DOCUMENT RESUME

05639 - [B1146093]

The Federal Information Processing Standards Program: Many Potential Benefits, Little Progress, and Many Problems. FGMSD-78-23; B-115369. April 19, 1978. 39 pp. + 5 appendices (28 pp.).

Report to the Congress; by Elmer B. Staats, Comptroller General.

Issue Area: Automatic Data Processing: Changeover to Other ADP Systems (107).
Contact: Financial and General Management Studies Div.
Budget Function: Miscellaneous: Automatic Data Processing (1001).
Organization Concerned: Office of Management and Budget; General Services Administration; Department of Commerce.
Congressional Relevance: House Committee on Science and Technology; Senate Committee on Commerce, Science, and Transportation; Congress.
Authority: Brooks Act (P.L. 89-306).

The Brooks Act called for a Federal automatic data processing (ADP) standards program that would permit the interchange of computer equipment, software, and data. It was also intended to stimulate competition by permitting Federal agencies to procure their ADP requirements from numerous vendors offering low-cost compatible products. Findings/Conclusions: Some standards have been developed, but agencies are not fully using them, and some standards do not yet exist. As a result, many Federal agencies have become locked into suppliers of computers and related services. The Government has depended too much on the commercial sector to develop standards, and manufacturers sometimes delay the development of commercial standards. The Department of Commerce's budget requests do not provide meaningful information on the scope and direction of the program. Standards development has suffered from a lack of funds allocated for this purpose, inadequate resource management, and lack of an effective staff devoted to the program. Weaknesses in the program also result from vague enforcement policies and lack of procedures to verify compliance. Recommendations: The President should give one agency the central authority for insuring compliance with ADP standards. The Director of the Office of Management and Budget (OMB) should issue policy guidance to this and other agencies citing the importance and relative priority of standards, requiring establishment of policies and procedures for implementing standards, insuring Federal participation in developing standards, and citing circumstances in which the Department should develop standards independently. Guidance to the single agency should give direction on approving requests to waive compliance, providing information on compliance, determining if Federal standards are met by vendors, and insuring that agencies acquire products which comply with standards. Using OMB's guidance, the Secretary

of Commerce should establish procedures for justifying, setting priorities for, and monitoring the development of standards; commit more resources to their development; coordinate agency participation; and unilaterally develop and issue standards when the commercial process is not timely. He should also establish a budget and cost-reporting system that gives information on its efforts in the program and submit to GAO for approval an updated design of an accounting system which identifies funds spent on these efforts. (HTW)

BY THE COMPTROLLER GENERAL

Report To The Congress

OF THE UNITED STATES

The Federal Information Processing Standards Program: Many Potential Benefits, Little Progress, And Many Problems

Federal agencies have become locked into suppliers of computers and services because essential automatic data processing standards have not been developed or agencies are not complying with present standards. As a result potential savings available through competitive procurement are not being fully attained.

The Government has depended too heavily upon the commercial sector to develop the standards it needs; thus, little progress has been made. It has also failed to manage adequately Federal funds devoted to standards development and to establish clearly defined policies for enforcing compliance with such standards.

This report provides information on the types of standards most needed to achieve Government-wide economies and suggests remedies to improve the Federal automatic data processing standards program.

FGMSD-78-23

APRIL 19, 1978

COMPTROLLER GENERAL OF THE UNITED STATES
WASHINGTON, D.C. 20548

B-115369

To the President of the Senate and the
Speaker of the House of Representatives

This report describes the Federal Government's efforts to develop and enforce the use of automatic data processing standards and how the limited progress of these efforts restricts competitive procurements of automatic data processing resources.

We made our review pursuant to the Budget and Accounting Act, 1921 (31 U.S.C. 53), and the Accounting and Auditing Act of 1950 (31 U.S.C. 67).

We have not included official agency comments because they were not received in time to evaluate and incorporate within the report. However, pertinent oral comments of agency officials were recognized in the report.

We are sending copies of this report to the Director, Office of Management and Budget; the Secretary of Commerce; the Administrator of General Services; and the heads of all other Federal agencies and departments.

Elmer B. Staats

Comptroller General
of the United States

COMPTROLLER GENERAL'S
REPORT TO THE CONGRESS

THE FEDERAL INFORMATION PROCESSING STANDARDS PROGRAM: MANY POTENTIAL BENEFITS, LITTLE PROGRESS, AND MANY PROBLEMS

D I G E S T

An effective Government-wide automatic data processing program is needed to reduce costs by increasing competition and promoting the effective interchange of automatic data processing equipment, computer programs, and data. The Congress authorized such a program with the passage of Public Law 89-306 (otherwise known as the Brooks Act).

Some standards have been developed, but agencies are not fully using them. Other urgently needed standards do not yet exist. As a result, many Federal agencies have become locked into suppliers of computers and related services.

Conversion of computer programs are expensive; they now cost the Government an estimated $450 million each year. An improved standards program will not achieve cost savings without good management, but it will offer the greatest impetus toward reducing conversion costs and promoting fully competitive procurements. (See ch. 2.)

Little progress has been made in developing and issuing Federal data processing standards because the Government has depended too much on the commercial sector to develop standards for Federal use. Only 10 of the 29 Federal standards have been developed independently. Progress has been slow because manufacturers can and sometimes do delay the voluntary development of commercial standards. The Government should have a strong program that either can work with industry in developing standards or can independently develop essential ones when the industry delays the process excessively. (See pp. 15 and 17.)

The Department of Commerce's budget requests fail to provide meaningful information on the scope and direction of the program. Commerce should request funds and report on expenditures to clearly identify the resources committed to each of its Brooks Act responsibilities--developing automatic data processing standards, providing advisory services to agencies, and conducting related research. (See p. 19.)

High-level attention has not been given to the standards program. Relatively little of the available funds are being devoted directly to standards development; instead most funds are being used for advisory and consulting services and for research. (See p. 20.)

Standards development projects are not assigned priorities based on the extent to which they address Brooks Act objectives. (See p. 21.)

Commerce has not adequately managed its resources to assure the effective and prompt development of standards. Task groups formed to develop standards have been staffed with volunteers from various agencies who generally do not have enough time to work effectively on the projects. (See p. 23.)

VAGUE ENFORCEMENT POLICIES DO NOT LEAD TO COMPLIANCE

The Federal standards program is not as effective as it could be because (1) the assigned responsibility for enforcing standards is vague, (2) the extent to which they are being used is unknown, and (3) compliance generally is low. Current policies do not assure that agencies will comply with standards. Procedures have not been developed that will show whether products and services offered for sale by the computer industry meet Federal standards. (See ch. 4.)

RECOMMENDATIONS

The President, through an Executive order, should give one agency the central authority for insuring compliance with automatic data processing standards including the authority to disapprove requests to waive compliance. (See p. 36.)

The Director of the Office of Management and Budget (OMB) should issue policy guidance to this agency as well as to other Federal agencies to assure the effective use of this authority and to strengthen the Government's efforts in developing data processing standards.

This guidance should (1) cite the importance and relative priority of standards, (2) require agencies to establish policies and procedures for implementing standards, (3) insure active Federal participation in the Federal and commercial processes for developing standards, and (4) cite the circumstances under which the Secretary of Commerce should develop standards independently of the commercial sector. (See pp. 26 and 36.)

OMB's guidance to the single agency should give direction on (1) approving agency requests to waive compliance with standards, (2) providing the Congress and OMB information on agency compliance with standards, (3) determining the extent to which vendor-supplied products and services meet Federal standards, and (4) establishing a mechanism to insure that agencies acquire products and services which comply with Federal standards. (See p. 37.)

Using OMB's guidance, the Secretary of Commerce should (1) establish procedures for justifying, setting priorities for, and monitoring the development of standards, (2) commit more existing resources to developing standards, (3) coordinate Federal agency participation and views before and concurrently with commercial standards development, and (4) unilaterally develop and issue Federal standards when the commercial process is not timely. (See p. 26.)

The Secretary should also:

--Establish a budget and cost-reporting system that gives the Congress and OMB information on the direction and results of Commerce's efforts to meet its Brooks Act responsibilities.

--Submit to GAO for approval an updated design of an accounting system which would clearly identify funds spent in support of these responsibilities. (See p. 27.)

AGENCY COMMENTS

Oral comments were obtained from OMB, Commerce, and the General Services Administration. The comments have been considered in the report, as appropriate. Written comments from OMB, the Department of Commerce, and the General Services Administration were not received in time to be considered in the report. (See pp. 25 and 35.)

Contents

ABBREVIATIONS

ADP	automatic data processing
COBOL	Common Business Oriented Language
CODASYL	Conference on Data Systems Languages
CPU	central processing unit
GAO	General Accounting Office
GSA	General Services Administration
I/O	Input/output
ISO	International Organization for Standardization
NBS	National Bureau of Standards
OMB	Office of Management and Budget

CHAPTER 1

INTRODUCTION

Soon after the turn of the century, Americans who had electric lights in their homes had to take their lamp fixtures to the store when bulbs burned out. It was the only reliable way to find the right replacement bulb among the many sizes and shapes available. This inconvenience, like many others that accompanied the growth of an industrialized society, was gradually eliminated through standards. Standard light bulbs and thousands of other products, services, and conventions have been established over the years because of the convenience and economy they afford. They have come about by Government regulations, customs, or the general consent of users and manufacturers.

A recent example of successful standardization is the development of standard characters printed in magnetic ink on the bottom of checks. This automatic data processing (ADP) standard, developed in 1956, is called magnetic ink character recognition. When account numbers and dollar amounts are printed on checks using the standard, a machine can read and process 96,000 of them per hour. This standard has enabled the banking industry to provide more efficient check-processing systems to its customers.

WHY THE FEDERAL GOVERNMENT NEEDS ADP STANDARDS

Like the banking industry, the Federal Government can benefit from ADP standards. The Government is the world's largest user of ADP resources. It spends over $10 billion per year for ADP equipment and technical personnel. As of September 1977, it owned or leased over 11,100 computers staffed with more than 150,000 technical personnel.

Government agencies use computers to process a wide variety of applications that affect all levels of Federal, State, and local governments, as well as commercial organizations and individual citizens. These applications range from processing and delivering health and welfare services, to administering social security and veterans benefits, to exploring space, and to other scientific endeavors.

The Congress and Federal agencies have long recognized the important role of standards in reducing procurement costs and promoting the effective use of ADP resources. In 1965 the Congress enacted Public Law 89-306 to achieve

"* * * the economic and efficient purchase, lease, maintenance, operation, and utilization of automatic data processing equipment by Federal departments and agencies."

This legislation, known as the Brooks Act, was passed because of recognized problems in the overall management of the Federal ADP program. One such problem was the lack of ADP standards, which was known to be serious almost from the time ADP equipment was introduced in the Government in the early 1950s. By 1965 the lack of ADP standards was believed to have seriously compromised the Government's overall ADP potential. The Brooks Act, therefore, called for a Federal ADP standards program that would permit the interchange of computer equipment, software, and data. This program was also intended to stimulate competition by permitting Federal agencies to procure their ADP requirements from numerous vendors offering low-cost compatible products.

Since the act was passed, the Congress has reaffirmed its strong support for a Federal ADP standards program on several occasions. In October 1976 the House Committee on Government Operations stated that meaningful hardware and software standards continued to be essential to achieving fully competitive ADP procurements. In May of 1971 the Joint Economic Committee reported that standardizing interfaces between computer components was needed to promote industry competition and to achieve Government procurement economies. On other occasions the Congress has identified the importance of standards in assuming the security of computerized data and in sharing Federal ADP resources.

The executive branch has also recognized the importance of Federal ADP standards. For example, in 1966 the Office of Management and Budget (OMB) told the Secretary of Commerce that the absence of standards was preventing the Government from effectively using ADP resources. In addition, OMB, Commerce, and the General Services Administration (GSA) have testified before congressional committees that standards play a key role in the economic procurement and the effective use of Federal ADP resources.

AGENCIES RESPONSIBLE FOR IMPLEMENTING A FEDERAL INFORMATION PROCESSING STANDARDS PROGRAM

Many Federal agencies and private organizations are involved in developing, implementing, or enforcing Federal ADP

standards. Under the Brooks Act, Commerce, OMB, and GSA are responsible for managing the program. Collectively, these agencies are charged with achieving a businesslike, Government-wide, coordinated effort in managing ADP. Policies adopted by these agencies involve the participation of many other Federal agencies and the ADP industry.

Overall management is assigned to OMB. This includes issuing Government-wide policy and exercising budgetary review of the Federal ADP standards program. Commerce is responsible for providing scientific and technological advisory services and for recommending uniform Federal ADP standards to the President. This latter responsibility was later expanded by an Executive order. The order delegated to Commerce the additional responsibility to promulgate Federal ADP standards on behalf of the President. Administrative responsibility for Commerce's functions has been delegated to the Institute for Computer Sciences and Technology within the National Bureau of Standards (NBS). As of June 1977, 29 Federal ADP standards had been approved by Commerce. Commerce intends most of these to be mandatory for all Federal agencies.

GSA has exclusive authority for acquiring all general purpose, commercially available ADP systems for the Government. As the central procurement agency, GSA is responsible for implementing Federal ADP standards in the procurement process.

CHAPTER 2

COMPETITIVE PROCUREMENTS CURTAILED BY A WEAK FEDERAL ADP STANDARDS PROGRAM

Contrary to a major objective of the Brooks Act, the Federal Government is not fully realizing potential savings available through competitive procurements. Federal agencies have become locked into suppliers of computers and related services either because certain essential standards have not been developed or agencies are not complying with existing standards. As a result they are making noncompetitive procurements to avoid extensive efforts to convert their computer programs and data. Conversions now cost the Government an estimated $450 million each year. Savings are also being lost through noncompetitive procurements because certain hardware standards do not exist. In a 1969 report we estimated this loss had reached $100 million, but it is much greater now.

SOFTWARE AND HARDWARE INCOMPATIBILITIES IMPEDE COMPETITIVE PROCUREMENTS

Comprehensive records do not exist on the number of noncompetitive procurements of ADP equipment made in the Federal Government. Evidence, however, suggests that the number is increasing. The House Committee on Government Operations reported in October 1976 that there had been a low percentage of fully competitive ADP procurements in fiscal year 1975. Agencies have become increasingly dependent on single sources of supply for their equipment and software, or they specify make and model, brand names, or the equivalent when making procurements. As a result the Government is losing substantial cost savings.

Software conversion costs

Agencies often make ADP acquisitions from current vendors noncompetitively because they estimate the cost to convert existing applications software to another vendor's equipment may exceed the procurement savings available through competition. Applications software are programs developed to automate user tasks, such as payroll, accounting, and statistical calculations. Some conversion costs are incurred even when equipment is replaced by the same manufacturer. However, the costs are usually higher when equipment is replaced by a different vendor, because each offers unique features in programing languages and hardware.

Government-wide information is not maintained on the number of existing computer systems replaced with new systems each year or on the total conversion cost. The Department of Defense has estimated, however, that over 80 percent, or about 8,500, of the general management computers in the Federal inventory will be replaced by 1985. In a recent report to the Congress, 1/ we estimated that software conversions cost the Government about $450 million each year.

Several other of our reports issued since 1969 have demonstrated that the high cost of converting machine-dependent software has impeded competitive ADP procurements. According to our review of the ADP standards program, high conversion cost estimates adversely affected competition in recent procurement actions by the National Institutes of Health, the Department of the Air Force, and the Geological Survey. We also reviewed a Government-wide teleprocessing services contract and found that agencies had developed computer applications using nonstandard programing languages provided by the contractor. These agencies either have incurred, or expect to incur, substantial costs when they eventually convert their software to a new vendor's system.

National Institutes of Health

The National Institutes of Health has requested several procurements that were not fully competitive to upgrade its computer systems. In 1971 it renewed a fiscal year 1972 lease costing about $4.8 million per year from its incumbent vendor. It estimated that conversion of the programs to another vendor's equipment would cost about $8.5 million. We were told that a similar request, again influenced by high conversion cost estimates, was made in 1974. At present, this agency is again attempting to procure computer equipment from the same vendor. The agency estimated in 1977 that conversion of its computer system, which is costing about $12 million a year, would cost over $50 million.

Department of the Air Force

The Air Force initiated a procurement in 1975 to replace a computer to operate a worldwide uniform military pay system. The Air Force requested GSA to acquire a computer system of a specific make and model because the Air Force believed

---

1/"Millions in Savings Possible in Converting Programs From One Computer to Another" (FGMSD-77-34, Sept. 15, 1977).

software conversion costs would be excessive. It justified the request on the basis that the cost of the requested computer was about $5 million and that if it were obtained, conversion costs would be insignificant. The Air Force estimated that if a computer of a different make and model were acquired competitively, software conversion would cost about $4.5 million.

The Air Force also pointed out that conversion would require staff beyond the installation's capabilities and that the equipment would be incompatible with auxiliary computer equipment planned to be used with the new computer.

Geological Survey

The Geological Survey has augmented its computer system by making several noncompetitive procurements. The agency estimated in a 1973 request that conversion costs for a fully competitive procurement could approach $2.5 million. In 1975 the agency acquired additional equipment from the same vendor without competition. In March 1976 the Geological Survey suggested that it make yet another noncompetitive procurement because conversion would cost about $10 million.

National teleprocessing services contract

Federal agencies frequently purchase computing services from commercial vendors rather than acquiring and operating their own equipment. Federal expenditures for these services, generally referred to as teleprocessing services, have increased greatly in recent years, and OMB has strongly encouraged greater use of this source. In fiscal year 1976, expenditures for teleprocessing services exceeded $78 million. About one-third of this amount was paid to one vendor under a national teleprocessing services contract awarded by GSA in 1972.

GSA began a new program in 1976 under which agencies may use vendors providing the most economical services. This program was started in recognition of the need for a more broadly based teleprocessing services program involving numerous vendors. GSA recognized that high software conversion costs would make it difficult for agencies to competitively procure services from new vendors, and in September 1976 the Commissioner of GSA's Automated Data and Telecommunications Service stated:

"A major problem that was experienced in the procurement of ADP equipment also became apparent in the services area; i.e., a customer easily becomes locked into one vendor's product to the future exclusion of other vendors. Such an occurrence, real and difficult to avoid, is anathema to a Government procurement policy based upon competition."

To determine the extent of conversion costs, we contacted installations at nine Federal agencies 1/ using the national teleprocessing services contract. Only one agency had completed a conversion. Officials there had not documented conversion costs but estimated that costs were about $100,000, or nearly 50 percent of the agency's annual teleprocessing services billings. Officials representing four of the other eight agencies made estimates of conversion costs ranging from $125,000 to $500,000; the remaining four agencies could not provide estimates.

Hardware incompatibilities

A computer system is composed of a central processing unit (CPU) and various peripheral devices (for example, card readers, magnetic tapes, and disk units) for entering data and producing output. The connections between the CPU and its peripheral devices are called interfaces. Because each manufacturer designs and assembles its computers somewhat differently, the interface characteristics may also differ. Thus, an independent peripheral manufacturer is forced to develop different peripheral devices to compete with all computer manufacturers.

Most peripheral equipment manufacturers have concentrated on developing devices compatible with the equipment of the International Business Machines Corporation because it produces about 70 percent of all commercial computer systems. Contrary to what one might expect, this manufacturer's share of the Government computer business is much less than its share of the market as a whole. It has provided only about 30 percent of the Government's current

---

1/Agency for International Development, Department of State; Department of Agriculture; Department of the Army; Department of Health, Education, and Welfare; Department of Housing and Urban Development; Department of the Navy; Federal Trade Commission; GSA; and Nuclear Regulatory Commission.

computer system inventory. As a result, agencies acquiring peripheral devices in most instances have limited sources of supply and must make noncompetitive procurements from the manufacturers already supplying their CPUs.

IMPROVED STANDARDS PROGRAM NEEDED TO MINIMIZE INCOMPATIBILITIES

The conversion costs identified at the National Institutes of Health, the Geological Survey, the Air Force, and at the agencies using the national teleprocessing service contract could have been substantially reduced if software standards had been issued and adhered to by the agencies. Software conversion costs are too high because:

--Agencies have written programs in machine-dependent nonstandard languages.

--Federal standards have not been developed for most high-level programing languages and for data-base management systems.

--Agencies have not adhered to the one existing Federal programing language standard.

Use of machine-dependent languages

Use of machine-dependent programing languages has contributed greatly to high conversion costs. Unlike some so-called high-level languages that are relatively easy to understand and use, machine-dependent languages are complex and are generally designed to the architecture of a specific computer. Because machine characteristics vary among different vendors' computers, machine-dependent languages cannot be standardized and programs using them are costly to rewrite when computers are changed.

Costs to convert programs written in machine-dependent languages composed a substantial part of the conversion estimates prepared by the National Institutes of Health and the Air Force. Although only about 6 percent of the computer programs at the National Institutes of Health were written in such a language, this agency recently estimated that conversion would cost $14 million. At the Air Force facility, conversion would cost an estimated $340,000.

If a standard high-level language is used, computer programs written in that language can be converted more easily and at less cost, thereby promoting competition among

vendors. Although machine-dependent languages may offer operational efficiencies, we concluded in a recent report 1/ that savings in conversion costs through use of transferable high-level languages generally more than offset these operating efficiencies. We also pointed out that it is in the Government's best interest to write programs in standard high-level languages because agencies will most likely need to acquire new replacement computer systems some time in the future.

Lack of standards for programing languages and data base management systems

The Congress, OMB, NBS, and GSA have identified the use of standard high-level programing languages as a way to reduce software conversion costs and facilitate competitive procurements. As of June 1977, however, only one language had become a Federal standard although several others were being used extensively. The one standard language is the Common Business Oriented Language (COBOL) which is generally used for business applications. The Federal Government does not yet have standard high-level languages for scientific, engineering, and other purposes. As a result, agencies are using various languages which are generally oriented to a particular vendor's equipment. The programs written in these languages are expensive to convert.

The Geological Survey, for example, uses two nonstandard high-level languages for its scientific applications. The agency estimates that conversion would cost over $5 million. The National Institutes of Health also estimates that converting its programs written in nonstandard high-level languages would cost $8.6 million.

Similar estimates were made by agencies using the national teleprocessing services contract. For example, one agency which extensively used nonstandard languages estimated conversion would cost $449,000, or 35 percent of its annual billings. Most of the agencies contacted indicated that additional programing language standards were needed to alleviate conversion problems.

1/"Better Communication, Cooperation, and Coordination Needed in Department of Defense Development of Its Tri-Service Medical Information System Program" (LCD-76-117, Oct. 6, 1976).

In addition, standards for data-base management systems are needed to reduce conversion costs. Data-base management systems are comprehensive software packages used to establish, maintain, and access computer files. Each such package operates only on certain computer manufacturers' equipment. These systems are becoming increasingly common in Government operations, and GSA states that conversion problems will continue without such standards.

Estimates provided by the Geological Survey and the Air Force confirm this view. The Geological Survey stated that converting its data-base management system would cost $1 million. The Air Force estimate was about $289,000. Although specific conversion cost estimates were not available from the agencies contacted, most of those using the teleprocessing services contract indicated that standards for data base management systems are necessary to reduce conversion costs.

Agencies are not adhering to the Federal COBOL language standard

Federal agencies are required to use standard COBOL for business applications. Computer manufacturers, however, also offer nonstandard COBOL features designed especially for use with their equipment. These vendor-unique features may sometimes enable agencies to optimize the efficiency of their computers and reduce operating costs. Their use, however, usually makes the programs unworkable on another manufacturer's equipment and necessitates partial program replacement if other equipment is used.

At the National Institutes of Health, about 31 percent of the computer programs are written in COBOL. Because these programs include nonstandard features, however, the agency estimates that conversion would cost about $3.7 million. A similar situation existed in the Air Force procurement we looked at, where most of the applications are in COBOL. The Air Force used nonstandard features of COBOL, which it estimated would cost $1.5 million to convert.

Hardware interface standards needed

In a 1969 report 1/ to the Congress, we stated that significant cost savings could be realized if Federal agencies

---

1/"Study of the Acquisition of Peripheral Equipment for Use With Automatic Data Processing Systems" (B-115369, June 24, 1969).

acquired ADP peripheral equipment competitively from manufacturers specializing in individual components rather than from producers of entire computer systems. However, incompatibilities among computers have impeded competition and resulted in lost opportunities for savings.

Hardware interface standards would enable independent manufacturers to produce peripheral equipment usable on any manufacturers' computers. Such standards would promote competitive procurements with cost reductions by expanding the number of potential competitors. The 1969 report estimated that about $100 million might have been saved had the Federal Government acquired computer components from alternative sources. A later NBS report stated that future savings far exceeding these early estimates may be possible.

LOW COMPLIANCE WITH FEDERAL ADP STANDARDS THROUGHOUT THE GOVERNMENT

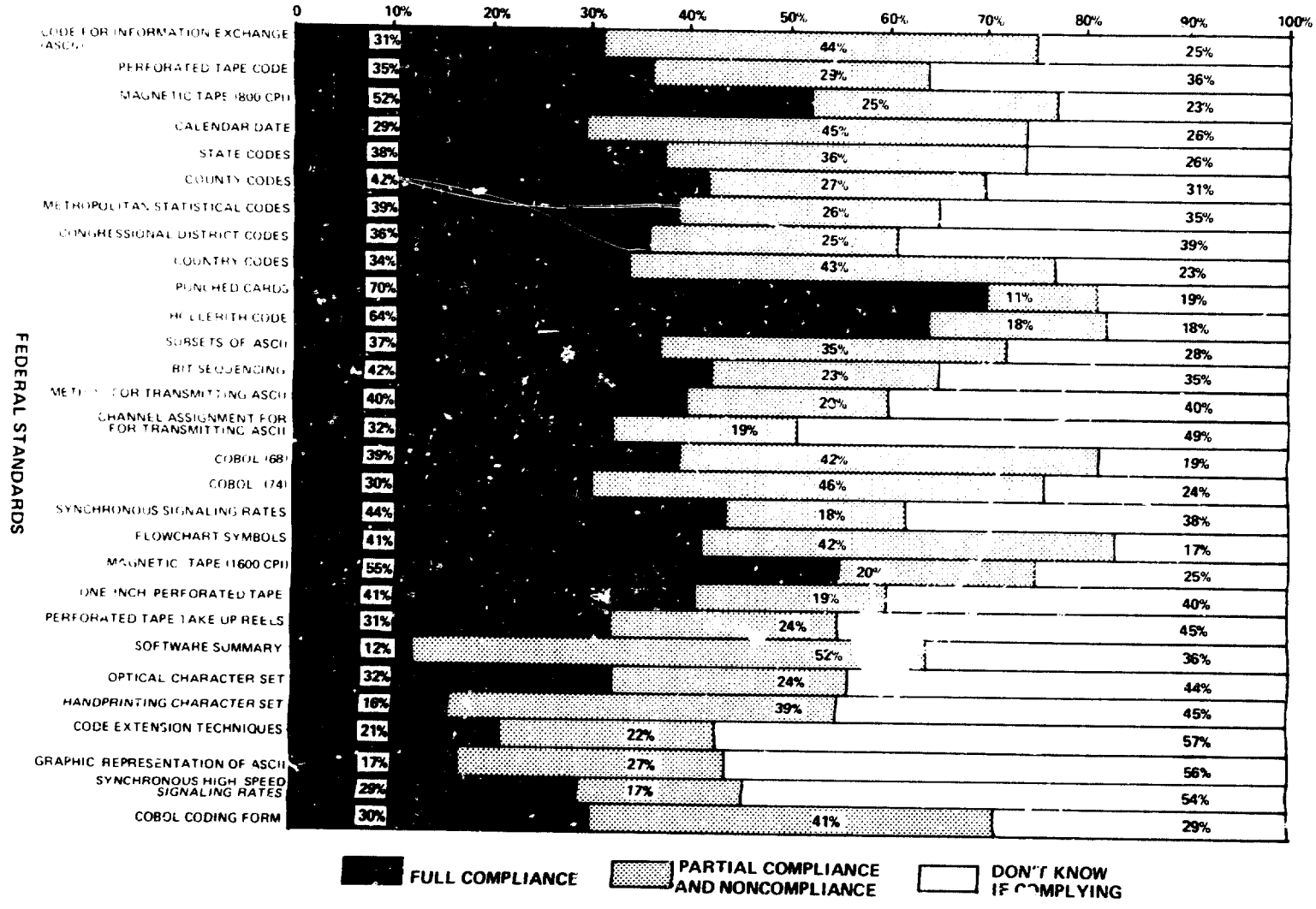
The extent to which agencies are using Federal ADP standards has never been determined by NBS. Consequently, we developed a questionnaire for this purpose. It was sent to the top management official responsible for data processing in each bureau, command, or office of all Federal agencies using ADP equipment. The questionnaire was intended primarily to indicate the potential Government-wide scope and magnitude of the problems we had observed at the nine agencies using the teleprocessing services contract, as well as the individual ADP facilities of the National Institutes of Health, the Air Force, and the Geological Survey. About 90 percent of the 251 questionnaires sent out were completed and returned to us.

The responses indicate that most Federal agencies have problems with standards similar to those noted at the agencies visited. The responses showed that agencies generally are not fully complying with existing standards and that additional standards are needed. Respondents were asked, for example, the extent of compliance in their organizations with each of 29 Federal standards available for use in January of 1977. Figure 1 on page 12 shows their responses.

Only four standards were reported as being followed completely by more than half the respondents; total compliance with the remaining standards ranged from 12 percent to 44 percent. Although our questionnaire was sent to officials most knowledgeable about the use of Federal ADP standards at their agencies, in many cases they did not know if the standards were being used.

FIGURE I

ESTIMATED LEVEL OF COMPLIANCE WITH APPLICABLE FEDERAL ADP STANDARDS



Most respondents (70 percent) feel that the existing Federal standards provide only slight to moderate benefits, but they expressed a strong need for additional standards. More than 75 percent of the respondents indicated an urgent or a moderate need for standards in (1) programing languages, (2) networks and data communication links, and (3) interfaces.

CONCLUSIONS

The Federal Government will not fully realize the savings available through competition as envisioned by the Brooks Act until it strengthens its ADP standards program. An improved program would offer the greatest impetus toward reducing conversion costs and promoting competitive procurements.

A Federal standards program should provide for the timely development, implementation, and enforcement of standards. It will not, of course, be a cure-all to achieve cost savings without good management, but Federal ADP policymakers and managers must recognize the need for compliance with standards to effectively carry out the Government's policies for achieving maximum competition.

The Government has become locked into vendors of ADP equipment and related services because of the lack of standards. In the continuing absence of standards, and without enforcement of those in effect, the cost to convert existing systems to new hardware of a different manufacturer will become so prohibitive that it may ultimately become impossible to justify fully competitive procurements.

The Government generally needs standards more than computer users in the private sector. The private sector, for the most part, uses only the equipment of one manufacturer and therefore already has a set of de facto standards. Federal agencies, on the other hand, are required by law to acquire computer systems competitively to the maximum practical extent. They therefore need standards not only to foster competition but also to be able to exchange equipment, software, and data.

The next two chapters discuss the Federal ADP standards program and provide recommendations to strengthen it.

CHAPTER 3

IMPROVEMENTS NEEDED IN THE FEDERAL STANDARDS DEVELOPMENT PROGRAM

Little progress has been made in developing and issuing ADP standards since the program began in 1965. Agencies responsible for the program have not effectively implemented policies and procedures which would assure that adequate resources, control, and visibility are given to the program.

DEPARTMENT OF COMMERCE RESPONSIBILITIES FOR THE PROGRAM

In December 1966 OMB gave Commerce responsibility for developing ADP standards in accordance with the Brooks Act. This guidance directed Commerce to develop and recommend ADP standards for Federal use, relying, when appropriate, upon voluntary commercially developed standards. The Secretary of Commerce delegated this responsibility to NBS's Institute for Computer Sciences and Technology.

Federal ADP standards are generally defined as sets of conditions which establish the characteristics of ADP products, processes, and procedures used by Federal agencies. They are generally declared mandatory for agency use and take various forms including:

--Physical hardware specifications (such as a requirement that computers be capable of interchanging information in a prescribed manner).

--Software conventions (such as a programing language).

--Computer-operating procedures (such as a method for encrypting computerized data when it is transmitted between two points).

--Data representations (such as a way to represent calendar dates in numeric or alphabetically coded form).

In 1973 NBS introduced a new concept called Federal ADP guidelines. Guidelines are advisory practices and procedures which Commerce publishes when it believes mandatory standards are not practical, feasible, or appropriate.

Because they are advisory, guidelines do not insure that Federal ADP systems or data are compatible or interchangeable. An example of a Federal guideline is a 92-page booklet on ADP physical security and risk management that agencies can voluntarily use as a reference and checklist in evaluating security programs.

As of June 1977, 29 Federal standards and 15 guidelines had been issued as a result of the Federal ADP standards program. The following table shows the types of standards and guidelines issued.

	Hardware	Software	Operations	Data	Total
Standards	18	4	1	6	29
Guidelines	1	7	5	2	15
Total	19	11	6	8	44

LITTLE PROGRESS IN TIMELY DEVELOPING FEDERAL ADP STANDARDS

After 12 years only 15 of 65 areas identified by NBS as requiring standards have been partially or fully satisfied by the existing standards. NBS recently reevaluated the requirements of the program and has now identified about 120 areas needing standards and guidelines during the next 5 years.

NBS officials have acknowledged that progress in developing standards has not been satisfactory and have suggested that the problem is lack of funds. However, NBS has not developed several standards within promised time frames even when the funds were available. In congressional testimony and in response to our reports and other evaluations, NBS has frequently stated its objectives for developing certain standards by specific dates. For example, NBS promised in congressional hearings to issue a data encryption standard by December 1974, but it was not issued until January 1977, 25 months later. Other examples of NBS's standards-related commitments and the results of its efforts follow.

NBS commitment	Results (note a)
Publish 13 Federal standards in fiscal year 1976	Two standards (note b) and six guidelines issued in fiscal year 1976 and the transition quarter
Publish 20 Federal standards in fiscal year 1975	Five standards and one guideline issued
Provide nine Federal standards in fiscal year 1974	One standard and two guidelines issued
Complete nine standards in fiscal year 1973	Five standards (note b) and one guideline issued
Issue in fiscal year 1976 a Federal standard programing language called FORTRAN (Formula Translator)	Now expected in fiscal year 1978
Issue in fiscal year 1975 a Federal standard programing language called BASIC (Beginners All-Purpose Symbolic Instruction Code)	Now expected by the end of fiscal year 1978
Issue by December 1974 guidelines on various computer systems documentation	A guideline issued in February 1976

a/Revisions to data element standards previously issued by OMB, and program management documents have not been included in this analysis.

b/Includes a revision to a previously issued standard.

NBS recognizes the need to develop standards systematically and promptly to achieve program objectives. According to NBS, each standard developed entirely within the Federal Government should take about 3 years to complete and issue. When voluntary commercial standards are developed and adopted by the Government, NBS expects the process to take about 5 years. Usually these time frames have not been met.

The time taken to develop and issue a Federal standard has averaged 6 years instead of 3. When commercial standards are developed for Federal use, the development cycle has averaged 8 years instead of 5. Some have taken more than 10 years. For example, work began in 1962 to develop a commercial standard for optical character recognition. It was first issued as a commercial standard in 1966 but was not adopted as a Federal standard until 1974. Development of a voluntary commercial hardware interface standard began in 1967; the standard has not yet been issued.

Federal standards developed independently of the commercial sector have also taken a long time. For example, NBS began work on a simple and nontechnical standard coding form in January 1974. It consisted of a sheet of paper with lines and symbols printed on it to help programers code computer programs. We were told that the technical development of the coding form had required only about 10 staff-days of part-time effort by three individuals over 5 months. A lengthy processing and approval cycle delayed issuing the standard until September 1976, or 32 months later. (See app. III.)

WHY MORE PROGRESS HAS NOT BEEN MADE

Little progress has been made in the Federal ADP standards program because its managers have

--depended too much upon the commercial sector to develop standards for Federal use,

--not made it visible to the Congress and OMB,

--not given it high-level attention,

--not established standards priorities,

--not exercised adequate control over the Federal standardmaking process.

Dependence on the commercial sector

The 1966 OMB guidelines directed NBS to promulgate, whenever possible, Federal standards consistent with the voluntary commercial standards developed by industry. The following table shows the extent to which this has been done.

Type of standard	Industry developed	Government developed	Total
Hardware and media	17	1	18
Software	2	2	4
Computer operations	0	1	1
Data elements and codes	0	6	6
Total	19	10	29

When the nature of computers and the number of standards needed are considered, few voluntary commercial standards have become available. Because the Federal standards program is so closely associated with the voluntary commercial process, delays within that process have adversely affected the Government program. With strict requirements for demonstrating consensus before adopting a standard, an objection by anyone involved in the development process can frustrate a standards effort. NBS has cited the dominance of large manufacturers in the commercial process as a primary reason for the slow progress in developing commercial standards.

The impact that industry can have on this process can be illustrated by the ongoing effort to develop hardware interface standards. The Government recognized in 1965 a need for such standards, and a project was started by the private sector in 1967 to meet this need. Nevertheless, nothing was developed for many years.

From 1967 to the early 1970s, some of the computer manufacturers were influential in frustrating and eventually ending an effort to develop an interface standard being considered internationally. They suggested numerous changes to the proposed standard, which added greatly to its complexity. Finally, the proposal was decided against because of its complexity. In 1974, however, individuals employed by peripheral equipment manufacturers began to participate in the development process and eventually dominated it. They were interested in developing interface standards so they could compete for a greater portion of the peripheral equipment market. This group was instrumental in promoting a proposed interface standard which is now being considered for adoption as a Federal and commercial standard. (See app. I.)

On the other hand, some voluntary commercial standards have been developed successfully because users were active in the development process. For example, during the development of COBOL, users participated heavily in developing language specifications and then required the manufacturers to sell

them the language capability with their equipment. Later, a subcommittee was formed to develop test problems to validate that the manufacturer-produced COBOL complied with the standard. The project fared poorly, however, and the subcommittee was abolished without the task being completed. Realizing that a COBOL standard would not be effective without a means for insuring conformity, the Department of the Navy developed validation routines. NBS later negotiated an agreement with the Navy to maintain and operate these routines to test all COBOL brought into the Government inventory. (See app. II.)

Program not visible to the Congress and OMB

NBS has stated that the standards program has been restricted because of limited funds. Nevertheless, it has not provided the Congress and OMB meaningful budgetary information on the scope and direction of the program which would justify additional funds. For several years before 1972, Commerce clearly identified the funding intended for the program in its annual appropriation requests. Since then, however, the requests have not fully identified the funding needed or the expenditures made to develop standards. For example, the fiscal year 1977 budget request for standards was included in the following submission.

Program activity	Budget request
	(000 omitted)
Computer security	$ 681
Computer utilization	1,435
Computer networking and performance measurement	1,037
Functional applications of computer technology	1,315
Mathematical supporting services	1,497
Total	$5,965

Our analysis shows that not all these funds were available to the Institute for Computer Science and Technology for carrying out its Brooks Act responsibilities. For example, the $1,497,000 requested for mathematical supporting services was for another NBS institute not involved in the Federal ADP standards program. The other listed funds were

intended for advisory services, research, and standards. Except for mathematical supporting services, all the program activities listed above contained some funds for standards work. Only a portion of the funds requested for standards, however, could be clearly identified in the supporting documents.

Our analysis of the six budget requests for fiscal years 1972 to 1977 showed that the program activities had been changed four times. These, in turn, caused changes in the NBS accounting system since it accumulates expenditures in cost centers that are directly related to each program activity. Without continuity in the budget reporting structure, it is difficult to make meaningful budget and historical cost comparisons for budgetary and internal management control.

Low-priority attention at NBS

In its 1966 guidance statement to Commerce on developing and issuing Federal ADP standards, OMB also instructed NBS to provide advisory and consulting services, conduct research on computer science and techniques, and operate a computer facility for use by Federal agencies. According to NBS records, funds budgeted for these and the standards development task have ranged from $6.1 million in fiscal year 1972 to $6.9 million in fiscal year 1976. During the latter year, the Institute for Computer Science and Technology employed about 155 people. About $4.1 million, or 59 percent of the fiscal year 1976 funds, was provided through direct appropriations, while the remaining $2.8 million came from reimbursable funds made available by other agencies for advisory, consulting, and computer services.

Institute officials have informed us and the Congress that Federal ADP standards are their highest priority and that over 75 percent of the Institute's $4.1 million in appropriated funds support standards development. Our evaluation shows, however, that only about 38 percent of the appropriated funds, or 23 percent of the combined appropriated and reimbursed funds, are devoted directly to standards development.

To make our evaluation, we reviewed official project management documents and other supporting evidence because the NBS accounting system does not show how much is actually

spent on standards. 1/ We also spoke with each project leader to obtain estimates on how much had been spent in the following categories in fiscal year 1976: (1) advisory and consulting services, (2) computer services, (3) research on computer sciences and technology, and (4) standards and guidelines development. We categorized as standards development, rather than research, any funds devoted to research projects that could be attributed by the project leaders to the eventual development of guidelines or standards.

Figure 2 on page 22 shows our analysis on how the Institute used its appropriated and reimbursed funds both separately and together to fulfill its Brooks Act responsibilities. This chart demonstrates that much effort is being directed to advisory and consulting services and to research. The following are examples of this type of work performed by the Institute.

--Advisory and consulting services, such as participating in an effort to develop an automated fingerprint identification system for the Department of Justice and assisting Federal agencies involved with promoting computer technology in international trade.

--Research, including experimenting with voice-oriented computer devices, the effects of radioactivity and other energy forms on computer magnetic storage media, and a programable robot system.

Standards priorities not established

In 1973 NBS published an official statement of objectives and requirements for the Federal ADP standards program. This statement identified requirements for specific standards. It also recognized that priorities were needed for directing development efforts to those standards which were most needed and offered the greatest potential benefits. At the time of our review, 4 years later, priorities still had not been established.

Without priorities there is little assurance that resources have been directed to those standards which offer the greatest potential benefit. For example, in fiscal year 1976, only about 17 percent of the Institute's appropriated funds were spent on developing standards which questionnaire respondents identified as the most urgently

---

1/The accounting system design was approved by the Comptroller General in 1953. NBS has not submitted it for approval since enactment of the Brooks Act.

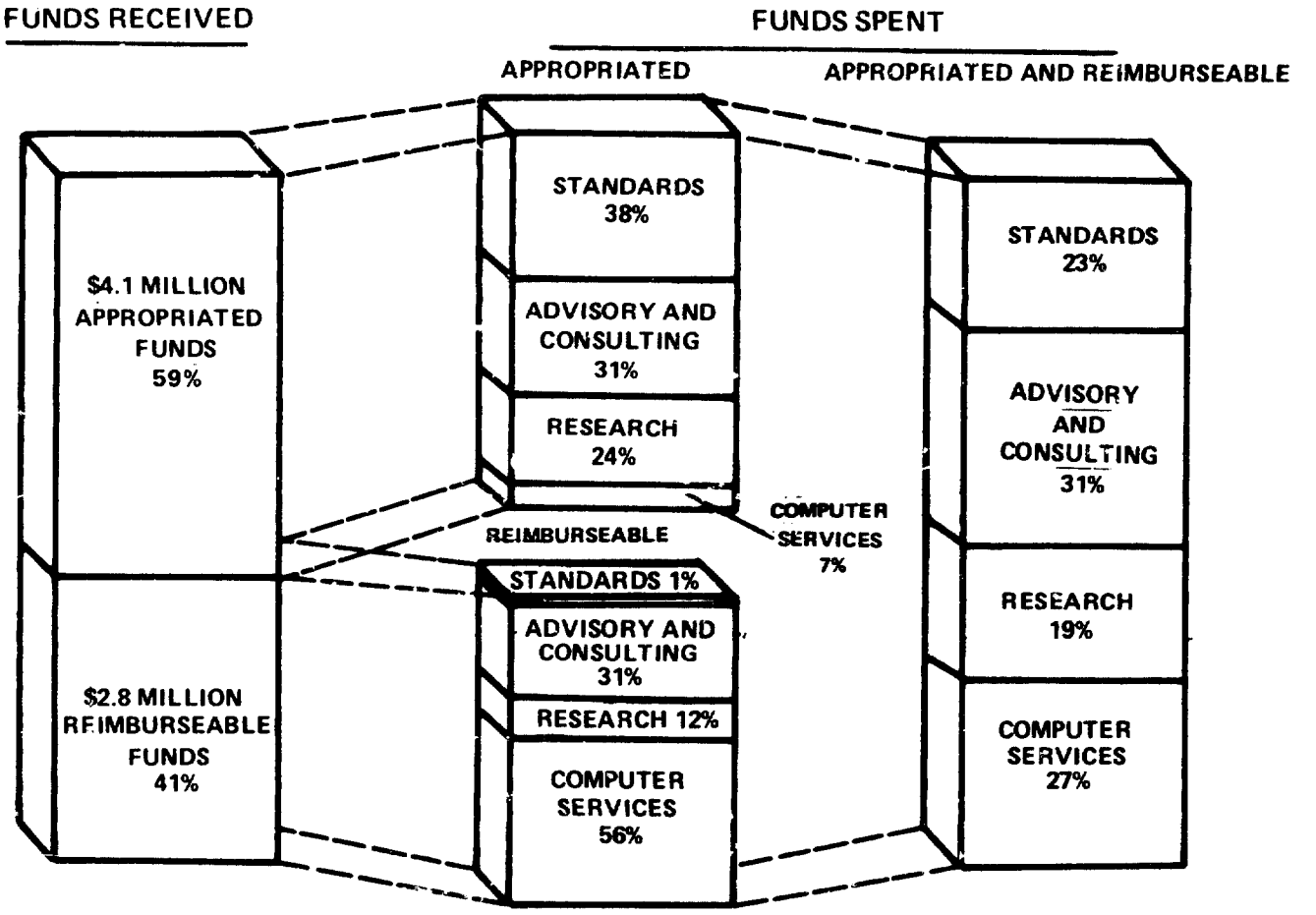


Figure 2. Percentage of expenditures spent by the Institute for Computer Sciences and Technology in fiscal year 1976, showing the separated and combined uses of appropriated funds and reimbursable funds from other agencies and for computer services. Funds for general purpose equipment are not included.

needed. These include programing languages, networks and data communication links, and interface standards.

NBS has not responded even when priorities have been clearly established for a particular standard. For example, annual funding for developing hardware interface standards averaged $27,400 during fiscal years 1966 to 1970. This low level prompted the Joint Economic Committee to conclude in its May 1971 report that:

> "* * * the National Bureau of Standards, while interested in the interface standards problem, had given no real priority to its solution. In fact, only one-half a man-year had been devoted to this program at the time of our hearings. In view of the consensus of expert opinion that great savings would result from the development of an adequate interface standard, and that standardization is technically feasible, the Commerce Department and the National Bureau of Standards appear to have been remiss in pursuing an exceptionally good opportunity for genuine economy in the Federal Government."

Even though the Committee strongly recommended to NBS that it accelerate its efforts on interface standards, including spending additional funds if necessary, annual funding for this project averaged only $44,200 at the Institute during the next 6 fiscal years (1971-76).

The absence of priorities has resulted in Federal resources being used to develop insignificant standards having minimal potential benefit, while critically needed standards have not been produced for lack of funds. For example, resources were spent to develop a Federal flowcharting template, which has had little impact on achieving Brooks Act objectives. (See app. IV.) Similarly, the Government devoted resources to develop a simple coding form, which contributes little to more economical procurements and more efficient computer operations.

Inadequate management control over the Federal standardmaking process

OMB policy guidance issued in 1966 required that NBS work closely with Federal agencies to assure proper consideration of their needs and views in developing Federal standards. Along with this guidance, NBS established in 1969 the Federal Information Processing Standards program, which relies extensively on the voluntary participation and commitment of resources by Federal agencies. Total resources are not centrally compiled, but we estimate that agencies other than NBS are spending about $1 million annually for this purpose.

NBS has not adequately managed these resources to assure the effective and prompt development of ADP standards. In this program task groups are generally responsible for the technical development of Federal standards. It is therefore crucial to timely development of standards that these groups function efficiently. Several factors inherent in the task-group approach have prevented NBS from effectively managing these activities.

--According to NBS officials, task groups have not always been staffed with the proper mix of technically skilled people necessary to develop standards. NBS is not authorized to obtain from other Federal agencies the necessary skilled personnel. Membership on Federal task groups is voluntary, and NBS may use only those staff made available by participating agencies.

--Task group members usually have full-time duties in their own agencies and can work on standards projects only part time. Task groups, for example, were scheduled to meet an average of only 5 days during fiscal year 1977.

--Until recently NBS has not required task groups to submit formal plans and milestones for doing their work, nor has NBS provided the task groups procedural guidelines.

CONCLUSIONS

Since the computer industry provides the bulk of the Government's ADP equipment and related services, the Government needs to work closely with industry and other users to develop the standards they jointly need. Consequently, to assure that its needs are known and met, the Government must actively participate in voluntary commercial standards-setting organizations. In some cases, however, the Government may need certain standards that a major segment of the industry does not want. The industry may perceive that these standards adversely affect its product lines or its share of the market. This requires the Government to have a strong internal standards program to assure that its needs are properly identified, justified, prioritized, and communicated to these organizations.

The Government should be prepared to develop and adopt standards unilaterally when it recognizes that industry or groups within industry are delaying excessively the development of essential Federal standards. Since the unilateral

development of such standards would be a significant step, the Government should establish guidelines that specify the circumstances under which this will be done.

The Federal ADP standards program needs to be strengthened in several areas. Management has neither requested funds nor reported expenditures in a way that clearly identifies the resources committed to each of its Brooks Act responsibilities. We believe management's claim that funds available for standards development are limited only heightens the importance of a budget and accounting system that can track funds back to these responsibilities. Without such information, the Congress, OMB, and the Department of Commerce cannot adequately assess progress or give enlightened direction to the standards program.

The program has also been weakened because management has not established an effective system to identify those standards with the highest potential for alleviating Federal ADP problems. NBS officials have frequently stated that limited resources have hampered the program. To the extent that this is true, the need for a priority system takes on increased importance. Such a system should attempt to tie in each proposed standard and its costs with the most critical problems facing Federal users of ADP resources.

The task group approach has not resulted in the timely development of standards or the effective use of skilled Government personnel. Task groups meet infrequently, and NBS cannot reasonably require or expect part-time volunteers to be productive within specific time periods. The continued availability of these people is determined ultimately by the parent agencies. As the calendar time of any particular standard project lengthens, there is less likelihood that the same individuals will continue to be available, thus reducing project continuity

AGENCY COMMENTS

Written comments on our draft report provided by OMB and Commerce arrived too late to be evaluated and incorporated into this report. However, we obtained oral comments from officials of these agencies and have considered their views in this chapter as appropriate.

OMB officials generally agreed with the findings, conclusions, and suggestions of this chapter. Commerce has recognized, as a result of our review, that major improvements are needed in the Federal ADP standards program.

Several internal studies have been undertaken, and a 5-year program plan has been developed which Commerce believes will deal with most of the issues.

While Commerce officials agreed with most of our recommendations, they disputed our conclusion that much of their funds are not spent on standards-related work. As mentioned earlier, our conclusion is based upon our analysis of project documents and discussions with nearly all project managers at the Institute. Neither we nor Commerce officials could base this analysis upon information directly from the NBS accounting and cost reporting system because the system does not categorize costs by Commerce's assigned Brooks Act functions. We remain convinced, therefore, that our analysis provides a true reflection of the Institute's standards-related work.

RECOMMENDATIONS

To make the Federal ADP standards program more responsive to Federal needs, we recommend that the Director of OMB issue policy guidance to the Secretary of Commerce and Federal agencies that would:

--Cite the importance of standards in addressing Federal problems.

--Specify and insure an active role by Federal agencies in Federal and voluntary commercial standards setting.

--Insure that Federal agencies fully coordinate with Commerce when participating in commercial standards development.

--Require Commerce to develop standards independently of the commercial sector and cite the circumstances under which this would be done.

--Guide Commerce in establishing priorities for its Brooks Act responsibilities.

We recommend that the Secretary of Commerce, using OMB guidance:

--Develop and implement procedures for justifying, setting priorities for, and monitoring the development of standards.

--Commit more existing resources to developing standards.

--Coordinate Federal agency participation and views before and concurrently with commercial standards development.

--Establish ad hoc task forces staffed with full-time qualified people under contract to Commerce or from Federal agencies to develop Federal ADP standards.

--Develop and establish Federal standards unilaterally if the commercial process takes too long.

--Establish a budgeting and cost-reporting system that will give the Congress and OMB information on the nature of, priority, justification for, and results achieved in (1) standards and directly related research and (2) assistance to agencies and directly related research.

Because the NBS accounting system was approved by the Comptroller General in 1953, before enactment of the Brooks Act, we also recommend that the Secretary submit to us for approval an updated design of an accounting system. This system should include categories for accumulating costs related to assigned Brooks Act functions, as well as other changes made since the system was approved in 1953. It should also include changes that are now contemplated.

CHAPTER 4

GOVERNMENT-WIDE COMPLIANCE WITH FEDERAL STANDARDS IS NECESSARY TO ACHIEVE SAVINGS

The effectiveness of the Federal ADP standards program has been hampered because the responsibility for enforcing standards is not clearly assigned and the extent to which agencies are using them is unknown. Current policies and procedures do not assure that agencies will comply with standards. Furthermore, procedures have not been developed that will disclose, during the procurement cycle, whether products and services offered by the computer industry meet Federal standards.

GOVERNMENT-WIDE ADP STANDARDS ENFORCEMENT MECHANISM NOT EFFECTIVE

The Brooks Act does not specifically provide for the enforcement of ADP standards by either GSA, Commerce, or OMB. These three agencies have central management responsibilities for the Federal ADP program. Among other things the act delineates the following responsibilities:

> "(a) The Administrator [of GSA] is authorized and directed to coordinate and provide for the economic and efficient purchase, lease, and maintenance of automatic data processing equipment by Federal agencies.
>
> "(f) The Secretary of Commerce is authorized * * * to make appropriate recommendations to the President relating to the establishment of uniform Federal data processing standards.
>
> "(g) The authority conferred upon the Administrator and the Secretary of Commerce by this section shall be exercised subject to direction by the President and to fiscal and policy control exercised by the Bureau of the Budget [OMB]."

Thus, the Brooks Act indicates that the President is responsible for standards. The President responded shortly after passage of the Brooks Act and told agency heads to give priority attention to achieving greater ADP compatibility through standards. Five years later, in April of 1971, a second presidential memorandum reaffirmed this position by telling agency heads that they were expected to apply

Federal ADP standards whenever their use would lead to greater operational efficiency and reduced costs. Neither of these memorandums mentioned ways and means to insure compliance.

The 1971 memorandum also authorized and empowered OMB to act finally, on behalf of the President, concerning the establishment of ADP standards. Two years later, on May 9, 1973, the President issued Executive Order 11717 transferring this authority from OMB to Commerce. Again, he did not specifically provide for enforcement. The President evidently expected the head of all Federal agencies to independently direct their organizations to comply with ADP standards.

OMB Circular A-71, dated March 6, 1965, identifies agency responsibilities for administering and managing ADP activities but contains no provisions concerning compliance with ADP standards. The December 1966 OMB guidelines to Commerce are also vague. These guidelines directed that NBS "* * * to the extent feasible and desirable, develop and recommend means for measuring compliance with Federal standards." Until recently NBS has interpreted this statement to mean only technical compliance, not administrative compliance.

Technical compliance is the degree to which any given product or service conforms to standards. Compliance by manufacturers can be implemented through procurement regulations and can be measured through validation services or qualified products lists. For example, computer magnetic tapes acquired from vendors for Federal use must undergo tests to determine that they comply with magnetic media standards.

The measurement of administrative compliance involves determining the extent that standards are being implemented by Federal agencies. NBS recognized in a 1971 study that a major problem existed in the Federal ADP standards program because there was no reporting system on compliance with Federal standards. NBS therefore recommended to OMB that a system be developed in which agencies would report the extent of compliance. OMB did not respond to this recommendation.

The Department of Commerce believes it does not have full authority to enforce compliance. OMB officials generally agree with this position; however, they believe that Commerce does have adequate authority to generally insure compliance

by using various management techniques, [illegible] requiring Federal agencies to develop internal p[illegible]es and procedures that will serve to enforce compliance.

Even though Commerce's authority may not be clear, it has declared most Federal standards mandatory for Government use, thus implying that the agencies are expected to implement them. However, 20 of the 29 Federal standards contain a provision which allows the agency heads to waive their use. Generally, all waivers and reasons are to be coordinated with NBS so that it may consider the impact of the decision on the Federal standards program. Eighteen standards require waivers to be coordinated with NBS, as follows:

> "The waiver is not to be made until a reply from the National Bureau of Standards is received; however the final decision for granting the waiver is a responsibility of the agency head."

The remaining two standards differ primarily in that the waivers need not be coordinated in advance.

GSA publishes procurement regulations which require agencies to use the standards it incorporates into the Federal Property Management Regulations. GSA has incorporated many of the NBS standards. The regulations provide agencies guidance for identifying the standards to be specified in procurement documents when acquiring ADP resources. They also direct agencies to follow the waiver procedures specified by NBS if the standards are not to be used.

Lack of user agency policies and procedures

Some agencies have failed to establish policies and procedures to implement and enforce standards and to coordinate waivers with NBS. Over half the respondents to our questionnaire indicated their agencies had not developed procedures for obtaining such waivers. Furthermore, 79 percent indicated that management reviews had not been made in their organizations to determine compliance with Federal standards. For example, only 54 waivers have been filed with NBS since the standards program began. Two-thirds of these have been submitted by six agencies. The questionnaire responses indicated that more waivers should have been coordinated with NBS because most standards are not being used.

INADEQUATE MECHANISM FOR ASSURING COMPLIANCE

Government agencies are not complying with Federal standards when acquiring ADP hardware, software, and services. Many acquisitions have been made from equipment lists authorized by GSA for selection by Federal agencies. These lists are used occasionally by the agencies to acquire complete systems but more often to augment existing ones. Most agencies acquire complete systems through negotiated procurements which are publicly advertised.

Neither GSA nor the vendors have identified the extent to which the equipment and software on these lists comply with standards. Sometimes procurements are negotiated individually with specific vendors under delegation of authority from GSA. In these actions agencies are generally not requiring compliance with Federal standards as specified in Federal procurement regulations. In neither instance has GSA established review procedures adequate to enforce compliance.

Nonstandard products procured under ADP schedules

ADP schedules are contracts negotiated by GSA with individual vendors. The schedules list each vendor's equipment offered for sale to the Government. In 1976 Federal agencies acquired equipment and software from these schedules valued at about $284 million, $199 million in rentals and $85 million in purchases. Even though authorized by GSA, many of these products do not comply with Federal ADP standards.

Neither GSA nor the vendors have identified the extent to which each product complies. In December 1975 GSA requested about 225 vendors to comment on a proposal that would require them to identify all hardware and software products that conformed to Federal standards. GSA received comments from only 37 vendors. Nearly half of those who responded agreed with the proposal; as a general rule, these were medium to small dollar volume vendors. One-third opposed the proposal, and these generally included the computer manufacturers which account for a large volume of Government sales. Some of the comments opposing the proposal follow.

--At least 95 percent of vendors offering products used for entering information onto disk packs would be eliminated from participation in the ADP schedule program because the vendors' products are nonstandard.

--Vendors, when analyzing their products, tend toward subjective judgments in their own interest.

--Complying with the requirement would be a costly and time-consuming effort.

As a result of the responses, GSA decided not to require the vendors to specify the extent to which their products comply with Federal standards. Furthermore, the vendors have refused, with GSA's concurrence, to accept any contractual liability for agency acquisition of nonstandard equipment from the schedules. GSA has required the vendors only to state in their ADP schedules that the agencies should incorporate Federal standards in contracts or that they should comply with waiver procedures, as appropriate. Thus, the individual user agencies have the burden of identifying technical compliance, and they generally lack the resources and expertise to do this. Although NBS has acknowledged its responsibility for measuring technical compliance, it has given little or no guidance to the agencies, nor has GSA or the vendors.

Noncompliance in the INFONET and teleprocessing service contracts

In March 1972 GSA awarded a contract with the INFONET Division of the Computer Sciences Corporation to provide teleprocessing services to Federal agencies. These services allowed subscribers to communicate with a regional or national computer network to support computational needs. In the 4-1/2 years ended September 1976, Federal agencies had spent over $67 million under this contract. Since several agencies are encountering significant conversion costs, we reviewed the contract and found that GSA had not required the vendor to comply with Federal standards. GSA told us this had been an administrative oversight. However, the contract was not amended as a result of our review because GSA began requiring agencies to use the Teleprocessing Services Program instead of INFONET for new services.

Under this program agencies are required to select--on the basis of competition--from all vendors having a schedule contract. Again the contract for this program did not require vendors to meet Federal ADP standards, which we discussed with GSA officials. The Request For Proposal was subsequently amended to incorporate all but the Federal COBOL language standard. According to these officials, this standard should not be included because it would, in effect, either impose Federal requirements upon non-Government users

of each vendor's services or require the vendors to support a special compiler for the Government's exclusive use.

At present OMB is encouraging Federal agencies to place more emphasis on acquiring ADP services from commercial organizations. As a result, the amount of expenditures for teleprocessing services is expected to continue to increase. GSA estimates that teleprocessing services valued at more than $263 million could be acquired by Federal agencies by the end of fiscal year 1979. If standards are not enforced at this high level of use, the locked-in problem recognized by GSA's Commissioner for Automated Data and Telecommunications Services (see p. 7) may become far worse under this program than it has been under INFONET.

Little GSA control over implementing standards during procurement

In fiscal year 1976 Federal agencies procured nearly $180 million of general purpose hardware and software under delegated authority from GSA. Authority must be obtained from GSA to procure equipment costing over $50,000 and software costing over $10,000. When GSA delegates procurement authority, it requires agencies to provide it solicitation documents showing that competition is being sought and that appropriate Federal standards are a requirement of the procurement. GSA must review these documents before the agency can proceed with the acquisition.

In fiscal year 1976 GSA granted 465 requests for delegation of procurement authority. Of 184 GSA procurement files that we examined, 130, or 70 percent, did not contain required solicitation documents. Consequently GSA had no way of knowing if standards were being specified as required by the regulations. Further, about half the remaining 54 files that included the documents failed to specify that vendors must comply with applicable Federal standards. GSA detected only one of these cases. GSA states that due to a lack of resources, it makes only random and cursory reviews to determine if standards are specified in the documents. When it does find that an agency has not specified such standards, it notifies the agency to amend the document; however, GSA asserts that, due to lack of resources, it does not follow up. GSA officials told us that agencies can easily circumvent procurement regulations without their awareness or approval. GSA has interpreted its regulatory program authority as excluding the examination of Federal agency compliance by on-site inspections or investigations.

Agencies do not need GSA's approval to procure hardware costing less than $50,000 or software costing less than $10,000. They are, however, required to solicit competition and comply with ADP standards. For this type of procurement, GSA received about 104 solicitation documents during fiscal year 1976. There are no means for determining how many have been prepared by agencies but not submitted to GSA. Federal ADP standards applied to 79 of the 104 available document . Forty-nine, or 62 percent, did not specify that the items being procured should meet applicable Federal ADP standards. GSA had identified only two of these cases. GSA told us that it reviews the documents only occasionally to determine whether standards are being specified.

CONCLUSIONS

Inadequate Federal policies have contributed to agency noncompliance with ADP standards. These policies do not provide a framework for measuring technical and administrative compliance with standards or for enforcing their use.

Each agency now determines whether it will comply with Federal standards. These standards, however, are intended for Government-wide use, and the potential benefits will not be realized if compliance is not achieved Government-wide. Each agency head cannot be expected to take a Government-wide perspective, particularly if the use of a standard might appear to add cost to his/her agency. Consequently, we believe that all waivers must be approved by a single agency to assure that standards are applied on a cost-effective Government-wide basis.

Federal standards cannot be developed and maintained effectively without information on the extent of agency compliance. It is essential, therefore, for the Government to develop a means for measuring compliance. Knowledge of compliance--or noncompliance and the reasons therefore--can greatly improve the Federal standards program by providing feedback not only on the degree of compliance but also on the benefits and problems of standards. This knowledge can help identify the needs and priorities for new or revised standards.

The Federal ADP standards program cannot be effective without strict agency adherence to the standards. However, vendors have no legal obligation to comply with the voluntary commercial standards they help develop; manufacturers sometimes do not comply because of a desire to distinguish their

products from those of their competitors. Therefore, a strong technical compliance enforcement program is needed to identify where commercially available ADP products do not comply with Federal standards. This information can add integrity and responsiveness to the development process.

It is not reasonable or cost effective to expect each agency to cope individually with the complexities of vendor technical compliance. Commerce has acknowledged its responsibility in this area. However, a more effective and efficient centralized effort is needed to measure and insure technical compliance than Commerce has provided.

AGENCY COMMENTS

We provided our preliminary report to OMB, Commerce, and GSA for comment. The written comments provided by these agencies arrived too late to be evaluated and incorporated into this report. However, we obtained oral statements from officials at all three agencies and have considered their views in this chapter as appropriate. These officials generally agreed with the findings, conclusions, and suggestions of this chapter.

There were differing views, however, regarding our draft suggestion that the President issue an Executive order designating the Secretary of Commerce as the central authority for insuring compliance with Government-wide ADP standards, including the disapproval of waivers when not adequately justified. We also suggested that GSA, operating under the guidance of Commerce, be assigned significant responsibilities for enforcing those standards that are enforceable during the procurement process. Almost everyone we have spoken with agrees that a standards enforcement mechanism should be under the authority of a single agency; however, some believe that GSA should be designated the central authority rather than Commerce.

We suggested Commerce because we believe the authority to approve or disapprove waivers should reside with the agency responsible for establishing the standards. The development process for standards needs the feedback that such an enforcement mechanism will provide. In addition, we believe the authority to disapprove waivers could be more effectively exercised by the agency having the technical expertise that is derived from the standards development process.

On the other hand, some believe GSA would be a better choice because it is more involved in the daily ADP operations of Federal agencies than Commerce and that it can better enforce the use of standards through its procurement authority. In addition, some believe the Congress intended GSA to have the primary operational responsibility for coordinating Government-wide ADP management, including the responsibility to enforce the use of ADP standards.

We believe the arguments for designating either Commerce or GSA both have merit. In our opinion the fundamental principle is that there be centralized control over enforcement of Government-wide ADP standards so standards will be implemented consistently throughout the Government. The Government will save money through the use of these standards only if they are consistently implemented. Furthermore, centralized information on standards compliance is needed by the Congress, OMB, and Commerce to assess the success of the standards development program.

The President's designation of either Commerce or GSA or perhaps some other agency as the central authority for standards may be influenced by the results of the President's Reorganization Project. This project is addressing ways for improving the overall management of data processing and eliminating overlap in agency jurisdictions. We believe the Administration should have the flexibility to propose, through its reorganization studies, the best organizational structure for strengthening ADP management, including standards enforcement. Such enforcement, however, should be centrally guided and controlled by a single agency.

RECOMMENDATIONS

We recommend that the President, through an Executive order, clearly designate a single agency as the central authority for insuring compliance with Government-wide ADP standards, including the authority to disapprove agency requests for waivers when they are not adequately justified.

We recommend that the Director, OMB, issue policy guidance to the heads of all departments and agencies. This guidance should require them to:

--Establish policies and procedures for implementing standards, including the use of internal audit to examine for compliance.

--Obtain prior approval to waive compliance with a standard from the agency that is designated by the President.

--Report annually on the degree of noncompliance with existing standards and agency plans for converting to standards.

We recommend that the Director, OMB, issue to the designated agency policy guidance for:

--Evaluating agency requests for waivers and authorizing compliance with standards, when justified.

--Providing to the Congress, through the annual appropriations request for the Federal ADP standards program, information on the degree of noncompliance with existing standards, the problems that may have been caused by inadequate compliance, and the progress being made in converting to standards.

--Determining the extent to which vendor supplied products and services comply technically with Federal ADP standards.

--Establishing a mechanism to insure that Federal departments and agencies acquire only those products and services during the procurement process that comply with Federal standards, unless appropriately waived.

CHAPTER 5

SCOPE OF REVIEW

In this Government-wide study, our objectives were to evaluate ways and means to improve the Federal ADP standards program and to determine the extent to which agencies need standards to comply with the Brooks Act. More specifically, we examined:

--Policies and procedures established by OMB and Commerce for developing and implementing ADP standards and by GSA for procuring ADP equipment, software, and related services that incorporate the standards.

--Records at NBS's Institute for Computer Sciences and Technology on developing voluntary commercial and Federal standards, providing advisory and consulting services to Federal agencies, and performing research.

--Records of the National Institutes of Health, the Geological Survey, and the Air Force Finance Center on recent ADP procurement actions.

--The ADP standards development process in the Federal and commercial sectors.

--Policies and procedures of the American National Standards Institute and the Computer and Business Equipment Manufacturers Association for developing voluntary commercial standards.

We developed a questionnaire that dealt with the impact of the Federal standards program on Federal agency ADP operations, staffing, and funding. It provided information on agency implementation and enforcement of standards and their participation in the development process.

Most Federal standards are derived from commercially developed standards, and both the commercial and Federal processes depend on the expertise of many part-time volunteers. Consequently, we interviewed many individuals in both the private and Federal sectors, including officials and members of the Computer and Business Equipment Manufacturers Association, the Computer and Communications Industry Association, the National Council of Technical Services Industries, the Association for Computing Machinery, and the Institute of Electrical and Electronics Engineers.

We alsc interviewed representatives of all of the major computer manufacturers and several of the peripheral equipment manufacturers. We solicited their comments and suggestions on a wide range of issues pertaining to the Federal and commercial ADP standards programs.

SPECIAL INTEREST GROUPS CAN DOMINATE THE STANDARDS DEVELOPMENT PROCESS: A CASE STUDY

Special interest groups in the computer industry are sometimes motivated to promote or delay the development of certain ADP standards, particularly those that may affect competition. Over the last 12 years, attempts to develop an input/output (I/O) channel interface standard have been both frustrated and promoted by such groups.

A computer system is composed of a central processing unit (CPU) and various peripheral devices and their controllers which are used to input and output data. The connections between the peripheral control devices and a CPU are known as the "channel interfaces." The characteristics of each manufacturer's interface usually differ, thus limiting a user's options for interchanging peripheral devices among the CPUs of different manufacturers. The primary purpose for developing an interface standard, therefore, is to permit a user to attach peripheral devices and their controllers made by any of several manufacturers to any CPU. The obvious impact of such a standard would be to expand competition between manufacturers making CPUs and peripheral devices and those making only CPUs or only peripherals.

In 1969 we reported that savings from competition on the then-existing Federal inventory of ADP equipment could amount to $100 million if peripheral devices from different manufacturers could be interchanged. On the other hand, some manufacturers, particularly those selling both CPUs and peripherals as a system, state that such a standard would inhibit technology by severely limiting the design options that would otherwise be available. They also stated that it would be too costly to implement.

During the early 1960s, the Federal Government became increasingly interested in the use of standards, including an interface standard. The lack of compatibility among ADP equipment was one of the major problems that eventually caused the enactment of Public Law 89-306 (the Brooks Act). Consequently, in response to this and initiatives at the international level to develop such a standard, the American National Standards Committee X3, Computer and Information

Processing 1/ established an ad hoc subcommittee to develop a domestic standard I/O interface.

Work began in March of 1967, and after 20 months and 15 meetings, a report was developed recommending guidelines under which a permanent committee would be established. The recommendation was approved, and the first meeting of the new group was held in February of 1969. During the next 7 years this technical committee, now known as X3T9, monitored and complicated the efforts of the International Organization for Standardization (ISO) to develop an international interface standard.

A JAPANESE PROPOSAL AND THE AMERICAN RESPONSE

Discussions were first held in 1961 by an international committee on the possibility of an I/O interface standard. However, an ISO technical subcommittee did not meet until 1967, and a proposed standard was not submitted internationally until June 1969. At that time, the Japanese representative to ISO submitted a proposal adapted from the interface design of the International Business Machines Corporation, the largest American systems manufacturer. The subcommittee accepted the proposal and requested other member countries to submit comments by the end of the year.

X3T9 was responsible for representing the United States at the ISO technical subcommittee. During this period, the X3T9 committee averaged 11 members, 8 of whom were employed by the large systems manufacturers. The other three members came from Government agencies. Occasionally, individuals employed by peripheral manufacturers and users also attended the meetings as observers, but they chose not to join the committee as voting members.

In its comments on the June 1969 Japanese proposal, X3T9 emphasized that the proposal lacked sufficient technical detail. The Japanese responded to these and other comments and submitted a second proposal in September of 1970. X3T9

1/This organization, which goes by the name X3, was formed under the auspices of the American National Standards Institute to develop standards in the computing field. The Computer and Business Equipment Manufacturers Association serves as the secretariat and provides essential administrative support. Technical committees formed by X3 to develop standards are given designations such as "X3T9" and "X3J4."

submitted comments in 1971 on the second proposal. It made no explicit statement of support or nonsupport but did suggest numerous requirements that it believed any proposed I/O channel interface standard should meet. These requirements were adopted by the ISO technical subcommittee.

In 1972 the subcommittee requested all member countries to submit channel interface proposals based upon these requirements. Japan again was the only member country to respond. It submitted its third proposal in October of 1972. In June 1973, X3T9 declined to submit a technical evaluation of this third proposal because it believed support for an I/O channel interface standard was diminishing both nationally and internationally. Sixteen months later, however, at the specific direction of X3, technical comments were submitted by X3T9 on the third Japanese proposal.

Japan responded and submitted its fourth proposal in July of 1975. X3T9, which was no longer dominated by the larger computer manufacturers, submitted written comments subsequently. It said that the comments did not imply acceptance of the proposal, even if its recommendations were incorporated.

At a March 1976 meeting of the international technical subcommittee, the United States spoke against submitting the fourth Japanese proposal for adoption as an international standard. A majority of the countries in attendance concurred. An ad hoc group was formed to clarify the proposal and the comments received. The United States was then requested to determine if the clarification offered by the ad hoc group solved the problem areas satisfactorily. However, in October 1976, X3T9 sent a letter to the international technical subcommittee stating that it was considering a different approach and was against the Japanese proposal because it (1) was far too complex, (2) attempted to satisfy much too broad a range of requirements, and (3) would be very difficult to implement, interpret, and maintain. X3T9 also admitted that much of the complexity was the result of its own previous comments and recommendations.

The Japanese member body expressed regret to the international secretariat that its proposal was unacceptable and chided those which had contributed vigorously to its complexity and then opposed the result as "far too complex."

PERIPHERAL MANUFACTURERS TAKE THE INITIATIVE

Although X3T9 was directed by its parent organization to develop a channel interface standard in 1969, essentially nothing was accomplished to develop an American standard for the next 4 years. During these years, X3T9 primarily monitored and commented on the Japanese proposal.

In late 1973, X3 even voted to take a negative position against the Japanese proposal, but the action was reversed. This reversal was caused by an NBS employee who unofficially appealed to the manufacturers of peripheral devices to actively participate in X3 and X3T9 activities. The employee was attempting to continue the development of I/O standards. Several peripheral manufacturers agreed to participate in spite of the high costs, which they estimated at about $25,000 per person per year. They had vested reasons for wanting standards. They believed standards would lessen the frequency of changes made to the interface specifications by the large systems manufacturers.

As a result of the interest of both these manufacturers and a few user organizations, the X3 secretariat called for an ad hoc meeting in February 1974. At this meeting the I/O interface standards program was reemphasized. During the following months, the average membership on the X3T9 subcommittee by computer manufacturers dropped to an average of five (from eight) while membership by peripheral manufacturers increased to seven (from none). The average attendance by Government and other user personnel continued at about three.

The first X3T9 meeting attended by the independent peripheral manufacturers occurred in March of 1974. In October of that year, the committee with its new members agreed to use the Japanese proposal as a probable basis for developing an American national standard. After a year of deliberations, however, the committee determined that the Japanese proposal had become too encumbered and voted to adopt as a proposed standard the channel interface that the peripheral manufacturers were already using. This interface was identical to that designed and used by the International Business Machines Corporation, whereas the Japanese proposal was not. It was compared to and found to generally comply with the requirements previously identified by X3T9 as being appropriate to any channel interface standard. Minor clarifications were made to the interface specifications document, and it was finally proposed as a standard by more than two-thirds of the X3T9 members. In September 1976 it was

forwarded to X3 for consideration as a national standard. The X3T9 subcommittee also submitted the proposed standard to the ISO technical subcommittee for consideration as an international standard.

By February 1977, X3 had decided to make the proposed standard available for public review and subsequent letter ballot. After these actions were taken, X3 submitted the proposed standard to the Secretariat in February 1978 for consideration as a national standard.

The X3T9 subcommittee, in existence since early 1967, took 10 years to agree on a proposed channel interface standard. However, once the membership was composed of individuals who desired to develop a standard and the decision was made to adopt a widely used interface, only 13 months elapsed before the members submitted a proposal for a national standard.

LESSONS LEARNED

Although the explicit charter of X3T9 was to develop an interface standard, the history of this effort shows that such committee objectives are not always shared by some of the participants. The policies of the American National Standards Institute do not prevent individuals from participating in development projects whose objectives they oppose. For example, one computer manufacturer recognized that implementation of an interface standard was contrary to its corporate goals. Its philosophy on I/O interface standards was stated in an internal report as follows.

--"It is to the users advantage to have an I/O interface standard of some sort.

--"It is to [the company's] advantage to have an internal standard I/O interface.

--"It is not to [the company's] advantage to have an external I/O interface standard."

The company representative on X3T9 therefore suggested that his company's strategy be to discourage any I/O interface standardization. We were told by other systems manufacturers that they had also sent employees to X3T9 to vote against any interface standard, rather than to develop one as charged by X3.

At the same time, the policies of the American National Standards Institute do not discourage interested groups from increasing the membership of technical committees to promote and control the development of desired standards, as was done by the independent peripheral manufacturers. Since the Government has no direct control over these policies, it has an increased responsibility, not only as a user of computer technology but also as a representative of the general public, to take unilateral action when the Government's and the public's best interests are not being served.

INVOLVED USERS LEAD TO SUCCESSFUL STANDARDS: A CASE STUDY

Standards can be successfully developed and maintained when computer users become heavily involved and are willing to commit the necessary resources. The COBOL programing language is a Federal, national, and international standard that exists largely because of user commitment.

In the early days of ADP, complicated machine languages were used to write programs that instructed the computer on what tasks to do and how to do them. These languages were machine dependent in that the instructions were written in a form intelligible to the internal circuitry of a particular computer. Computer professionals, therefore, soon sought to develop more sophisticated programing languages that would permit programing to be done for any machine using common and more understandable forms of expression. One such high level language developed to meet these objectives was the Common Business Oriented Language, otherwise known as COBOL.

THE VITAL ROLE OF USERS IN DEVELOPING COBOL

By 1959 a wide body of users as well as computer manufacturers recognized that a business-oriented language was needed. Several computer manufacturers began independently to develop such languages, but users realized there would be severe compatibility problems if each manufacturer produced its own. Therefore, in May 1959, the Department of Defense sponsored a meeting of over 40 individuals representing users and manufacturers interested in developing a common language. This group organized itself into the Conference On Data Systems Languages (CODASYL) and began work on a language.

CODASYL includes a broad spectrum of both users and manufacturers. Its recommendations are not binding, and it receives no funds from any source. Instead, CODASYL has relied upon people and organizations to volunteer time and resources. Using a small development committee composed of volunteers, CODASYL published the first specifications for the COBOL language in April 1960. The specifications have been revised and updated by CODASYL several times since then.

The specifications developed by CODASYL are used by the American National Standards Committee X3, Computer and

APPENDIX II

Information Processing (X3), to develop COBOL into a national standard. X3 and its technical committees are responsible for developing computer-related voluntary standards. Its COBOL technical committee, known as X3J4, recommends the parts of the CODASYL-developed specifications which it believes should be incorporated in a standard. The first American national standard for COBOL was approved by the American National Standards Institute in August 1968. The standard was revised as of May 1974, and a further revision is being developed.

Over the past 18 years, computer users have played a key role with the computer industry in developing and standardizing the COBOL language. For example:

--The Department of Defense was responsible for calling the first meeting of CODASYL and has provided energetic leadership ever since. In addition, the Canadian Government has provided printing services for many years, and mailing services have been supplied by both the Navy and Air Force as well as by several commercial organizations.

--Users were instrumental in initiating steps to enhance the compatibility of the COBOL developed by computer manufacturers. The first COBOL compilers were not compatible because the manufacturers were free to incorporate whatever parts of the CODASYL-produced specifications they wanted to implement and to make their own interpretations of the specifications. Consequently, programs could be transferred only with extreme difficulty. Working through CODASYL, the users were able to get procedures established that identified those specifications that must be included if the manufacturer-produced language was to be called COBOL.

--Users provided an incentive to the manufacturers to develop COBOL by requiring it to be provided with acquired equipment. For example, Defense issued a directive in September 1963, which stated that the selection of computers for business applications would be limited to computers for which COBOL compilers were available. Several alternative languages being developed by manufacturers were then dropped in favor of COBOL.

--A subcommittee of X3J4 was formed to develop test problems to validate that the manufacturer-produced COBOL actually complied with the standard. This

project fared poorly, however, and X3 eventually removed the responsibility from the subcommittee. Realizing that a COBOL standard would not be effective without a means for insuring conformity, the Navy developed a working set of validation routines for Navy use. Department of Defense responsibility for COBOL validation was later assigned to the Navy, and eventually the Navy was given Government-wide responsibility to perform this service.

LESSONS LEARNED

Successful ADP standards are more likely to be developed when users clearly identify their needs, work vigorously with the computer industry to develop them, and then demand them in the marketplace. There may be occasions, however, when the computer industry will not or cannot produce what is needed because of competitive and economic pressures. Users then must work unilaterally to develop whatever they must have to meet their objectives.

APPENDIX III

AN UNWIELDY DEVELOPMENT PROCESS CAUSES EXCESSIVE DELAYS: A CASE STUDY

The development process for a Federal ADP standard takes a long time under the best of circumstances. Much time is needed because standards are usually developed by committees which meet infrequently and are staffed with volunteers. However, a disproportionate amount of time taken to create a Federal ADP standard does not involve committee action or inaction, as the case may be. It is affected by other forms of Federal bureaucracy, which is marked by inefficient procedures and a diffusion of authority among numerous individuals, committees, and offices.

NBS GOAL

NBS has estimated that a typical ADP standard not developed by the private sector and needed by the Government will probably take about 3 years to develop internally. Development includes about 6 months to determine need, 2 months to form a task group, 12 months for development, 5 months to coordinate the proposed standard with the agencies and to resolve differences, 3 months for approval by the Secretary of Commerce, and 7 months to publish and distribute the standard and to develop implementation procedures and instructions.

The Government's policy since the ADP standards program began in 1965 has been to rely, when possible, on the private sector. Consequently, of the 29 standards that existed as of June 1977, only 10 were developed by the Government. Six of these are data elements and codes, which identify, for example, States, counties, and congressional districts. All six were developed under the direction of OMB, before responsibility for data elements and codes was transferred to Commerce in 1973.

We looked at one of the remaining four standards developed by the Government to determine the extent to which the development process met NBS goals. The standard selected is a simple coding form intended to be used by programers when developing programs using COBOL. Basically, it is a sheet of paper with lines and symbols printed on it to aid programers during the coding process. It serves a useful but not an essential purpose.

HOW IT ALL BEGAN

By the early 1970s the COBOL language had been in use long enough for there to be hundreds of coding forms, each developed to serve basically the same purpose. Consequently, in January 1974 a Federal ADP standards committee voted to assign a three-person subcommittee to develop a single standard form. These individuals collected and analyzed more than 20 COBOL coding forms used by various Federal agencies and then selected what they thought were the best features of each. It was not a complex or highly technical task, and the subcommittee completed its work in about 2 months and submitted two proposals to the committee. The committee selected one of the proposals but suggested several modifications. The subcommittee redrafted the adopted form in accordance with the committee's recommendations and prepared a document announcing the standard. These procedures were accomplished in about 3 months. According to one of the subcommittee members, the entire 5-month exercise took the three individuals about 10 staff-days of effort.

Several factors inherent in the above process caused delays.

--Committee meetings were held infrequently and the project was not discussed each time the committee met.

--The subcommittee members worked part time, and the project was secondary to most participants.

--The development and modification of the coding form was hampered by a lack of agency resources to provide needed services, such as clerical and graphics support. Funds were not available to have these services performed by a contractor on a timely basis.

THE STANDARD PROCESS BOGS DOWN

After it was approved by the committee, the proposed standard was submitted to a coordination and advisory committee, which consisted of representatives from all major Federal agencies interested in Federal ADP. It was chaired by an NBS representative. This committee accepted the form but suggested a few simple changes. For example, it wanted a handprinting guide included. This consisted of examples on how to print by hand the alphabet, the numbers 0 through

APPENDIX III

9, and several commonly used symbols. The advisory committee believed such a guide, if used by the programers, would make it easier for the coding sheets to be read by keypunch personnel, who are usually the only other people that use these documents.

These changes required 5 months to accomplish, again because committee meetings were held infrequently. Once approved by the advisory committee, the proposed standard was sent to NBS for further processing. NBS prepared letters to agencies asking for comments on the proposed standard. Public comment was also requested through a notice in the Federal Register. This process took about 9 months--3 months to prepare the notices, 3 months for comments, and 3 months to review the comments.

Eleven replies were received from 10 agencies. No comments came from public or private industry. A lack of response was taken as concurrence with the standard. Negative comments pertained to several things, including the handprinting guide.

At a development committee meeting about 21 months after the project's initiation, the group unanimously passed a motion that the advisory committee remove the handprinting guide. This suggestion was made because the agencies indicated that it had not been developed with programers in mind and might not be readily accepted by them. After much debate, however, the advisory committee defeated the motion and approved the proposed standard a second time. This final approval occurred 22 months after the project had been started. During this time the development process involved development committee action six times and advisory committee action four times.

The standard was now ready for approval by Commerce. About 3 months were required to prepare justification. It was then transmitted to the Secretary of Commerce. On the way it had to be cleared first through seven offices at NBS and six others within Commerce, which took 3 months. Within NBS these clearances came from the Project Officer, the Division Chief, the Associate Director of ADP Standards Management, the Legal Officer, the Director of the Institute for Computer Sciences and Technology, an Editoral Review Board official, and the Director of NBS. At Commerce it was cleared by the Assistant General Counsel for Science and Technology, the Assistant Secretary for Administration, the Executive Secretary, the General Counsel, the Assistant Secretary for Science and Technology, and the Under Secretary.

APPENDIX III

The COBOL coding form was published as a Federal Information Processing Standard on September 1, 1976. The project took 32 months to complete, not counting the time necessary for agencies to develop implementation procedures and instructions. It generally met the overall NBS goal of 3 years to develop ADP standards unique to the Government.

LESSONS LEARNED

The first task called for in the NBS estimate is a 6-month study, which would be conducted to determine the need for and priority of the proposed standard. We found no evidence that such a study had been conducted by NBS before development. For all intents and purposes, the development of this standard was not justified nor managed while the project was underway. However, upon completion a justification document was prepared and the proposal was then subjected to numerous clearances and approvals by NBS and Commerce officials. Some of those approvals might better have come before the project began.

NBS established a goal of about 5 months to coordinate a proposed standard with the agencies and to resolve differences. This process was done twice for the coding form standard--once through the coordination and advisory committee, which had representatives from most of the concerned agencies, and a second time when the proposed standard was published in the Federal Register for public and agency comment. These two steps required about 17 months instead of the estimated 5.

On the other hand, though NBS estimated that it should take 12 months to develop the standard, a committee of three worked part time for 10 staff-days over 5 months. Had this been a difficult project technically the project might have continued on for much longer.

The Federal Government has too much at stake to allow standards to be developed in a haphazard and unmanaged manner. As demonstrated in this study, standards take a long time to develop even when they are simple. Consequently, they should be thoroughly justified and given priority based upon their potential for improving Government operations. Then development should be properly managed to insure that the projects are completed and the benefits are realized promptly.

APPENDIX IV

STANDARDS MADE TWICE OVER DO NOT MAKE FOR BETTER STANDARDS: A CASE STUDY

The Federal process for adopting commercial standards is long and redundant. NBS required 34 months to review, coordinate, and approve a standard for flowcharting symbols. This delay occurred even though the standard had been through the private sector process, in which a Federal representative had participated on the development committee and an NBS representative had participated on the approval committee.

WHAT ARE FLOWCHART SYMBOLS?

The purpose of a flowchart is to improve communications between people when they describe and analyze an information processing problem. Flowcharting is a technique in which symbols represent both the sequence of operations and the flow of data and paperwork.

Use of flowcharts became widespread in information processing concurrently with the application of electronic computers to problems of business and industry. Occasionally, however, the interpretation of a flowchart resulted in misunderstanding. One source of misunderstanding stemmed from a lack of uniformity of meaning for specific symbols in the flowcharts. For example, a symbol used to indicate storage by one programer might be used to mean the merging of files by another.

The historical development of flowchart symbols has many facets. Initially, groups of individuals in a company coordinated their work on flowcharting. Later, this same need for a uniform set of symbols became apparent to larger groups of persons who exchanged flowcharts--for example, Government, commercial, and industrial user groups, equipment manufacturers, forms suppliers, professional societies, and consultants. Eventually, as each group attempted to establish a uniform set of symbols for its own members, the need for a commercial standard for flowchart symbols was recognized.

ADOPTION OF A PRIVATE SECTOR STANDARD

In the private sector ADP standards are developed by a committee of part-time volunteers. It is made up of representatives from manufacturers, users, Government agencies, and public interest groups. Subcommittees are established for the technical development of standards. Once a standard is approved by a subcommittee, it is reviewed and voted on by the committee.

The flowchart symbols standard went through this process originally in 1963. It was then revised in 1965, 1966, 1968, and 1970.

After the September 1970 revision, NBS required about 19 months to review and draft an announcement document suitable for coordination and comments with agencies. The task group method was not used, which would have involved selecting qualified people from various agencies who would volunteer their support and resources. (See app. III.) Instead the standard was assigned to an NBS project officer. The project officer reviewed the standard on a part-time basis and drafted the document announcing the standard. His time for reviewing the private sector publication should have been minimal, since the Federal standard adopts in whole the commercial standard except for a minor qualification. 1/ We were told that the 19-month delay had been due to a low priority being given to adopting the standard since it was not controversial.

In the 20th month, requests for comments and concurrences were mailed to about 80 Federal agencies. Public comment was also requested. This comment period lasted 60 days. All 30 agencies that responded concurred with the proposal. Two States also concurred. No manufacturers or suppliers of flowcharting templates responded. The absence of a response was assumed to indicate either concurrence or no interest. NBS responded to the comments about 4 months after the comment period ended.

Approval

Eight additional months were required to approve, process, and publish the Federal standard. This period started when NBS forwarded the proposed standard to its Editorial Review Board for technical and policy review, which took about 2 weeks.

About another 3 months were required before the Secretary of Commerce approved the document and forwarded it to the Office of Management and Budget. About half of the 3 months was spent preparing a document justifying the standard. The other 4 to 6 weeks were required to transmit the proposed standard through six offices before it reached the Secretary.

1/The Federal standard relaxed the proportion specifications as long as care was taken to maintain the distinctive shape of the symbol. This does not reflect any problems with the symbols or the technical content.

APPENDIX IV

The standard was then sent to OMB since OMB was responsible for approving ADP standards at the time. Although the standard was approved by OMB in about 4 weeks, another 3 months were required to publish it. It became a Federal standard on June 30, 1973, 34 months after its approval as a commercial standard.

LACK OF COORDINATION PROLONGS ADOPTION

The December 15, 1966, OMB policy statement to the Secretary of Commerce directed NBS to study and provide recommendations on Government use of each commercial standard approved by the American National Standards Institute for ADP equipment, computer languages, and techniques. Standards related to data elements and codes were excluded. OMB also directed NBS to arrange for and insure representation and active participation from other Federal agencies on private sector committees, subcommittees, and task forces. This would complement NBS participation with additional expertise from the operating segments of the Government. NBS was to monitor and coordinate all such participation by Federal agencies to ensure consistency with Government objectives.

A Federal participant served on the subcommittee that developed the commercial standard for flowchart symbols. He told us that he had had very little contact with NBS during the development of the commercial standard or its adoption as a Federal standard.

However, NBS was aware of the commercial standard before September 1, 1970, because NBS had participated in the private sector ADP standards committee and was aware of its procedures for approving ADP standards. It was known that the commercial standard had been through a lengthy development, review, and approval process in the commercial sector. Nevertheless, NBS went through a similar process in the Federal sector.

LESSONS LEARNED

The Federal process for adopting commercial standards duplicates the commercial process and does not allow for the timely adoption of standards. Thirty-four months were required to adopt the commercial standard on flowchart symbols, 19 months to review it, and 15 months to approve and publish it as a Federal standard. Since NBS serves on the commercial standards committee and Federal representatives participate in the technical development of standards, the Government should be able to accept or reject a noncontroversial standard as soon as it is adopted as a commercial standard.

PRINCIPAL OFFICIALS RESPONSIBLE FOR ACTIVITIES DISCUSSED IN THIS REPORT

	Tenure of office	
	From	To
DEPARTMENT OF COMMERCE		
SECRETARY OF COMMERCE:		
Juanita M. Kreps	Feb. 1977	Present
Elliot Richardson	Jan. 1976	Jan. 1977
Rogers C. B. Morton	May 1975	Dec. 1975
John K. Tabor (acting)	Mar. 1975	Apr. 1975
Frederick B. Dent	Feb. 1973	Mar. 1975
Peter G. Peterson	Feb. 1972	Feb. 1973
Maurice H. Stans	Jan. 1969	Feb. 1972
C. R. Smith	Mar. 1968	Jan. 1969
Alexander B. Trowbridge	June 1967	Mar. 1968
Alexander B. Trowbridge (acting)	Feb. 1967	June 1967
John T. Connor	Jan. 1965	Jan. 1967
ASSISTANT SECRETARY FOR SCIENCE AND TECHNOLOGY:		
Jordan J. Baruch	May 1977	Present
Betsy Ancker-Johnson	Apr. 1973	May 1977
Richard O. Simpson (acting)	Aug. 1972	Apr. 1973
James T. Wakelin	Feb. 1971	Aug. 1972
Richard O. Simpson (acting)	Dec. 1970	Feb. 1971
Myron Tribus	Mar. 1969	Nov. 1970
Allen V. Astin (acting)	Feb. 1969	Mar. 1969
John F. Kincaid	Oct. 1967	Feb. 1969
Allen V. Astin (acting)	July 1967	Sept. 1967
J. Herbert Hollomon	May 1962	July 1967
NATIONAL BUREAU OF STANDARDS		
DIRECTOR:		
Ernest Ambler	Feb. 1978	Present
Ernest Ambler (acting)	July 1975	Feb. 1978
Richard W. Roberts	Feb. 1973	June 1975
Lawrence Kushner (acting)	May 1972	Feb. 1973
Lewis M. Branscomb	Sept. 1969	May 1972
Allen V. Astin	June 1952	Aug. 1969

APPENDIX V

	Tenure of office	
	From	To
INSTITUTE FOR COMPUTER SCIENCES AND TECHNOLOGY (note a)		
DIRECTOR:		
M. Zane Thornton (acting)	July 1977	Present
Ruth M. Davis	Nov. 1970	June 1977
James P. Nigro (acting)	June 1970	Nov. 1970
Herbert R. Crosch	June 1967	May 1970
Vacant	Dec. 1966	May 1967
Norman J. Ream	Sept. 1965	Nov. 1966
GENERAL SERVICES ADMINISTRATION		
ADMINISTRATOR:		
Joel W. Solomon	May 1977	Present
Robert T. Griffin (acting)	Feb. 1977	May 1977
Jack Eckerd	Nov. 1975	Feb. 1977
Arthur F. Sampson	June 1973	Oct. 1975
Arthur F. Sampson (acting)	June 1972	June 1973
Rod Kreger (acting)	Jan. 1972	June 1972
Robert L. Kunzig	Mar. 1969	Jan. 1972
Lawson B. Knott, Jr.	Nov. 1964	Feb. 1969
OFFICE OF MANAGEMENT AND BUDGET		
DIRECTOR:		
James T. McIntyre, Jr.	Mar. 1978	Present
James T. McIntyre, Jr. (acting)	Sept. 1977	Mar. 1978
Bert Lance	Jan. 1977	Sept. 1977
James T. Lynn	Feb. 1975	Jan. 1977
Roy L. Ash	Feb. 1973	Feb. 1975
Caspar W. Weinberger	June 1972	Feb. 1973
George P. Shultz	July 1970	June 1972
DIRECTOR, BUREAU OF THE BUDGET (note b):		
Robert P. Mayo	Jan. 1969	June 1970
Charles J. Zwick	Jan. 1968	Jan. 1969
Charles L. Schultze	June 1965	Jan. 1968

a/And its predecessor organizations.

b/Under the President's Reorganization Plan 2, effective July 1, 1970, the Bureau of the Budget was incorporated into the newly established Office of Management and Budget.

(91323)