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REPORT TO THE CONGRESS

UNITED STATES
GENERAL ACCOUNTING OFFICE

~~GAO~~

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Problems In Developing The Advanced Logistics System

Department of the Air Force

The Advanced Logistics System was intended to modernize the Department of the Air Force's logistics management activities through automation. GAO concluded that the Air Force has not exercised prudent management during the system's development. The Air Force continued to develop the system, despite strong evidence of technical problems that would preclude its successful completion.

In December 1975 the Congress instructed the Air Force to terminate the system--after 9 years of work and the expenditure of about \$250 million--and directed the Air Force to develop a new system after restudying its needs for logistical information and after the Secretary of Defense approved a plan to develop a new system using machine-independent software.

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

B-163074

C1 To the President of the Senate and the
Speaker of the House of Representatives

This report describes the major events that caused the development of the Department of the Air Force's Advanced Logistics System to be terminated after 9 years of work and the expenditure of \$250 million.

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

We are sending copies of this report today to the Director, Office of Management and Budget; the Secretary of Defense; the Secretary of the Air Force; and the Administrator of General Services.

A handwritten signature in black ink, appearing to read "Luther B. Stacks".

Comptroller General
of the United States

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ABBREVIATIONS

ALS	Advanced Logistics System
CCS	Central Control System
IBM	International Business Machines
GAO	General Accounting Office
RCA	Radio Corporation of America

D I G E S T

(In December 1975 the Senate and House Committees on Appropriations instructed the Department of the Air Force to terminate the design and development of its Advanced Logistics System. The termination of this effort was made after 9 years of work and the expenditure of about \$250 million because software, computer equipment, and system design problems prevented the Air Force from achieving the system's original design objectives.) (See pp. 4 and 14.)

(The Air Force's problems concerned computer systems acquired from the Control Data Corporation.) The Air Force accepted those systems as ready for use. But the computers could not be operated as planned because of deficiencies in the sophisticated operating software the Control Data Corporation developed and in the software the Air Force developed to connect the operating software with the applications programs. (See pp. 4, 8, and 9.)

(Remedial efforts by the Air Force and the Control Data Corporation were not successful, despite contract changes to enable the Control Data Corporation to correct its software deficiencies and the Air Force to make the computer systems compatible with requirements that had changed during the system's development.) (See pp. 6 to 10.)

(Many factors contributed to the Air Force's unsuccessful system design and development efforts. But the major factor was that the Air Force did not manage the system as a complex, high-risk program that stressed computer equipment capabilities and software technology. Although the Air Force was aware of potential technological programs, it did not exercise prudent management when system development problems emerged. The Air Force continued with the system, hoping that time and software and design changes would overcome the problems.) (See p. 4.)

The Air Force assessed the system shortly after GAO completed its fieldwork. That assessment confirmed many GAO findings, but the Air Force elected to continue with the system rather than to terminate it, as GAO had proposed to the Secretary of the Air Force. (See pp. 10, 12, and 13.)

The Secretary approved a plan in April 1975 to complete the system by July 1978. That plan would have cost the Government about \$563 million through the first half of fiscal year 1982. (See pp. 13 and 14.)

The Assistant Secretary of the Air Force (Financial Management) told GAO that the plan was the least costly of all alternatives considered, provided benefits, and satisfied user needs with acceptable mission-support risks. (GAO concluded that the alternative of terminating the system and developing a new automated logistical system tailored to today's computer technology, as necessary, to satisfy the Air Force's long-term logistical information needs was preferable.) (See pp. 16 and 17.)

In December 1975 the Senate and House Committees on Appropriations instructed the Air Force to terminate the system; to augment its existing logistical computers, if necessary; and to operate them until a new system could be designed, tested, and implemented. The Committees also instructed the Air Force to restudy its logistical information requirements before initiating any new design and to consider using in its new logistics systems transferable data management software. This, in essence, was GAO's proposal to the Secretary of the Air Force. (See p. 14.)

(GAO is making no recommendations since the Committees' terminating the program has eliminated the need for further programmatic decisions) However, GAO is issuing this report to illustrate the nature of the risks involved in pursuing large, high-technology, automated data processing programs and the pitfalls in acquiring new computers while attempting to develop software. (See p. 20.)

CHAPTER 1

INTRODUCTION

1 In 1966 the Department of the Air Force initiated a program to design and develop a computer-based information and data processing system called the Advanced Logistics System (ALS). This program was intended to modernize the Air Force Logistics Command's information and data processing systems. 2 These systems are used to manage inventories valued at over \$13.8 billion and to provide to all air commands--worldwide--the logistical and technical information needed to maintain their aircraft, missiles, and equipment at top efficiency.

NEED FOR ALS

A series of Air Force studies made in 1967 indicated that the command's information systems were no longer capable of supporting the Air Force's logistical mission. Each of the command's 376 individual information systems had been developed to accomplish a particular function such as procurement, supply, transportation, and maintenance. These systems are complex and interrelated, as illustrated by the fact that over 60 percent of them must directly exchange information with one or more systems. In addition, many systems must indirectly exchange information with nearly all other systems.

Most of the present information systems were designed to include their own data files, even though duplicative information existed in the files of other related systems. This "design-in" duplication was caused by one of the limiting characteristics of the computers used to process the information. In this instance sequential or batch processing precluded the economic sharing of a common file by multiple computers or systems. The excessive time required to process duplicative files created a workload which tended to saturate the computers. Other computer characteristics limited the command's ability to implement new management techniques.

Cost effectiveness studies indicated that the overall logistics system could be modernized by exploiting the latest management innovations and applying technological advances in computer equipment, software, and communications networks to the logistical support functions.

DESCRIPTION OF ALS

In 1967 the command established the Advanced Logistics System Center as the central design agency for planning, designing, developing, programing, and testing ALS. However, the command retained the overall management responsibility for the program. The Center completed the master plan for developing ALS in March 1968. In September 1970 the Air Force estimated that ALS would cost about \$821 million to develop, implement, and operate through fiscal year 1979.

The plan was to design and develop an information system that would be capable of providing logistical managers at all levels with ready access to all available data from a common data base. Such access was to be provided through a complex network of computers, communication networks, and remote terminals whereby specific data could be introduced or displayed in a matter of seconds, minutes, or hours, depending on the urgency of need. The ability to selectively recall data was intended to provide up-to-date information for more prompt and accurate decisions or responses to users. Thus, the new system was expected to

- provide more responsive logistics support to operational units by enabling managers to make prompt and accurate decisions,
- attain a more economical allocation and utilization of Air Force resources for which the logistics command is responsible by enabling managers to respond more rapidly to customer requests for material, and
- achieve improved internal logistics command operations and management through more timely and comprehensive access to and use of logistical information.

PROGRESS AND PRESENT STATUS OF ALS

Since the completion of the master plan for developing ALS in March 1968, the Air Force has spent considerable effort to design, develop, and implement the new system. This work continued until September 1974, when it was generally suspended because of faulty software and computer equipment. We reported those problems to the House Committee on Appropriations by letter dated July 12, 1974 (B-163074).

The Air Force Logistics Command subsequently established a task group to assess the entire ALS program and to make recommendations for improving it. The assessment was completed

in January 1975. The task group proposed several alternatives, one of which was to terminate the ALS program. However, the command did not consider the termination to be a viable alternative and instead recommended to the Secretary of the Air Force that the program be continued on an evolutionary basis. The estimated cost of the "Get Well Plan" was \$563 million through the first half of fiscal year 1982. On April 3, 1975, the Secretary of the Air Force approved the continued development of ALS, as recommended by the command. "

C₂ = R
C₃
On December 10, 1975, the Senate and House Committees on Appropriations instructed the Air Force to terminate the ALS program and to design and develop a new automated logistics system based on the latest computer technology to satisfy its long-term logistical information needs.

R Our work, which was initiated in response to a request from the House Committee on Appropriations, showed that no single factor, but a combination of factors, led the Air Force to the point where the ALS program could no longer be developed successfully.

CHAPTER 2

PROBLEMS IN DEVELOPING ALS

ALS was canceled in December 1975 after the Air Force had spent about \$250 million to design and develop it over a 9-year period. The system was canceled because computer equipment and software problems prevented the Air Force from completing ALS as initially planned, and a new plan to redesign the system was not acceptable to the Senate and House Committees on Appropriations.

The problems began to surface shortly after the computer system contract was awarded to the Control Data Corporation on April 6, 1972. They concerned the CYBER 70 computers acquired from Control Data and sophisticated software developed by Control Data and the Air Force. Control Data was responsible for providing system software needed to operate the CYBER 70s while the Air Force was responsible for providing a Central Control System (CCS) to serve as the link between the operating system and Air Force application programs.

Control Data and the Air Force tried to resolve the problems. But remedial efforts were not successful despite contract changes that were intended to enable Control Data to correct its software deficiencies and the Air Force to make the computer systems compatible with its requirements.

Numerous factors contributed to the Air Force's unsuccessful efforts to design and develop ALS. These included unclear definitions of requirements, the inability of Control Data to deliver operable computers and software, incomplete testing, concurrent development of operating and application software, the use of CCS and the unified data base concepts that were new and unproven, system design changes, and others. But the major factor, in our opinion, was that the Air Force did not manage ALS as a complex, high-risk program that stressed computer equipment design and software technology. Although it was aware of potential technological problems, the Air Force did not exercise prudent management when the computer system problems and its system design problems emerged. The Air Force continued with ALS hoping that time and software and design changes would overcome those problems.

FULLY DEVELOPED SOFTWARE WAS NOT DELIVERED TO THE AIR FORCE

Control Data was awarded the computer system contract on the basis of its proposal stating it could provide the

needed equipment and software from its regular line of commercial products. The contract required Control Data to deliver the first CYBER 70 computer system, including the operating software system called ZODIAC, to Wright-Patterson Air Force Base. The delivery was to be made by October 6, 1972, or 45 days after the successful completion of preinstallation testing at the contractor's plant in Sunnyvale, California--whichever was later. ZODIAC and the computer and communication equipment were to be delivered fully developed and ready for use.

Control Data delivered the CYBER 70 on time and the Air Force began computer system acceptance testing. During that testing the Air Force found that the system was not operable primarily because of deficiencies in the ZODIAC system. ZODIAC was chronically deficient during preinstallation testing, and many of the deficiencies were not corrected at the time of delivery. The Air Force should not have accepted the delivery of the system until the corrections were made.

Preinstallation testing was not completed

Preinstallation testing was intended to insure that the CYBER 70 computer system, including related communication equipment, and the ZODIAC system functioned effectively with the Air Force's CCS and selected application programs. The Air Force's decision to accept delivery of the CYBER 70 computer system and to proceed with acceptance testing at Wright-Patterson was to be made on the basis of the preinstallation testing results. The installation of the systems for each of the other ALS complexes was to follow on an incremental basis after the Air Force accepted the first system.

Preinstallation testing, which began in May 1972 and continued until shortly after the first CYBER 70 system was installed at Wright-Patterson and readied for acceptance testing in October 1972, was not successfully completed. The testing showed that the CYBER 70 computer system had a high failure rate and that the ZODIAC system contained significant problems that emerged as testing progressed. The Air Force, during the preinstallation testing, had identified 228 problems as of October 1972. When the computer system was delivered and acceptance testing began at Wright-Patterson, 72 problems were outstanding, of which 44 seriously affected the development of ALS and precluded the successful completion of preinstallation testing.

Although the Air Force had the contractual option to delay the delivery of the first computer system until the

software problems were satisfactorily resolved, the Air Force permitted Control Data to deliver the CYBER 70 to Wright-Patterson and to certify that it was ready for computer system acceptance testing on October 6, 1972. According to the Air Force, the decision to accept delivery and proceed with acceptance testing was based on the belief that sufficient progress had been made at the Sunnyvale test facility and that sufficient manpower and expertise were available within Control Data to reasonably assure that acceptance testing could be satisfactorily completed.

ZODIAC problems aborted computer system acceptance testing

Computer system acceptance testing was contractually established as the basis for the Air Force to accept the CYBER 70 computer system at each site. The contract required Control Data to demonstrate during the tests that the CYBER 70 system could operate in conformance with the technical specifications as quoted in Control Data's proposal. The system had to maintain an effectiveness level of 90 percent for 30 consecutive days within a 120-day test period before the Air Force would accept the system. If the system failed to meet the standard of performance after 120 calendar days, the Air Force had the option to request a replacement system or to terminate the contract.

Computer system acceptance testing began at Wright-Patterson Air Force Base on October 6, 1972. That testing, like preinstallation testing, also was not successfully completed primarily because of problems with the ZODIAC system. According to Air Force documentation, a principal shortcoming was with the ZODIAC data management system which could not access the data bank or create large size records. In addition, there were interface problems between the CYBER 70 and the communications system which prevented communications with the remote stations.

The ZODIAC problems continued unabated until November 15, 1972. On that date the Air Force advised Control Data that the Government was considering terminating the contract because of contractor nonperformance. The Air Force cited the following deficiencies as the reason for its action.

- The contractor was not able to successfully perform the benchmark test.
- The cumulative computer performance averaged only 23.04 percent during the last 30 days of operation.

--The Government could not conduct any meaningful testing of its software and application programs due to deficiencies in both the computers and related software.

The notification resulted in the formal termination of computer system acceptance testing on January 25, 1973, and the renegotiation of the contract with Control Data during January and February 1973.

In our opinion it was inappropriate for the Air Force to accept delivery of the first computer system and to initiate testing before its capabilities were proven. The sophistication of ALS required equipment and software whose availability was questionable at the time the request for proposal was being prepared. At that time, the Air Force was cautioned by potential vendors that there was a serious question on the availability of adequate software and that it might be beyond the state of the art. Also, a consultant said that critical software was not generally available. Further, the decision was contrary to the Air Force's stated ALS management philosophy of proceeding from success that required one development phase to be successfully completed before proceeding to the next phase.

ALS PROGRAM REDIRECTED

The termination of testing in January 1973 provided the Air Force with an opportunity to review other problems being encountered with ALS. These included problems with the unified data base which could not be adequately loaded and efficiently accessed, inadequate restart-recovery capability needed to restore computer operations after failures, and the need to redesign and reprogram CCS to reduce system overhead and to improve efficiency. In addition, the Air Force had indications that a large portion of the data processing workload was oriented more to batch processing than to transaction processing, as initially intended. This problem was most significant because the ZODIAC system and CCS were designed primarily for transaction processing and had little batch-processing capability. It appears that the origins of this problem were deficiencies in the original Air Force specifications, but this did not become apparent until later in the program. This problem indicated that the CYBER 70 computer system was not compatible with the Air Force Logistics Command's data processing requirements.

Problems with the CYBER 70 and ZODIAC systems strongly indicated that ALS could not be completed as planned. Nevertheless, the Air Force elected to proceed with ALS, hoping that the problems could be eventually resolved. Accordingly,

it initiated studies to identify solutions to the ZODIAC and Air Force software problems, including those related to CCS, computer throughput, and restart-recovery capabilities. It also changed its incremental plan in which increment I represented about 60 percent of the ALS processes and was to be followed by two additional increments.

In the new approach the Air Force divided increment I into 10 phases and sized and scheduled each phase for implementation over a 13-month period ending November 1974. This required new planning; system design changes, including the extensive redesign of completed application programs; and the building of software to accommodate or link phases and/or current data systems.

Also, as part of this new approach the Air Force determined that 83 of the 107 data systems included in increment I could not be adequately handled by the ZODIAC system. It merged, eliminated, and replaced 26 of those systems and deferred the implementation of the remaining 57 until ZODIAC could adequately handle batch-processing workloads. This required further development of the ZODIAC system beyond that needed to correct those deficiencies identified during computer system acceptance testing. The feasibility and practicality of designing a batch-processing capability into the ZODIAC system was an unknown quantity at that time and represented a major risk to completing ALS. In the meantime the Air Force planned to process the batch workloads at Wright-Patterson using a third CYBER 70 computer system and software other than ZODIAC.

With the changes to the ALS program, the Air Force abandoned its approach to developing ALS on the basis of supposedly proven equipment and software. It began to develop ALS on the basis of three major assumptions: that Control Data could make the CYBER 70 computer system operational in due time, that the ZODIAC system could be redesigned to handle batch processing and to provide an adequate restart-recovery capability, and that computer throughput could be sufficiently increased. Under these conditions the Air Force proceeded to renegotiate its contract with Control Data.

Renegotiation of the ALS contract

The Air Force had an option to terminate the contract with Control Data on the basis of contractor nonperformance during computer system acceptance testing. However, it elected to retain the CYBER 70 computer system and work with Control Data in correcting the system's major operational deficiencies. Accordingly, the Air Force negotiated contract

modifications to give Control Data more time to solve the ZODIAC system problems and a second opportunity to pass computer system acceptance testing at Wright-Patterson Air Force Base. The testing was rescheduled for July 1, 1973.

The Air Force, in return for continuing the contract, received additional software and features including two software packages called "Multiple Data Base" and "SCOPE." The Multiple Data Base software was intended to solve the Air Force's problems with the unified data base which, according to Control Data, was extremely inefficient with only a 5-percent density. The Multiple Data Base was to resolve some of those inefficiencies by providing for the separation of the unified data base into independent but related data bases. The SCOPE software was provided to the Air Force on a trial basis for use at Wright-Patterson to test SCOPE's batch-processing capabilities.

The renegotiated contract did not include the needed restart-recovery capability and did not provide for sufficient batch-processing capability in the redesign of the ZODIAC system. These were to be contracted for at Government expense after the Air Force and Control Data completed a study of the additional software requirements. Consequently, the renegotiated contract was not sufficient to make the CYBER 70 computer system operational but it committed the Government to making it operational through future software development programs.

The Air Force accepted the CYBER 70 to proceed with its remedial work and the development of ALS. This was accomplished through the second computer system acceptance testing that was completed on July 30, 1973, within the minimum allowable time. The CYBER 70 equipment demonstrated during the test an equipment effectiveness level that exceeded the minimum performance standard of 90 percent required by the contract.

The Air Force, on the basis of the test, accepted the CYBER 70 computer system as ready for use at Wright-Patterson and committed the Government to monthly lease payments effective July 1, 1973. Subsequently, computer systems were installed and accepted at the other ALS sites. This occurred even though in February 1971 we endorsed a recommendation by the Air Force Scientific Advisory Board Information Processing Panel that no additional computer systems be acquired by the Air Force until the prototype system was completely tested and evaluated under operational loads. That endorsement was contained in an earlier report to the Chairman, House Committee on Appropriations, entitled "Potential Problems in Developing the Air Force's Advanced Logistics System," (B-163074, February 4, 1971).

The Air Force began to implement the first increment of ALS at Wright-Patterson in October 1973. Concurrent with this implementation, it initiated a software study to identify those capabilities and features needed to make the CYBER 70 operate in a production environment. The study was completed in April 1974. It identified numerous deficiencies and shortcomings, many of which were attributable to system design changes made by the Air Force to accommodate the batch-processing requirements.

The Air Force, as a result of its study, planned an extensive software development program to make the CYBER 70 computer system operational. The program was to be directed toward developing, on an incremental basis over a period of about 2 years, a single software operating system with capabilities and features needed to operate the CYBER 70 in a real-time and batch-processing mode within a production environment. The new software was to be developed primarily by Control Data at Government expense and was scheduled for completion in December 1976. It was to replace ZODIAC and SCOPE--the interim software acquired by the Air Force for batch processing.

The Air Force awarded a number of contracts to Control Data to develop the needed software. However, in the meantime, the development, test, and implementation of many phases of increment I were delayed, and the operation of those implemented was impeded because the Air Force continued to encounter computer system problems.

AIR FORCE ASSESSMENT OF ALS PROBLEMS

In September 1974 the Air Force suspended further development of ALS because of those problems. The Air Force Logistics Command formed a 126-man task group to make a comprehensive assessment of the ALS program. The task group reviewed every major area of the ALS program including computer equipment, software, management, and contracting. It completed its work in November 1974 and reported its findings to Headquarters, Air Force Logistics Command, and subsequently to Headquarters, U.S. Air Force. Some of the findings reported in the "Advanced Logistics System Assessment" are quoted below.

Computer equipment

"(1) Hardware Problems. Although the CYBER central processing unit (computer) has speed and versatility, the reliability of the equipment has been disappointing. Failures of key components such as extended core storage bays, remote devices, and some communications interface computers have hampered operations.***"

"g. The CDC hardware system does not provide acceptable levels of protection to data being used and processed. The more common data protection features are not designed into the CYBER hardware, nor is there any known method to include checking devices in the current CYBER equipment.***"

"(6) The technology of the CYBER computers is approximately 10 to 12 years old and as such does not contain many of the advanced engineering features developed to improve reliability and to maintain large data bases and terminal operations."

Software

"(1) A large, totally transaction oriented system requirement, as originally envisioned by the ALS, is beyond the software state-of-the-art. Personnel skills are not available in sufficient numbers in AFLC to undertake such a development successfully."

"(2) Software Problems. The software, like the hardware, was to have been an off-the-shelf commercially available system. Actually, the ZODIAC software was essentially undeveloped.***"

"(5) The ZODIAC software and the AFLC Central Control System's data integrity and error detection and analysis features are inadequate to maintain processing reliability."

"d. The current ALS on-line operating software (ZODIAC) is an immature operating system and will not support AFLC logistics in a production environment now or in the near future.***"

"e. The on-line and batch processing workloads require the use of separate on-line and batch processing operating software systems if CDC equipment is used. The ALS design, pursued in 1972-1974 for the ALS Increment 1 workload, was based on using a single operating system (ZODIAC). The Increment 1 batch processing requirements was so large that existing ADPE had to be retained, in addition to the CYBER 70 ZODIAC configured system, to provide batch processing capability."

Other problems

"(5) Other Problems. There have also been problems with the Unified Data Bank. In the original ALS design,

the United Data Bank concept was to reduce data duplication and inconsistencies. Each application AFLC has tried to implement has been adversely affected by the data base structure. Redesign has been necessary in all cases, and the problem has not been solved for any phase. As it turned out, concurrent development of the ZODIAC software and the Air Force Central Control System (CCS) resulted in duplication of some functions.***"

ALTERNATIVE SELECTED FOR CONTINUING ALS

The Air Force Logistics Command concluded, on the basis of its assessment, that the development of ALS should continue solely on an evolutionary and incremental basis because of its unprecedented size and complexity. This decision reaffirmed the Air Force's ALS objective of improving customer support. The command also recognized the need to redesign its major data systems and the need to replace obsolete computers so that new management techniques and related productivity improvements, which are critically dependent on modern software and third generation computers, could be exploited and achieved.

The command elected to continue with ALS after considering the following five alternatives that were evaluated by the assessment task group.

I. Continue with ZODIAC and use SCOPE for post-increment I ALS requirements.

II. Use SCOPE as the ALS backbone and develop ZODIAC for future online requirements. Also retain current online capability and augment as necessary until ZODIAC proves successful.

III. Use SCOPE as the ALS backbone. Retain, augment, and upgrade current online capability as necessary.

IV. Discontinue use of all Control Data equipment. Augment and replace current computers as necessary, and initiate specified procurement for International Business Machines (IBM) 370s.

V. Discontinue use of all Control Data equipment. Retain and augment current computers as necessary and initiate a new procurement.

The command selected alternative III as the most desirable for completing ALS although the task group indicated that it was not the most desirable from a technical viewpoint, as shown below.

<u>Alternative</u>	<u>Critical criteria</u>			<u>Technical criteria</u>	
	<u>Earliest date benefits can be achieved</u>	<u>Total cost</u> (millions)	<u>Man-years</u>	<u>Hardware</u>	<u>Software</u>
I	FY 79	\$366	15,000	a/red	red
IIA(note b)	FY 79	396	14,700	red	c/yellow
IIB(note b)	FY 79	364	13,300	yellow	d/blue
III	FY 78	357	13,200	yellow	blue
IV	FY 79	357	12,500	e/green	blue
V	FY 80	381	14,000	green	green

a/ Unsatisfactory.

b/ The difference between IIA & B is that under IIA, ZODIAC is successful and all Control Data equipment is retained. Under IIB, ZODIAC is not successful and all ZODIAC-related equipment is returned.

c/ Marginal.

d/ Satisfactory.

e/ Excellent.

ALS GET WELL PLAN

The command developed a plan to complete ALS as two separate systems--one for batch processing and one for online processing--by July 1978. It stressed improved management control, including a System Program Office; disciplined standards to effectively document ALS development; continuous reviews to insure validity of design, adequacy of documentation, and assurances that the system will accomplish its intended function; and simulation and workload measurements to achieve efficient transition of the workload to the ALS computers. The estimated cost of the plan was \$563 million through the first half of fiscal year 1982.

The plan required the Air Force to renegotiate its contract with Control Data to reconfigure the CYBER 70 computer system and to extend the Government's purchase option. The modifications became effective on March 15, 1975.

The modified contract extended the Government's purchase option from April 15, 1975, to June 30, 1976, and preserved the Special Purchase Conversion Incentive Price. This price is based upon a 25-percent discount of the equipments' list prices, credits for all net rentals paid since July 1, 1973, and an additional purchase discount of \$13 million, provided that all computer systems are purchased. The Government paid Control Data \$8 million as a specific charge for extending the option to purchase.

The plan was approved on April 3, 1975, by the Secretary of the Air Force. Shortly afterwards Air Force officials discussed the plan and the ALS assessment with the staff of the House Committee on Appropriations. The discussion was related to the Air Force's request for funding to continue with ALS during fiscal year 1976. On the basis of that discussion and supplemental information provided by the Air Force and our Office, the Committee concluded that ALS should be discontinued and a thorough review of Air Force logistics requirements be made before any new system is installed.

The decision to terminate ALS was upheld by the Committee of Conference on December 10, 1975. The Committee, at that time, also directed the Air Force to:

- Develop a comprehensive plan for automated data processing support to be approved by the Secretary of Defense.
- Operate existing computers until a new system can be designed, tested, and implemented.
- Augment existing computers, if necessary.
- Restudy its logistical information requirements before initiating any new design. Specifically, the Air Force must determine the data elements and management information required to provide improved logistical support for its mission responsibilities and use this information as the basis for the new design.
- Use machine-transferable data management programs in any new logistical system it develops.

CHAPTER 3

CONCLUSIONS, AGENCY AND CONTRACTOR

COMMENTS, AND OUR EVALUATIONS

The ALS program demonstrates the need for system proponents to exert intensive management and control over the development of large, complex, automated data processing systems and particularly those that stress computer equipment capabilities and software technology. Management needs to recognize that the various phases of system development, such as identifying requirements, planning, system specifications, testing equipment and software, detailed system design, and programing are interrelated and dependent on each other. Management needs to make sure that each phase is successfully completed before the development proceeds to the next phase and that changes are controlled and evaluated before they are made so that their impact on the various phases will be understood and provided for by the development team. Management must also make sure that the prototyping of the system is successfully completed before additional computers are acquired and installed at the operating sites.

The Air Force did not use this management approach when the ALS development problems began to emerge. This is illustrated by the Air Force Logistic Command's decisions to proceed with computer system acceptance testing rather than wait until preinstallation testing was successfully completed; to accept the CYBER 70 computer system, knowing that the system was deficient rather than delay acceptance until the system was operable or acquire a new system; and to install CYBER 70 computer systems in all Air Force Logistics Centers rather than wait until prototyping was successfully completed.

We believe that the Air Force lost control over the ALS program because it did not exert intensive management control over its development. Because of this it lost early opportunities to terminate the program or to redirect it on the basis of new system specifications, computers, and software. It also spent substantial resources to overcome the system development problems as they continued to emerge. The remedial efforts subsequently caused the system design and the requirements to be degraded to the point where it was no longer possible for the Air Force to complete ALS as planned.

Because we concluded that the development of ALS should not continue, we proposed to the Secretary of the Air Force, in a draft of this report submitted to the Air Force in April 1975, that he terminate the ALS program and allow the computer system contract with Control Data to expire on June 30, 1975, by not exercising the Government's annual option to extend the term of the contract. We further proposed that the Secretary require the logistics command to reassess the specific objectives established for ALS to either reaffirm their validity or establish new objectives tailored to today's computer technology and logistical environment. The reassessment was to include a restudy of the information and data processing requirements of the command's functional users to assure that they have been adequately identified. The purpose of the assessment was to establish a foundation for determining the type and characteristics of the automated system that would meet the needs of the Air Force's logistical operations and for planning the development of that system.

Also, as an interim measure, we proposed that the Secretary direct the logistics command to continue operating its present logistical data systems until a new automated system could be designed and developed. We suggested that if additional computer capacity was needed for that operation, the present computer systems should be supplemented as necessary.

AGENCY COMMENTS AND OUR EVALUATION

By letter dated July 30, 1975 (see app. I), the Assistant Secretary of the Air Force (Financial Management), on behalf of the Secretary of Defense, commented on our findings and proposals. He stated that our report was a reasonable treatment of the facts and that there were many more similarities than differences in the GAO and Air Force assessments of the ALS program.

However, the Assistant Secretary did not agree with our conclusions and recommendations. He stated that the Air Force, during its assessment of ALS, considered an alternative similar to our recommendation--i.e., expiration of the Control Data contract; some augmentation of current systems; and design and development of a new automated system culminating in a competitive procurement. He did not select the alternative because it would have been too costly; would have postponed realization of logistics benefits; and would have required the logistics command to rely on obsolete equipment for an extended period, causing a risk of mission support failure. He said that instead, the Air Force elected to continue developing ALS using the Control Data

hardware under the control of SCOPE as the principal computer resource and to retain, augment, and/or upgrade current online capability as necessary because that approach would achieve logistics benefits sooner at the least cost, and at an acceptable level of risk.

We agree with the Secretary that the cost to terminate the ALS program and to design and develop a new automated system with advanced computer technology would be greater than the cost to complete ALS. However, the additional cost, which the Air Force estimated to be \$24 million, could have provided the logistics command with the advanced computer system needed for the long term. In comparison the ALS alternative chosen would provide the command with obsolete data processing capability that would need to be subsequently upgraded at an additional cost to satisfy the command's long term needs. We believe that by continuing the development of ALS, the Air Force would merely delay incurring the cost of a new advanced automated system. We believe that it is preferable for the Air Force to start on that system now rather than to spend more funds on ALS.

We also agree with the Assistant Secretary that some logistics benefits may be delayed by the Air Force's developing a new data processing system. But his reasoning does not take into account the long term data processing needs of the logistics command and those benefits that can be achieved by providing the command with computer technology necessary to meet those needs. The opportunity to take advantage of such technology should compel the Air Force to develop a new system.

We believe the potential for mission support failure is minimal, even if the logistics command is required to rely on its obsolete computers for an extended period of time. According to the Air Force, the IBM 7080/1401 computer systems, which the command would retain, have exceeded their expected life. However, there are no definitive signs of imminent failure and there is a good stockpile of replacement parts and components to keep them operating.

Also, those computers have some excess capacity that can be increased by eliminating ALS interfaces and testing requirements and by concentrating on improving operating efficiency. The Air Force plans to use that capacity to absorb workloads of the command's obsolete Radio Corporation of America (RCA) 301 computers, which reportedly are experiencing some support problems, and for new data processing requirements as they are approved. In this event the IBM 7080/1401 computers may not have spare capacity to handle the workload if any of the computers failed. This condition

could cause mission support problems. But the Air Force has options of retaining the RCA 301 computers, augmenting the IBM 7080/1401 computers, and upgrading its IBM 360/40 computers to provide that cushion. Consequently, appropriate precautions can minimize the chances of mission support failure.

CONTRACTOR COMMENTS AND OUR EVALUATION

The President of Control Data Systems and Services Company, by letter dated September 10, 1975 (see app. II), also commented on our findings for contract performance. He stated that our report does not reflect an objective analysis of the ALS program in that it does not recognize the limits of the contractual responsibilities of Control Data, it fails to properly assign responsibility to the Air Force for the failure of CCS, and it does not consider the Air Force's changed requirements and the redirection of the program as a result of extensive Air Force program assessments.

Specifically, he expressed concern that our report said the problems encountered by the Air Force in implementing the ALS program were primarily the result of deficiencies on the part of Control Data, whereas the official correspondence for contractual performance shows that Control Data has delivered both the hardware and software contracted for in accordance with the contract specifications. He stated that Control Data's efforts were made under trying circumstances due to changing Air Force requirements for a system that was procured under an inappropriate procurement method using deficient specifications. He further stated that those deficiencies, coupled with the problems encountered by the Air Force in designing and implementing the CCS were major factors in the Air Force's decision to redirect efforts from the Control Data ZODIAC-based, transaction-oriented processing system to the Control Data SCOPE-based, batch-oriented operating system.

In retrospect we believe the failure of ALS can be attributed to highly interrelated factors, including being beyond the state of the art, the uniqueness of CCS and its concurrent development with ZODIAC, and other factors mentioned in Control Data's letter. But Control Data contracted with the Air Force within that environment and agreed to deliver the computer equipment and sophisticated software needed to make ALS a transaction-oriented system. The history of ALS shows that Control Data did not deliver the sophisticated software required, that its remedial efforts to correct the ZODIAC deficiencies were not successful

despite numerous contractual modifications which reduced the sophistication of ALS, and that the Air Force ultimately rejected ZODIAC as immature and unable to satisfy the data processing requirements of the logistics command. Accordingly, Control Data must share with the Air Force the responsibility for the failure of ALS, although its substantial efforts were made in good faith; under trying conditions; and within a changing environment.

As of March 15, 1975, the Government waived and released all claims that it had or could have had against Control Data arising out of asserted deficient performance. In turn, Control Data released the Government of all claims for equitable adjustments arising from the performance of the contract as extended. In effect the Air Force and Control Data mutually acknowledged their responsibility for the ALS failure and absolved each other of that responsibility.

The President of Control Data Systems and Services Company also stated that we did not adequately address the responsibility for the software operating system. He said that a crucial element of software essential to successful operation of the system was the Air Force's CCS, which was to provide functions normally performed by an operating system executive monitor and was the interface between ZODIAC and the Air Force-developed application programs. He expressed concern that our preliminary report did not address problems encountered by the Air Force in designing and coding CCS to meet the original system design concepts and stated that it was the complex interaction of the batch-oriented application programs, CCS and ZODIAC, and the programming techniques used by the Air Force that failed to take advantage of the system's transaction capabilities that resulted in unforeseen problems--not the Control Data-supplied ZODIAC operation system alone, as indicated in the report.

We recognize the merit of Control Data's argument and have modified our report to indicate that the Air Force and Control Data were mutually responsible for developing the required sophisticated software. However, many of the ZODIAC problems encountered by Control Data during preinstallation testing and the first computer system acceptance testing were attributable to the underdevelopment of ZODIAC and were not directly related to the interfacing with CCS. Those early problems and the Air Force's need to redesign and reprogram major segments of CCS to accommodate Control Data's ZODIAC and computer equipment triggered and compounded the subsequent ALS problems. Had Control Data delivered the operating system and computers as required, ALS problems might have been minimized and isolated to the Air Force's CCS and applications programs.

The President of Control Data Systems and Services Company also noted that our report did not consider the studies undertaken by the Air Force to completely assess ALS program progress or to reexamine the Air Force's goals toward implementing an automated logistics system. He said that, as a result of the assessment, the Air Force and Control Data were rigorously pursuing a revised program implementation plan with confidence that Air Force requirements as presently envisioned could be met by close attention to program objectives and implementation schedules.

Our report has been updated to include the Air Force's assessment of the ALS program. That assessment fortified our conviction that the ALS program should have been terminated rather than continued as planned. We believe that the two-system approach--one system for batch processing and one for online processing--to completing ALS was contrary to the stated needs of the Air Force Logistics Command. Consequently, we do not agree with Control Data that the Air Force's requirements could have been met by continuing with ALS.

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This report contains no recommendations since actions taken by the Senate and House Committees on Appropriations terminating the program have eliminated the need for further programmatic decisions.

However, the report is being released to illustrate the nature of the risks involved in pursuing large, highly technical, automated data processing programs such as ALS. The report illustrates the more common pitfalls associated with acquiring new computers while attempting to develop operating and application software; the failure to recognize the interrelationships between the various system development phases; and the need for early and continuous management reassessments of the program's conformance to system development criteria, to established objectives, and to the probabilities of success.

CHAPTER 4

SCOPE OF REVIEW

Our review was made at the Air Force Logistics Command, Headquarters, Wright-Patterson Air Force Base, Ohio; San Antonio Air Logistics Center, Texas; Directorate, Data Automation, Department of the Air Force, Washington, D.C.; and Control Data Corporation, Sunnyvale, California.

We reviewed the ALS feasibility documentation and requirements, planning and programming documents, cost-benefit study that justified ALS, the request for proposal documentation, computer equipment contract and modifications, ALS progress reports, ALS assessment reports, and the Air Force's ALS Get Well Plan. At Wright-Patterson Air Force Base we analyzed computer system test reports and investigated various software deficiencies. We analyzed the development of various phases of ALS to ascertain the degree of progress, conformity with the ALS concept, and the impact the software deficiencies were having on their development. We also observed the operation and testing of the CYBER 70 computer system, including live test demonstrations conducted at Sunnyvale.

We interviewed and discussed the development of ALS, its objectives, cost, and benefits with management and design personnel at all locations. We used the services of a consultant to evaluate the ALS functional design and the expected logistical improvements.

DEPARTMENT OF THE AIR FORCE
WASHINGTON 20330



OFFICE OF THE ASSISTANT SECRETARY

30 JUL 1975

Mr. Fred J. Shafer
Director, Logistics and Communications
Division
U.S. General Accounting Office
441 G Street, N.W.
Washington, D.C. 20598

Dear Mr. Shafer:

The Secretary of Defense has asked me to reply to your report of April 1975, "Should the Air Force Continue to Develop Its Advanced Logistics System (OSD Case #4071)."

The Air Force has completed a penetrating and exhaustive assessment of the ALS project, its problems and its objectives. The foundation of this assessment was a comprehensive analysis produced by a task group of 126 full-time, highly qualified people from the Air Force, industry, and the academic community. Based on this analysis and the subsequent Air Force assessment of ALS, some 50 development alternatives were considered and ultimately narrowed to five, including one similar to the approach recommended in your report, i.e., expiration of the Control Data Corporation contract, some augmentation of current systems, and design and development of a new automated system culminating in a competitive procurement. After thorough consideration, this alternative was not selected because it would have been too costly and would have postponed realization of logistics benefits. In addition, the Air Force Logistics Command (AFLC) would have been forced to rely on obsolete equipment for an extended period causing mission support failure risk to be the highest of any alternative considered.

On 3 April 1975, the Secretary of the Air Force approved implementation of the AFLC Commander's recommended alternative. This calls for continued development of ALS using CDC hardware under the control of the SCOPE Operating System as the principal computer resource and to retain/augment/upgrade current on-line capability as necessary. The Air Force selected this approach over the other alternatives considered because it will achieve logistics benefits sooner, at the least cost, and at an acceptable level of risk.

We have attached specific comments that address the draft GAO report's primary conclusions and recommendations. They cover: The Air Force assessment conclusions; specific rationale for, and description of, the development approach chosen; cost benefits; contractual considerations; and logistics requirements. Editorial suggestions and additional clarifications for your consideration in finalizing the draft report are also attached. In addition, copies of the complete AFLC ALS Assessment Report, dated 31 January 1975, which includes the cost benefit analysis and milestone schedule for the approach selected by the Air Force, have been provided to the GAO staff as well as to the House and Senate Appropriations Committees.

We appreciate the considerable efforts of your staff in developing this draft report, which is a reasonable treatment of the facts. Although our final conclusions do not agree, we note that there are many more similarities than differences in the GAO and Air Force assessments of the ALS program.

Please be assured that we in the Air Force will continue to work to ensure that we obtain all of the logistics benefits originally envisioned for ALS.

Sincerely,



WILLIAM W. WOODRUFF
Assistant Secretary of the Air Force
(Financial Management)

2 Attachments

1. GAO Conclusions and Recommendations/
Air Force Comments
2. Editorial Suggestions and
Clarifying Comments

CORPORATE HEADQUARTERS
8100 34TH AVENUE SOUTH, MINNEAPOLIS, MINNESOTA
MAILING ADDRESS • BOX 0, MINNEAPOLIS, MINNESOTA 55440

CONTROL DATA

September 10, 1975

Mr. Fred J. Shafer, Director
United States General Accounting Office
Washington, D. C. 20548

Dear Mr. Shafer:

We have reviewed the draft GAO report, "Should the Air Force Continue to Develop its 'Advanced Logistics System'". This letter provides you with our comments concerning Chapters I and II, Pages 6 through 22 which you provided for comment by your letter of May 28, 1975.

Of major concern is the perhaps inadvertent theme throughout the report that the problems encountered by the Air Force in the implementation of the ALS program were primarily the result of deficiencies on the part of Control Data. Control Data has committed very significant corporate resources to provide the necessary hardware and software and has gone to great lengths to assist the Air Force in its endeavor to successfully implement the Advanced Logistics System. Our efforts were made under very trying circumstances due to the dynamically changing Air Force requirements for a system that was procured under an inappropriate procurement method using deficient specifications.

The official correspondence related to contractual performance shows that Control Data has delivered both the hardware and software contracted for in accordance with the contract specifications. There seems to be no question, however, that serious deficiencies existed in the Government drafted specifications which caused them to fall short of satisfying the ALS objectives as conceived in the late 1960's.

The serious inadequacies of the Government drafted specifications are only mentioned as a minor item on page 21 of the draft report. In fact these inadequacies, coupled with the problems encountered by the Air Force in the design and implementation of the Central Control System (CCS) were major factors in the Air Force's decision to redirect efforts from the CDC ZODIAC based transaction oriented processing system to the CDC SCOPE based batch oriented operating system. Control Data's delivery of hardware and software which met the requirements of the ALS Contract GS-008-11737 is supported by the ALS Assessment Panel Briefing held at WPAFB on 18 November 1974. The concluding statement made by the Contracts Panel states:

"The Contractor has delivered the hardware and software in accordance with the contract specifications; however, there are serious deficiencies in these Government drafted specifications which cause them to fall short of satisfying the ALS objectives."

BEST DOCUMENT AVAILABLE

The GAO draft report states that CDC had responsibility for the software operating system and that the Air Force had responsibility for the application programs. This is a very misleading statement since a crucial element of software essential to successful operation of the system was the Central Control System designed and implemented by the Air Force. The Central Control System (CCS) provides functions normally performed by an Operating System Executive Monitor and was the interface between the CDC supplied ZODIAC Operating System and the Air Force developed application programs. The report does not address problems encountered by the Air Force in the design and coding of CCS to meet the original system design concepts. It was the complex interaction of all three (the batch oriented applications programs, the Central Control System and ZODIAC) and the programming techniques used by the Air Force that failed to take advantage of the transaction capabilities of the system that resulted in unforeseen problems -- not the CDC supplied ZODIAC Operating System alone, as portrayed in the report.

Any review of the ALS program must consider the efforts undertaken by the Air Force starting in mid 1974 to completely assess the progress and re-examine the Air Force's goals toward the implementation of an automated logistics system. Very significant resources were employed by the Air Force over a period of several months. Study panels, consisting of experts from the Government, industry and academic institutions were established to thoroughly examine and review every aspect of the program and the changing requirements of the Air Force. As a result of these studies a comprehensive plan was developed for a revised program implementation. As a part of this revised program implementation, negotiations were carried out between the Air Force and Control Data resulting in a modification to the ALS contract that redirected efforts from the ZODIAC based Operating System to the CDC SCOPE based Operating System. This change eliminated the requirement for the Air Force designed Central Control System and provided a more efficient software system for the changed Air Force requirements (i.e., the current requirement for a heavily batch oriented system versus the previous requirement for the transaction oriented ZODIAC system). The revised program implementation plan is well underway and, based upon information available to us, is proceeding as planned. The Air Force and Control Data are rigorously pursuing this revised implementation plan, and we are confident that Air Force requirements as presently envisioned can be met by close attention to program objectives and implementation schedules.

In summary, the GAO draft report, in our opinion, does not reflect an objective analysis of the ALS program -- it is severely deficient in recognizing the limits of the contractual responsibilities of Control Data Corporation; it fails to properly assign responsibility to the Air Force for the failure of the Central Control System; and it does not consider the Air Force's changed requirements and the redirection of the program as a result of the extensive Air Force program assessment.

BEST DOCUMENT AVAILABLE

Mr. Fred J. Shafer
Page 3
September 10, 1975

We have provided comments concerning certain specific portions of the draft GAO report in the attachment to this letter. A careful review of these comments and a recognition in your report of the facts presented will serve the objective of determining the present status of the ALS Program in meeting the current needs of the Air Force.

Yours very truly,

CONTROL DATA
SYSTEMS AND SERVICES COMPANY



Robert M. Price
President

/dlb
Attachment

PRINCIPAL OFFICIALS RESPONSIBLE
FOR THE ADMINISTRATION OF ACTIVITIES
DISCUSSED IN THIS REPORT

Tenure of office
From To

DEPARTMENT OF DEFENSE

SECRETARY OF DEFENSE:

Donald H. Rumsfeld	Nov. 1975	Present
James R. Schlesinger	July 1973	Nov. 1975
William P. Clements, Jr. (acting)	May 1973	July 1973
Elliot L. Richardson	Jan. 1973	May 1973
Melvin R. Laird	Jan. 1969	Jan. 1973
Clark M. Clifford	Mar. 1968	Jan. 1969
Robert S. McNamara	Jan. 1961	Feb. 1968

ASSISTANT SECRETARY OF DEFENSE
(COMPTROLLER):

Terence E. McClary	June 1973	Present
Donald R. Brazier (acting)	Jan. 1973	June 1973
Robert C. Moot	Aug. 1968	Jan. 1973
Robert N. Anthony	Sept. 1965	July 1968

DEPARTMENT OF THE AIR FORCE

SECRETARY OF THE AIR FORCE:

Thomas C. Reed	Jan. 1976	Present
James W. Plummer (acting)	Nov. 1975	Jan. 1976
Dr. John L. McLucas	July 1973	Nov. 1975
Dr. Robert C. Seamans, Jr.	Feb. 1969	May 1973
Harold Brown	Oct. 1965	Feb. 1969

ASSISTANT SECRETARY OF THE AIR FORCE
(FINANCIAL MANAGEMENT)

Francis Hughes	Mar. 1976	Present
Arnold G. Bueter (acting)	Aug. 1975	Mar. 1976
William W. Woodruff	Apr. 1973	July 1975
Spencer J. Shedler	June 1969	Apr. 1973
Thomas Nielsen	Jan. 1968	June 1969
Leonard Marks, Jr.	June 1964	Dec. 1967