A system view of controls facilitates review, necessary for determining the adequacy of the control structure.

General OIS Audit Requirements

Even though OIS's will change the way in which accounting information systems are audited, the general audit requirements for an OIS are the same as those for any office system whether manual or computer-based. The auditability of any office system is dependent upon the availability of:

1. An accurate and complete description of the accounting office system organizational structure;
2. Means for performing a detailed analysis of the application's internal control structure;
3. The existence and operation of controls; and
4. Means for controlling and managing work in progress and completed work.

The key to effectively auditing an OIS lies in the development of a computing environment that supports the audit function. This position is shared not only by the authors but by the American Institute of Certified Public Accountants (AICPA) in their computer services guidelines for the audit of advanced EDP systems. In this report, the AICPA calls for cooperative effort between systems designers, computer vendors, management and auditors. For unless management and auditors make their concerns known to computer specialists, advanced computer systems will be unnecessarily costly to audit. Even though the report did not resolve the many problems associated with the audit of advanced EDP systems, it did indicate the major reasons contributing to unauditable systems. Their message is so critical to OIS developers, that it is reprinted here.

> "For a variety of reasons control usually takes a back seat to other objectives in the development of innovative electronic data processing applications. The pressure to bring a new application "on the air" by its scheduled date often causes desirable control objectives to be overlooked or not implemented. This, in turn, may result in the need to retrofit

control mechanisms -- usually at considerable expense -- after the application has been operating for a time.

In addition, consideration of audit approaches often is deferred until a new system has been operational for some time. Therefore, opportunities to use cost effective EDP audit techniques may be lost.

Adequate control mechanisms have been devised for many present-day systems, but technological developments are leading to more system changes. Advanced systems are now a reality. If the hardware for these systems does not provide adequate controls, or if operating systems do not have the processing integrity to assure proper treatment of all transactions by application programs, controlling and auditing these systems after they have begun operations will be unnecessarily costly and perhaps less successful." 9AICPA, 1977, p.V)

The New Audit Environment

The audit of an OIS will undoubtedly be greatly influenced by the computing environment it provides. Information availability, office procedure accessability, the ever changing office environment, and the absence of physical controls defies the audit process. In order to audit OIS's, the auditor will have to place greater reliance on the controls of the system. Controls are required that not only regulate information access but ensure that the OIS is properly designed, implemented and operated. However, present computer controls are rather primitive and none of the applicable EDP auditing techniques can serve as a standalone method for performing the complete audit.

Despite the challenges posed by OIS's, OIS's potentially possess several accounting and auditing related advantages that are not found in traditional computer-based systems. The first concerns the availability of accounting information. In an OIS, information is captured earlier and stored in an integrated fashion thus reducing data entry and data storage redundancy and enhancing internal data consistency. Information contained within the electronic documents of the OIS has established relationships with other documents forming a database of interrelated documents. These databases in turn may have established relationships with conventional databases comprising an expanded global database. In addition to enhancing the availability of timely accounting information for administrative purposes, this global distributed database concept will be useful for performing the audit in much the same way as a conventional database is presently utilized by the auditor equipped with generalized audit software. However, now the database includes accounting information that was previously contained on paper. This expanded database will assist the auditor in locating and analyzing business transactions that have not been completely processed but which affect the financial statements of the firm.

Since many office procedures will be performed mechanically in an OIS, they are subject to processing limitations imposed at the work station. This provides the opportunity to implement controls over OIS operations. These controls will take on many forms. Conventional computer controls such as password and processing controls will be an important part of the control mechanism. Processing control enhancements are also possible to systematically guarantee a level of control that far surpasses the level of control that is typically found in modern information systems. These con-

trols would monitor accounting activities at the work station and would restrain office workers' behavior according to prespecified control criteria. For instance, only authorized work station operators would be able to access and prepare vouchers. This control could be stiffened by limiting voucher access to authorized work station operators on a transaction basis. That is, before an authorized operator may access a voucher for a transaction, the operator must have received the necessary supporting documents (e.g., receiving report, purchase order, invoice, and requisition) from the appropriate sources.

An important internal control concept is the separation of duties. Conventional information systems effectively prevent the separation of duties by centralizing the computing function. OIS's are distributed systems that greatly reduce the need for complex centralized systems potentially reestablishing the separation of duties. For example, in an OIS, the completion of an office procedure may automatically trigger other office procedures, but because of their interactive and autonomous nature, the initiated procedure requires human action and thus human awareness unlike similar events in a centralized system. Even if the triggered office procedures were fully automated, the procedures would have been written by the agent responsible for the procedure, or at least under his direct supervision. In either case, the responsible agent is aware of the processing that takes place within the scope of the agent's authority. This better matching of work responsibilities with work performance and enhancement of the decentralization of duties enables accounting information systems to be more modular in design. The advantages of the modular design include ease of implementation, conceptual manageability, maintainability, and flexibility.

AN INTEGRATED AUDIT APPROACH

If the unproductive cycle of retrofitting controls and EDP audit techniques to OIS's is to be avoided, a general approach to the audit of OIS's is required. A methodology that outlines an integrated approach to reviewing, controlling, evaluating and testing the OIS is imperative to performing the audit function within the limits prescribed by generally accepted auditing standards. The methodology should support the current EDP audit techniques that are adaptable, controls for governing office procedure specifications and execution, and the means for formally evaluating actual office systems.

The general design of such an audit system is shown in Figure 1 which displays the major functions, control flows, and data flows of the system. The system is designed to control and assist the development, implementation, operation and audit of an OIS. The audit system is driven by a model of the accounting office system. Once the model has been reviewed for adequacy of internal controls and accepted, the model is then used by the audit system to guide the implementation of office tasks and to control their execution. An audit facility for tracing and logging real-time business transactions is provided along with Generalized Audit Software (GAS) for analyzing accounting data. A librarian is used to secure the office procedures and to record maintenance changes. Since office tasks are modular, formal office task verification may be possible. In addition, a management override capability exists which is overseen and monitored by audit modules.

Office Model

Fundamental to the audit of an OIS is the need for a model of the OIS. It is necessary for internal control docu-

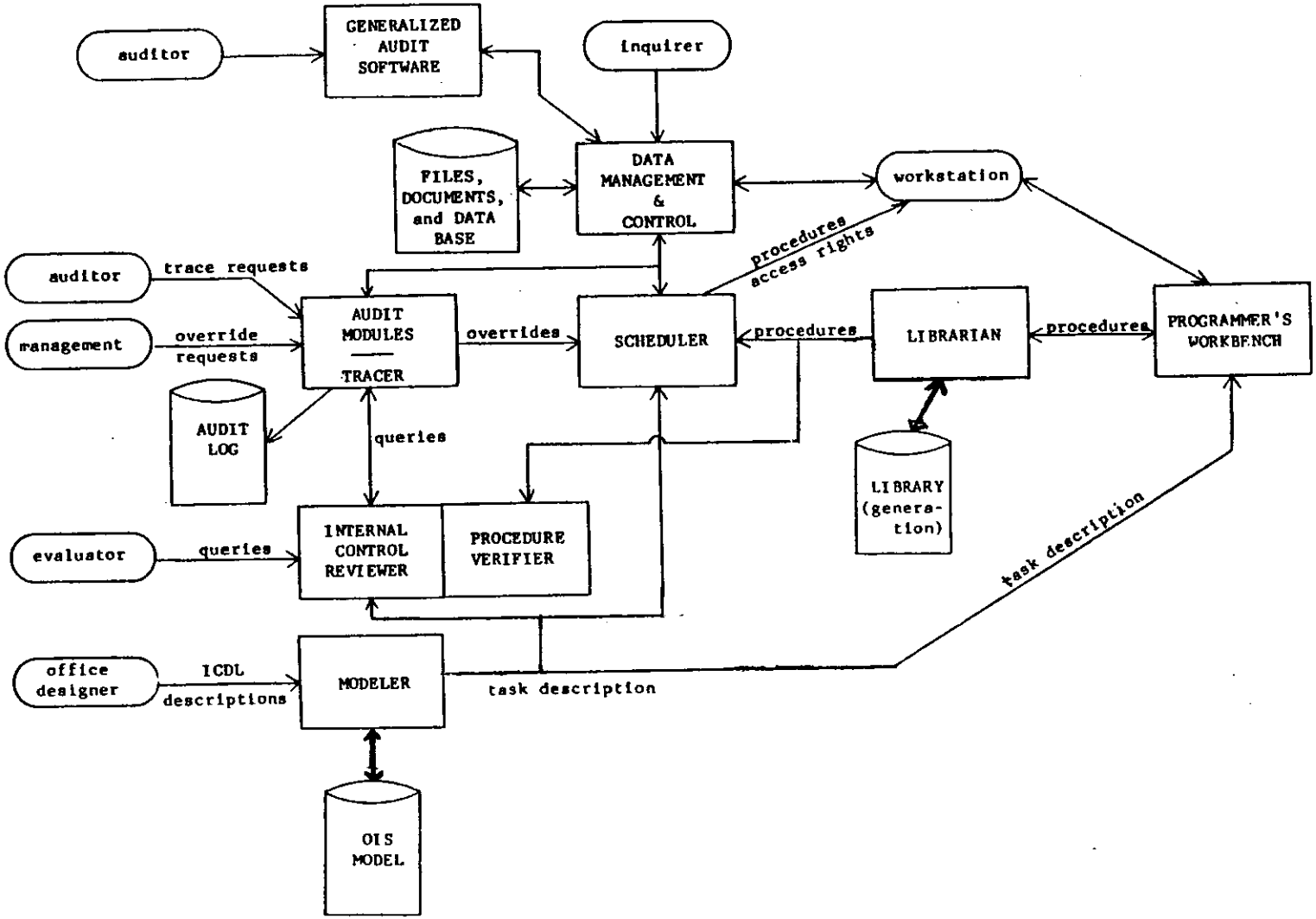

Figure 1. An Audit System for OIS's

mentation and evaluation. It serves as a blueprint for OIS implementation and control. Not all phases of office activity are suited to office modeling and analysis. For instance, it would be difficult to effectively model and analyze communication flows in an organization which is very loosely structured around numerous highly autonomous groups. However, OIS's which are developed around formal lines of communication and formal work station activities are subject to precise modeling suitable for review and analysis.

A system for documenting and analyzing accounting OIS's has been developed (Bailey, Gerlach, McAfee, Whinston, 1981-1983) and implemented (Bailey, Duke, Gerlach, Ko, Meservy and Whinston, 1983). The system is called TICOM-II. The system consists of a modeling language for describing the firm's operations. The formal input it provides for the TICOM-II modeling process is consistent with the information collected by Deloitte, Haskins, and Sells (1979) in their manual verification of internal control procedures. The model describes each office worker's condition access rights to restricted information and processing responsibilities. Figure 2 shows a loan approval procedure specified in the modeling language. A querying capability permits auditors to pose questions concerning the internal control behavior of the modeled system.

Review of anticipated office activity is essential for ensuring that office procedures are properly designed. Subsequently, the modeled system must be implemented and operated in compliance with the specifications.

Office Implementation

Implementation of the office begins by decomposing the OIS model into an executable form. Each office worker would be uniquely identified and classified according to job position. Office workers would be permitted to construct office procedures for tasks listed under their job position in accordance with the accounting model. The modeled description of the procedure directs procedure development by identifying the major inputs and outputs. With the aid of a programmer's workbench, the office worker would specify the processing required to generate the desired outputs. To clarify, the ASSIGN command in Figure 2 only indicates what field of the loan request is to be filled in. It remains to be stated how the required information is to be calculated, edited and entered. Based upon the data contained in the loan request, status report and credit history, loan approval or rejection may be algorithmically decided if the request falls deterministically into one of two categories. Otherwise, the loan office faces a nonrecurring problem which requires discretion. In this work, procedural specifications

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LOAN-OFFICER:
  WAIT FOR LOAN-REQUEST, STATUS-REPORT, CREDIT-HISTORY;
  ASSIGN APPROVAL OF LOAN-REQUEST;
  TRANSFER LOAN-REQUEST TO CREDIT MANAGER;
  PUT STATUS-REPORT, CREDIT-HISTORY INTO CUSTOMER-FILE;
  END TASK.
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Figure 2. Model of a Loan Approval Task

ae cooperative partners in performing office work.

Office Verification

An OIS language and programming environment that can effectively aid office workers in writing office procedures based on abstract models of the procedures potentially offers several accounting and auditing related benefits. By ensuring that all office procedures comply with their specifications, office compliance is controlled and largely guaranteed. Another benefit is realized if the implemented office procedures can be formally analyzed. Office procedures are naturally modularized according to function by the distributive nature of office systems. If the modular asks are written in a high-level, accounting-oriented language, then perhaps program verification techniques would be useful for examining individual modules that the auditor deems critical for the proper performance of the OIS. The OIS model shows the linkage and ordering of the office procedures. Once the examiner understands the sequencing of office activities, detailed examination of the office can proceed on an individual procedure basis. This two-tiered office description may permit the formulation of a practical OIS verification methodology.

A secured library could identify procedures by name, control and log procedure specifications, and present to the system for execution the current versions of the procedures upon demand. In this way, procedures can be modified only by authorized personnel and modifications are noted for inspection. If in addition, the auditor was assured that the office procedures were consistently executed in compliance with the OIS model, then there would be "reasonable" assurance that the accounting information collected is complete, reliable, and accurate.

Office Operations

A model-driven monitor is envisioned that enforces a measure of office compliance by controlling OIS operations on a real-time basis. The monitor would trace the progress of each transaction and office procedure and automatically initiate or execute the procedures at the appropriate times. Thus, the computer and the workstation operator would interact in a joint undertaking, with the monitor enforcing compliance with the OIS model.

Intuitively, when firm employees use the OIS to manipulate forms or execute office procedures, the related processing will be examined by the monitor to enforce compliance with the accounting model specifications. The latter will then consider whether the specified processing implies a violation of accepted office activity. In regards to the loan approval procedure shown in Figure 2, only an authorized loan officer may approve a loan request. Before doing so, the officer must first receive the request, the status report and the credit history report. Upon filling out the approval field of the loan request, the loan request must be forwarded to the credit manager and the other two reports deposited into the customer file. Deviations from this specification such as modifying the contents of the credit history report are prohibited by the system.

By administering access rights to individual workstations on a situation basis, greater control and support of workstation activity can be attained then by employing static object-agent access privileges. For instance, in a purchasing system, requisitions for goods costing more than $10,000 may require special managerial approval - an internal control. Based upon the accounting model, the audit system would know of this requirement and would make certain that requisitions

for $10,000 or more were duly authorized by the proper personnel by controlling the routing and the preparation of the forms. In addition, the findings of one office worker may control the activities of another. Consider once again the purchasing system. if an accountant discovered that the receiving report was inconsistent with the invoice in regards to the items reportedly received and the items reportedly shipped, then the control structure may dictate that inventory be searched by an agent in the Inventory Department and the result recorded on the receiving report. Further processing of the purchase transaction would be determined by the report from the Inventory Department and the OIS model. Again, a developed model of the accouning OIS would make it possible to control this real-time office activity.

It is important to note here that not all office activity needs to be monitored and tightly controlled. For example, it is not desirable to control the preparation and dissemination of routine memos and letters in this manner. The audit system would only control and monitor sensitive information and office procedures. These items would be identified by their inclusion in the accounting model. System items such as memos and letters that are not included in the model, would be subject to whatever controls the OIS provides for general office use. Accounting office procedures and activities would be permitted to access both kinds of information; however, only access to sensitive information would be controlled by the audit system.

Office Information Management

The model-based plan also serves as a basis for implementing a facility for control and management of work in progress and completed work. The system supports the audit software for the examination and review of life accounting transactions and accounting information stored in documents and data bases.

Audit Modules

A facility for implementing audit modules and tracing live accounting transactions enables the auditor to automatically monitor critical office activities and log suspected or irregular activity for review by the auditor at a later time. Management override requests of the OIS model are monitored and controlled by audit procedures supplied by the auditor. These procedures would regulate overrides based on prespecified control criteria. At the very least, the procedures could flag override transactions and record relevant information for the auditor's inspection. Controls will also be needed to regulate he processing of unanticipated transactions for which no accounting procedures are defined to handle them. This necessitates the need for management override.

Cost-Effectiveness

An important and practical audit concern is he cost of controlling an OIS. Sophisticated control mechanisms like the ones described above are expensive to implement and maintain. This cannot be ignored. However, these contrl mechanisms are compatible with other OIS goals; therefore, many of these controls may be present in an OIS for reasons other than auditability. For instance, OIS's need to be modeled so that they can be analytically reviewed for processing efficiency. Perhaps the same model or an extended version could also be used for internal control documentation and review. Automatic triggering of office procedures is also a general objective of OIS's. This necessitates the need for embedding knowledge of the sequencing of office procedures in the OIS. Closely

related to this issue is the need for office procedure libraries and restricted access. Again, auditors and accountants share these same needs. Since the cost of these sophisticated control mechanisms will be shared by multiple users, we believe that these mechanisms can be enhanced to include audit and accountability requirements on a cost-effective basis.

CONCLUSIONS

The accountability of an OIS poses many new challenges. The answers to these questions must be found in the same technology that presents them. The real-time control of an OIS requires the development of matching OIS hardware controls and operating system controls for tracing, scheduling and monitoring office activity. The inclusion of the audit function during OIS design is necessary if the resulting system is to be auditable. If the control and audit issue is delayed until after these systems are operational, then controlling and auditing these systems will be unnecessarily costly and certainly less effective.

This article has presented a general design of an integrated approach to the audit of OIS's. The key feature of this approach is the real-time monitoring of OIC activity based on a model of acceptable OIS behavior. Further development of this work and integration of the audit system in an OIS would virtually result in a continuous audit.

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