136110

United States General Accounting Office

GAO

Report to the Chairman, Committee on Government Operations, House of Representatives

May 1988

ADP STANDARDS

Army Cancels Restrictive 3-Tier Architecture Standards

136110

GAO/IMTEC-88-13

543149/136110

GAO

United States
General Accounting Office
Washington, D.C. 20548

Information Management and
Technology Division

B-226935

May 17, 1988

The Honorable Jack Brooks
Chairman, Committee on Government
Operations
House of Representatives

Dear Mr. Chairman:

On March 30, 1987, you requested that we determine whether the Army's 3-tier architecture policy and its associated standards are in compliance with the Brooks Act, the Competition in Contracting Act, and the Federal Information Resources Management Regulation (FIRMR). You also requested that we evaluate the potential long-term effects of the Army's 3-tier architecture policy and the standards, and provide a perspective on previous Department of Defense and Army standardization efforts.

The 3-tier architecture policy outlined three tiers (levels) for processing and exchanging data to promote interoperability[1] among the Army's various automated systems. Army officials selected proprietary computer products (mostly operating systems software) and designated these products as standards to be used in automated systems within the three tiers. Then, the Army issued implementation guidance to assist commands in specifying the standards when issuing automated data processing (ADP) requests for proposals.

On July 1, 1987, we briefed your staff and informed them that the Army, in response to direction from the Deputy Secretary of Defense to withdraw the 3-tier architecture standards, had instead withdrawn only the implementation guidance for the standards. As a result, you asked that our report also contain information on whether the Army was refraining from referring to the 3-tier architecture standards in its recent procurements. In December 1987, the Army informed us they had cancelled the standards because of confusion within Army activities with regard to their interpretation.

In response to your question concerning whether the 3-tier architecture policy is in compliance with the laws and the regulation mentioned

[1]Interoperability, as it relates to the Army's 3-tier architecture, would, at a minimum, permit individual computer systems within and between any of the defined tiers to electronically exchange data. However, neither the policy nor the standards provide a clear or specific definition of what the Army intends or means to include by the term interoperability.

above, we found that the policy is a conceptual architecture and does not specify computer products. Specifically, since the policy describes information required at each of three levels for information exchange within Army mission areas, the policy is independent of procurement laws and regulations. Thus, we have no basis on which to conclude that the Army's 3-tier architecture policy violates applicable procurement laws or regulations.

However, the 3-tier architecture standards, which were developed to implement the above policy, specify proprietary computer products. The Competition in Contracting Act of 1984 requires agencies to develop specifications to promote full and open competition and permits the use of restrictive provisions only to the extent necessary to satisfy agency needs, or as authorized by law 10 U.S.C. Section 2305(a)(1)(Supp. III 1985). A procuring agency must be able to support the restrictions it imposes as necessary to meet its minimum needs. Here, in order to meet its need for interoperability, the Army imposed an across-the-board proprietary restriction for all future ADP procurements, when it appears that this restriction would not necessarily ensure interoperability, and that the need could have been satisfied by using functional specifications that are much less restrictive. Accordingly, it appears unlikely that the Army could reasonably justify such proprietary standards.

In response to your question concerning the long-term effects of the Army's 3-tier architecture policy and standards, we found that the Army did not measure economic and other long-term effects of implementing the 3-tier architecture policy and standards as called for in the FIRMR. Information we obtained from a congressional report[2] on procurement competition, along with the views of officials from the General Services Administration and 17 of the computer industry's major hardware and software companies, indicates that requirements like the Army's 3-tier architecture standards can significantly increase long-term acquisition costs and the rate of technological obsolescence.

Our review of three Army requests for proposals that occurred between the time the Army was directed to withdraw the standards in April 1987, and their actual withdrawal in December 1987, disclosed no reference to the standards. However, the three proposals contained compatibility limited requirements, that is, proprietary computer operating systems software products identical to those called for in the standards. After concerns were raised by a prospective vendor, one of the requests

[2]House of Representatives Report 98-1157, Competition In Contracting Act of 1984, Oct. 10, 1984.

was modified to remove the requirement for these products. Whether Army procurements such as the ones we analyzed are in compliance with the Brooks Act, the Competition in Contracting Act, and the FIRMR, depends on whether the Army has adequately justified compatibility limited requirements for each of these procurements.

Conclusions

The Army 3-tier architecture standards, which specified proprietary computer products without justification, would have limited all future Army ADP procurements in a manner which is inconsistent with the requirements under the Competition in Contracting Act. We believe that the Deputy Secretary of Defense's direction to the Army to withdraw the standards and develop new standards that are in compliance with public laws and federal and Defense regulations will, if properly implemented, help to correct the problems discussed in this report. However, in view of our findings concerning the requests for proposals and the confusion within the Army that led to the cancellation of the standards, it is important that the Army should ensure that it is complying with public laws and the laws implementing federal and Defense regulations when performing ADP procurements.

Recommendations

We recommend that the Secretary of the Army take steps to review Army ADP procurements in order to ensure that the Army is complying with federal and Defense ADP procurement regulations regarding the specification of proprietary products.

The Army's Development of the 3-Tier Architecture

In May 1984, Army staff information policy planners proposed the concept of interoperability as the goal of the Army's automated information policy. This concept, which was approved by the Assistant Chief of Staff for Information Management in March 1986, envisioned an environment where computers operating anywhere in the world can process and exchange information in a more timely and effective manner than existing systems can.

The Army's first step toward interoperability was to develop an information architecture consisting of three tiers (levels) for processing and exchanging data. The lowest level, tier 3, was defined as the individual workstation for the soldier—the desk-top computer; the mid-level tier, tier 2, was defined as the processing and exchange of standard Army systems data between Army organizations; and the highest level, tier 1, was defined as the processing and exchange of standard Army systems

data at regional data processing centers, specified commands, and installations.

The Army's second step toward interoperability was to select standards that would support communication within and between the defined tiers. The Army selected proprietary software (operating systems software) products for each tier.[3] The standards were approved by the Assistant Chief of Staff for Information Management in June 1986.

The Army's third and final step in this progression was the development of guidance for incorporating the standards into ADP procurements. The guidance consisted of examples of how each standard was to be specified in Army ADP requests for proposals.

In December 1986, the Commanding General, Information Systems Command, forwarded the draft implementation guidance to selected Army activities as advance notification of future Army policy. On February 12, 1987, the Deputy Director for Architecture Design and Control within the Office of the Assistant Chief of Staff for Information Management, forwarded the draft implementation guidance to Army headquarters activities and commands as future Army policy. The forwarding memorandum stated that, "It is the intention of this office to publish these instructions as formal policy not later than 27 Feb 87...."

The Deputy Secretary of Defense Directs the Army to Withdraw 3-Tier Standards

As early as June 1986, discussions were held among Army managers responsible for the standards and the Office of the Assistant Secretary of Defense, Comptroller. These discussions addressed the Assistant Secretary's concerns with the need for relating the standards to specific Army mission needs and whether implementation of the standards would restrict full and open competition. These concerns were documented in formal correspondence from the Assistant Secretary of Defense, Comptroller, to the Assistant Secretary of the Army for Financial Management on three separate occasions. The correspondence portrayed shortcomings in the standards, including concerns from industry. Additionally, in a March 1986 memorandum, the Army's Chief of Contract Law advised Army officials that

[3]Products defined by tier are: tier 3: UNIX-5 compatible or MS-DOS; tier 2: singly or in combination, VM with CMS, MVS, VSE, or UNIX-5 compatible; and tier 1: MVS. Additionally, at tiers 1 and 2, the Army required the use of the Structured Query Language, which is a standard promulgated by the American National Standards Institute and subsequently adopted as a Federal Information Processing Standard.

"To be legally permissible, such standards must be well justified on the basis of the Army's needs rather than stated in terms of compatibility with any particular vendors' product lines. To the extent that potential vendors might view the Army-wide standards placing them at a competitive disadvantage, we should expect both litigative and congressional challenges."

Despite this advice, the Army proceeded with its implementation of the standards without the required mission needs justification.

In April 1987, after being briefed on these events, the Deputy Secretary of Defense directed the Secretary of the Army to withdraw the standards. He also directed the Army to

- identify and evaluate mission requirements that cannot be satisfied by existing Defense, federal, national, and international standards and revise the Army standards accordingly;
- solicit industry comments on proposed standards and resolve them with the recommendations of the Competition Advocate;[4] and
- ensure that the revised proposed standards and implementation guidance are clear and consistent with federal and Defense policies.

In response to the Deputy Secretary's direction, on June 23, 1987, the Army's Director of Information Systems for Command, Control, Communications, and Computers informed Army commands that the draft standards implementation guidance had never been official Army policy, was being withdrawn, and must be discarded. Although the draft guidance (which cited examples of how each standard was to be used as a specification in ADP procurements), was withdrawn, the standards themselves (which call for proprietary computer products for each tier), were not withdrawn. According to the Director of Information Systems for Command, Control, Communications, and Computers, withdrawal of the message that promulgated the 3-tier architecture standards policy was not necessary because adherence to federal and Defense policies was required and the standards were to be used only when justified.

However, some confusion arose within Army activities in interpreting the applicability of the standards. Accordingly, in December 1987, the Director of Information Systems for Command, Control, Communications, and Computers rescinded the 3-tier architecture standards.

[4]The Competition Advocate is responsible for promoting full and open competition in the procurement of goods and services as provided for in Section 115 (c) of the Competition in Contracting Act (Public Law 98-369, 98 Stat. 1175, 41 U.S.C. 251 Note).

The Army's 3-Tier Standards Do Not Ensure Compliance With Public Laws

In the opinion of the General Services Administration and our office, without proper justification, the Army's use of the 3-tier architecture standards would violate the Brooks Act and the Competition in Contracting Act. These public laws require specifications for the purchase of ADP equipment, software, and services that allow for full and open competition with due regard to the nature of the property and services to be acquired.

The FIRMR, which in part implements these public laws, provides that awards may be based on other than full and open competition only in specifically justified situations. Procurements of ADP equipment and software referencing the Army's 3-tier architecture standards as justification for other than full and open competition fall within the FIRMR-defined category called compatibility limited requirements because the particular proprietary software products identified in the Army's 3-tier architecture standards require either (1) International Business Machines Corporation (IBM) or IBM-compatible products, or (2) American Telephone and Telegraph, Inc. (AT&T) or AT&T-compatible products. The FIRMR defines specific steps for reaching a justification for compatibility limited requirements and states that such a justification may not be based solely on reasons of economy or efficiency.

The Army promulgated its 3-tier architecture standards, which relate to all Army ADP procurements, without satisfying the requirements of the Competition in Contracting Act to develop specifications to promote full and open competition, or following the procedures required by the FIRMR for justifying compatibility limited requirements.

Economic and Other Long-Term Effects of Selected Standards Not Analyzed by the Army

The Army did not perform a requirements analysis and an analysis of alternatives, including an analysis of the long-term technical, operational, and economic effects of the 3-tier architecture standards. Within the Department of Defense, these FIRMR requirements are implemented through DOD Directive 7920.1, Life Cycle Management of Automated Information Systems, and DOD Instruction 7041.3, Economic Analysis and Program Evaluation for Resource Management.

Army managers within the Office of the Director of Information Systems for Command, Control, Communications, and Computers acknowledged that they should have analyzed the economic, operational, and technological impact of the standards prior to proceeding, and further, they endorsed the need for developing firm functional requirements for future Army standards.

However, other Army managers—those directly associated with and responsible for the development of the standards, including the Technical Director to the Commander of the Information Systems Command—indicated that the selection of the standards was primarily based on an inventory of currently installed computer equipment. They added that the selection was also based on a perception among Army managers that the selected standards represented the most prevalent computer operating systems software in use within the private sector.

Since the Army did not prepare a requirements analysis and an analysis of alternatives as required by the FIRMR, we requested commentary on the potential economic and technological effects of the standards from private companies that would be affected by the standards—those that manufacture, develop, and market most of the computer equipment and software sold in the United States. We obtained opinions from 17 of the computer industry's largest hardware and software suppliers.

The 17 suppliers were neutral toward the Army's 3-tier architecture concept. All but 4 (3 hardware and 1 software) suppliers, however, were concerned that the Army's selected standards would restrict competition for future information system procurements. Hardware suppliers' concerns focused on the operating systems standards, whereas software suppliers were most concerned with the time allowed for implementing the Structured Query Language, a data base management system requirement of the standards.

We also contacted the General Services Administration to obtain their opinion on the Army's 3-tier architecture standards. As part of their response they stated that "the Army may be at risk of imposing a moratorium on the advancement of technology supporting the Army or, in the worst case, the introduction of obsolescent technology."

The Army Has Not Referred to the 3-Tier Architecture Standards in Recent Requests for Proposals

We performed an examination of requests for proposals from 3 of 19 large acquisitions that occurred after the Deputy Secretary's direction to withdraw the 3-tier architecture standards. These requests for proposals were the first that we were able to obtain and analyze. We found no reference to the Army's 3-tier architecture standards in the proposals. However, we identified proprietary products identical to the products named within the standards in these requests for proposals. Because of concerns raised by a prospective vendor on one of the requests for proposals, the Army removed requirements for these products prior to formal release of the request. Whether specifying these products would

result in non-compliance with the FIRMR depends on whether the products were adequately justified by the Army.

Our objectives, scope, and methodology are contained in appendix I. Appendix II presents detailed information on the 3-tier architecture standards. Appendix III presents a perspective on previous Defense and Army standardization efforts.

At the close of our review we discussed key facts with and obtained updated information from responsible Army and Department of Defense managers and have recognized their comments where appropriate. However, in accordance with your wishes, we did not obtain official agency comments on this report. We performed our work in accordance with generally accepted government auditing standards.

As arranged with your office, unless you publicly announce its contents earlier, we plan no further distribution of this report until 30 days after its issue date. At that time, we will send copies to the Secretary of Defense, the Secretary of the Army, and to other interested parties upon request.

Sincerely yours,

Ralph V. Carlone
Director

Contents

Abbreviations

ADP	automated data processing
AT&T	American Telephone and Telegraph, Inc.
CMS	Conversational Monitoring System
DIA/DCA	Document Interchange Architecture and Delivery/Document Content Architecture
DOD	Department of Defense
FAR	Federal Acquisition Regulation
FIRMR	Federal Information Resources Management Regulation
GAO	General Accounting Office
IBM	International Business Machines Corporation
IMTEC	Information Management and Technology Division
MVS	Multiple Virtual Storage
SNA	Systems Network Architecture
SQL	Structured Query Language
VIABLE	Vertical Installation Automation Baseline Project
VSE	Virtual Storage Extended
VM	Virtual Machine

Objectives, Scope, and Methodology

Concerns about the Army's continuing dependence on costly and restrictive computer acquisitions and its reluctance to take advantage of the benefits of full and open competition to procure automated data processing (ADP) resources prompted the Chairman of the House Committee on Government Operations to ask us to evaluate specific aspects of the Army's 3-tier architecture policy. Following discussions with the committee, we agreed to

- determine whether the 3-tier architecture standards comply with the Brooks Act (Public Law 89-306, 40 U.S.C. 759), the Competition in Contracting Act (Public Law 98-369, 98 Stat. 1175, 41 U.S.C. 251 note), and the Federal Information Resources Management Regulation (FIRMR);
- evaluate the potential long-term effects of the Army's 3-tier architecture standards on ADP procurements and provide a perspective on prior Department of Defense and Army standardization efforts; and
- determine whether the Army continued to refer to the 3-tier architecture standards after the standards were withdrawn by order of the Deputy Secretary of Defense in April 1987.

To determine whether the Army's 3-tier architecture and implementing standards complied with provisions of the Brooks Act, the Competition in Contracting Act, and the FIRMR, we reviewed provisions of the applicable legislation. We also reviewed legal advice provided to Army officials when they established the 3-tier architecture standards and obtained legal opinions from our legal staff and from the General Services Administration.

To evaluate the long-term effects of the Army's 3-tier architecture standards, we requested supporting documentation on the Army's mission requirements, including economic analyses, to ascertain if the Army had considered the potential long-term effects of the standards prior to selecting and implementing them. Staff members within the Army's Office of the Director of Information Systems for Command, Control, Communications, and Computers and the Information Systems Command informed us that the Army had not prepared economic or other analyses, including documentation of the potential long-term effects of implementing the standards.

Because the computer industry's major hardware and software suppliers would be affected by the Army's 3-tier architecture standards, we obtained opinions on the standards and their long-term effects from 17 of the computer industry's major hardware and software suppliers. We also obtained views on the potential long-term effects of the standards

from a consultant and interviewed officials of the General Services Administration, National Bureau of Standards, and Office of Management and Budget.

We also interviewed Army officials to characterize and document the development of the 3-tier architecture, its standards, and implementing guidance. To establish a context of prior Defense and Army standardization efforts, we reviewed our past reports[1] and an Army Audit Agency report.[2]

We identified 19 large procurements that were active following the direction from the Deputy Secretary of Defense to withdraw the 3-tier architecture standards to determine whether the Army was continuing to refer to the standards. We obtained and analyzed 3 of the 19 procurements' requests for proposals.

Our review was conducted from March through December 1987, primarily at the Army's office of the Director of Information Systems for Command, Control, Communications, and Computers in the Pentagon; the Information Systems Command at Fort Huachuca, Arizona; the Information Systems Engineering Command at Fort Belvoir, Virginia; and the Information Systems Selection and Acquisition Activity in Alexandria, Virginia. We also visited the Office of Management and Budget and the General Services Administration in Washington, D.C.; the National Bureau of Standards in Gaithersburg, Maryland; the Corporation for Open Systems in McLean, Virginia; and the following computer hardware and software suppliers:

- Amdahl Corporation, Washington, D.C.
- Apple Computer, Inc., Reston, Virginia
- Applied Data Research, Inc., Vienna, Virginia
- Cincom Systems, Inc., Oakton, Virginia
- Control Data Corporation, Rockville, Maryland
- Computer Corporation of America, Alexandria, Virginia

[1] DOD Instruction 5000.5x, Standard Instruction Set Architectures for Embedded Computers (MASAD-82-16, Jan. 27, 1982).

The Department of Defense's Standardization Program for Military Computers—A More Unified Effort is Needed (LCD-80-69, June 18, 1980).

DOD Should Change Its Approach To Reducing Computer Software Proliferation (MASAD-83-26, May 26, 1983).

[2] Report of Audit: The Vertical Installation Automation Baseline Audit (HQ, Army Audit Agency, 85-717, Aug. 28, 1985).

- Cullinet Software, Inc., Falls Church, Virginia
- Digital Equipment Corporation, Washington, D.C.
- Harris Corporation, McLean, Virginia
- Honeywell Information Systems, Inc., McLean, Virginia
- International Business Machines Corporation, Bethesda, Maryland
- National Cash Register Corporation, Rockville, Maryland
- Oracle Corporation, Bethesda, Maryland
- Software AG, Inc., Reston, Virginia
- UNISYS Corporation, Tysons Corner, Virginia
- VION Corporation, Washington, D.C.
- Wang Laboratories, Inc., Bethesda, Maryland

At the close of our review, we discussed key facts with Defense officials and with the Army's Director of Information Systems for Command, Control, Communications, and Computers and members of his staff. We have recognized their comments where appropriate. We also obtained updated information from Defense officials concerning one of the three requests for proposals in October 1987 and information on the cancellation of the 3-tier architecture standards in December 1987. In accordance with the requester's wishes, we did not obtain official agency comments on a draft of this report. Our work was performed in accordance with generally accepted government auditing standards.

The Army's 3-Tier Architecture Standardization Initiative

In March 1986, the Army's Assistant Chief of Staff for Information Management established the Army Information Architecture to obtain a fully interoperable information environment at all levels within the Army at an affordable cost. Primarily, the architecture was to provide for the interoperability of the Information Mission Area elements—strategic, theater/tactical, and sustaining base. The architecture was organized with 3-tiers, was to be open in terms of promoting competition, and was to be implemented through the establishment of standards.

In June 1986, the Assistant Chief of Staff for Information Management issued standards for information systems to implement the 3-tier architecture. These standards specified vendor proprietary software and hardware and were selected to create interoperability. Draft implementing instructions for use of the standards were issued by the Deputy Director for Architecture Design and Control on February 12, 1987. The instructions stated that, "It is the intention of this office to publish these instructions as formal policy not later than 27 Feb 87...." These instructions mandated the use of the standards at all three tiers of the architecture. However, the standards could be waived because of interoperability problems and economic considerations.

Industry and the Congress criticized the standards as being competition-limiting and unsubstantiated by validated mission needs. In April 1987, the Deputy Secretary of Defense directed the Secretary of the Army to withdraw the standards. Although the draft implementing guidance (which cited examples of how each standard was to be used as a specification in automated data processing [ADP] procurements), was withdrawn in June 1987 by the Director of Information Systems for Command, Control, Communications, and Computers,[1] the standards (which call for proprietary computer products at each tier), remained in effect. The Army did require its commands to justify the use of the standards in accordance with federal and Department of Defense regulations governing acquisitions involving less than full and open competition. However, in December 1987, the Army cancelled the standards, citing confusion within Army commands concerning interpretation of the standards.

[1]During a departmental reorganization in March 1987, the Army Assistant Chief of Staff for Information Management was elevated and redesignated the Director of Information Systems for Command, Control, Communications, and Computers.

Our examination of three requests for proposals, which were active following the withdrawal of the 3-tier architecture standards implementation guidance, showed that the Army did not refer to the 3-tier architecture standards in the requests for proposals. However, the three requests for proposals did contain requirements for vendor-specific products identical to those described in the 3-tier architecture standards. For example, the three requests we analyzed contained requirements for the UNIX operating system at the second tier and the MS-DOS operating system at the third tier.

A Description of the 3-Tier Architecture

The 3-tier design was intended to be mandatory and Army-wide in scope. The Army planned to link its stand-alone automated systems so that information could be exchanged between tiers. The 3-tiers were defined as follows:

- Tier 1 consists of the Army's five regional data processing centers and specifically identified activities. These activities use large processors, production systems, distribution systems, and other information tools to support the needs of the general population of Army users. Large standard Army applications and their supporting data reside at this level.
- Tier 2 is defined as organizations, such as theaters, commands, armories, and centers within the Army. Standard and organization-unique applications, local information products and services, off-the-shelf software, and data to support these applications reside at this level.
- Tier 3 is the individual workstation for the soldier and the desk-top level. At this level, users are provided the capability to perform independent processing, communications, storage, and office automation functions. Some standard Army applications, off-the-shelf software, and data to support the applications reside at this level.

Army 3-Tier Architecture Standards and Implementing Guidance

In June 1986, the Assistant Chief of Staff for Information Management issued the following mandatory standards for the 3-tier architecture:

Operating Systems:

Tier 1, Multiple Virtual Storage (MVS).
Tier 2, singly or in combination: Virtual Machine (VM) with CMS, MVS, VSE, or UNIX 5 compatible.
Tier 3, UNIX 5 compatible or MS-DOS.

Data Base Management Systems:

All data base management systems at tiers 1 or 2 will include a Structured Query Language (SQL) interface.

Hardware:

General-purpose personal computers will be IBM/PC compatible.

Artificial Intelligence:

Workstations procured for artificial intelligence applications will be capable of supporting "Common LISP."

Communications:

Systems Network Architecture (SNA) or an SNA gateway with a minimum of remote job entry, 327x, and Document Interchange and Delivery/Document Content Architecture (DIA/DCA) capabilities, and an option for delivery of Defense protocols upon government request.

Part of the June 1986 3-tier architecture standards policy stated that implementation guidance would be issued in future correspondence from the Office of the Assistant Chief of Staff for Information Management. The policy also stated that any acquisition that limits competition must be justified on the merits of the specific situation and in accordance with federal, Defense, and Army policies. Since the operating systems, hardware, and communications systems are vendor-specific, the Army directive implies that use of these standards would require a justification for each acquisition.

In December 1986, the Commander of the Army Information Systems Command issued draft implementation guidance for the standards. This draft implementation guidance was again issued by the Deputy Director, Architecture Design and Control, as future Army policy on February 12, 1987. The guidance stated that the standards were mandatory at all tiers and within all environments for every procurement of hardware, software, and communications resources. Waivers to the standards could be granted when justified by economic or interoperability considerations.

Justification for the Army's 3-Tier Architecture Standards Is Legally Insufficient

The justification for the Army's 3-tier architecture standards and associated implementation guidance is legally insufficient. Opinions from our legal staff as well as the General Services Administration indicate that without completion of the required justification, use of the Army 3-tier architecture standards would not ensure compliance with the Brooks Act, the Competition in Contracting Act, and the Federal Information Resources Management Regulation (FIRMR). Additionally, as part of the Army's normal coordination of proposed policies, the Army's Competition Advocate of the Office of the Judge Advocate General provided legal advice on the proposed 3-tier architecture policy and standards. Although the Director of Information Systems for Command, Control, Communications, and Computers received this legal advice, which was consistent with the General Services' opinion and our opinion, the Army proceeded to issue and implement the standards without performing the required studies and completing the necessary justification.

Provisions of the Brooks Act, Competition in Contracting Act, and FIRMR

The Brooks Act authorizes the Administrator of the General Services Administration to purchase data processing equipment, software, and services for the federal government and to promote the economy and efficiency of these operations. Additionally, the Competition in Contracting Act requires that any acquisition over $25,000, that is based on other than full and open competition, must have a justification and be approved, according to the value of the award, at the appropriate level. The required provisions to be used in the control of these purchases are contained in the FIRMR. This regulation states that functional specifications are the preferred option in solicitation documents. If these alone are not sufficient to describe the agency's needs, the FIRMR lists other types of specifications in order of preference:

- equipment performance specifications,
- software and equipment plug-to-plug compatible, functionally equivalent specifications,
- brand name or equal specifications, and
- specific manufacturer and model specifications.

The regulation further prescribes that compatibility limited requirements tend to restrict competition and should not be made mandatory solely for reasons of economy or efficiency.

Legal Opinion Questions Army Justification

At our request, the Associate General Counsel, General Services Administration, reviewed the Army's 3-tier architecture standards. His legal opinion was that the Brooks Act, the Competition Act, and the FIRMR permit an agency to establish restrictive specifications that represent the minimum needs of the agency if the specifications are properly justified. However, additional formal correspondence[2] provided with the General Services' legal opinion stated that "while the Army's standard policy document contained a reference to the need to supply required justification when requirements restrict competition, we found no such reference to justifications in the standards implementation document...." We have reviewed the Army's 3-tier architecture standards and the implementing guidance and we question whether the reasons provided by the Army for the blanket compatibility limited restrictions in the standards could provide a basis for such restrictions under the Competition in Contracting Act. The restrictions are based on a stated need for "interoperability," a concept which the Army has neither explained nor fully defined. The restrictions were adopted without either a market survey or an initial unrestricted procurement to help determine the feasibility or availability of functional or other less restrictive standards. The Federal Acquisition Regulation (FAR) provisions implementing the Competition in Contracting Act requirements for full and open competition provide that an agency as a part of its required justification must describe the market survey taken which supports the restriction, or explain why no market survey was conducted. Instead of conducting a market survey, the Army appears to have based the restriction on the fact that its existing ADP inventory consisted primarily of equipment which supported versions of the proprietary operating systems listed in the standards.

However, because this equipment was acquired at different times and supports different versions or releases of the various operating systems, the systems are, in fact, not all compatible or interoperable. Similarly, newly acquired systems, which complied with the stated compatibility requirements, would not be interoperable with all of the existing Army systems, or with each other. Therefore, using "interoperability" to mean that all computer systems within and between the defined tiers would have the ability to electronically exchange data with each other—the only trait which the Army identifies—the compatibility limited restrictions do not accomplish the Army's stated need.

[2]Memorandum from the General Services Administration's Deputy Commissioner for Federal Information Resources Management to Associate General Council, Personal Property Division, dated Aug. 13, 1987.

In addition, the Army standards were adopted without any justification and imposed the blanket use of proprietary operating system compatibility limitations as a restriction on all future agency ADP equipment acquisitions, requiring a justification by any procuring activity which did not want to use this restriction in any particular procurement. Thus, even though the Army's transmittal document advised activities to comply with existing laws and regulations in affected procurements, the accompanying standards appeared to exempt future Army ADP procurements from complying with the usual FIRMR requirement for a special justification for any compatibility limited specification. Such special justifications normally require, among other things, a software conversion study to minimize the cost of conversion to future ADP replacement systems, and a consideration of the risk of conversion failure before determining that noncompliant equipment may be excluded.

The Army Did Not Follow the Advice of Its Judge Advocate General

Although advised by the Army's Chief of Contract Law that the standards were potentially troublesome from a justification standpoint, the Army proceeded to issue the standards without performing the required studies and documenting the necessary decisions. The Chief of the Contract Law Division, the Army's Judge Advocate General, reviewed the standards to provide legal advice on how standards could be set to promote compatibility. Specifically, he advised the following:

> "As we move in the direction of implementing the standards, there are some lingering concerns from a litigator's perspective for which preventive medicine should be considered....Under the terms of the Federal Information Resources Management Regulation (FIRMR) issued by GSA [General Services Administration], the Army's ADP standards would likely be deemed by the GSBCA [General Services Administration Board of Contract Appeals] to be a "compatibility limited requirement" for which special documentation is required."

Furthermore, to comply with the FIRMR, he advised that compatibility should be based on function rather than in terms of any particular vendor's product lines. He indicated that to be legally permissible, the justification would have to show that the stated need for systems compatibility was necessary to satisfy the Army's "minimum mission needs." It was his opinion that the need to document these mission-related reasons for the restriction could not be over-emphasized and that reasons based solely on economy and efficiency might not suffice.

Information on the Use of Standards in Recent Army Procurements

Following industry, congressional, and internal Defense criticism, the Deputy Secretary of Defense directed the Secretary of the Army, on April 22, 1987, to withdraw the standards and take the following actions:

- Identify and evaluate specific Army mission-related requirements that existing Defense, federal, national, and international standards cannot satisfy and develop a revised standards proposal.
- Solicit industry review and comments by an announcement in the Commerce Business Daily and resolve the comments in conjunction with the Competition Advocate.
- Ensure that the revised standards are consistent with federal and Defense policies.
- Coordinate the above actions with the Assistant Secretary of Defense, Comptroller, prior to the release of the revised standards.

On June 23, 1987, the Director of Information Systems for Command, Control, Communications, and Computers informed the major commands that the draft standards implementation guidance distributed in February 1987, had never been official Army policy, was being withdrawn, and must be discarded. The message did not withdraw the standards, which were issued by his predecessor, the Assistant Chief of Staff for Information Management, in June 1986. According to the Director of Information Systems for Command, Control, Communications, and Computers, withdrawal of the message that promulgated the 3-tier architecture standards policy was not necessary because adherence to federal and Defense policies was required and the standards were to be used only when justified. Specifically, Army components were given the following direction:

"as in the past, all sole-source acquisitions and those involving proprietary products will continue to be fully justified and submitted to the appropriate authority for approval prior to any acquisition actions."

The Director also announced plans to review the requirements that support the need for standards and ordered that the revised draft standards be made consistent with Defense, federal, and international policies "to the fullest extent possible."

However, confusion arose within Army commands relative to interpretations of the applicability of the standards. Accordingly, in December 1987, the Director of Information Systems for Command, Control, Communications, and Computers cancelled the 3-tier architecture standards.

We performed a preliminary examination of 3 requests for proposals to determine whether Army activities were continuing to use the standards after their withdrawal. These three requests for proposals represented the first 3 proposals that we obtained and analyzed from 19 proposals that were active following the Deputy Secretary's direction to withdraw the 3-tier architecture standards. Although the requests for proposals did not refer to the 3-tier architecture standards, the requests did cite some specific requirements identical to requirements mandated by the standards. Following a protest from a prospective vendor, the Army removed requirements for propriety products from the Corps of Engineers Automation Project request for proposals. This action was taken prior to the formal issuance of the request to industry. The results of our examination are presented in table II.1.

Table II.1: Proprietary Products Required in the Three Requests for Proposals[a]

Procurement	Standards Cited	Operating System			Network Protocols	
		MVS[b]	UNIX[c]	MS-DOS[d]	SNA[e]	DIA/DCA[f]
Corps of Engineers Automation Project	no	no	yes	yes	yes	yes
SuperMicro Computer	no	n/a	yes	yes	yes	yes
Fourth Generation Language	no	yes	yes	yes	n/a	n/a

[a]Other proprietary products are required within the requests for proposals shown in this table. The table indicates only those products cited in the Army 3-tier architecture standards.

[b]MVS—Multiple Virtual Storage operating system. Product of International Business Machines Corporation.

[c]UNIX—Product name given to operating system. Product of American Telephone and Telegraph, Inc.

[d]MS-DOS—MicroSoft Disk Operating System. Product of MicroSoft, Inc.

[e]SNA—Systems Network Architecture. Product of International Business Machines Corporation.

[f]DIA/DCA—Document Interchange Architecture/Document Content Architecture. Product of International Business Machines Corporation.

As discussed earlier, the use of specifications that unduly restrict competition should be limited. Their use, however, is not inconsistent with the Brooks Act, the Competition Act, and the FIRMR, provided the Army activities responsible for these procurements have appropriately justified such restriction.

The Army's 3-Tier Architecture Standards Could Have an Impact on Long-Term Acquisition Costs and the Rate of Technological Obsolescence

Because the Army's 3-tier architecture standards mandate the use of vendor-proprietary products, they restrict competition to suppliers that provide those specific products. This limitation increases the potential for higher procurement costs and the rate of technological obsolescence. An established procurement principle is that competition provides the government with better assurance of receiving fair and reasonable prices when purchasing goods and services. Procurement experts estimate that prices obtained from sole source and compatibility limited ADP equipment procurements are 25 to 40 percent higher than those obtained from full and open competition.

Moreover, the FIRMR requires agencies to justify specifications that promote less than full and open competition by preparing an analysis of alternatives including an analysis of the technical, operational, and economic considerations. Within the Department of Defense, these requirements are implemented through DOD Directive 7920.1, Life Cycle Management of Automated Information Systems, and DOD Instruction 7041.3, Economic Analysis and Program Evaluation for Resource Management. Army managers within the Office of the Director of Information Systems for Command, Control, Communications, and Computers acknowledged that they should have analyzed the technical, operational, and economic impact of the 3-tier standards prior to proceeding with their implementation. Additionally, they endorsed the need for developing firm functional requirements for future Army standards.

The Army Chose Standards for Quick Interoperability

Officials of the Office of the Director of Information Systems for Command, Control, Communications, and Computers stated that standards would enable them to attain quick interoperability, reduce initial unit costs, and reduce long-term training costs. The Army made this choice even though it had obtained information indicating that standards, such as the 3-tier architecture standards, could increase the potential for technological obsolescence, increase sunk costs in computer assets, provide inefficient common solutions to specific problems, and reduce competition. For example, in October 1985, the Associate Technical Director of the Army's Information Systems Command indicated that procurement experts had estimated sole source and compatibility limited procurement costs to be 25 to 40 percent higher than those obtainable under full and open competition. He added that the loss of creative ideas and innovative approaches to problem solving was a greater penalty than increased costs. He indicated that this was true because the assumptions driving selection of the particular standards the Army selected were that (1) total information systems interoperability was

needed, (2) this need was time critical, and (3) quick success required the use of equipment and software compatible with the preponderance of currently installed Army systems.

The Army did not, however, assess the level of interoperability needed to meet mission requirements and its potential costs and benefits. Additionally, staff from the Office of the Director of Information Systems for Command, Control, Communications, and Computers acknowledged that if the standards supported an open systems environment, they could maintain technological flexibility, reduce module costs, increase efficiency in matching solutions to requirements, prevent entrapment by large sunk costs, and increase competition for information resource procurements. However, in our opinion, since the selected standards did not provide for an open systems environment, the Army sacrificed these acknowledged advantages.

Vendors Foresee Long-Term Problems

Hardware and software vendors predicted adverse impacts resulting from the Army 3-tier architecture standards. Although there is a range of vendor opinions, many of them indicated that the Army's standards could result in substantially higher procurement costs and slower advances in technological innovation.

We discussed the Army information architecture and its standards with 11 hardware vendors to obtain their views. Although some of the vendors expressed doubt that the Army's goal of interoperability is attainable in the near future, the 3-tier architecture concept met with little criticism.

The three vendors whose hardware is IBM-compatible stated that they believe the use of IBM as a standard offers adequate competition for the procurement of automated systems. However, the eight vendors whose hardware is not IBM-compatible expressed opposition to the standards. Their comments included the following points:

- The Army has equated standards with uniformity.
- The standards are based on the Army's identified computer equipment inventory, a sunk cost, rather than functional requirements.
- The standards do not ensure portability of applications between tiers 1 and 2.
- The Army has not identified its real requirements. As a result, the Army has designated software products as standards.
- The standards could discourage technological innovation.

- The standards restrict competition and are in violation of the Competition in Contracting Act.
- The lack of competition could increase the government's procurement costs.

Two of the hardware vendors who opposed the standards have product lines that are IBM-compatible at tier 3, but not at tiers 1 and 2. The majority of the vendors stated that the Army should use the standards developed by the National Bureau of Standards or the Institute of Electrical and Electronics Engineers.

We also interviewed six software vendors to obtain their views. All have products that are compatible with IBM and have no problems with either the architecture or the standards. Several of these vendors, however, were concerned that the Army's implementation schedule did not allow them sufficient time to adjust their software packages to the standards and would effectively exclude them from competition.

The Army's Approach to Standardization Includes Positive and Negative Aspects of Previous Department of Defense Standardization Efforts

The Army's information architecture concept and its implementing standards and guidance include both positive and negative aspects of previous Department of Defense standardization efforts. Historically, the Army and the Department of Defense have advocated computer standardization to control the proliferation of incompatible systems and to solve the resulting inefficient use of automation resources. Our review focused on the previous approaches to standardization taken by Defense that are analogous to the current Army approach. Some of these approaches were to provide general purpose automation support to many mission areas. Other approaches identified specific vendor proprietary products as the standard. The previous efforts that focused on general purpose automation support have experienced some success. Those efforts oriented toward vendor-specific products were never implemented.

The Army's 3-Tier Architecture Concept Has Advantages Similar to Previous Successes

The Army's information architecture concept is similar to previous successful Defense and Army standardization efforts. The architecture, with its 3-tier design, was to be open in terms of promoting competition and supportive of a heterogeneous vendor environment where appropriate standards would permit a variety of products to be used. The architecture sought to correct perceived problems of interoperability affecting the existing information systems by ensuring that newly developed information systems were effectively integrated. The 3-tier architecture concept is analogous to those past efforts oriented toward general purpose standardization, because its intent is the achievement of interoperability through full and open competition. The following summaries identify those previous efforts that, in our opinion, have experienced some degree of success.

High Order Language Working Group

In mid-1975, Defense established the High Order Language Working Group to investigate the application languages in use and to recommend the adoption of one language for use in embedded weapons, communications, command, control, and intelligence systems. The group obtained requirements from Defense components, contractors, and other potential users to identify the functions and features that a generalized language of this nature should possess. The requirements were analyzed and modified for a year and a half and were approved in January 1976. Contracts were competitively awarded to four contractors to develop a prototype standard language. After 4 years of intensive study, analysis, and evaluation, one design, now called ADA, was selected. ADA is not yet in general use.

Department of Defense Instruction 5000.31: Interim List of Defense-Approved High Order Programming Languages

When the High Order Language Working Group began, the military was using more than 500 different computer languages and dialects to program its systems. In November 1976, while the group was working, Defense issued Instruction 5000.31 to reduce the number of approved computer languages to seven. Under the instruction, each service could select no more than two languages. The Navy selected CMS-2 and SPL-1. The Air Force selected two dialects of the JOVIAL language. The Army selected TACPOL. Defense added federal standard COBOL and FORTRAN to the languages the services selected.

Vertical Installation Automation Baseline (VIABLE) Project[1]

In mid-1982, the Army awarded a $616 million, 10-year contract that called for the total replacement and modernization of its base operations computer systems at 47 Army activities. The Army used an Office of Management and Budget Circular (A-109) procedure in running this procurement. This procedure required suppliers to demonstrate their solutions to the Army's functional requirements before the contract was awarded. The Army selected the vendor who proposed a 2-tier solution consisting of large mainframe computers located at five regional data processing centers and terminals located at user activities. The government retained ownership of the computer equipment and the vendor operated the regional data processing centers.

The Army's 3-Tier Architecture Standards and Guidance Have Disadvantages Similar to Previous Unimplemented Standardization Efforts

The standards and guidance issued to implement the Army Information Architecture are similar to past Defense standardization efforts that were not implemented. The 3-tier architecture standards and guidance mandated the use of vendor-specific proprietary products at all organizational levels. This methodology was analogous to previous standardization efforts that also identified vendor-specific products as proposed standards. None of these previous efforts, described below, were implemented.

[1]Report of Audit: The Vertical Installation Automation Baseline Audit (Hq, Army Audit Agency, 85-717, Aug. 28, 1985).

Department of Defense Instruction 5000.5X: Instruction-Set Architecture[2] Standardization Policy for Embedded Computers

In 1978, Defense proposed Instruction 5000.5x to reduce operating and support costs associated with embedded computer systems by requiring the services to use only government approved and owned computer hardware architectures. This action would have reduced the number of assembler languages used by Defense in embedded systems.

Some industry and military officials stated that implementation of Instruction 5000.5x would hinder development of the ADA language, discourage competition from a significant portion of the computer industry, and duplicate, at government expense, the commercial investment in advanced computer technology. In 1982, we reviewed the instruction and concluded that advances in software technology made standardization on instruction-set architectures needless. We recommended[3] that the Secretary of Defense not implement the pending instruction and that he direct the services to reevaluate their efforts and demonstrate why they were more cost effective than (1) standardizing on a high-level language and (2) relying on the computer industry to provide the stimulus for computer innovation.

The Senate and House Armed Service Committees' Conference Report on the Fiscal Year 1983 Authorization Act directed that Instruction 5000.5x not be implemented until Defense could reevaluate and report to the Congress on its standardization efforts. However, the required actions to be taken by Defense, as specified in their report, were superseded by progress made on the ADA effort. The ADA language was seen as a better approach to standardization because it could provide the means to adapt a variety of applications to a wide range of computer architectures.

The Military Computer Family Project

In the mid-1970s, the Army initiated the $100 million Military Computer Family project to develop computers based on the Army's hardware-specific architecture. The project's primary objective was to solve the Army's computer proliferation and hardware obsolescence problems without jeopardizing its extensive software investment. By selecting a

[2]The attributes of a digital computer as seen by an assembler language programmer. The attributes include processor and input/output instruction format, operation codes, and addressing modes; memory management and partitioning; the speed of accessible clocks; interrupt structure; and the manner of use and format of all registers and memory locations that may be directly manipulated or listed by an assembler language program.

[3]DOD Instruction 5000.5x, Standard Instruction Set Architectures for Embedded Computers (MASAD-82-16, Jan. 27, 1982).

specific computer hardware architecture as a standard, the Army intended to

- achieve commonality in equipment, software languages, support systems, training and development;
- reduce maintenance costs;
- increase competition among vendors for Army hardware procurements;
- increase control over technology infusion; and
- increase system interface capabilities.

We found[4] that the project received internal Defense and outside resistance because (1) the commercial firm involved was reluctant to accept the Army's assurances that the firm's proprietary architecture would not be re-marketed commercially and (2) industry was not interested in providing hardware based on a competitor's design. In late 1979, the Army abandoned the project to adopt a newly developed and government-owned architecture called Nebula. We concluded[5] that the Nebula project implemented the pending Department Instruction 5000.5x. In addition, we concluded that projects, such as the Military Computer Family and Nebula, that attempt to standardize with vendor proprietary computer hardware architectures, would not (1) encourage competition from a significant portion of the computer industry and (2) halt Defense's duplication of commercial investments in computer technology advances. As with the Defense Instruction 5000.5x proposal, the Military Computer Family project was superseded by advances in software technology that diminished the Army's perceived need for a standard hardware architecture.

[4]The Department of Defense's Standardization Program For Military Computers—A More Unified Effort is Needed (LCD-80-69, June 18, 1980).

[5]DOD Should Change Its Approach To Reducing Computer Software Proliferation (MASAD-83-26, May 26, 1983).

Requests for copies of GAO reports should be sent to:

U.S. General Accounting Office
Post Office Box 6015
Gaithersburg, Maryland 20877

Telephone 202-275-6241

The first five copies of each report are free. Additional copies are $2.00 each.

There is a 25% discount on orders for 100 or more copies mailed to a single address.

Orders must be prepaid by cash or by check or money order made out to the Superintendent of Documents.

United States
General Accounting Office
Washington, D.C. 20548

Official Business
Penalty for Private Use $300

First-Class Mail
Postage & Fees Paid
GAO
Permit No. G100