BY THE COMPTROLLER GENERAL

Report To The Congress

OF THE UNITED STATES

Continued Use Of Costly, Outmoded Computers In Federal Agencies Can Be Avoided

Many Federal agencies' computers today are not up to date. If this outmoded equipment were replaced with modern computers that are more effective, efficient, and economical and that could improve processing capabilities, costly operations would be avoided.

The Office of Management and Budget and the General Services Administration are the key agencies that should jointly instigate procedures for removal of outmoded computers and replacement with modern systems.

Agency heads should evaluate their present and future ADP requirements, plan short and long range procurement strategies, and improve their ADP resource management.

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

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

Many computers in the Federal inventory are outmoded. Modern computers with the same relative compute power can be more effective, efficient, and economical.

This report discusses the costs and problems associated with the continued use of outmoded computers and recommends ways to resolve existing obsolescence problems and prevent their recurrence.

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

Comptroller General
of the United States

COMPTROLLER GENERAL'S
REPORT TO THE CONGRESS

CONTINUED USE OF COSTLY, OUTMODED COMPUTERS IN FEDERAL AGENCIES CAN BE AVOIDED

D I G E S T

Computers in the Federal inventory are out of date, with only 2 percent of the large- and medium-scale computers using 1975 or later technology. Much of this equipment uses 1971 or earlier technology. Newer equipment of similar capacity could (1) use existing software without significant changes, (2) provide such benefits as faster speeds, better reliability, greater capabilities, lower energy consumption, and (3) avoid costly operations.

A variety of causes have created the current situation. Agencies have not recognized the costs and problems of continuing to use outmoded equipment. Annual savings of $1.4 million are attainable by replacing older equipment just at the four Federal installations GAO reviewed. (See pp. 8 - 9.) Hundreds of other Federal installations have similar, old equipment. The guidance called for in OMB's Circular A-71 for replacing outmoded equipment is needed to assist Federal managers' implementation of current technology, but such guidance has not been issued.

More and better knowledge of computer technology would enable Federal managers to better recognize and evaluate available economical alternatives. Effectively addressing management shortfalls will improve the use of Federal ADP resources and will work toward dissolving the credibility gaps that exist among agency top management, the Congress, and those responsible for the overall management of Federal data processing. The current murky acquisition cycle, which is long, complicated, and frustrating, has contributed to the obsolescence of Federal computers.

AFMD-81-9

RECOMMENDATIONS

Where replacement of obsolescent equipment now can result in savings, GAO is recommending that the General Services Administration (GSA) (1) issue guidance to agencies outlining the criteria to be used and the cost comparisons to be made in determining outmoded equipment and (2) set forth procedures for expeditiously replacing that equipment. GAO suggests that GSA and the Office of Management and Budget (OMB), acting in concert, require that

--replacement systems obtained on this basis be approximately the same relative compute power as the old systems;

--replacement computers use existing software (including, where possible, plug compatible or emulation processors);

--agencies commit themselves to periodic reporting to OMB and GSA on progress toward (a) replacing obsolescent software with standard high order languages, (b) implementing other Federal ADP standards, and (c) assessing the agency's mission and analyzing how ADP can best help; and

--the internal audit group verify the cost calculations. (See pp. 34 - 35.)

To minimize the possibility of outmoded equipment becoming a recurring problem in the future, GAO is also recommending that GSA develop and issue the guidance and criteria called for in Circular A-71. These would help ensure that, over the long term, Federal computers are continually economical and efficient. (See p. 34.)

Since issuing these guidelines will take time, GAO is also recommending that Federal agencies determine immediately if their systems are economically outmoded by using the same criteria and restrictions as the replacements in GAO's illustrations. (See app. I.) If the equipment is found to be outmoded, then it should be replaced as quickly as possible. (See p. 34.)

To improve the management of ADP resources generally, GAO is recommending that OMB require Federal agencies to

--assess their ADP requirements for the 1980s and plan appropriate short and long range procurement strategies,

--institute a program to improve top managers' knowledge of current computer technologies and concepts,

--increase top management involvement in the acquisition and resource allocation processes, and

--ensure that ADP cost-accounting procedures reflect the principles of full costing and total system-life-cycle costing. (See p. 35.)

AGENCY COMMENTS

Both OMB and GSA acknowledged that the subject of ADP obsolescence is a matter of great concern. OMB commented that this report will be a valuable catalyst in solving this computer problem and GSA agreed that hidden costs of using older computer systems should be included in agency planning and in equipment selections.

Both agencies provided a number of observations for GAO's consideration. The more significant of these--which are dealt with in the body of the report--relate to such topics as questions of noncompetitive procurements and the need for guidelines. (See pp. 35 - 37.)

Contents

ABBREVIATIONS

ADP	automatic data processing
GAO	General Accounting Office
GSA	General Services Administration
OMB	Office of Management and Budget

CHAPTER 1

INTRODUCTION

Many observers have stated that the Federal computer inventory is outmoded. In 1979, the President's Reorganization Project on Automatic Data Processing (ADP) reported that the Government's information technology used outdated methods and equipment. In 1978 the Survey and Investigations Staff of the House Committee on Appropriations commented unfavorably on the age and capabilities of the Government's computers. The private sector, through trade journals and data processing business leaders' comments, has made similar statements. The Federal Government was once considered a pioneer in computer use, but in previous studies we have observed that many installations are using obsolescent equipment. (See app. II.) Today, many Federal computers are models which have been out of production for as long as 10 years. Most of the medium- and large-scale computers Federal agencies use today were first available in the 1960s and early 1970s. Thus, Federal ADP managers are using equipment which is two or more production cycles behind current technology.

COMPUTER TECHNOLOGICAL GAINS ARE SUBSTANTIAL

The computer industry is about 30 years old. Its life to date has been characterized by continuous improvements in performance and dramatic price reductions. As technology allows the development of more powerful computers, users are demanding even more powerful computers to help solve energy, environmental, and military problems. As technology reduces the size and cost of computers, society is finding more uses for the computer in the home, in business, in industry, and in government. In 1950 there were seven computers in the United States; today there are over a million. The number has grown because technology has been able to provide, in an inflationary era, a better product at sharply reduced prices.

ENIAC 1/, the first electronic computer, was installed in 1946. It cost $400,000 and could perform 5,000 additions per second. Its capital cost was $80 per addition per second of capability. One of the most powerful scientific computers currently available is 4,000 times more efficient than ENIAC.

1/Electronic Numerical Integrator and Computer.

It has a capital cost of 2 cents per addition per second and can perform 800 million additions per second. In every performance area--cost, physical size, electrical consumption, compute speed, reliability, maintainability, and ease-of-use--today's computers are far better than those of 25, 10, or even 5 years ago. In this environment of rapid progress, users wedded or restricted to old equipment are failing to harvest the fruits of technological progress.

Responding to the needs of the day, the computer industry now offers a wide range of products--from the affordable small, general business computers to large, complex, distributed processing systems. The microprocessor has affected our personal lives as well as the business environment. Automobiles, appliances, games, and toys are now computerized. Microprocessors are small, inexpensive, and highly reliable. As stand-alone computers they are appropriate for monitoring scientific experiments and energy consumption. They are also being integrated into large computer systems, frequently as a controller or linking unit between a central processor and peripherals--such as magnetic disk memory units, printers, and terminals.

Developments in office automation provide a good example of the capabilities of current computer technology. Office automation should accelerate as personnel costs increase and new technology information storage, processing, and communication costs decline. Recent and emerging technological innovations have led to predictions that office automation trends will merge to form an entirely new office environment. Office systems, data processing, and telecommunications technologies will merge into one. Computing, word processing, and document creation, copying, and transfer will be the functions of a single piece of hardware. Bridging the gap between the technology represented by the Government's current computer inventory and the technology of the 1980s is the challenge facing Federal managers.

FEDERAL ADP MANAGEMENT ASSIGNED TO FEDERAL AGENCIES

The Brooks Act (Public Law 89-306) was passed in October 1965,

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

The responsibilities under the act are assigned to several agencies. The Office of Management and Budget (OMB) is responsible for fiscal and policy control. The General Services Administration (GSA) is responsible for developing, implementing, and monitoring Government-wide policy for acquiring, using, and managing ADP resources. The Department of Commerce, primarily through the National Bureau of Standards, is responsible for providing scientific and technological advisory services and for developing Federal Information Processing Standards. In addition, each Federal agency has certain responsibilities for managing its own ADP resources.

OMB Circular A-71 prescribes Government-wide responsibilities for the administration and management, including acquisition practices, of ADP activities. According to this circular, OMB

> "* * *will develop programs and issue instructions for achieving increased cost effectiveness through improved practices and techniques for the selection, acquisition and utilization of ADP equipment and resources."

Also, GSA was charged to

> "* * *develop and publish guidelines and criteria governing the replacement of equipment to avoid usage of such equipment beyond the point of economic advantage."

OBJECTIVES, SCOPE, AND METHODOLOGY

We undertook this review to determine if the Federal computer inventory is outmoded, and if so, how this situation arose, what types of costs and problems obsolescence 1/ has imposed, what should be done to resolve these problems, and how to prevent the situation from recurring.

The Federal inventory of general purpose computers showed that 12,645 processors were in use as of April 1979. Our area of interest was the 1,366 medium- and large-scale computers that had a central processing unit purchase price of more than $250,000 or a leasing price of over $10,000 per month. This represented 76 percent of the Federal inventory as of that date, based on purchase price.

1/For the purpose of this review, obsolescence is defined as declining in usefulness (useful being the economical, efficient, and effective processing of data) and, generally speaking, outmoded.

We discussed obsolescence problems with officials from Federal policy and operational agencies, computer manufacturers, and ADP associations. We visited or contacted over 20 typical Federal facilities processing large- or medium-scale scientific or general business applications. (See app. IV.) To illustrate the nature of the problem, at least one computer manufactured by each of four large-scale computer vendors was included in our individual installation studies. (See app. I.) The system configurations selected were representative of Federal computer centers nationwide.

We used the GSA Management Information System to identify computer installations with older equipment. Although this system is not complete and has other inaccuracies, it is the best information available on the Government's computer inventory and it was adequate for our purposes.

CHAPTER 2

THE USE OF OBSOLESCENT COMPUTERS INVOLVES UNNECESSARY COSTS AND PROBLEMS

The Federal inventory of medium- and large-scale computers is outmoded. Of the 1,366 such processors included in the April 1979 inventory, over half were technologically of the 1971 era or earlier. Almost a third of them were technologically 15 years old or older. Only 2 percent used the technology of 1975 or later. Unless action is taken to modernize the Government's computers, avoidable costs and unnecessary problems will continue.

Our work showed that the operational costs of obsolescent, Government-owned equipment can exceed the costs of using newer equipment even if the newer equipment is obtained on a short term lease basis. The maintenance, power, and cooling costs of outmoded, owned equipment were greater than the leasing, maintenance, power, and cooling costs of newer equipment. This alone can justify immediate replacement.

There are other, frequently unrecognized, costs of using older equipment--less efficient processing, increased personnel costs, greater floor space requirements, and the need to purchase commercial time-sharing when older, unreliable equipment breaks down. At the four installations we studied, we estimate that over $750,000 could be saved annually in maintenance, power, and cooling costs alone; other savings of over $600,000 appear readily achievable by switching to modern equipment.

In addition to higher costs, agencies using obsolescent equipment face many operational problems, including inflexibilities imposed by limitations of the older equipment and frequent unavailability of the system due to maintenance requirements and equipment failures.

In this chapter, we present information on the age of the inventory, the avoidable costs being incurred, and the operational problems being encountered. In chapter 3 we discuss the causes of the Federal computer obsolescence and the need to resolve the immediate problem and prevent its recurrence.

THE FEDERAL INVENTORY IS OUTMODED

The Federal inventory of medium-and large-scale computers is old and growing increasingly outmoded. As of April 1979, the 1,366 medium- and large-scale computers in the Federal

inventory had been acquired an average of 7 years earlier. 1/ The technology of the 978 processors from four major manufacturers was about 12 years old. Clearly this does not represent current computer technology. These 1,366 computers had a combined purchase value of $1.3 billion but are estimated to be worth just over one-fourth of their original value.

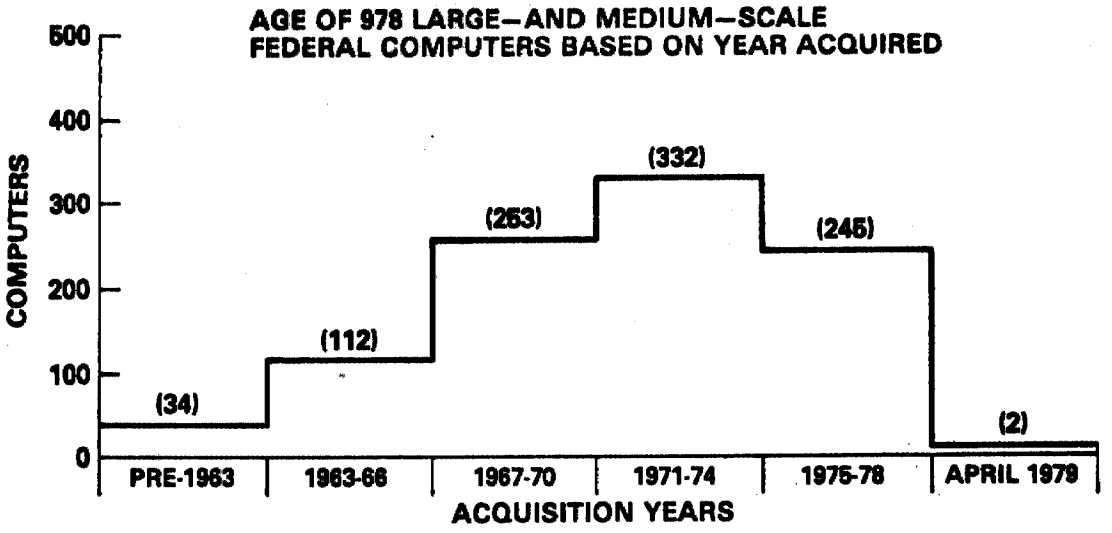
According to the General Services Administration, 12,645 computers were in the Federal inventory as of April 1979. We identified the 1,366 medium- and large-scale processors that represented 76 percent of the inventory based on purchase price. The 978 medium- and large-scale processors we examined from four major manufacturers' lines had an average acquisition date of August 1971. The charts on page 7 show the age of these 978 computers based on their technological age and their acquisition dates.

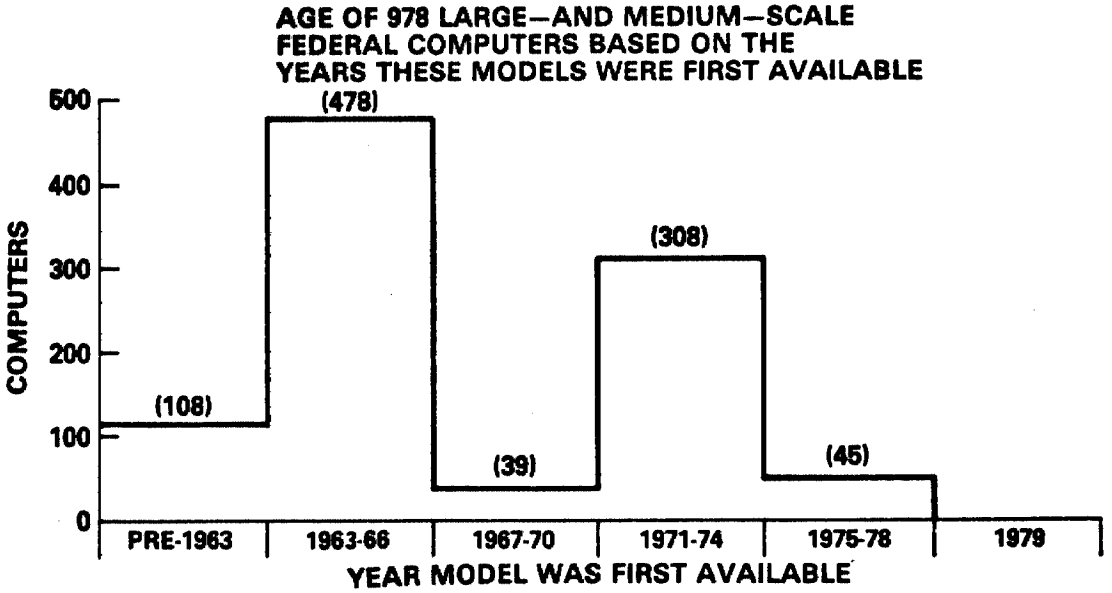
As clearly shown in the charts, these processors are very old from a technology standpoint. Most of them were first available in 1965. Technologically, 30 percent are 15 years old; another 24 percent are 9 years old. Less than 2 percent used technology that was introduced since 1975. Most of the 978 computers were acquired before 1973; about 75 percent were acquired between 1956 and 1974. Acquisitions dropped from a peak of 105 in 1973 to 55 in 1978. And despite the increased technology and growing awareness of computers, more were acquired in 1968 than in 1978.

The often quoted purchase price value of the Federal computer inventory is very misleading as an indicator of its present worth. The 1,366 medium- and large-scale computers in the April 1979 inventory had a combined purchase value of $1.3 billion; however, we estimate that the depreciated value of these computers was only a small portion of this amount on that date.

For example, a typical Federal computer still in use is a 1965 technology processor acquired in 1971 for about $450,000. A computer broker in the private sector estimated that this processor has no real value today, costs a great deal to operate and maintain, and is a high energy consumer. The broker estimated that it could be replaced by a current technology processor at considerable savings which would perform better. This was demonstrated in illustration D. (See pp. 49 - 52.)

1/Although our study did not include small computers, an OMB analysis shows their average age since acquisition to be 6.5 years.


AGE OF 978 LARGE–AND MEDIUM–SCALE
FEDERAL COMPUTERS BASED ON YEAR ACQUIRED
COMPUTERS
500
400
300
200
100
0
(34)
(112)
(253)
(332)
(245)
(2)
PRE-1963
1963-66
1967-70
1971-74
1975-78
APRIL 1979
ACQUISITION YEARS


AGE OF 978 LARGE–AND MEDIUM–SCALE
FEDERAL COMPUTERS BASED ON THE
YEARS THESE MODELS WERE FIRST AVAILABLE
COMPUTERS
500
400
300
200
100
0
(108)
(478)
(39)
(308)
(45)
PRE-1963
1963-66
1967-70
1971-74
1975-78
1979
YEAR MODEL WAS FIRST AVAILABLE

OBSOLESCENT COMPUTERS ARE EXPENSIVE TO OPERATE

Many Federal ADP managers have failed to identify all the costs associated with using outmoded equipment. They are overlooking high operating expenditures, extraordinary maintenance expenses, excessive energy consumption, and additional costs of supplemental services. Salaries, materials, supplies, and other budgeted items are relatively visible, but hidden costs are also associated with using older equipment. Extra expenses attributed to greater personnel requirements, system unavailability, larger floor space requirements, and additional hardware expenditures should be considered.

Many Federal ADP managers are operating with old, purchased equipment. The decision to purchase these systems was prudent at the time of purchase, and much of the equipment appears to have more than paid for itself. But Federal managers must continually look for the most effective, efficient, and economical alternatives to perform their mission. Our illustrations in appendix I demonstrate that about $1.4 million can be saved annually by replacing older equipment just at the four installations we reviewed. We show that older equipment operational costs can actually exceed the costs of leasing and operating newer equipment. We looked at four computer facilities, and, as shown below, even with the replacements leased on a short term basis, at least 15 percent of annual operating expenses could be saved.

Savings Attainable by Replacing Older Equipment at Four Installations (note a)

Installation	Agency	Annual cost of Old system	Annual cost of New system	Firm annual savings	Potential additional savings (note b)	Total savings
A	W	$2,661,921	$2,347,890	$314,031	$567,096	
B	X	716,252	576,227	140,025	-	
C	Y	947,605	837,185	110,421	60,000	
D	Z	688,230	490,744	197,486	-	
Total		$5,014,008	$4,252,046	$761,963	$627,096	$1,389,059

a/Based on cost data current at the time of our review.

b/Potential additional savings include personnel savings, floor space reductions, and the like.

While each case must be analyzed independently, hundreds of Federal computer facilities have similar old equipment.

At least one computer manufactured by each of four large-scale computer vendors was included in our individual installation studies. Equipment of different vendors was selected to demonstrate that obsolescence can apply to any manufacturer's system. The models selected are general purpose computers which were first available in the 1960s. We accepted that the existing workload represented valid agency needs. Our proposed replacements had

--about the same relative compute power 1/ as the existing equipment,

--the same amount of or minimum available main (core) and magnetic disk memory storage capacity,

--a capability to use the installation's software without change, and

--the ability to be installed with minor or no operational disruptions.

Higher operating costs of older equipment

The rapid advances in computer technology have reduced operational costs of newer equipment. Users operating obsolescent computers are incurring higher maintenance charges, excessive energy costs to operate and cool their equipment, and additional costs for timesharing services. Appendix I presents our examples of outmoded computers at four Federal installations and shows that modern equipment can handle the same workload more effectively, more efficiently, and more economically.

Higher maintenance costs

Improved maintenance capabilities and the rising cost of "onsite" field engineers are changing the computer industry's approach to system maintenance. The earlier approach of having around-the-clock "onsite" maintenance is very expensive. New technology frequently makes this unnecessary; therefore, maintenance is far less expensive. For example, the annual maintenance cost alone for the obsolescent, owned equipment in illustration A (see pp. 40 - 43) is $2.3 million of a total $2.7 million. The leasing and maintenance costs for the replacement systems was less--$2.2 million annually, including $550,620 for maintenance.

1/Relative compute power is a measure of a computer's processing capability in terms of the number of instructions (operations) processed per second and other factors.

Some manufacturers have already announced that in the near future it will be their policy to provide only "on-call" service, rather than having field engineers at a site full time. This change in system maintenance is the result of

--improved system reliability,

--online maintenance and diagnostic software that can detect defects and potential problems,

--the automatic isolation of components that have failed (or are about to fail) so the system will continue to operate at less than full capacity until preventive or corrective maintenance is performed,

--increasing salary costs of field engineers, and

--difficulties in hiring enough qualified personnel.

Remote maintenance facilities are replacing "onsite" field engineers as the primary analytical maintenance tool for modern computers. Today's computers are being designed so that when preventive or corrective maintenance must be performed, the computer system is electronically coupled with a computer at a remote maintenance facility operated by the computer manufacturer. Maintenance and diagnostic programs are run; they pinpoint defective components and transmit instructions to the manufacturer's local service center. The local office then dispatches a service representative to correct the problem. If spare parts are kept onsite, the computer operator may be instructed to remove the defective component and replace it with an operable spare part.

Higher energy costs to operate and cool computers

Data processing installations that are using the latest computer technology are enjoying an added savings--reduced energy consumption. These energy savings come from the reduced power requirements of newer processors and magnetic disk memory units, and related reduced system air conditioning and environmental cooling requirements. Some of today's processors can operate on as little as 20 percent of the electricity required by older units with the same relative compute power. A processor introduced in the mid-1960s, and still widely used in the Government, can be replaced by a comparable modern processor with dramatic savings in power consumption. The old processor's power requirement, expressed as kilovolt amperes (KVA), is 24.3; the replacement unit--doing comparable work--operates on only 4.8 KVA. This is a reduction of 80 percent. (See illus. D, pp. 49 - 52.)

Energy consumption of old and new disk memory units is not significantly different when compared on a unit-by-unit basis. However, when one considers the 20-fold increase in capacity provided by newer disk memory units, the energy savings can be significant. One agency we visited has 184 disk memory units providing 7,656 million bytes of online storage. Fourteen modern disk units can provide 7,998 million bytes of online storage. The energy requirement of the 184 disk units is 174.1 KVA, while the replacement units require only 16.4 KVA. Annually, $61,314 in power costs (1.2 million kilowatt hours per year) could be saved by using the modern disk units at this installation. (See illus. D, pp. 49 - 52.)

Even more energy can be saved by new computers because they require less special air conditioning and humidity control. New technology processors generate less heat, and many can be installed in a general office environment. Air conditioning costs for air-cooled or water-chilled systems can be substantial. A comparison of the air conditioning requirements for the processors discussed in the previous paragraph shows a savings of 78 percent over the existing equipment needs. The newer processor requires less than one-fourth the energy that the older unit required to cool. This can save $67,632 annually at current power rates.

Recent dramatic increases in energy costs, and their continuing projected upward trend, will increase the importance of energy consumption in evaluating computer system procurements. An agency that is evaluating the replacement of its computers nationwide developed an energy use projection model as part of its ADP feasibility studies. The model was used to compare the energy requirements of eight obsolescent computer models with modern replacement computers having the same relative compute power. The projected 15-year life-cycle power usage of the older equipment was 514 million KVA at a cost of $13,107,000. New computers can accomplish the same amount of work while requiring only 385 million KVA. Based on present energy rates, $3,289,500 (25 percent) could be saved by replacing these obsolescent computers. The evaluation disclosed KVA savings ranging from 28 to 38 percent, depending on workload growth, when modern equipment was used. Energy-efficient systems can both save money and contribute to the Nation's energy conservation goal.

Additional costs of supplemental timesharing services

Agencies that have older, less reliable systems are experiencing frequent breakdowns; therefore, they must purchase supplemental timesharing services so they can process their

workloads. Costs of timesharing can be significant. The computer systems in illustration C (pp. 46 - 48) frequently broke down and were unavailable for extended periods. To get its work done, the agency purchased over $500,000 in timesharing services in 12 months. Replacing this unreliable equipment could save the agency over $450,000 annually in such timesharing expenses.

Hidden costs of using older equipment

Some costs associated with older equipment are incorrectly accepted as fixed expenditures that can be neither reduced nor eliminated. Personnel and floor space costs, and those expenditures attributable to system unavailability, are justified once and routinely approved thereafter. They should be reviewed periodically to see if they are reasonable. Also, the effect on capital items--such as uninterruptable power supplies, front end processors, and other hardware adapters--should be considered. As discussed below, the replacement of obsolescent equipment by modern gear can reduce these costs.

Greater personnel requirements

Computer centers operating older equipment are more labor intensive than facilities with new equipment. They require more operating personnel, programmers, and systems analysts. The earlier high expense of computer hardware engendered a philosophy of operating the equipment 7 days a week, 24 hours a day, to justify its cost. This approach is changing as hardware costs decline and labor costs increase. Computer centers frequently are operating with fewer shifts than before, but are more economical overall. In some cases the computers are being run unattended for extended periods. This type of operation is possible because new computer systems are more reliable and because users have access through remote terminals to greatly expanded online storage capacity. This expanded storage capacity can reduce the need for personnel to load and remove magnetic tapes and removable disk storage units from the system.

Overall operational costs can also be reduced as lower hardware costs allow the acquisition of more powerful computers which accomplish the work in less time. Labor costs can also be reduced by replacing two or three older systems with a single more powerful system which requires fewer personnel. In one of our examples, replacing seven outmoded systems with two new systems would reduce personnel requirements between 25 and 34 positions; this would save at least $450,000 annually, over and above the firm operational savings discussed in the example. (See illus. A, pp. 40 - 43.)

System programmers and analysts can perform their tasks more effectively and efficiently on modern computers than on older equipment. Interactive capabilities of current computers allow these personnel to test and "debug" new applications far more easily. Modern computer hardware is designed to take advantage of such software enhancements as automatic documentation, data dictionaries, coding optimizers, and extensive software libraries. System programmers and analysts may be marginally productive at best when involved with older equipment because the hardware operating system may no longer be supported by the manufacturer. When this is true, time must be spent maintaining software which the manufacturer may provide free or at a low cost for use on its current systems.

Extra expenses attributed to system unavailability

Older unreliable systems can significantly lower operational availability time. The actions taken by agencies as a result of system unavailability can be expensive. These actions could include longer maintenance (preventive and unscheduled) periods, extensive machine reruns, unscheduled personnel overtime, and increased use of outside computer services. The high incidence of and the costs and problems attributed to systems unavailability are discussed in detail later in this chapter. (See pp. 15 - 18.)

More floor space needed

Older computer equipment requires more space than modern equipment. The seven systems in illustration A require 17,522 square feet. The two newer systems, which could do the same work, need only 6,042 square feet, a savings of 11,480 square feet. Relinquishing this commercially leased space would save over $117,000 of annual lease costs, thereby reducing operating expenses. The floor space needed for disk storage units at another facility would be reduced to about one-tenth of its present size (998 sq. ft. vs. 104 sq. ft.). (See illus. D, pp. 49 - 52.)

Avoidable hardware expenditures

Agencies operating older equipment may incur capital expenditures for such items as uninterruptable power supplies, front end processors, peripheral equipment controllers, communication adapters, and other hardware optimizers. Replacing outmoded equipment with modern gear can reduce or eliminate the need for, and costs associated with, these capital items.

Where there is need for an uninterruptable power supply, savings are attainable with newer equipment. Because the

older equipment uses more power, an uninterruptable power supply for such equipment must have greater capacity--at greater cost--than that needed for newer equipment of the same relative compute power. The KVA requirement of a recently installed uninterruptable power supply system could have been cut in half, with a reduction in total capital and operating costs, if the agency had had modern, energy-efficient computers and disk storage units. The monetary savings can be significant since an uninterruptable power supply system generally costs about $1,500 per KVA. The present processors and disk storage units at this facility require 262 KVA, while newer units would need only 30 KVA. Thus, capital costs of about $348,000 could have been avoided if newer equipment had been used.

Older complex computers may require a front end processor 1/ to improve the processing efficiency of the system. Newer computers have this capability designed into the system and do not need a separate front end processor. A front end processor can be a costly capital expenditure. A computer introduced in 1969 that requires a front end processor can be replaced by a comparable modern computer that can perform all the functions of both the main and front end processors. An agency recently acquired one of these older computers but did not consider an up-to-date computer that was similar in capacity and price; it also provided other advantages. (The acquisition is further analyzed on pp. 28 - 29.) The price of the old computer system included the front end processor--the list price is over $300,000.

The seven systems in illustration A cannot directly interchange data, nor do they share peripherals. Agency personnel are considering the installation of a front end processor(s) to improve the systems' computing efficiency. Preliminary estimates for making the front end processor(s) operational range from $600,000 to $1 million. Replacing these seven outmoded systems with two up-to-date systems is economically justifiable and would also allow the computers to directly interchange data and share peripherals. Thus, the replacement systems would eliminate the need and capital expenditure for the front end processor(s).

1/A front end processor (usually a smaller computer) relieves the main computer of inefficient data communication management functions, thereby permitting the main computer to concentrate on the tasks for which it was specifically designed.

Hardware optimizers have been added to many older computers to perform functions which were not included in the original equipment design. These optimizers include controllers, communication converters, switches, adapters, and other interface devices. These optimizers are eliminated by incorporating their functional capability in the design of up-to-date computer systems. Four Federal installations in fiscal 1980 will spend over $116,000 to lease and maintain computer hardware optimizers. While the cost attributable to these optimizers may be relatively small, it is avoided when up-to-date computers are installed.

USING OBSOLESCENT COMPUTERS POSES PROBLEMS

The processing efficiency of outmoded computers is diminished by the problems related to system unavailability and by the technological limitations inherent in the design of old and new equipment. Older computer systems tend to break down more frequently, require longer scheduled and unscheduled maintenance periods, and may not be capable of operating in a degraded mode. 1/ Users of obsolescent equipment face technological limitations as well. Older computers are restricted by small main memory capacity, may be incompatible with new accessory supporting equipment, and may use only obsolescent software. In some cases outmoded equipment lacks a migration path to new technology.

Problems related to systems unavailability

Computers of recent design can significantly increase operational availability time as compared with the older systems, which tend to break down more frequently, require longer scheduled and unscheduled maintenance periods, and may not be capable of operating in a degraded mode. To accommodate the workload, users of older equipment may have to obtain additional capacity as backup when their basic equipment fails, or they may have to use outside timesharing services to supplement their owned equipment.

Our analysis of available data on equipment failures supports computer industry claims that today's computers are significantly more reliable than previous models. For example, the "mean time between failure" (frequency with which the equipment breaks down) for a class of computers introduced in 1978 improved 160 percent over the same vendor's mid-1960s computers.

1/See "Fault Isolation," p. 16, for a description of degraded mode.

A facility that had three outmoded (1960s vintage) computers was experiencing system reliability problems. Over a 1-year period (ending February 1979) the monthly mean time between failure of these three computers averaged less than 50 hours, and two systems never ran more than 80 hours without an interruption. Newer computer models offered by the same manufacturer are operating with a mean time between failure exceeding 500 hours. A user who has both the old and newer equipment as a dual-processor system described the reliability of the newer system as "an order of magnitude greater" than that of the older equipment.

Performing system maintenance on old computers can require a great deal of time. Sometimes the system must be taken out of operation. At one facility we visited, scheduled maintenance required 8 to 9 hours each week. (This does not count unscheduled maintenance time.) A recently introduced computer has no planned weekly or monthly maintenance, and the only preventive maintenance procedure is to replace the air filters once a year.

Several technological innovations have also helped improve computer system availability. Many of the computers in the Federal inventory do not have these capabilities. Some of these innovations are:

--Error detection and correction. This capability is an internal control mechanism that checks the accuracy of the work being processed. The computer automatically detects and corrects certain types of mistakes without stopping the processing, thereby avoiding the need to redo the work.

--Online maintenance and diagnostics. A portion of the system's memory storage capacity is allocated to maintenance and diagnostic programs. This avoids the need to shut down the system whenever maintenance must be performed. With this online capability, maintenance analysis can be performed whenever the system is not totally occupied with production work.

--Simultaneous maintenance monitoring. The system software is designed to constantly check the system as the computer is processing the work. Potential defects are noted and corrective action can be taken before a stoppage occurs.

--Fault isolation. The computer detects the defective component or module and blocks it out from the rest of the system. Although the system's performance is reduced as a result--termed operating in a "degraded mode"--the system continues its work.

Valuable production time is also lost because older systems frequently break down. Sometimes they are inoperative for extended periods because spare parts are not readily available. An agency that has two obsolescent computers (late 1960s technology) has had extensive breakdowns. Operational personnel estimated that 1 out of every 10 days is lost because one of the systems is inoperative. On two recent occasions, extended outages occurred (7 and 10 days) due to the lack of spare parts. The manufacturer of these machines is no longer in the computer business; consequently, the replacement parts had to be handcrafted.

Another facility with two obsolescent systems was experiencing frequent breakdowns; it used outside timesharing services to sustain its operations. The agency estimates that such use of outside timesharing services would increase its annual operating cost by $2.5 million. During the first 6 months of 1979, the total system downtime on these older, owned systems ranged from 43 to 96 percent per month. As an interim solution, this facility would like to replace these obsolete systems with a modern single system with the same relative compute power. Leasing a current technology computer for 3 years would result in significant net savings in operational expenditures, including reduced energy consumption.

Poor system reliability not only increases computer operational cost, but it can have a significant impact on those who rely on the system outputs. An agency that had an old computer that frequently broke down measured the financial impact of these outages. The agency was able to identify a loss of $110,407 in 1 month due to computer downtime. This downtime caused

--increased contractual expenditures for outside computer use,

--operational charges incurred while the system was idle,

--unscheduled overtime by end users, and

--additional manual labor on work normally done by the computer.

The study concluded that the biggest impact was the late delivery of and/or lack of key management reports. However, no monetary value could accurately be assigned to this area.

Today's computers are more reliable, require less scheduled and unscheduled maintenance, and can continue operating while in a degraded mode. These benefits offered by

newer technology translate into increased system availability. This increase can be used to process additional work and/or reduce outside timesharing requirements.

Technological limitations of older equipment

Users of outmoded equipment face many obstacles. Older computers cannot expand their processing capabilities, may be incompatible with new accessory supporting equipment, and may use only obsolescent software. In some cases existing older equipment lacks a migration path to new technology; i.e., the programs will not function on any new computer unless they are completely rewritten.

The maximum amount of memory (direct access storage) of many older computers is in the thousands of bytes or words. 1/ The memory capacity of modern computers is in the millions. The maximum memory of a processor in illustration A is 262,000 words, while its replacement starts at 524,000 words and is expandable to 4,192,000 words. (See pp. 40 - 43.) To overcome storage limitations of older equipment, users have added external storage devices, such as magnetic disk memory units and extended core storage units. However, the limited capacity and small number of external devices which can be attached to older computers is also a problem. Expanding main storage enables a computer to process work more efficiently than one which has to rely on external storage devices. For example, one agency's outmoded computer, even using extended core storage, required 39 hours to run a program. The same task performed on a modern computer required only 8 hours of processing time.

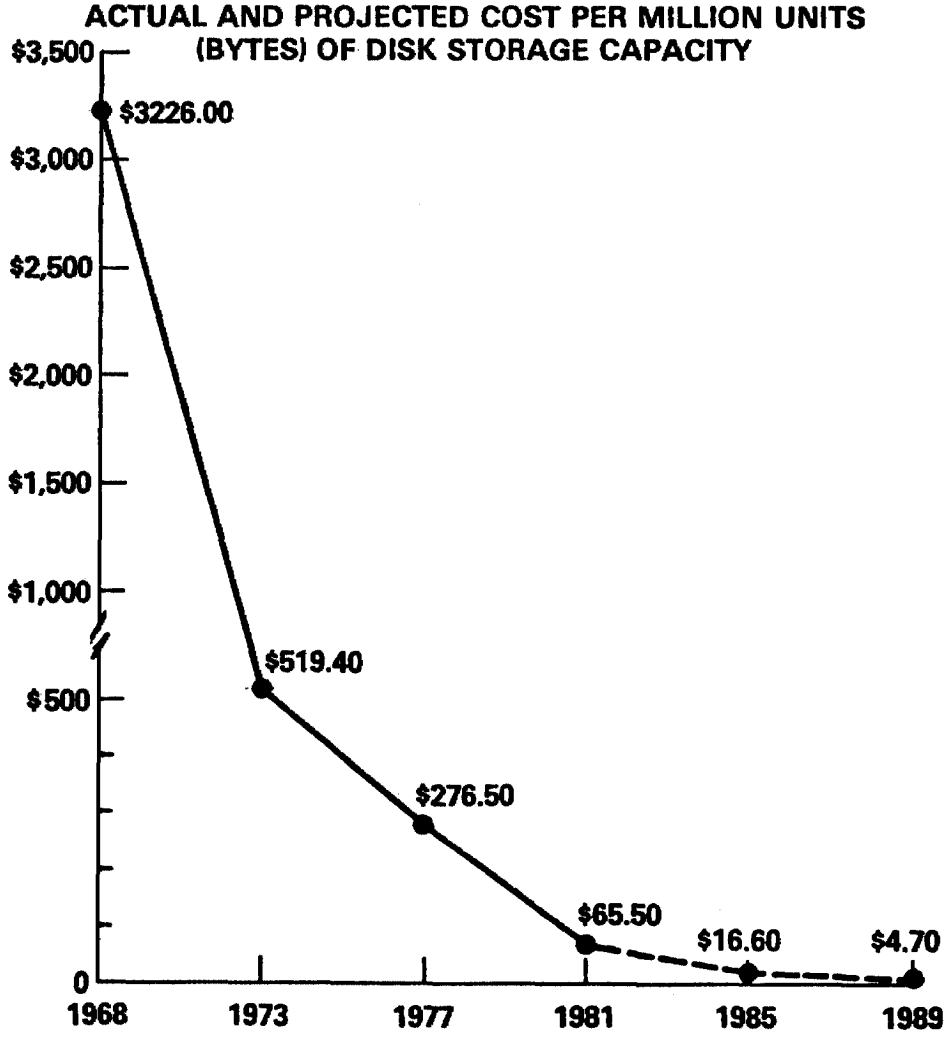
Input-output limitations

The input-output capacity of older computers can also restrict its processing. When a system becomes busy, the limited input-output function can create a bottleneck which restricts the system's processing capability. Newer computers are designed with greater input-output capacity. Thus, additional terminals or printers can have access to the computer without creating such bottlenecks.

1/Depending upon the manufacturer, the memory capacity is described in terms of words or characters.

Disk memory unit limitations

Users of obsolescent processors cannot take advantage of great improvement in disk memory unit technology because the newer disks cannot operate with agencies' older computers. Newer disk units are faster and have a far greater capacity at a lower unit storage cost. The maintenance and electrical consumption costs of older disk units often exceed the leasing, maintenance, and electrical consumption costs of newer disk units. In each of our illustrations, equivalent storage capacity was provided by fewer modern disk units. The graph below shows how the capital cost for a million units of disk storage has dropped in recent years; it is projected to drop even further.



Peripheral equipment limitations

Generally, computer manufacturers design new processors to operate with older peripheral equipment. As the age differential widens, however, manufacturers said they will not design newer computers to be compatible with very old equipment. One manufacturer's recently announced product line, which uses microprocessors to interface the computer with its peripherals, is not useable with older computers or peripherals. Federal users who acquire this vendor's latest processor must replace the peripheral equipment as well.

Software limitations

Some computers are restricted to using operating systems which are no longer supported by the manufacturer. These agencies must spend their own resources to maintain and modify the operating software. Users of more modern equipment can take advantage of the corrections and enhancements offered when a manufacturer releases a newer version of its current equipment's operating system.

The continued use of obsolete software also affects the morale of programmers and analysts. These people tend to leave Federal agencies that have older equipment so they can remain current with industry trends and retain marketable skills. Obtaining and training new programmers is difficult because they do not want to work with obsolete languages. One of the installations we visited had five openings for programmers to work on its outmoded systems. They could recruit only three people for job interviews, and none would accept a position. Furthermore, formal classes for training new personnel in the use of obsolete software are difficult to arrange and, in some cases, are simply unavailable.

No technological migration path

Some Federal computers become obsolete because their programs, as written, will not run on any manufacturer's new equipment, and rewriting the programs would be very costly. This situation is created when the computer's manufacturer (1) has discontinued this class of computers or (2) is no longer in the computer business. In these cases, the only way users can upgrade their equipment is to replace both the system hardware and software with a complete system redesign. Our study did not address systems in this category.

SUMMARY

In summary, the Federal computer inventory is old and growing increasingly obsolescent. The operational costs of

outmoded Government-owned equipment can exceed the costs of using newer equipment. In many instances the maintenance, power, and cooling costs of older, owned equipment is greater than the leasing, maintenance, power, and cooling costs of newer equipment. At the four installations we studied, we estimate that about $1.4 million can be saved annually on these costs by replacing obsolescent equipment.

Replacing obsolescent computers can avoid or lower other costs as well. Comparable up-to-date replacements for outmoded computers can process more work. Newer computers have better reliability, maintainability, and capability; therefore, system availability for processing is increased. Today's computers can overcome many of the technological limitations that users of obsolescent equipment encounter, and even more importantly, up-to-date computer systems can integrate subsequent technological innovations more readily.

Our conclusions and recommendations with respect to the issues discussed in this chapter, as well as OMB and GSA comments on our draft report, are provided in chapter 4.

CHAPTER 3

THE CAUSES OF OBSOLESCENCE AND NEED TO RESOLVE THE PROBLEM

If older equipment is not economical to operate today, why is the Government holding on to these outmoded computers? We believe our work shows that agencies are not fully aware of the operating costs of the older equipment, so they continue using it. While this report disclosed the matter of excessive operating costs and other problems, other factors have a bearing on the obsolescence problem, including

--GSA's failure to issue guidance on economic replacement policy, although the agency was tasked by OMB to develop such guidance;

--a lack of top level management involvement in the ADP acquisition and resource management function; and

--a procurement process that is complex and lengthy and can result in manufacturers proposing obsolescent equipment to meet the Government's needs.

Prompt GSA action in providing guidelines for agency use to determine when systems are outmoded and how to replace them expeditiously can resolve the obsolescence problem and prevent this situation from recurring. The success of this endeavor will require OMB and GSA, in concert, to monitor agency commitments and the implementation of policies and guidelines.

THE CAUSES OF OBSOLESCENCE ARE VARIED

Shortfalls in managing Federal ADP resources have contributed to the present situation of obsolescence. Agencies have not recognized the costs and problems of continuing to use outmoded equipment, and policy and guidance in replacing older equipment has not been provided to Federal managers to help them implement current technology. In addition, the current ADP procurement process is complex and lengthy and can result in manufacturers proposing older equipment for Federal acquisition.

Government-wide ADP responsibilities for guidance have been ignored

Agencies with Government-wide ADP responsibility have provided no direction or guidance regarding computer hardware obsolescence. OMB and GSA have acknowledged that there is no

central Federal policy regarding computer obsolescence, and the requirements in OMB Circular A-71 (issued Mar. 6, 1965), that OMB and GSA address computer obsolescence, have been overlooked. According to this circular, OMB was to provide overall leadership and coordination in managing Federal ADP equipment and resources and

> "develop programs and issue instructions for achieving increased cost effectiveness through improved practices and techniques for the selection, acquisition and utilization of ADP equipment and resources."

OMB was to discharge its responsibility by

--providing policies and criteria, procedures, regulations, information, technical advice, and assistance;

--evaluating, through the review of agency programs and budgets, their effectiveness in managing ADP resources;

--encouraging the use of advanced techniques in the design of data systems; and

--providing at all levels of Government the information needed for effective management of ADP resources.

GSA's assigned responsibilities under Circular A-71 include the following functions:

> "* * * provide to executive agencies, on request, comparative information on the characteristics and performance capabilities of equipment, * * *."

> "* * * develop and publish guidelines and criteria governing the replacement of equipment to avoid usage of such equipment beyond the point of economic advantage,* * *." [underscoring added]

OMB and GSA officials agreed that a specific policy and guidance is needed to resolve the obsolescence problem. These officials could not explain why no action had been taken since the circular was published 15 years ago.

Potential future improvements

Recent events do offer some potential for improvement. The consolidation of two OMB divisions--Information Systems Policy and Regulatory Policy and Reports Management--recognizes the relationships among reports management, paperwork burdens, regulatory processes, and information management. Also, the

recently introduced Paperwork Reduction Act of 1980 (H.R. 6410) would create a centralized Federal office in OMB to set Government-wide information policies and oversee Federal agency information management activities. This act would consolidate fragmented policy and oversight responsibilities and should result in the development of badly needed changes in Federal information management controls. The new office would set policies, standards, and guidelines for data processing and telecommunications functions and activities; review agency activities in these areas; and promote automation in using and disseminating agency information. A strong and active OMB is needed to accomplish these objectives, resolve existing obsolescence problems, and prevent the recurrence of those problems.

GSA has recently developed and submitted for agency comments revised drafts of the Federal Property Management Regulations and the Federal Procurement Regulations. These regulations appear to provide a sound basis for the long term management of Federal ADP resources. Under these regulations the Government's basic procurement objective is to satisfy its ADP needs at the lowest overall cost, while promoting maximum practicable competition. Full implementation of these regulations will require studies and extensive analysis by agency management. The regulations call for an examination of the agency's mission, ADP requirements analysis to meet mission needs, exploration of all feasible alternatives, life-cycle cost studies, and annual agencywide ADP plans. The regulations also require agencies to use standard high order languages when developing new software. These regulations will require extensive work over a long period of time, but they are needed to improve the management of Federal ADP resources. They do not, however, address economic obsolescence as called for in Circular A-71. (See pp. 3 and 23.)

Shortfalls in managing Federal ADP resources

Federal efforts at implementing technological ADP innovations have not been very good. Top agency managers frequently do not understand computer capabilities, or how to evaluate their agencies' needs. These shortfalls in managing Federal ADP resources have been the subject of numerous GAO reports. (See app. II.) Other studies and private industry sources have also commented on extensive management problems. Our two recent reports on Federal efforts to implement up-to-date technologies attest to Federal failures to utilize technological innovations effectively, efficiently, and economically. 1/

1/"Data Base Management Systems," FGMSD-79-35, June 29, 1979, and "Federal Productivity Suffers Because Word Processing Is Not Well Managed," FGMSD-79-17, Apr. 6, 1979.

Private sector comments on Federal management

Industry representatives we talked with cited numerous factors which have inhibited Federal management efforts and allowed obsolescence to occur. In their view, some of the relevant contributing elements were:

--Lack of guidance to determine whether or not a computer system is outmoded.

--Lack of detailed guidance to implement the policies set forth in OMB Circular A-109. 1/

--A procurement cycle that is cumbersome, regressive, unrealistic, and expensive.

--Failure to examine (1) the agencies' needs and overall mission and (2) how ADP can effectively and efficiently assist in meeting them.

--At the user and operator levels, knowledge of modern technology capabilities is reasonably current, but as you go up the management structure this awareness diminishes.

--Agencies do not have the skills to evaluate their function, determine their ADP needs, and then evaluate the capabilities of various manufacturers to fulfill these needs. There is no focal point in the Government that can do this.

--The failure to adopt standard, high order languages has impeded the opportunities to improve systems.

1/OMB Circular A-109 presents a systematic methodology for planning and acquiring major systems. The circular requires:

--Top level management's attention throughout the procurement process.

--Evaluation and reconciliation of needs in the context of agency mission, resources, and priorities.

--Solicitation of private industry's views and recommendations.

--Exploration of alternative systems.

--Competitive demonstration and evaluation.

The President's Reorganization Project on ADP and the report of the House Surveys and Investigations Staff corroborated the industry viewpoint.

Agency level shortfalls

We believe that Federal ADP management shortfalls are most pronounced at the department or agency headquarters level. This belief is based on our extensive work in the computer area over many years. 1/ Perhaps it is at the headquarters level that improvements will be the hardest to come by. Top agency managers frequently do not understand computer capabilities and do not know how to evaluate their agencies' ADP needs.

Agency or department problems with managing information resources frequently encompass

--little top management involvement in the ADP acquisition process, limited commitment of resources, and lack of management direction to implement GAO and other recommendations;

--inadequate or nonexistent long range ADP planning;

--weak or nonexistent centralized management of computer-based information systems; and

--no effective departmentwide plan for coordinating ADP activities.

These problems have created a situation where data processing is not being used to its potential for meeting agency mission needs. Technological innovations are not being implemented or properly used, and in the meantime, existing equipment becomes outmoded. The agency users suffer as well because their requirements are ignored or deferred by management.

Top management's shortcomings have created a credibility gap between themselves and both the Congress and officials responsible for the overall management of Federal ADP resources. This gap exists because top management has not

--met its commitments to competitively replace systems when it was permitted sole-source upgrades on an interim basis to meet urgent, unforeseen requirements;

1/App. II lists previous GAO reports on the acquisition and use of Federal ADP resources.

--converted to standard, high order languages or implemented other Federal ADP standards; or

--implemented the recommendations of external studies made by agency-hired consultants, congressional committees, or us.

Improved top management of ADP resources should help dissolve this credibility gap and increase the agency's chances of obtaining approval for more ADP resources.

Federal managers often further stifle use of new technology by specifying component performance, rather than system performance, in their procurement solicitations. Consequently, acquisitions are immediately denied or postponed at higher review levels because the proposal did not have technological merit or because it failed to consider other alternatives.

Managers at the computer operations level are reasonably aware of the capabilities of new computer technology. However, many operational ADP managers have guarded their areas of expertise and kept top management in the dark regarding computer technology. Other operational managers have not found time to become involved in planning for future ADP needs, claiming that much of their time is spent resolving daily problems. In both cases communication has suffered and top managers have found it more difficult to address computer issues.

In our view, Federal managers at all levels have contributed to this communication problem. Agencies with Government-wide ADP responsibility have provided no direction or guidance regarding the replacement or updating of outmoded hardware. Many top agency managers do not understand data processing, and their failures to honor agency commitments to competitively replace interim computer upgrades obtained on a sole-source basis have reduced the agency's credibility. On the other hand, operational managers may have a good understanding of technological developments, but they frequently do not communicate this understanding with top agency managers.

Implementing modern computer technology can help achieve several Government objectives for the 1980s, including the two most vital--reducing the size and cost of Government and improving productivity. Federal ADP management must be improved if these objectives are to be met. Federal managers will have to bridge the gap between 1960s and 1980s computer technology. Implementing up-to-date technology will be difficult, and perhaps painful, and managers will always have to deal with those who cannot or will not make the changes.

Lengthy and difficult acquisition process

Federal procurement regulations generally require that Government ADP managers, unlike their private industry counterparts, replace obsolescent computers competitively. The current Federal acquisition cycle is long, complicated, and frustrating. Some major ADP procurements take 6 years or even longer to complete. The President's Reorganization Project on ADP, the House Appropriations Committee Survey and Investigations staff report, several GAO reports, and private industry sources have all called for changes to the current acquisition process, 1/ better guidance to assist Federal ADP managers, and improved management of Federal ADP resources.

The difficulties encountered by those Federal ADP managers who have ventured into the acquisition process have left many others reluctant to follow their lead. The process is viewed as a negative experience requiring long hours, numerous studies, continuous reviews, and last-minute cancellations.

An ADP manager who had recently traversed the acquisition process vowed never again to buy a computer as long as he worked for the Federal Government. He felt the aggravations were not worth the effort, and he said he will make do with what he has rather than attempt to procure another computer system. Several ADP managers who were attempting or had attempted to procure new systems said they believe the acquisition process must be changed significantly before the Government can acquire up-to-date computers. While these managers admitted that their own efforts might have been better, they have received little guidance and frequently only criticism from upper management and the agencies responsible for overseeing acquisitions.

Obsolescent equipment proposed for Government procurements

Under present procurement regulations, manufacturers have successfully proposed obsolescent equipment to meet the Government's needs. Heavy emphasis on the lowest hardware price has often left the ADP user "penny wise and pound foolish." Computer industry representatives readily admitted that they frequently propose, for Federal acquisition, equipment which is out of production or close to the end of the production cycle. These bargains are available to the Government either because the manufacturers have recouped the research and

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1/A GAO study of the Federal ADP acquisition process is in progress.

development costs attributable to this model or because a newer model has been introduced and the manufacturers want to unload the leftovers.

An agency following the competitive acquisition process recently paid $4 million for a clearly outmoded system. The user is meeting present needs, but the system is dead-ended. If the user's processing requirements grow, the system cannot be expanded to handle them. The user was not aware that for 10 percent more than the purchase price, the same manufacturer could have provided an up-to-date computer system with the same relative compute power but with far greater flexibility. In addition, the maintenance charges for the modern system would have been $5,700 per month less than for the system obtained. The schedule below compares the two systems.

Purchased system	Up-to-date system
Cost: $4,000,000	Cost: $4,400,000
Core memory size is limited to 65,000 words.	Core memory size is 131,000 words and is expandable.
Does not have error detection and correction capability.	Has error detection and correction capability.
Requires a front end processor.	No front end processor needed.
Cannot be upgraded to a more powerful processor.	Processor is upgradable.
Can only use an operating system software that is no longer supported by the manufacturer.	Uses the latest operating system software.
Most of the peripheral equipment that can be attached is out of production.	All but a few of the necessary peripherals are in production currently.

Procurement requests stating the Government's minimum needs over the system's useful life, including a better assessment of possible increases in computing requirements could avoid situations like this one. Procurement personnel should be focusing more on the best value to the Government as determined not only by acquisition price, but by operational costs, maintenance, and other factors. They should, in essence, seek a life-cycle cost approach.

ACTION IS NEEDED TO RESOLVE OBSOLESCENCE AND PREVENT ITS RECURRENCE

Federal agencies need guidelines to determine when systems are outmoded and, if so, how to replace those systems quickly. New technology and concepts have evolved which enable computer systems to more effectively, efficiently, and economically accomplish existing workloads. Newer processors with the same relative compute power can today replace many outmoded Federal computers, resulting in savings of time and money and improved production. The recent changes at OMB and the proposed GSA regulations will, over the long term, improve the Federal ADP environment. But solutions to the Federal obsolescence problem exist now and can save money immediately.

Prompt GSA action is needed to provide guidelines for determining when systems are outmoded and how they can be replaced expeditiously when justified both technologically and economically. These guidelines should not require all the extensive studies and analysis that appear in the proposed GSA regulations. These guidelines should provide for a firm agency commitment to examining its long term ADP requirements and should require a plan for implementing the directives as stated in the proposed regulations. The following are suggestions that GSA could incorporate in its guidelines regarding expeditious replacement of outmoded computer systems.

--The existing applications and workloads need not be rejustified.

--Require replacement systems obtained on this basis to be approximately the same relative compute power as the old system.

--Restrict the system's memory storage (core and disk) capacity to the existing amount.

--Require that replacements to systems be capable of using existing software including, where possible, plug-compatible or emulation processors. 1/

1/Current technology has improved emulation techniques. Prior emulators used one computer to process programs originally created for another computer. Only a limited number of such combinations has been available. Emulation processors are now available which are highly flexible and use hardware, software, and microcode to simulate other computers. Many such combinations are now commercially available.

--The agency's top level management should make a formal commitment to participate in the ADP acquisition process, should include the agencies' ADP goals and objectives in Senior Executive Service appraisal agreements, and should report periodically to OMB and GSA on (a) replacement of obsolete software by standard high order languages, (b) implementation of other Federal ADP standards, and (c) assessing the agency's mission and analyzing how ADP can best help.

--Life-cycle cost analysis of all practical replacements must be made, including the determination of the best procurement method.

--All system software programs and a plan for evaluating and replacing obsolete software should be identified.

--The agency's internal audit group should be required to verify the cost calculations.

Federal agencies should use these suggestions to begin, immediately, to determine if their systems are economically obsolescent. The agencies should follow their internal procurement procedures for urgent procurements to the extent they do not conflict with the approach discussed in this report. Applicable procurement statutes and regulations should be observed, and competitors for the procurement will be those vendors whose equipment can process the existing workload and whose equipment can be delivered promptly.

Obsolescence problems can be prevented by a strong cooperative OMB and GSA effort in managing Federal ADP resources. Having expeditiously replaced their outmoded equipment, agencies should adhere to the life-cycle criteria that is set forth in the proposed GSA regulation.

The following chapter presents our conclusions and recommendations with respect to the issues discussed in this report, as well as comments of OMB and GSA on a draft of this report.

CHAPTER 4

CONCLUSIONS, RECOMMENDATIONS, AND AGENCY COMMENTS

CONCLUSIONS

The Federal inventory of medium- and large-scale computers is, without a doubt, outmoded. Our analysis shows that over half of these computers use 1971 or earlier technology. As an analogy, it is as though the Air Force's inventory of planes were primarily pre-jet-engine aircraft. The rapid advances in computer technology have made existing Federal computers increasingly out of date. In general, older equipment is less economical, less reliable, and less capable than newer equipment. Federal data processing technology will remain in the 1960s until effective action is taken to correct the situation.

Our illustrations demonstrate that the operational costs of older, owned equipment exceed the costs of using newer, off-the-shelf equipment. The new equipment is less expensive even when obtained on a short term lease basis, which is an expensive acquisition method. The maintenance, power, and cooling costs of older equipment are greater than the leasing, maintenance, power, and cooling costs of newer equipment. There are other, frequently unrecognized, costs of using older equipment--less efficient processing, increased personnel costs, greater floor space requirements, the need to purchase commercial time-sharing when older unreliable equipment breaks down, and the penalties imposed by delayed processing due to extended equipment outages.

In recent years new technology and concepts have evolved which enable computer systems to more effectively, efficiently, and economically accomplish existing workloads. Newer processors with the same relative compute power can replace many outmoded Federal computers. The newer equipment can use the existing operating system software without significant changes and provide such benefits as faster speeds, better reliability, greater capabilities, and lower energy consumption.

A variety of causes has created the current situation. Agencies have not recognized the costs and problems of continuing to use obsolescent equipment. Policy and guidance in replacing older equipment is needed to help Federal managers implement current technology, but such has not been promulgated. More and better knowledge of computer technology would enable Federal managers to better recognize and evaluate available economical alternatives. Effectively addressing

management shortfalls will improve the use of Federal ADP resources and will work toward dissolving the credibility gaps that exist between agency top management and those responsible for overall management of Federal data processing. The current murky acquisition cycle, which is long, complicated, and frustrating, has contributed to the obsolescent status of Federal computers.

OMB and GSA have not fulfilled their responsibilities for administration and management of automatic data processing activities, as prescribed in OMB Circular A-71. OMB and GSA should take action to stimulate removal of outmoded computers from the Federal inventory and prevent a recurrence of obsolescence. These key agencies should encourage the replacement of outmoded equipment without requiring extensive studies and analysis that could delay replacements and continue unnecessary excessive costs. Our proposed expeditious competitive acquisition recommendations will save the Government considerable money. Once this initial replacement is accomplished, agencies should periodically report to GSA and OMB on their progress toward such long term goals as agency mission accomplishment, ADP needs analyses, and emphasis on use of standard, high order languages. Recognizing that expeditious replacement of outmoded computers--by requiring that they be capable of using existing software--may result in fewer competitors, we urge that GSA obtain formal agreements from agencies' top management that future procurements will use maximum practicable competition.

For example, if the current system is scheduled to be replaced in 4 years, the expeditious replacement procurement should not be a substitute for normal replacement procurement which must follow. GSA should obtain such an agreement from each agency as a condition of the procurement.

Advances in technology have fortuitously provided the Government with economic solutions to present obsolescence problems and can help in achieving several Government objectives in the 1980s. This avenue may not be available in the future. Agency managers who are permitted expeditious replacements to bridge the gap between 1960s and 1980s must not ignore their long term obligations. We believe that agencies inhibited by obsolescent computer systems should replace this equipment, when economically justified, as expeditiously as possible under the current competitive acquisition process. A strong cooperative OMB and GSA effort in managing agency adherence to Federal ADP policies and guidelines can prevent obsolescence problems.

RECOMMENDATIONS

While we have pointed out the factors contributing to the present situation, poor decisions of the past that led to this situation cannot now be changed. We believe two things need to be done.

--Replace obsolescent computers with modern economical equipment.

--Improve the management of Federal ADP resources so that obsolescence does not happen again.

Recommendation to the Administrator of General Services

Replacement of obsolescent equipment now can result in savings. We recommend that GSA issue guidance to the agencies outlining the criteria to be used and the cost comparisons to be made in determining economic obsolescence. (Our suggestions are on pp. 30 - 31.) GSA should also set forth procedures for expeditious replacement of ADP equipment determined to be obsolescent. We suggest that GSA, working with OMB, require the agency's internal audit group to verify the cost calculations.

To minimize the possibility of obsolescent equipment becoming a recurring problem in the future, we also recommend that GSA issue the guidance and criteria called for in Circular A-71. This would help ensure that, over the long term, Federal computers are continually economical and efficient. (See pp. 3 and 23.)

Recommendations to heads of Federal agencies

Recognizing that it will take some time for GSA to issue this guidance, we recommend that the heads of Federal agencies immediately institute a program to determine if their systems are currently economically obsolescent (using the same methods we used), and if they are, to replace them expeditiously.

Recommendation to the Director, Office of Management and Budget

To improve the management of ADP resources generally, we recommend that OMB require Federal agencies to

--assess their ADP requirements for the 1980s and plan appropriate short and long range procurement strategies,

--institute a program to improve top managers' knowledge of current computer technologies and concepts,

--increase top management involvement in acquisition and resource allocation processes, and

--ensure that ADP cost-accounting procedures reflect the principles of full costing and total system-life-cycle costing.

AGENCY COMMENTS

We sent our report to OMB and GSA for comment in view of their Government-wide responsibilities in the area. Since agency facilities are discussed only to illustrate the Government-wide situation, we did not request individual agency comments on the draft.

In commenting on our draft report the Office of Management and Budget noted that it had also been looking into the causes and possible solutions related to the Federal computer obsolescence problem. OMB added that our report, coupled with numerous contacts with our staff, has been very helpful in its attempt to better understand and deal with this complex issue. GSA also commented that this report presents data concerning ADP obsolescence that merits airing. Both agencies provided a number of detailed observations which are presented in their entirety in appendix III.

One of the major observations both agencies made dealt with the definition of obsolescence. It was pointed out that at least four definitions must be considered, including functional obsolescence, physical obsolescence, economic obsolescence, and technical obsolescence.

Our study focused on economic obsolescence because it provides a means to clearly demonstrate obsolescence, because actions to eliminate it can immediately save the Government money, and because guidelines for determining it are a requirement of OMB Circular A-71. The report emphasizes economic obsolescence but in chapter 2 also discusses functional obsolescence. (See pp. 15 - 21.) Physical obsolescence is also demonstrated. (See pp. 16 - 18 and 47 - 48.) A Bureau of the Budget (now OMB) report to the President in February 1965 cited economic obsolescence of Federal computer equipment as a problem and recommended that GSA take actions. Those recommendations were subsequently prescribed in Circular A-71 (Mar. 6, 1965).

Age in and of itself is an indication of probable obsolescence in the computer area and should lead the user to evaluate possible replacements. Computer systems which are

two or more production cycles behind current vendor models are primary candidates for the expeditious competitive replacements we are proposing. Unfortunately, the Federal Government has many such candidates.

We are not advocating that all replacements be justified on economic grounds; we recognize that other justifications are possible as well.

GSA did not agree with the draft report's observation that Federal procurement regulations encourage obsolescence. (See pp. 28 - 29.) Agency officials said that a user falling into the trap of acquiring outmoded equipment (as described on pp. 28 - 29.) does so by ignoring the procurement regulations, not by following them. If this is true, then we believe GSA--as the contracting officer for this solicitation 1/--was remiss in not so advising the agency involved.

We have revised our wording to show that the implementation of the regulations, not the regulation per se, has contributed to the obsolescence problem. GSA's proposed regulations (see p. 24) can change the present emphasis on lowest hardware price to lowest overall cost over the system/item life. The proposed regulations encourage Federal managers to take advantage of enhancements brought about by new ADP technology. It is incumbent upon GSA to provide guidance that will enable agencies to acquire the best ADP equipment with their available resources.

Some of the other more relevant observations made were related to

--obsolescence of small-scale computers,

--the question of whether our report would result in noncompetitive procurements,

--the question of whether guidelines as recommended are actually needed, and

--the question of whether present procurement practices are too complex and lengthy and thus a cause of obsolescence.

1/GSC-CD PR-D-008N, contract GSC-00C-50303.

Our response to each of these follows.

On page 6 we acknowledge OMB's study of Federal small-scale computers. We agree that they, too, could be obsolescent. We concentrated on larger computers because based on purchase price, they represented 76 percent of the Federal inventory.

Concerning possible noncompetitive procurements in replacing outmoded equipment, we feel that competition will frequently be present because manufacturers of plug-compatible equipment, emulators, and microcoded processors could all meet the requirement of using existing software.

As to whether guidelines are in fact needed, this is central to our position. Obsolescence is not a recent problem; in February 1965 the Bureau of the Budget reported to the President that "a policy* * *[is] clearly needed * * * to assure recognition of the fact that equipment still useful may no longer be economically useful." (underscoring supplied) When OMB Circular A-71 was issued in March 1965, GSA was given the responsibility for developing such guidance but to date has not done so. In our view, the antiquity of the existing Federal computer inventory strongly attests to the agencies' need for guidance.

Regarding the point that the acquisition process contributes to the problem, much evidence is available to support the position. For example, the President's Reorganization Project on ADP, the House Surveys and Investigations Staff, and industry representatives have all commented that the present procurement process is complex and lengthy. Computer technology has been changing and is continuing to change rapidly, but we found that some major ADP acquisitions take 6 years or longer to complete. We reported to GSA that we confirmed a generally held perception "* * * that the ADP procurement process is lengthy* * *." 1/ As mentioned in this report, we are now studying the problems associated with the Federal ADP procurement process to develop recommendations that will shorten and clarify the present process. However, the fact that the process is long has been proved; and that it is considered cumbersome, awkward, and difficult has been frequently reported.

1/Our Dec. 7, 1979, letter to the Administrator of General Services.

ILLUSTRATIONS OF ECONOMICAL REPLACEMENTS OF OLD EQUIPMENT

The illustrations in this appendix show how newer equipment can more effectively, efficiently, and economically meet present user requirements. The agency computer systems we selected for comparison process general purpose applications. In each case the equipment was manufactured or maintained by a leading large-scale computer company. The operational costs of the replacement equipment are based on short term leasing prices. Even though this is not the most economical procurement method, the newer equipment is less expensive. In an actual situation, a life-cycle cost analysis should be performed to determine whether leasing or purchasing is the most cost effective procurement method. The decision will depend on how long an agency anticipates keeping the replacement equipment.

The table below summarizes the salient points of comparison between the existing equipment and proposed replacements. Each illustration is then presented in detail.

Summary of Economical System Replacement Illustrations

	Illustration A		Illustration B		Illustration C		Illustration D	
	Agency W		Agency X		Agency Y		Agency Z	
	Old	New	Old	New	Old	New	Old	New
Relative compute power (note a)	26.9	26.0	3.2	3.7	2.25	2.5	37	37
Processors	13	4	4	4	3	2	3	3
Core memory (note b)	1,834,000 bytes	2,096,000 bytes	262,000 words	262,000 words	456,000 words	512,000 words	c/6MB	12MB
External storage:								
Disk	5373MB	5660MB	5156MB	5536MB	986MB	1000MB	7656MB	7998MB
Drum	189MB	-	-	-	-	-	-	-
Floor space (sq. ft.):								
System	17522	6042	6000	4800	-	-	-	
Processor	7560	1860	284.4	118.3	-	-	564	83
Disk	-	-	218.4	64.0	-	-	998	104
Electrical consumption (KWH/yr) (note d)	8.3 million	2.75 million	1.65 million	.77 million	1.6 million	.19 million	2.08 million	.24 million
Cost (Annual):								
Timesharing services	-	-	-	-	$504,000	$ 50,000	-	-
Maintenance	$2,300,112	$ 550,620	$299,496	$ 86,352	328,284	-	$478,452	-
Rental	-	1,677,324	383,856	474,552	47,248	778,680	31,512	$470,316
Electricity	361,809	119,946	32,900	15,323	68,073	8,505	178,266	20,458
Total	$2,661,921	$2,347,890	$716,252	$576,227	$947,605	$837,185	$688,230	$490,774

a/Relative compute power is a measure of a computer's (s') processing capability. Based on these figures, one cannot compare the processor performance capability between manufacturers but only between processors of the same manufacturer.

b/Depending on the manufacturer, the size of core memory is described in terms of words, bytes, or characters.

c/MB - Megabytes, a million units (bytes) of storage capacity.

d/KWH/yr - Kilowatt hours per year.

APPENDIX I

APPENDIX I

ILLUSTRATION A

Annual Operating Cost

Current equipment	$2,661,921
Replacement equipment	(2,347,890)
Firm savings	$ 314,031
Potential space and personnel cost savings	$ 567,096

Agency W's data processing center operates online personnel information systems and other systems which support worldwide management activities. The seven systems operate on 13 computers. Five of the systems are available to interactive users; two systems process only batch jobs. The peripheral equipment on the systems includes tape drives, disks, drums, add-on memory, printers, card readers, and card punches. The processors' technology was introduced in 1964. The April 1979 Federal inventory listed 55 processors from this series.

The facility is configured into six dual and one single processor systems, each with 262,000 bytes of core memory. Each system has dedicated disk files and magnetic tape drives. The systems cannot directly interchange data and they do not share peripherals. A copy of the operating software, supporting applications, and libraries resides in each system. There are 5.6 billion characters of external storage capacity available on disk and drum for all the systems. The facility also has 66 tape drives for the seven systems.

The cost of maintaining these systems will greatly increase when the present maintenance contract expires in April 1981. The current contract was negotiated in 1973 and established fixed prices for the contract's duration. Thus, while scheduled maintenance costs have risen each year, this agency is paying 1973 prices. The current annual maintenance cost is about $0.8 million but would be about $2.3 million if fiscal 1980 ADP schedule prices were applied. Since the present contracts expire in 1981, we have used 1980 prices for our comparison.

The cost of onsite engineering personnel would be an additional maintenance expenditure in a new contract. Based on the fiscal 1980 Federal ADP schedule, providing the present support level would cost an additional $585,000. The 1973 contract price included onsite engineering personnel, but the manufacturer no longer includes onsite service as part of its basic Federal ADP schedule maintenance agreement.

We asked the manufacturer to review the present configurations and present a replacement. The manufacturer complied with our request and provided a configuration based on a 1977 technology processor. The new configuration retains some of the old peripheral equipment, but the disk units would be replaced and the number of tape drives was reduced. The replacement processors should run all the existing software with no major modifications. 1/

Savings attainable with replacement systems

The annual operating cost for the new equipment would be about $314,000 less than the maintenance and electrical costs of the old, owned equipment. Other potential savings total about $567,000. The following tables detail these savings. The rental and maintenance figures are based on the fiscal 1980 Federal ADP schedule. Fiscal 1981 costs will probably increase by 7 to 10 percent.

Annual Operating Costs

Characteristics	Configuration Old	Configuration New	Firm savings
Maintenance (note a)	$2,300,112	$ 550,620	
Rental	-	1,677,324	
Electrical consumption	361,809	119,946	
Total	$2,661,921	$2,347,890	$314,031

Other potential savings	
Personnel	$450,000
Leased commercial space	117,096
	$567,096

a/Does not include the cost of onsite maintenance.

1/The extent of any software changes that may be required cannot be accurately estimated without completely analyzing the existing software. Unique operating instructions or unusual time dependencies are examples of the software that might have to be changed. Such changes are generally not required; however, if needed they are considered minimal and do not pose an obstacle to converting to new technology.

Central processor evaluation

A comparison of processors shows clearly that the processor at this facility is outmoded. Present memory capacity is not expandable, and the present equipment requires substantially more floor space and electricity than the replacement processor. The replacement processor has three times the computing capability of the old processor, and its memory can be expanded to four times that which is included in the proposed replacement configuration. Thus, fewer processors are needed to produce the same relative compute power.

The current processor cannot share peripherals in a multisystem environment. Each system must be configured with enough peripherals to handle peak workloads, but some peripherals will frequently be idle. The seven systems at this facility require 66 tape drives. The replacement systems, which can share peripherals, will require only 32 tape drives to meet peak workload requirements.

The replacement processor is compatible with the current processor; that is, all current software will run on the replacement processors with at least equal efficiency. Since the channels are faster and the unit has more main memory, the replacement will have greater throughput efficiency.

More throughput will also result from an increase in memory available to users. Memory for operating systems and supporting applications is reserved in each of the current seven systems. This uses up 40 percent of the total memory. The replacement systems would require the dedication of only 5 percent of total memory for these purposes.

External storage

Disk storage technology has made significant gains since the mid-1960s. The old configuration uses 82 storage units (combination of drum and disk) to attain a 5,562 million character capacity, whereas 14 units of a current technology disk hold 5,660 million characters. The newer disks are substantially more reliable and, as shown below, have a quicker average access time and a higher data transfer rate.

	Drums	Old disk	New disk
Access time	17 milliseconds	60 milliseconds	23 milliseconds
Transfer rate	1.4 megabytes per second	0.3 megabytes per second	2.1 megabytes per second

The new disk units are of the "Winchester" technology; they are substantially more reliable and more easily maintained. The new disk control units perform many of the overhead functions currently handled by the central processors.

Energy and air conditioning

The old equipment consumes a considerable amount of electricity to operate and cool the systems. The current systems require 729.44 KVA (kilovolt amperes) and 215.22 tons of air conditioning. The replacement systems can operate on 246.94 KVA and 67.69 tons of air conditioning. The total power requirement for the old systems is 8.3 million KWH (kilowatt hours) per year vs. 2.75 million KWH per year for the new systems, a reduction of 5.55 million KWH per year. The installation is currently paying about $.0436 per KWH. Electrical consumption costs could be reduced by $241,863 per year with new equipment.

Floor space

The size of agency W's computer room could be significantly reduced with the replacement system. The considerable floor space saved could be made available to meet expansion requirements. The 13 current processors occupy 7,560 square feet; the 4 replacement units would need only 1,860 square feet. Currently, the seven systems, including peripherals, require 17,522 square feet. The two replacement systems would reduce computer room needs to 6,042 square feet, a savings of 11,480 square feet. The agency rents space for this computer facility in a commercial office building at an annual leasing cost of about $10.20 a square foot. Therefore, the agency could save $117,096 annually if this excess space were relinquished. We did not include this in our calculation of firm savings.

Personnel reductions

The replacement systems could reduce staffing by 25 to 34 positions, depending on peak workload requirements. Presently 9 supervisors and 58 operating personnel work three shifts per day at the facility. At an annual cost of $18,000 per position (wages and fringe benefits), the agency would save at least $450,000 annually. We did not include this in our computation of firm savings.

ILLUSTRATION B

Annual Operating Cost

Current equipment	$716,252
Replacement equipment	(576,227)
Firm savings	$140,025

Agency X operates an automatic data processing facility that supports its administrative and technical systems. The current configuration contains two dual processor systems with add-on memory, disks, and tape drives. One system's processor represented 1963 technology and was 1 of 63 of its series in the April 1979 Federal inventory. The second system's processor represented 1971 technology. The April 1979 inventory listed 31 processors from this series.

The processors can interact with each other and can share peripherals and data files. One processor is used primarily for batch processing, the other for interactive users. Each processor can be used for both interactive and batch processing, but facility managers believe segregation is more efficient. When there is a lull in interactive requests, some batch jobs are done on the interactive processor at night.

We asked the manufacturer to review the current systems and design a new technology replacement configuration offering about the same relative compute power. The manufacturer complied, submitting a configuration based on a recently announced processor. (We also considered systems based on a less powerful processor, but we found these systems to be more costly than the alternative proposed although they still involved lower costs than that of existing equipment.)

The configuration would still contain two dual processors. However, 4 disk units would replace 24 in the current design and offer 7 percent greater disk storage capacity. Floor space required for the equipment would be reduced by more than half. The replacement processors are compatible; that is, they would interface with the current peripheral equipment and should run all existing software with no major modifications. 1/

1/The extent of any software changes that may be required cannot be accurately estimated without completely analyzing the existing software. Unique operating instructions or unusual time dependencies are examples of the software that might have to be changed. Such changes are generally not required; however, if needed, they would be minimal and do not pose an obstacle to converting to new technology.

Savings attainable with replacements

The replacement configuration would result in a savings of about $140,000 in annual operating costs, about 20 percent of the operating costs of the present processing and disk equipment. Maintenance cost would decrease by 71 percent. The following table details the savings; rental and maintenance costs are based on the fiscal 1980 Federal ADP schedule.

Annual Operating Costs

Characteristics	Configuration		Firm savings
	Old	New	
Maintenance	$299,496	$ 86,352	
Rental	383,856	474,552	
Electrical consumption	32,900	15,323	
Total	$716,252	$576,227	$140,025

The new configuration would probably not result in a savings in space and personnel costs. Although the new equipment would require less room, the space is Government owned. The same number of computer operators would be required with the new configuration.

Systems' evaluation

Not all equipment in the current configuration would have to be replaced. The current tape units can interface with the proposed replacement processors. It would not be as economical to replace them.

Memory on the current processors is not expandable. Both processors have been fully expanded, with add-on core, to 131,000 words of core storage. While the replacement would offer the same core storage, memory on each is expandable to 2.6 million words.

Energy and air conditioning

The new equipment proposed for this agency would require less than half the power consumed by the current hardware. The old systems require 120.9 KVA and 358,660 BTUs per hour of air conditioning. The replacements would operate on 56.3 KVA and 172,315 BTUs per hour. Total electrical consumption would be reduced by 0.88 million KWH per year. The new equipment would require 0.77 million KWH per year as compared to 1.65 million KWH per year for the old hardware. At the estimated local electrical rate of 2 cents per KWH this agency could save about $17,500 annually.

ILLUSTRATION C

Annual Operating Cost

Current equipment	$947,605
Replacement equipment	(837,185)
Firm savings	$110,420
Potential personnel savings	$ 60,000

Two units of an agency jointly operate a computer service bureau. The equipment--a dual processor and a single processor--is located at agency Y's data processing center. The systems support these two units and numerous agency facilities nationwide. The data processing center operates real-time information systems. The peripheral equipment on the systems, including tape drives, disks, and add-on memory, were made by a company that is no longer in the computer business. The equipment is now maintained by a major manufacturer. The processors represent mid-1960s technology. There were 20 processors from this series in the April 1979 inventory.

The single processor system supports interactive users; the dual processor supports a batch-oriented system. The systems are not interconnected and they use different operating system software. The available disk space on the single processor system is 210 million characters. The dual processor system has 776 million characters of disk capacity. Both systems rely heavily on magnetic tape for data storage and retrieval. The data center maintains a tape library of 15,000 reels.

We provided the maintaining manufacturer with a systems equipment listing. We asked the manufacturer to review the material and present a replacement configuration based on its latest technology. The replacement processor the manufacturer proposed was selected because it had a relative compute power rating only slightly greater than the combined power of the three current processors. The replacement system will run all current dual processor software with minimal

modification. 1/ The single processor software would have to be converted. However, other agency facilities have already converted this system software to operate on replacement series machines. Thus, the agency can avoid the conversion process by obtaining copies of these programs for use on the new system.

Savings attainable with replacements

The annual operating costs for the new, leased equipment would be about $110,000 less than the costs of the old, purchased equipment. The following tables detail these savings. The rental and maintenance figures are based on the fiscal 1979 actual costs and the Federal ADP schedule.

Annual Operating Costs

Characteristics	Configuration		Firm savings
	Old	New	
Maintenance	$328,284	$ -	
Rental	47,248	a/ 778,680	
Electrical consumption	68,073	8,505	
Timesharing services	504,000	50,000	
Total	$947,605	$837,185	$110,420

Other Potential Savings

Personnel	$ 60,000

a/ Includes maintenance charges

Current system evaluation

All equipment on both current systems would have to be replaced. The original peripherals will not work with the maintaining manufacturer's peripherals. Also, most of the existing equipment would probably be replaced anyway because

1/The extent of any software changes that may be required cannot be accurately estimated without completely analyzing the existing software. Unique operating instructions or unusual time dependencies are examples of the software that might have to be changed. Such changes are generally not required; however, if needed they are considered minimal and do not pose an obstacle to converting to new technology.

the equipment is continually breaking down. The total system availability during the first 6 months of 1979 averaged 22.5 percent on the single and 24.3 percent on the dual processor systems. The systems were first produced in the mid-1960s; no new spare parts have been produced for them since the original manufacturer went out of the computer business in 1970. The maintaining manufacturer purchased the business and provides both software and maintenance support on an "as available" basis. Overall, computer equipment users can expect declining support and spare parts shortages with this type of equipment.

Timesharing services

The inability to expand the current systems, as well as frequent system outages, has forced the agency to rely on outside computer service organizations to process its workload. Replacing these obsolescent systems would reduce the need for timesharing services and lower overall processing costs by about $450,000.

Energy and air conditioning

The electrical demand of the old systems significantly exceeds the demand of the replacement system--it uses eight times as much energy to operate and seven times as much to cool. The old systems require 200.1 KVA and 577,600 BTUs per hour of air conditioning. The replacement system operates on 25.5 KVA and 77,500 BTUs per hour. The total electrical consumption would be reduced by 1.41 million KWH per year (1.6 million vs. 0.19 million) when the new system is installed. At the current local electrical rate of 2.5 cents per KWH, the agency would save $59,568 annually.

Personnel reductions

By consolidating processing into a single system, this facility will be able to reduce personnel requirements by three positions. Annual savings of $20,000 per position, which includes wages and fringe benefit, can be realized. We did not include this in our computation of firm savings.

ILLUSTRATION D

Annual Operating Cost

Current equipment	$688,230
Replacement equipment	(490,744)
Firm savings	$197,486

Agency Z's data processing center operates online information systems and other accounting and management systems which support the activities of 30 medical and prosthetics centers, regional offices, outpatient clinics, and cemetery office stations. The systems operate on three 1965-technology computers. The peripheral equipment on the system includes tape drives, disks, and add-on memory made by plug-compatible manufacturers. Some disk drives and all the printers, card readers, and card punches were from the original manufacturer. The April 1979 Federal inventory listed 221 computers from this processor series.

The three central processing units (CPUs) communicate with each other on a CPU channel-to-channel basis. One processor acts as a "master," executing the operating system software and controlling the activity of the other two computers. All disk files are shared and are accessible by any of the three computers. The total amount of available disk space on the system is 7.7 billion characters.

We provided the manufacturer with a listing of all the equipment associated with the system as well as a schematic and wiring diagram showing all interconnections. We asked the manufacturer to review the material and propose a replacement system. The manufacturer complied, providing us with a configuration based on a recently announced processor. 1/

1/The manufacturer cautioned that the proposed replacement system addressed the central computing complex only. It was based on a unit-by-unit replacement. They stated that a thorough examination of the configuration and application software could result in a more efficient and less costly configuration. We agreed, but felt that the obviously less than optimal new configuration still shows the dramatic benefits of the new technology.

The replacement processors should run all the existing software with no major modifications. 1/

Savings attainable with replacement system

The leasing, maintenance, and electrical costs for the new equipment are 28.7 percent less than the maintenance and electrical costs of the old, less reliable, owned equipment. The following table compares the major characteristics of the old and new equipment.

Annual Operating Costs

Characteristics	Configuration		Firm savings
	Old	New	
Maintenance	$478,452	$ -	
Rental	31,512	a/470,316	
Electrical consumption	178,266	20,458	
Total	$688,230	b/$490,774	$197,456

a/Lease charges under the monthly lease plan include maintenance charges. Annual lease cost will decrease by $13,572 (to $456,744) after the first year under the rental agreement.

b/When the systems are initially acquired, a one-time charge of $1,365 for utility equipment would be incurred.

Central processor evaluation

The current processor is clearly outmoded. With only two million characters of memory, it requires seven times the floor space of the replacement processor. The old processor uses five times as much energy to operate and four times as much to cool. The maintenance cost for the owned unit exceeds the cost of leasing and maintaining the replacement processor. Also, the current computer became a "dead end" machine in the early 1970s--the new, high efficiency disk

1/The extent of any software changes that may be required cannot be accurately estimated without completely analyzing the existing software. Unique operating instructions or unusual time dependencies are examples of the software that might have to be changed. Such changes are generally not required; however, if needed, they are considered minimal and do not pose an obstacle to converting to new technology.

memory units cannot be connected to it. Hence, installations using the processor are forced to operate with old, unreliable, bulky, and expensive-to-maintain peripherals. The existing operating system is no longer supported by the manufacturer and the new operating systems will not run on the old processor. These problems would be eliminated with the new processor.

The new processor is compatible with the old; that is, all current software should run on the new processor with at least equal efficiency. Since the channels are faster and the unit has more main memory, the new computer will have greater throughput capacity. Additionally, the new processor has significantly better component reliability, requires no scheduled preventive maintenance, and is easier to repair. This also equates to greater system capacity.

Disk storage

As previously mentioned, disk storage technology has made substantial gains in the past 15 years. Unfortunately, the new technology disks in the manufacturer's line cannot be coupled to the present computers. This has hastened the obsolescence of these processors. The old configuration uses 184 disk units, commonly called "drives" or spindles to attain a 7,656 million character capacity. Fourteen spindles of current technology disks hold 7,998 million characters. Again, the newer disks are substantially more reliable, have a shorter average access time (20 milliseconds vs. 75 milliseconds), and a higher data transfer rate (1.859 million bytes per second vs. 0.312 million bytes per second).

To obtain the benefit of the new disk drives, the disk data currently on the system must be converted. This is usually accomplished by using data utility programs that restructure the data files to formats required by the new devices. The data control portions of the programs must be modified to be consistent with the different physical characteristics of the new devices; that is, track size, number of tracks, and other technical features. These changes should not affect those portions of the program that deal with logical record or data handling.

Energy and air conditioning

The old equipment uses 2.1 million KWH per year, as compared to only 0.24 million KWH for the new equipment. The installation is currently paying about 5 cents per KWH. On an annual basis, the difference in energy costs to run the systems alone amount to $90,956.

The manufacturer informed us that as a rule, energy for air conditioning costs about 75 percent of the energy required to operate the units involved. Thus, the total difference in electrical consumption costs between the old and new systems would be $157,173 per year.

Floor space

When computers were first introduced, the physical space required for a megabyte--or million characters--of storage was 400 cubic feet. Today, a megabyte of storage in the proposed replacement computer is .03 cubic feet. The size of agency Z's computer room could be significantly reduced from 564 square feet to 83 square feet with the replacement units, thus making floor space available to meet other needs. The floor space needed for disk storage units could be reduced to one-tenth the space now used. If the current disk units were placed end to end, they would cover the length of a football field; new technology disks would cover only 13 yards. The old units occupy 998 square feet; new disks with equivalent capacity would require only 104 square feet.

Capital cost avoidance

In 1979 the General Services Administration entered into a contract for the installation of an uninterruptible power supply for the computers at this data processing center. If agency Z had been able to plan for a system replacement like we have suggested here, a smaller uninterruptible power supply could have been acquired, saving about $348,000.

Other matters

More reliable systems should reduce costs due to system unavailability. These costs are magnified in an online environment, because online users are not productive when the system is unavailable.

Another alternative would be to replace the three processors with a single larger processor. In that case, personnel requirements would be reduced by seven positions, and annual savings of $20,000 (including wages and fringe benefits) per position could be realized.

APPENDIX II

LIST OF ADP REPORTS WE HAVE ISSUED ON ACQUIRING AND USING FEDERAL ADP RESOURCES

Title 1/	Report No.	Date
Compilation of Recommendations to the Office of Management and Budget for Improving Government Operations	GGD-77-85	Sept. 13, 1977
Millions in Saving Possible in Converting Programs From One Computer to Another (OMB-NBS)	FGMSD-77-34	Sept. 15, 1977
Cooperative Action Results in More Economical Computer Acquisition and Improved Security at the New Orleans Computer Center (USDA)	LCD-77-118	Dec. 23, 1977
GC Decision to the General Counsel of GSA on DOE acquisitions of ADP equipment in compliance with the Brooks Act	B-115369	Feb. 6, 1978
Accounting for Automatic Data Processing Costs Needs Improvement	FGMSD-78-14	Feb. 7, 1978
Farmers Home Administration Needs to Better Plan, Direct, Develop, and Control Its Computer-Based Unified Management Information System	CED-78-68	Feb. 27, 1978
Shifting the Government's Automatic Data Processing Requirements to the Private Sector: Further Study and Better Guidance Needed	FGMSD-78-22	Apr. 11, 1978
The Federal Information Processing Standards Program: Many Potential Benefits, Little Progress, and Many Problems	FGMSD-78-23	Apr. 19, 1978
Inadequacies in Data Processing Planning in the Department of Commerce	FGMSD-78-27	May 1, 1978

1/Before 1977 we issued about 300 reports on Government-wide management, acquisition, sharing, use, planning, and control of ADP resources.

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Title	Report No.	Date
Improving Federal Agency Efficiency Through the Use of Productivity Data in the Budget Process	FGMSD-78-33	May 10, 1978
Strong Centralized Management Needed in Computer-Based Information Systems	LCD-78-105	May 22, 1978
Inadequacies in Data Processing Planning in the Department of the Interior	FGMSD-78-41	June 23, 1978
New Ways of Preparing Data for Computers Could Save Money and Time and Reduce Errors	FGMSD-78-39	July 18, 1978
Letter Report to Congressman Jack Brooks on the Bureau of the Census' management and use of ADP resources	FGMSD-79-5	Dec. 13, 1978
Letter Report to the Administrator of GSA on the review of the ADPE interim upgrade acquisition process	FGMSD-79-10	Dec. 28, 1978
Changing World of the Computer and Implications of ADP for the GAO	ADP Briefing	Feb. 13, 1979
Federal Productivity Suffers Because Word Processing Is Not Well Managed	FGMSD-79-17	Apr. 6, 1979
National Bureau of Standards Needs Better Management of Its Computer Resources to Improve Program Effectiveness	CED-79-39	Apr. 17, 1979
Letter report to the Secretary of Labor on Labor's comments on GAO's report concerning Labor's employment security automation project	HRD-79-71	Apr. 26, 1979
Letter report to Congressman Jack Brooks on plans to noncompetitively upgrade the VA Data Processing Center at Austin, Texas	FGMSD-79-27	May 23, 1979
Data Base Management Systems--Without Careful Planning There Can Be Problems	FGMSD-79-35	June 29, 1979
Better Information Management Policies Needed: A Study of Scientific and Technical Bibliographic Services	PSAD-79-62	Aug. 6, 1979

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Title	Report No.	Date
Implementation of Major Syst. Acquisition Process--A-109--Is Inconsistent Among Civil Agencies	PSAD-79-89	Aug. 14, 1979
Letter report to Congressman Jack Brooks on problems associated with developing large, complex data processing systems	FGMSD-79-49	Aug. 16, 1979
Letter report to Congressman Jack Brooks responding to comments from the Federal Judicial Center relating to their acquiring ADPE	B-193861	Aug. 24, 1979
Improvements Needed in the Tennessee Valley Authority's Management and Use of Its Automatic Data Processing Resources	EMD-79-81	Sept. 6, 1979
The FBI Operates Two Computerized Criminal History Information Systems	GGD-79-81	Sept. 7, 1979
Letter report to the Secretary of Health, Education, and Welfare on the need for SSA to continue long range planning	HRD-79-118	Sept. 20, 1979
Letter report to Senator Henry Bellmon on a review of Department of Health, Education, and Welfare guidelines for acquiring automatic data processing systems under the Social Security Act	HRD-79-126	Oct. 2, 1979
The Air Force Should Cancel Plans to Acquire Two Computer Systems At Most Bases	FGMSD-80-15	Oct. 26, 1979
Contracting for Computer Software Development--Serious Problems Require Management Attention to Avoid Wasting Additional Millions	FGMSD-80-4	Nov. 9, 1979
Tactical Operations System Development Program Should Not Continue as Planned	LCD-80-17	Nov. 20, 1979

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Title	Report No.	Date
The World-wide Military Command and Control System--Major Changes Needed in Its Automated Data Processing Management and Direction	LCD-80-22	Dec. 14, 1979
Letter report to Congressman Jack Brooks on the Air Force's unwarrented sole-source computer acquisitions	FGMSD-80-30	Jan. 24, 1980
Letter report to Congressman Jamie Whitten on the review of selected computer system procurements	FGMSD-80-34	Feb. 15, 1980
Stronger Management of EPA's Information Resources Is Critical To Meeting Program Needs	CED-80-18	Mar. 10, 1980
Wider Use Of Better Computer Software Technology Can Improve Management Control and Reduce Costs	FGMSD-80-38	Apr. 29, 1980
Conversion: A Costly, Disruptive Process That Must Be Considered When Buying Computers	FGMSD-80-35	June 3, 1980
VA Must Strengthen Management Of ADP Resources To Serve Veterans' Needs	FGMSD-80-60	July 16, 1980

APPENDIX III

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF MANAGEMENT AND BUDGET
WASHINGTON, D.C. 20503

SEP 24 19[illegible]

Mr. Donald L. Scantlebury
Director, Financial and General
Management Studies Division
General Accounting Office
441 G Street, NW
Washington, D.C. 20548

Dear Mr. Scantlebury:

I have read your draft report on computer obsolescence with great interest. As you know, we have also been looking into the causes and possible solutions related to the computer obsolescence problem in the Federal Government. Your draft report and numerous contacts with your staff have been very helpful to OMB in our attempt to better understand and recommend solutions for this complex issue.

Listed below are detailed observations concerning your draft report:

(1) Your definition of obsolescence on page 1 seems too limited. We feel that there are at least four definitions or concepts of obsolescence which must be considered including: functionally obsolescent, physically obsolescent, economically obsolescent and technologically obsolescent. Your study focused on economic obsolescence. We question whether it may not be possible that functional obsolescence represents an equally serious problem requiring different solutions.

(2) On pages 5-6, you indicate that your review only concerned medium and large-scale computers. We have evidence that obsolescence is also a potential problem area for small-scale computers in the Federal inventory.

(3) Your three major points on page 32 concerning the primary causes of computer obsolescence seem not to recognize some relevant possibilities including: the Federal Government's oldest computers partially reflect its initiative in being the first computer user, GSA emphasis on the reutilization of older computers, and lack of incentives for government ADP managers to replace obsolescent computers.

(4) Your concept of "immediate replacement" through GSA guidelines on pages 43-44 is not completely clear or specific. For example, unanswered questions include: (a) Is this a competitive or noncompetitive process? (b) Can existing GSA procurement regulations be followed? (c) What incentive exists for agencies to take advantage of this opportunity?

(5) Several places in the report you refer to the lack of OMB action and initiatives in eliminating obsolete computers. Specifically on page 34 you state, "these officials (OMB and GSA) could not explain why 15 years had elapsed since publication of the Circular (A-71) with no action having been taken." This is not an accurate reflection of our views.

There was no Federal Government computer obsolescence problem in 1965 and no perceived problem until well into the 1970's. This problem was gradual in developing and was not widely perceived as a problem until the 1978-1979 time frame in which the PRP report on ADP and the House Appropriations Committee comments were published.

During the late 1970's OMB has taken two major actions relevant to understanding and resolving this issue. First, OMB changed its ADP budget review from a hardware/technology orientation to an programmatic needs/economic orientation. Second, OMB has undertaken a study with agency assistance to attempt to evaluate this problem area.

In conclusion, although we do recommend some changes, we feel that your report will be a valuable catalyst in trying to solve the Federal Government computer obsolescence problem.

Sincerely,

Jim J. Tozzi
Assistant Director for
Regulatory and Information Policy

APPENDIX III

General
Services
Administration Washington, DC 20405

SEP 23 1980

Honorable Elmer B. Staats
Comptroller General of
the United States
General Accounting Office
Washington, DC 20548

Dear Mr. Staats:

This is in reference to your letter of August 20, 1980, regarding the draft report to the Congress entitled "Continued Use of Obsolescent Federal Computers Is Costly But Avoidable." The report presents some facts and figures concerning ADPE obsolescence which merit airing. However, we have six comments for your consideration in the final rewrite:

1. The report begins with a footnote on page 1 that defines "obsolescence." This definition is vague; moreover, the term "obsolescent" is used interchangeably in the report for "old." A more textbook-like and precise usage would not recognize age, per se, as an equivalent measure. Classically, obsolescence is one of three types: physical, functional, or economic. Using age as a proxy will not invariably lead to a proper conclusion, even in the field of rapid technological innovation.

2. The report repeatedly asserts that the present procurement practice is too complex and lengthy (see pages 32, 33, 36, 40, 46) and is a cause of obsolescence. We believe another GAO study team is looking at the very issue of procurement times, their cause and impact. The statements in this report are unsupported by data and should be reconciled with the observations of the other GAO study.

3. A principal finding, viz, that obsolescent computers should be replaced non-competitively (with systems of similar compute power) but all future procurements should be competitive, has a touch of illogic. If it's good to avoid conversion, training and other disruptive costs in the present, then the same may prove true in a future situation. We always operate in the present. In fact, that's what industry normally does (i.e., save the software) until the software fails. The long standing debate on competitive versus non-competitive procurement isn't amenable to simple resolution by the expedient of expounding one principle now and another later. We need a consistent policy of applying common sense in all situations.

APPENDIX III

In addition, the estimates of savings potential (approximately 15%) through replacement derived from four specific situations are too narrow a base from which to make general Government-wide conclusions.

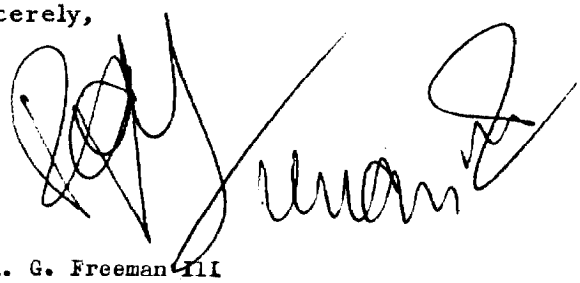
4. The sections which deal with the shortcomings of agency top management in managing acquisitions (pages 37-39) of course are well known. Curiously, it appears that some of these "bad practices" (e.g., sole source procurements, retention of lower level languages) appear to be the same as the short-term replacement strategy proposed in the report.

5. We cannot agree with the report's observation on page 41 that Federal Procurement Regulations encourage obsolescence. In fact, a user falling into the trap illustrated on this page does so by ignoring the procurement regulations, not by following them.

6. Finally, the report (pages 43 and 44) suggests GSA develop guidelines that would enable users to replace obsolete equipment. These guidelines are not necessary. There is no requirement today that agencies keep obsolete equipment. Each agency may choose today, for reasons of economy and efficiency, to replace equipment -- and do so without imposing arbitrary restrictions upon themselves as suggested by the report.

Overall, the report is a good discussion of the "hidden" costs of using older data processing systems. We agree that such costs should be included in agency planning and in equipment selections.

Sincerely,



R. G. Freeman III
Administrator

APPENDIX IV

LIST OF DEPARTMENTS, AGENCIES, AND OTHER ORGANIZATIONS CONTACTED DURING THE STUDY

Federal Agency Headquarters

Department of Defense
- Department of the Air Force
- Department of the Army
- Department of the Navy
- Office of the Secretary of Defense

Department of Energy
Federal Aviation Administration, Department of Transportation
General Services Administration
Internal Revenue Service, Department of the Treasury
National Bureau of Standards, Department of Commerce
Office of Management and Budget
Veterans Administration

Federal Computer Facilities

AMES Research Center, Moffett Field, Calif.
Army Military Personnel Center, Alexandria, Va.
Bonneville Power Administration, Portland, Oreg.
Brookhaven National Laboratory, Brookhaven, N.Y.
Command and General Staff College, Fort Leavenworth, Kans.
Corps of Engineers, Vicksburg, Miss.
Defense Logistics Center, Alexandria, Va.
Federal Aviation Administration, Jamaica, N.Y.
Federal Aviation Administration, Pomona, N.J.
Federal Aviation Administration, Ronkonkoma, N.Y.
General Services Regional Center, New York, N.Y.
General Services Administrative Operations, Washington, D.C. Region
Internal Revenue Service, Mid-Atlantic Region, Holtsville, N.Y.
Korant Institute, New York, N.Y.
National Bureau of Standards, Gaithersburg, Md.
National Oceanic and Atmospheric Administration, Princeton, N.J.
Naval Air Development Center, Warminster, Pa.
Naval Aviation Supply Office, Philadelphia, Pa.
Princeton Plasma Physics Laboratory, Princeton, N.J.
Stanford Linear Accelerator, Stanford, Calif.
Transportation Computer Center, Washington, D.C.
Veterans Administration, Austin, Tex.
Veterans Administration, Philadelphia, Pa.
U.S. Military Academy, West Point, N.Y.

Private Sector Organizations

Amdahl Corporation, Sunnyvale, Calif.
Association of Data Processing Service Organizations, Washington, D.C.
Burroughs Corporation, Washington, D.C.
Computer Business Equipment Manufacturers Association, Washington, D.C.
Control Data Corporation, Minneapolis, Minn.
Digital Equipment Corporation, Washington, D.C.
Honeywell Incorporated, Washington, D.C.
International Business Machines, Washington, D.C.
Sperry Univac, Washington, D.C.

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