

GAO

Report to the Chairman, Committee on
Governmental Affairs, U.S. Senate

June 1993

SOFTWARE TOOLS

Defense Is Not Ready to Implement I-CASE Departmentwide



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RELEASED

**Information Management and
Technology Division**

B-252604

June 9, 1993

The Honorable John Glenn
Chairman, Committee on Governmental Affairs
United States Senate

Dear Mr. Chairman:

The Department of Defense, faced with the challenge of maintaining a strong military with fewer resources, began its Corporate Information Management (CIM) initiative to help streamline operations and manage resources more efficiently. To support the goals of CIM, Defense started several Departmentwide technical initiatives, including the integrated computer-aided software engineering (I-CASE) acquisition—potentially worth over one billion dollars.¹ I-CASE is intended to provide standard software development tools to the Department to improve software quality and reduce the costs of developing and maintaining Defense software. This report responds to your request that we determine whether Defense is adequately managing the planned introduction of I-CASE technology into its software development and design activities. Appendix I details our objective, scope, and methodology.

Results in Brief

The I-CASE acquisition presents Defense with an opportunity to investigate the use of computer-aided software engineering (CASE) technology to improve software development and maintenance in the Department; however, its plan to procure and install I-CASE throughout the Department is risky and premature. First, because the I-CASE industry is immature and changing rapidly, Defense faces several technical impediments to its proposed large-scale investment in CASE. For example, no comprehensive standards currently exist to support I-CASE technologies, and the ongoing standards efforts often overlap and conflict. In addition, little evidence yet exists that CASE tools can improve software quality or productivity. Further, experts estimate that CASE has a low success rate, failing in 80 percent of the organizations in which it is introduced.

Second, in spite of these risks, Defense plans to install CASE tools without adequately analyzing its software development processes, and without prototypes to determine whether I-CASE will be capable of supporting those processes. As a result, Defense has little assurance that its software design

¹Other technical initiatives include the Defense data administration and software reuse programs. In addition, Defense is planning to consolidate its automated data processing and software design activities.

activities will be ready to use this technology before they acquire CASE tools. Unless Defense redirects I-CASE—by incorporating a more systematic approach to implementing this technology across the Department—it risks wasting millions of dollars on automated software tools that do not meet its needs and will not be used effectively.

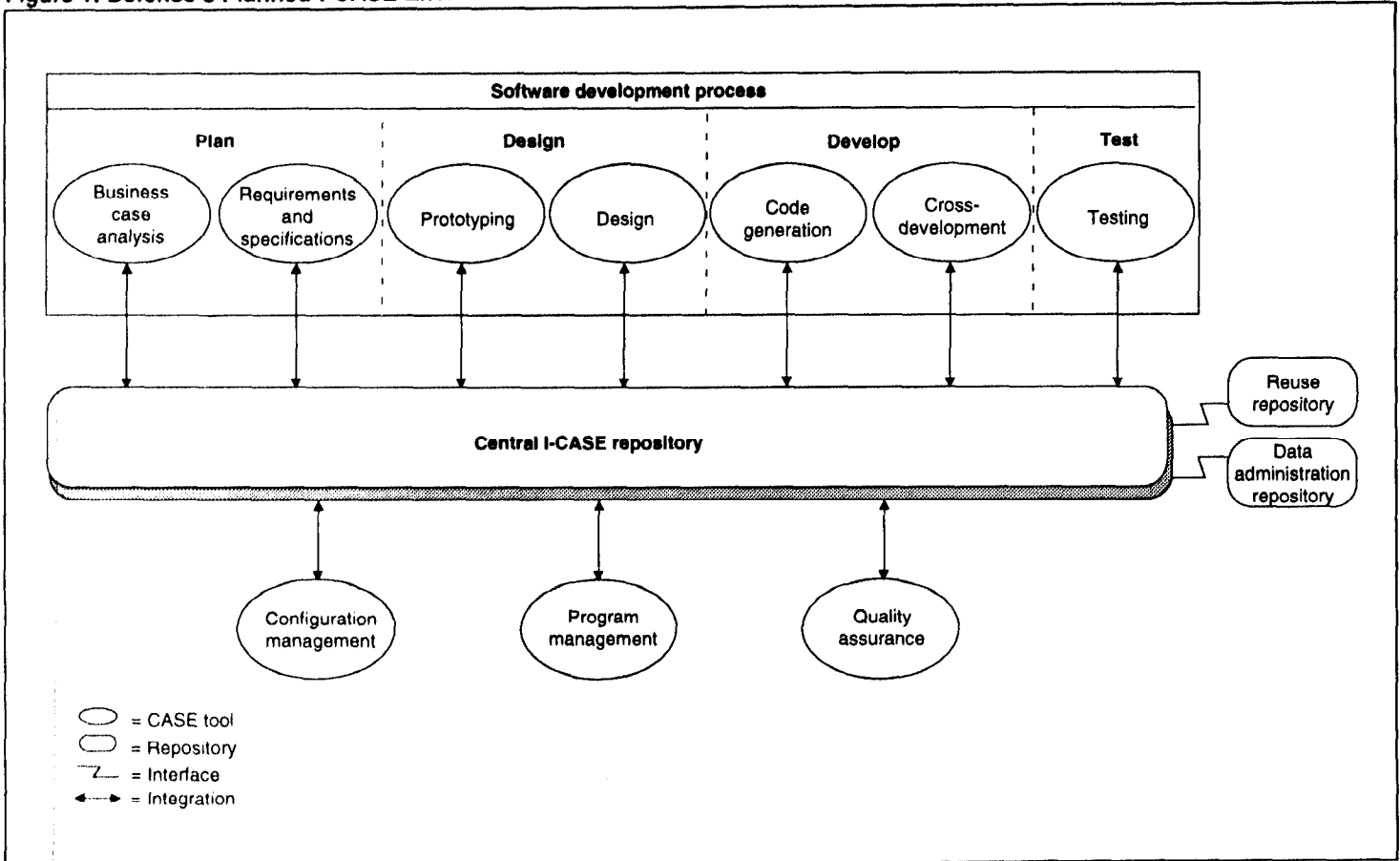
Background

The goal of the I-CASE procurement is to improve software quality by providing a standard, integrated set of CASE tools for use Departmentwide. A CASE tool is a computer-based product aimed at supporting one or more software engineering phases within a software development process. For example, one tool may automate the requirements analysis of a system, another may help design software addressing those requirements, and the next may automatically generate code on the basis of that design. I-CASE consists of a collection of CASE tools together with a support structure that integrates most or all of the activities within a software development process. As illustrated in figure 1, some CASE tools are used to automate specific software development phases—including the planning, design, development, and test phases—while other tools, such as configuration management tools, support the entire software life cycle. To facilitate the transfer of information from one tool to another, Defense plans to integrate the tools through a central repository. In addition, it plans for this I-CASE repository to interface and exchange data with other Departmentwide repositories, such as the software reuse and the data administration repositories.

The I-CASE contract, scheduled for award this September, is intended to provide hardware, software, training, and other services to support Defense's software development process. The contract is to be a 2-year indefinite-delivery, indefinite-quantity contract with eight 1-year options for renewal. The contract will require Defense to spend 20 million dollars. However, if all options are exercised, the contract could be worth over a billion dollars.

To promote standardization at its software development activities, Defense plans to mandate the use of I-CASE on its

Figure 1: Defense's Planned I-CASE Environment



government-developed automated information systems after contract award. In addition, Defense plans to require that all software developed by contractors be delivered in a form that can be maintained and modified by the I-CASE environment.

Technical Impediments to I-CASE Implementation

The I-CASE industry is evolving and changing rapidly. The industry has agreed on few accepted tool standards and has not achieved consensus on which software development projects can best benefit from the use of I-CASE tools. Further, because the industry is relatively immature, few objective case studies have been conducted that demonstrate the overall effectiveness of CASE tools in improving the productivity of software development activities. The tools that are available today do not provide

the integration capabilities that Defense requires. As such, Defense's plan to acquire a set of integrated CASE tools for use throughout the Department is very risky.

I-CASE Standards Are Still Evolving

Despite many ongoing efforts to develop standards, none currently exists for integrating CASE tools from different vendors. According to the Software Engineering Institute (SEI), a software research center at Carnegie-Mellon University, there were approximately 250 tool interconnection standards efforts in progress in 1986, 19 of which deal directly with CASE.² In the absence of standards, Defense has little assurance that the tools it acquires through the I-CASE contract will be compatible with future I-CASE tools and technology.

Defense is attempting to address the issue by establishing a partnership with industry to develop standards based on a proposed European CASE standard—the Portable Common Tool Environment (PCTE).³ The goals of the partnership are to address the shortcomings of PCTE and to develop a validation suite to test whether CASE tools are PCTE-compliant. The partnership has only recently begun, however, and its outcome remains in doubt. A major producer of CASE products, several users of those products, and some Defense officials disagree with the approach being taken by the participants of the partnership. According to these groups, the PCTE activity is incorrectly based on a standard that does not represent current technology. For example, PCTE does not effectively support object-oriented design and programming.⁴ As a result of selecting PCTE, Defense risks implementing a standard that may not be the most technically appropriate or widely accepted in the future.

CASE Tools May Not Improve Productivity

Claims of productivity improvements resulting from the use of CASE tools have not been validated by empirical evidence. Currently no widely accepted, systematic approach for evaluating a CASE tool's effectiveness exists. Reports of productivity improvements from CASE use are inconclusive, and are not based on a standard set of evaluation criteria.

²Paul F. Zarrella, CASE Tool Integration and Standardization (CMU/SEI-90-TR-14, December 1990), p. 17.

³The European Computer Manufacturers' Association (ECMA) developed PCTE to provide a common interface for CASE tools. The International Standards Organization is currently considering designating PCTE as a formal international standard.

⁴Object-oriented design is a software development technique in which a system or component is expressed in terms of objects and connections between those objects.

Indeed, some CASE tool users report no productivity or quality improvements at all. As a result, Defense risks investing resources in a technology that may neither deliver improved quality and productivity, nor reduce program costs.

A September 1991 SEI study reported that there is little evidence demonstrating that CASE tools can consistently deliver improvements in software development productivity.⁵ While some organizations reported achieving substantial productivity gains from the use of CASE tools, others have reported few benefits. Further, according to a June 1992 Institute of Electrical and Electronics Engineers (IEEE) report, CASE vendors have yet to publish any controlled studies that validate their claims of increased software development productivity.⁶

While Defense officials have stated that the use of CASE tools is expected to generate productivity gains in the Department, they do not have evidence to support such a claim. In addition, as noted in a recent Defense I-CASE briefing, industry experts have estimated that CASE fails in 80 percent of the organizations in which it is introduced; this is due to factors such as poor integration of the CASE tools, inadequate training, and a lack of standards or methodologies. While interest exists in determining the types of projects that benefit most from the use of CASE tools and the scope of any improvement, empirical evidence is sparse, and industry observers do not yet agree on the value of CASE technology.

Limited Tool Integration Capabilities Currently Exist

The I-CASE industry is constantly changing; new tools appear on the market regularly. Although tools to aid programmers have been available for nearly 15 years, integrated CASE tools to support the entire software development process have only recently begun to appear. According to the Software Technology Support Center, an Air Force software support group, few commercial I-CASE products have been thoroughly tested by use on many projects.⁷

The I-CASE products that are available fall short of Defense's requirements because an integrated CASE environment that provides support to all phases of software development and maintenance and can incorporate

⁵Paul F. Zarrella, Dennis B. Brown, and Edwin J. Morris, Issues in Tool Acquisition (CMU/SEI-91-TR-8, September 1991), p. 3.

⁶Casper Jones, "CASE's Missing Elements", IEEE Spectrum, Volume 29, Number 6 (June 1992), p. 41.

⁷Bob Hanrahan, Ron Peterson, Judi Peterson, and Dennis Barney, Software Engineering Environment Report 1992, U.S. Air Force, Software Technology Support Center (Hill AFB, Utah: March 1992), p. 25.

tools from several vendors does not currently exist. In the I-CASE solicitation, Defense identified the requirement for an environment that would allow the integration of different vendors' tools and products. Currently, however, interfaces to I-CASE products are often proprietary, thereby precluding integration with other vendors' CASE tools. According to SEI, difficulty integrating different vendors' CASE tools stems in part from a lack of officially approved, vendor-independent CASE standards.⁸

Defense is attempting to mitigate these technical risks by identifying both mandatory and optional requirements in the solicitation for proposals. The mandatory requirements are those that Defense expects to be commercially available at the time of contract award, such as a source code generator. Thus, at a minimum, to be rated acceptable for contract award, vendors must demonstrate that they can meet these basic CASE tool requirements. Vendors will also be rated during the source-selection process on their ability to meet optional requirements. These include those tools and capabilities that are not yet commercially available, but that the government expects industry to have available in later years of the potentially 10-year contract. As part of their proposals, vendors must submit a "migration" plan to describe an approach and time frames for eventually meeting the optional requirements of the contract. Defense will evaluate the migration plans as part of the vendors' proposals. However, these plans will not be contractually binding, and it remains uncertain whether industry will be able to meet Defense's requirements over the life of the contract.

Defense Is Not Ready to Implement I-CASE Departmentwide

Defense's strategy to procure and install integrated sets of CASE tools throughout the Department has serious shortcomings. Because I-CASE is an evolving and risky technology that may have a profound impact on the culture of the organization, Defense must systematically manage its introduction into its software development activities. Defense has not, however, taken the steps necessary to reduce the risks of this acquisition and help ensure successful implementation of I-CASE. First, Defense has not clearly defined its software development goals or determined how I-CASE technology will support those goals. Second, it plans to make this potentially powerful technology available to software design activities that may not be able to effectively use it. Finally, although pilot projects to promote the use of I-CASE are planned, Defense does not intend to use a prototyping strategy to measure the costs and benefits of the new technology, or to assess any potential drawbacks to its use.

⁸Paul F. Zarrella, p. 2.

I-CASE May Not Support Defense's Software Development Goals

The Defense software development environment is changing rapidly. The ongoing software reuse and data administration initiatives—as well as the consolidation of software design activities—will have a profound impact on how Defense software will be developed in the future. However, Defense has not adequately considered these changes in planning its I-CASE procurement. As a result, the Department has little assurance that I-CASE technology will support the future structure of its software development activities, even if the technical impediments are resolved.

According to CIM guidance governing business process improvement, Defense should continuously reexamine and redefine business policies, processes, and business methods before acquiring information technology.⁹ An October 1992 CIM status report emphasized the importance of business process improvement to avoid “precipitous ‘progressive’ actions without consideration of human and procedural complexities [that] have resulted in well documented administrative disasters.”¹⁰ Several methods, such as the functional economic analysis and requirements analysis, are available to assist in identifying how technology can support an organization's business processes. In planning the I-CASE acquisition, however, Defense has not taken full advantage of these methods.

The functional economic analysis, a component of business process improvement, is used to determine and document the costs and benefits of business process improvements and any related investments in information technology. While Defense has conducted a functional economic analysis for I-CASE, this analysis is inadequate because it does not justify the purchase of I-CASE technology but, rather, outlines different methods of obtaining CASE tools. Without an analysis that clearly outlines how I-CASE will support the changing business environment, Defense risks employing a technology that may not meet its goal of improving software development.

In addition to the functional economic analysis, a requirements analysis could provide Defense with valuable information tying functional requirements to information technology needs. The Federal Information Resources Management Regulation (FIRMR) requires that, before awarding a contract for federal information processing resources, an agency define

⁹The Executive Level Group Model, endorsed by the former Deputy Secretary of Defense, describes a management philosophy that emphasizes improving the business process before identifying specific computing and communications technologies.

¹⁰Status of the Department of Defense Corporate Information Management (CIM) Initiative, U.S. Department of Defense, (October 1992), p. 5.

its information requirements. In addition, FIRMR requires that an agency prepare an analysis of alternatives to compare and evaluate different ways of meeting its information needs. Defense has conducted neither a requirements analysis nor an analysis of alternatives. Without a detailed requirements analysis or analysis of alternatives, Defense may acquire CASE technologies that do not adequately meet its software development needs.

Software Development Activities May Not Be Ready for I-CASE

Defense has not taken the necessary steps to ensure that activities that would purchase tools from the I-CASE contract will be prepared to use them effectively. Specifically, Defense does not plan to require its software development organizations to undergo a software process assessment before purchasing CASE tools, even though such evaluations are recommended by industry experts. A software process assessment could determine if a software organization is ready to use CASE tools. In addition, Defense does not plan to require that organizations demonstrate a minimum level of software development expertise before they are allowed to purchase CASE tools. Therefore, Defense plans to make I-CASE products available to all of its software development organizations, regardless of their capability to effectively use them.

According to a noted software engineering industry expert, "one of the first steps in planning for CASE must be a technical audit of the organization's software process maturity."¹¹ One such assessment is SEI's capability maturity model for software, a framework describing the elements of an effective software process. The model also provides organizations with guidance on how to gain control of their processes for developing and maintaining software, and how to evolve toward a culture of software engineering excellence.

Defense plans to perform full SEI assessments at all of its software development activities; however, it may take years to complete these assessments. Nonetheless, activities will be allowed to purchase tools from the I-CASE contract before they are assessed. Further, before purchasing CASE tools, some software development activities may initially receive "mini-assessments" that address only limited segments of a development activity's process. In addition, software development organizations may refuse to be assessed prior to purchasing tools from the I-CASE contract. As a result, Defense will not know which design activities

¹¹Edward Yourdon, *The Decline and Fall of the American Programmer* (Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1992), p. 158.

are most capable of using CASE tools, and which are more likely to fail. Defense has initiated a program to address software process improvement and includes software process assessments. However, the program has only recently begun, and Defense has not developed a comprehensive plan detailing how software development will be improved within the Department.

Finally, Defense does not plan to require software development activities to attain a minimum level of software development expertise before the purchase of CASE tools from the I-CASE contract. According to industry experts, a software development activity that has an ad hoc, poorly defined process will not be able to effectively employ I-CASE. And SEI has reported that when CASE tools are introduced into an organization that has a chaotic software development process, CASE can actually hinder that organization's ability to effectively produce software.¹² Because Defense does not plan to require organizations to demonstrate a certain level of software development capability before purchasing CASE tools, less proficient software development organizations could suffer a productivity loss rather than a gain.

Defense Plans No Prototypes to Introduce I-CASE

Even with the risks described, Defense does not plan to use prototypes to introduce I-CASE into the Department's software development activities. A prototype is a preliminary form of a system that serves as a model for later stages. Prototypes could be useful in identifying the best way to implement I-CASE, and could allow Defense to identify both potential benefits and problems associated with the new technology. In addition, in a draft report presented to the I-CASE program manager, SEI recommended that when implementing a new technology such as I-CASE, an organization should use a strategy of evolutionary prototyping for development and transition.¹³

According to SEI, evolutionary prototyping is a strategy that begins with currently available technology and aims toward incremental (rather than revolutionary) improvements in the capabilities of software organizations. The strategy begins with the assumption that initial implementation of the technology will be flawed and unable to support the production and maintenance of software on a large scale. Such a strategy minimizes the risk of committing to an emerging technology and aids in clearly defining an organization's needs. However, since Defense does not plan to use

¹²Watts S. Humphrey, CASE Planning and the Software Process, (CMU/SEI-89-TR-26, May 1989), p. 9.

¹³Ed Morris, Dennis Smith, Dick Martin, and Peter Feiler, Lessons Learned from Previous Environment Efforts (DRAFT, June 1992) p. 31.

prototypes, it will forego an opportunity to test and possibly improve the way I-CASE is introduced into software design activities throughout the Department.

While no prototypes are planned, Defense is planning 28 pilot projects. However, the pilots are not intended to test products from the I-CASE contract but, rather, are to promote the use of I-CASE throughout the Department by demonstrating early examples of success. The criteria for selecting the pilots reflect these goals: preference would be given to small or medium-sized projects that could be completed within 6 to 12 months. Due to the narrow scope of the pilot projects chosen, however, no individual pilot will exercise the full range of I-CASE functionality.

Further, while Defense plans to collect information from the pilot projects, it does not plan to use this information to thoroughly evaluate the technical success of I-CASE. According to an official of the Office of the Director of Defense Information, the pilots are not intended to be prototypes that test the effectiveness of I-CASE because Defense expects I-CASE to work. Therefore, the current pilot projects are not an adequate substitute for prototypes that would thoroughly and objectively evaluate I-CASE technology and implementation, and provide a mechanism for phased implementation of proven, effective products.

Conclusions

As Defense depends more and more on information systems to support its critical business functions, the role of software becomes increasingly critical. The more quickly and efficiently high-quality software can be developed, the more flexible Defense will be in responding to changes and threats in an unstable world environment. It is therefore appropriate for Defense to investigate the use of CASE tools as part of its software process improvement program.

However, acquiring CASE tools is not the only option Defense can take to improve its software process, and the introduction of CASE tools does not guarantee improvements in productivity. Due to the immaturity and evolving nature of the I-CASE industry, it is very risky for Defense to attempt to implement I-CASE Departmentwide. Further, Defense's strategy of acquiring I-CASE tools before determining how its business process will change and what its future software development needs will be is not prudent. Consequently, Defense has little assurance that the I-CASE contract will deliver products and services that will meet the goal of improving productivity while reducing software development costs.

Recommendations

In order to reduce the risks of the I-CASE procurement and ensure that the chosen solution will meet its needs, Defense should redirect its I-CASE implementation strategy to more thoroughly test the CASE concept and better prepare for the changes that employing the new technology will bring. Accordingly, we recommend that the Secretary of Defense instruct the Assistant Secretary of Defense for Command, Control, Communications, and Intelligence to take the following actions:

- Restrict purchases from the I-CASE contract to those software development activities necessary to support the planned pilot projects. In addition, the pilot projects should be redirected to test and evaluate I-CASE to allow Defense to identify the benefits and potential problems associated with using CASE tools. This redirection should also ensure that the pilots selected include large as well as smaller projects, and that some pilots test the total spectrum of the I-CASE products.
- Initiate a software development business process improvement program to address Defense's overall software development goals and how technology should be applied to meet those goals. The business process improvement program should include a complete functional economic analysis to justify the money to be spent on the technology, and outline what benefits can be expected from employing I-CASE.
- Require that any software development activity be fully assessed as to its skill level in developing software prior to purchasing tools from the I-CASE contract. The results of the assessment should be used to determine what tools are most appropriate for the activity to use.

Agency Comments and Our Evaluation

In commenting on a draft of this report, the Department of Defense generally disagreed with the report's findings and recommendations. Overall, Defense believes that its I-CASE acquisition strategy prudently addresses most of the issues we have raised. As such, in its written comments, the Department disagreed with our recommendation that it restrict purchases from the I-CASE contract to those software development activities necessary to support the planned pilot projects. Subsequently, however, on May 7, 1993, the Deputy Secretary of Defense issued a memorandum essentially conforming to our position, stating that purchases from the I-CASE contract should be limited to the minimum necessary to implement the pilot projects. According to the memorandum, Defense will await the results of the pilot projects before deciding whether to proceed with the I-CASE program.

In our view, restricting the contract is the overriding issue in the report, and we believe Defense has acted appropriately in deciding to take this action. Further, we believe the Department's decision, once properly implemented, will help mitigate many of the risks discussed in the report.

Concerning the remainder of the Department's written comments, Defense disagrees with several aspects of the report. Specifically,

- Defense does not agree that standards do not exist for integrating CASE tools from different vendors,
- Defense disagrees with our contention that claims of productivity improvements resulting from the use of tools have not been validated by empirical evidence, and
- Defense disagrees with our recommendation that it initiate a software business process improvement program that includes a complete functional economic analysis to justify the money to be spent on the technology.

Standards

According to the Department, a number of standards exist for integrating CASE tools from different vendors, including PCTE, the CASE Data Interchange Format (CDIF), A Tool Interface Standard (ATIS), and the Common Ada Programming Support Environment Interface Set (CAIS-A), also known as MIL-STD-1838A. The Department contends that while many of these standards are evolving, Defense must provide direction in a volatile environment.

The standards mentioned by Defense in its response are proposed standards, not officially approved standards, with one exception. CAIS-A is an approved U.S. military standard designed to promote the source-level portability of Ada programs, particularly Ada software development tools. However, CAIS-A standardizes those host-to-tool interfaces most crucial for tool portability, not the requisite tool-to-tool or tool-to-repository interfaces that are needed for I-CASE integration. Our main point, which Defense acknowledges, is that a number of efforts, including PCTE, are still underway, and that no strong consensus on tool integration standards exists.

Further, by citing PCTE as an optional requirement, Defense is increasing the risk of adopting a standard that may not be supported in the future. PCTE provides weak support for a major technological innovation in

software development, and is opposed by significant vendors in the I-CASE market.

Productivity

In discussing the issue of CASE tool effectiveness, the Department states that we imply that such tools improve neither quality nor productivity. The Department disagrees that claims of productivity improvements resulting from the use of CASE tools have not been validated by empirical evidence. Rather, Defense notes, software engineering literature is replete with articles and reports documenting substantial productivity and quality gains from CASE technology. The Department further states that it believes we have misinterpreted the SEI studies cited in the report to support our views. According to Defense, the main point of the studies was that "benefits of CASE tools are real, but that the evidence of those benefits are as yet only available through anecdotal evidence."

Defense misinterprets our point: we do not mean to imply that CASE tools cannot improve quality or productivity. We state that reports of productivity vary, and that some users report no productivity or quality improvements. Further, an April 1992 risk assessment prepared by Defense itself confirms a moderate risk that I-CASE may not improve productivity or quality. According to the report, "There is not objective evidence that CASE or I-CASE environments increase productivity or quality for every organization that has implemented this technology."

There is to date a lack of empirical evidence supporting productivity gains: (1) the IEEE study showed a lack of controlled studies by CASE vendors; (2) the SEI report noted little evidence that CASE consistently delivers improvements; and (3) an October 1992 Defense briefing noted an 80-percent failure rate for I-CASE. There is no body of empirical evidence to support the claim that CASE tool usage produces consistent productivity improvements.

Business Process Improvement Program

Finally, Defense disagrees with our recommendation that it conduct a business process improvement program that includes a complete functional economic analysis to justify purchasing CASE tools. The Department states that the I-CASE program does not mandate that any Defense component spend money on that technology. Rather, the program makes available, through the Department, a contract that allows software organizations to purchase such technology. According to the Department, the contract does require that if components purchase such technology,

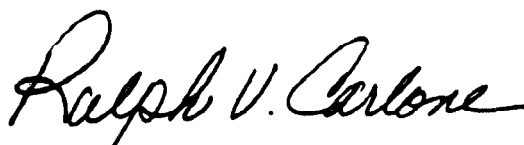
they do so through this contract. Defense further states that it will be up to each organization to justify the purchase.

Defense's statement that the I-CASE program does not mandate that any component spend money on that technology contradicts its established policy. As noted in the background section of our report, a February 27, 1992, memorandum signed by the former Director of Defense Information states that "it is DOD policy that I-CASE will be used by each military department and defense agency for all in-house, government-developed AISS (automated information systems)." Defense components will have to purchase tools from the I-CASE contract to comply with this policy.

We conducted our review between June 1992 and May 1993, in accordance with generally accepted government auditing standards. As arranged with your office, unless you publicly announce the contents of this report earlier, we plan no further distribution of it until 10 days from the date of this letter. We will then send copies to the Secretaries of Defense and the Air Force and other interested parties, and will make copies available to others upon request.

This report was prepared under the direction of Samuel W. Bowlin, Director, Defense and Security Information Systems, who can be reached at (202) 512-6240. Other major contributors are listed in appendix II.

Sincerely yours,



Ralph V. Carlone
Assistant Comptroller General

Objective, Scope, and Methodology

This report responds to the May 15, 1992, request by the Chairman, Senate Committee on Governmental Affairs, that we determine whether Defense is adequately managing the planned introduction of I-CASE technology into its software development and design activities. To meet this objective, we assessed the current state of the I-CASE industry and then assessed Defense's planning and strategy to introduce I-CASE into the Department.

In assessing the state of the I-CASE industry, we

- interviewed officials from leaders in the CASE tool industry, including Knowledgeware, Inc., and Texas Instruments, Inc.;
- interviewed officials from CASE integrators and consultants, including Westinghouse Electric Corporation and ICF Technologies, Inc.;
- interviewed officials from academia, including the Software Engineering Institute, Carnegie Mellon University, Pittsburgh, Pennsylvania; George Mason University, Fairfax, Virginia; and the Massachusetts Institute of Technology, Cambridge, Massachusetts;
- reviewed documents and interviewed officials from the Advanced Research Projects Agency, Arlington, Virginia;
- reviewed documents and interviewed officials from the National Institute of Standards and Technology, Rockville, Maryland; and
- reviewed articles from software periodicals, including IEEE Software, IEEE Spectrum, Computerworld, CASE Trends, Datamation, The Journal of Systems Management, Information Week, Software Magazine, and others.

In assessing Defense's planning and management of the introduction of I-CASE technology, we

- reviewed contract documentation and interviewed officials from the I-CASE program manager's office, the Standard Systems Center, Maxwell Air Force Base—Gunter Annex, Alabama;
- reviewed planning documentation and interviewed officials from the Office of the Director of Defense Information, Office of the Secretary of Defense, Washington, D.C.;
- reviewed documentation regarding the technology transfer program and interviewed officials from the Software Systems Engineering Directorate, Center for Information Management, Defense Information Systems Agency;

Appendix I
Objective, Scope, and Methodology

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- interviewed officials from several pilot sites, including Washington D.C.; Falls Church, Virginia; and Maxwell Air Force Base—Gunter Annex, Alabama; and
 - interviewed the Air Force action officer from the Air staff, Washington, D.C.

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