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April 29, 2004

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# Acquisition

Summary Report on the Military  
Departments' Transition of Advanced  
Technology Programs to Military  
Applications  
(D-2004-078)

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Department of Defense  
Office of the Inspector General

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### **Acronyms**

AFRL	Air Force Research Laboratory
ATD	Advanced Technology Demonstration
CE	Critical Experiment
FNC	Future Naval Capability
IPT	Integrated Product Team
S&T	Science and Technology
TRL	Technology Readiness Level



INSPECTOR GENERAL  
DEPARTMENT OF DEFENSE  
400 ARMY NAVY DRIVE  
ARLINGTON, VIRGINIA 22202-4704

April 29, 2004

MEMORANDUM FOR UNDER SECRETARY OF DEFENSE  
(COMPTROLLER)/CHIEF FINANCIAL OFFICER  
DIRECTOR, DEFENSE RESEARCH AND ENGINEERING

SUBJECT: Summary Report on the Military Departments' Transition of Advanced  
Technology Programs to Military Applications  
(Report No. D-2004-078)

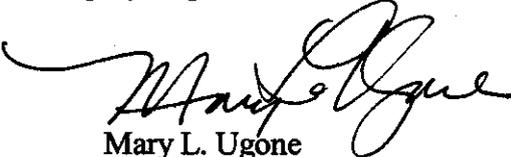
We are providing this report for review and comment. We considered management comments on a draft of this report in preparing the final report.

Comments provided on the draft of this report did not conform to the requirements of DoD Directive 7650.3. Comments provided by the Deputy Under Secretary of Defense for Advanced Systems and Concepts for the Director, Defense Research and Engineering, to Recommendation 1. did not address the recommendations and were nonresponsive. Comments provided by the Deputy Comptroller, Office of the Under Secretary of Defense (Program/Budget) on Recommendation 2. were responsive. We request additional comments from the Deputy Under Secretary of Defense for Advanced Systems and Concepts on Recommendation 1. by May 28, 2004.

If possible, please send management comments in electronic format (Adobe Acrobat file only) to [Audam@dodig.osd.mil](mailto:Audam@dodig.osd.mil). Copies of the management comments must contain the actual signature of the authorizing official. We cannot accept the / Signed / symbol in place of the actual signature. If you arrange to send classified comments electronically, they must be sent over the SECRET Internet Protocol Router Network (SIPRNET).

We appreciate the courtesies extended to the staff. For questions, please call Mr. Bruce Burton at (703) 604-9071 (DSN 664-9071) or Mr. Roger H. Florence at (703) 604-9067 (DSN 664-9067). See Appendix E for the report distribution. The team members are listed inside the back cover.

By the direction of the Deputy Inspector General for Auditing:

  
Mary L. Ugone  
Director  
Acquisition Management Directorate

## Office of the Inspector General of the Department of Defense

Report No. D-2004-078

(Project No. D2003AB-0121)

April 29, 2004

### The Military Departments' Transition of Advanced Technology Programs to Military Applications

#### Executive Summary

**Who Should Read This Report and Why?** Science and technology officials in the Office of the Secretary of Defense and the Military Departments should read this report because it evaluates the DoD process for increasing the likelihood that emerging technology would more quickly transition to the warfighter for use.

**Background.** Congress and DoD officials voiced concern that technology has not quickly transitioned to the warfighter. In response, DoD issued advisory guidance that recommended best practices be adopted to enhance technology transition, and the Military Departments made process changes to improve coordination.

**Results.** The Military Departments' research organizations have not fully adopted the best practices suggested by the Office of the Secretary of Defense for advanced technology development-funded projects. Also, the performance appraisal process for science and technology personnel did not sufficiently address technology transitioning as a performance element. In addition, the financial guidance on using advanced technology development funds does not emphasize technology transitioning. As a result, advanced technology development-funded projects were not sufficiently coordinated to ensure that successful technology would transition to the next development or acquisition stage.

The Director, Defense Research and Engineering should require that best practice procedures be followed to ensure coordination between the science and technology and the communities that acquire the technology for the warfighter to use. The goal of achieving transition also needs to be appropriately measured in science and technology managers' performance plans. In addition, the Under Secretary of Defense (Comptroller)/Chief Financial Officer should revise the definition for using advanced technology development funds in the DoD Financial Management Regulation to emphasize technology transitioning. (See the Finding section of the report for the detailed recommendations.)

**Management Comments.** The Deputy Under Secretary of Defense for Advanced Systems and Concepts provided comments for the Director, Defense Research and Engineering. The Deputy Under Secretary nonconcurred with the recommendations. The Deputy Under Secretary stated that advanced technology development projects do not necessarily lead to subsequent development or procurement because the technology projects may not mature enough to pursue. The Deputy Under Secretary stated that advanced technology development still needs to be conducted to compare and contrast competing technologies before committing to an acquisition program. Requiring an acquisition commitment will lead to fewer systems being evaluated, increased risk, and

less optimal solutions. The Deputy Under Secretary concluded that existing guidance encourages the focus of technology on the ultimate procurement objectives as soon as possible and, therefore, the existing guidance is sufficient to achieve that objective.

The Deputy Comptroller, Office of the Under Secretary of Defense (Program/Budget) concurred with the recommendation to revise the definition for advanced technology development funds in the DoD Financial Management Regulation. See the Finding section of the report for a discussion of management comments and the Management Comments section of the report for the complete text of the comments.

**Audit Response.** Management comments provided by the Deputy Under Secretary of Defense for Advanced Systems and Concepts were nonresponsive to the report and did not address the recommendations. The report focuses on the management process for coordinating advanced technology development projects between the science and technology community and the planned acquisition community so that technology projects that use advanced development funds (budget activity three) have a goal of transitioning some or all technology into the acquisition process within the Future Years Defense Program. Otherwise those projects should be replaced with more viable candidates. Having a management process that requires goals for technology transitioning, integrated product teams, memorandums of understanding for technology development, and funding to transition the technology as it matures increases the likelihood that some or all technology will transition more quickly to the warfighter for use. We request that the Deputy Under Secretary of Defense for Advanced Systems and Concepts provide additional comments on the final report by May 28, 2004.

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## Background

**Defense Acquisition Guidance.** The Deputy Secretary of Defense issued DoD Directive 5000.1, “The Defense Acquisition System,” on May 12, 2003. The directive states that science and technology (S&T) programs shall address user needs; maintain a broad-based program spanning all Defense-related sciences and technologies to anticipate future needs and those not being pursued by civil or commercial communities; preserve long-range research; and enable rapid, successful transition from S&T programs to useful military products. The directive goes on to state that advanced technology shall be integrated into producible systems and deployed in the shortest time practical. In addition, coordination through teaming among warfighters, users, developers, acquirers, technology experts, industry, testers, budgeting officials, and system maintainers should begin during the requirements definition phase.

**Science and Technology Guidance.** In 1999, the DoD S&T Affordability Task Force chartered by the Director for Defense Research and Engineering issued a Handbook and, in 2001, the Deputy Under Secretary of Defense for Science and Technology issued a Guide to the Military Departments and Defense agencies that contained best practices which, if instituted, would assist in transitioning technology. In 2003, the Under Secretary of Defense for Acquisition, Technology, and Logistics issued a Manager’s Guide that reemphasized the technology management issues cited in the Handbook and the Guide. In addition, in response to congressional concerns that DoD had not been successful in transitioning technology, the Under Secretary of Defense for Acquisition, Technology, and Logistics issued advisory guidance to the Military Departments and Defense agencies and a report to Congress identifying why technology was not transitioning. See Appendix B for more details on the S&T guidance issued and the recommended best practices.

**Director, Defense Research and Engineering.** The Director, Defense Research and Engineering is the principal advisor and assistant to the Under Secretary of Defense for Acquisition, Technology, and Logistics on all matters associated with science and technology. As principal advisor, he provides direction on the DoD S&T Program; establishes vision, strategies, and priorities; and oversees program management, execution, and output. In this capacity, he directs the Military Departments and Defense agencies on all S&T activities that are supported by funds for basic research, applied research, and advanced technology development. The Director, Office of Technology Transition, who assists the Director, Defense Research and Engineering in executing the DoD S&T Program, is responsible for formulating policies and establishing and managing programs that transition advanced technologies from research and development to weapon systems in an affordable manner.

**Army S&T Process.** The Army Science and Technology Master Plan presents the S&T investments that are required to achieve the Army vision of transforming its force’s capabilities to dominate the full spectrum of operations. The Army vision is to create an Objective Force capable of deploying a combat brigade in 96 hours, a combat division in 120 hours, and five combat divisions in 30 days to anywhere in the world. The Army S&T projects were reshaped to speed

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development of technologies necessary to achieve the Army's transformation vision. The transformation path from today's force to the future Objective Force includes incorporating technologies into existing and developing systems. The Army funded about 260 advanced technology projects or tasks from FYs 1999 through 2001 to develop capabilities for military applications. The Army funding for advanced technology development in FY 2003 was \$1.04 billion.

**Navy Future Naval Capabilities Process.** In 1998, the Vice Chief of Naval Operations instituted the Future Naval Capabilities (FNCs) process to focus the S&T investment on achieving future capabilities for Naval forces. The Navy adopted the process in November 1999. The Office of Naval Research is responsible for managing the Navy's S&T budget and for executing the FNCs. The FNC process was designed to align and partner the requirements, acquisition, and S&T communities to deliver and transition priority Naval capabilities within 1 to 6 years and also to bridge the gap between the acquisition community and the Office of Naval Research. At the center of the FNC process, an integrated product team (IPT) for each FNC brings together key members at the Flag Officer or Senior Executive Service level from the requirements, acquisition, and S&T communities.

The Vice Chief of Naval Operations, the Assistant Commandant of the Marine Corps, and the Assistant Secretary of the Navy for Research, Development, and Acquisition approved 12 FNCs that concentrate the Navy's S&T resources on achieving the highest priority capabilities. Each FNC consists of multiple projects to develop capabilities. The FNC process formally began in FY 2002. The Navy funding for advanced technology development in FY 2003 was \$836 million.

**Air Force Process.** In 1997, the Air Force Research Laboratory (AFRL) was created through the consolidation of four former Air Force laboratories and the Air Force Office of Scientific Research. The four laboratories were reorganized into nine directorates, each with different technology disciplines. The nine technology directorates are responsible for exploratory technology development (applied research) and advanced technology development research, and the Office of Scientific Research is responsible for basic research.

The AFRL Science and Technology Mission Area Strategic Plan for FYs 2002 through 2009 provides a roadmap for the future technologies. The objective of the S&T program is to provide the technical foundation for the Air Force. In addition, the AFRL Strategic Plan for FYs 2002 through 2009 established a core strategic objective to demonstrate and transition technology to useful military products. To accomplish that objective, AFRL partnered with the Major Commands to ensure that at least 50 percent of the AFRL advanced technology development funds are directed towards advanced technology demonstrations (ATDs) through FY 2009. Another goal of this partnership was to ensure funding for 75 percent of the ATD transition plans. The Air Force funding for advanced technology development in FY 2003 was \$706 million.

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## **Objective**

The objective of this report is to summarize the audits of the Military Departments' processes for transitioning advanced technology development projects to military applications and to develop recommendations for the Office of the Secretary of Defense to improve the process. See Appendix A for a discussion of the audit scope and methodology and prior coverage for the three Military Departments' reports.

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## Transitioning of Advanced Technology Development Projects

The Military Departments' research organizations had not fully adopted the best practices suggested by OSD for advanced technology development-funded projects. The performance appraisal process for S&T personnel also did not sufficiently address technology transitioning as a performance element. In addition, the financial guidance on using advanced technology development funds does not emphasize technology transitioning. Those conditions exist because the best practices are advisory and because the Military Departments' research officials believe that different standards exist among projects funded with advanced technology development resources. As a result, advanced technology development-funded projects were not sufficiently coordinated to ensure that successful technology would transition to the next development or acquisition stage.

### Technology Development Guidance

The Deputy Secretary of Defense issued acquisition guidance on May 12, 2003, that requires the Military Departments' S&T programs to address user needs, maintain a broad-based program spanning all Defense-related sciences and technologies to anticipate future needs and those not being pursued by civil or commercial communities, preserve long-range research, and enable rapid successful transition from the S&T base to useful military products.

The Handbook and Guide (discussed in Appendix B) provide best practices and procedures for S&T managers' consideration in enhancing the likelihood that ATD projects will transition to the warfighter. The Handbook practices were endorsed by the Deputy Under Secretary of Defense for Acquisition and Technology's Affordability Task Force that was chartered by the Director, Defense Research and Engineering. The Guide practices were endorsed by the Deputy Under Secretary of Defense for Science and Technology to develop solutions on how to strengthen DoD S&T programs for transitioning to the warfighter.

The Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics issued a "Manager's Guide to Technology Transition in an Evolutionary Acquisition Environment," January 31, 2003, which reemphasized the best practices that were endorsed in the Handbook and Guide.

### Science and Technology Projects Reviewed

**Advanced Technology Development Projects Reviewed.** The Military Departments developed their own processes for identifying and managing ATD projects.<sup>1</sup> The prior audits of the Army, Navy, and Air Force examined 89 projects

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<sup>1</sup>Reference to individual Military Department audit reports can be found in Prior Coverage, Appendix A.

that were funded with advanced technology development funds under the research, development, test, and evaluation appropriation. Funding for the 89 projects in FY 2003 was \$336 million, with an additional \$650 million planned for FY 2004 through FY 2007. The Military Departments planned to complete 75 of the 89 projects before FY 2007. The following table summarizes the audit results using the recommended best practices outlined in the Handbook and the Guide. Appendix B describes the best practices. Appendix D provides the details of the individual Military Department audit results.

### **Advanced Technology Development-Funded Projects<sup>2</sup>**

<b><u>IPTs at the Project Level</u></b>	<b><u>Army</u></b>		<b><u>Navy</u></b>		<b><u>Air Force</u></b>	
	<b><u>Projects</u></b>	<b><u>Percent</u></b>	<b><u>Projects</u></b>	<b><u>Percent</u></b>	<b><u>Projects</u></b>	<b><u>Percent</u></b>
Team established	13 of 20	65	33 of 37	89	23 of 28	82
Charter established	7 of 13	54	0 of 33	0	2 of 23	9
Acquisition program manager included	13 of 27	48	33 of 38	87	23 of 24	96
Acquisition program prime contractor included	12 of 27	44	24 of 28	86	21 of 22	95
<b><u>Planned Technology Recipient</u></b>						
MOU/MOA/TTP/TTA <sup>3</sup>	5 of 40	13	26 of 39	67	12 of 28	43
Exit TRLs <sup>4</sup> formally agreed	0 of 29 <sup>4</sup>	0	12 of 39	31	7 of 29	24
Exit criteria formally agreed	3 of 40	8	22 of 39	56	11 of 29	38
Currently funded by acquisition user to transition	4 of 26	15	0 of 5	0	5 of 13	38

<sup>2</sup>Each business practice element does not add to 89 because not all elements applied. See Appendix D for individual Military Department's results.

<sup>3</sup>Memorandum of Understanding (MOU), Memorandum of Agreement (MOA), Technology Transition Plan (TTP), Technology Transition Agreement (TTA).

<sup>4</sup>Technology Readiness Levels (TRL). At the time of the Army review, the TRL requirement had only recently been established. The TRL requirement was established in July 2001.

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## Project Level Coordination

The Deputy Secretary of Defense issued acquisition guidance on May 12, 2003, which states that IPTs will be used and the teams will include warfighters, users, developers, acquirers, technology experts, industry, testers, budgeting officials, and system maintainers. To be effective, IPTs must include the acquisition program manager(s) and have an established charter that identifies individual roles and responsibilities. The prime contractor should also be considered for IPT participation, if appropriate, to facilitate the technology integration.

The establishment of IPTs between the S&T manager and the planned recipient has been recognized as a significant contributor to coordination at the Military Department level. The table shows that IPTs were established for most of the S&T projects and that the IPTs included representatives from the planned technology recipient as well as the recipient's prime contractor. However, we were told that IPTs were generally not established for S&T projects in the early phases of advanced technology development because those projects were usually associated with technologies recognized by the S&T community (referred to as technology push), as opposed to projects that focus on satisfying a near-term military need (referred to as technology pull). Technology push projects are sponsored by the S&T community and are not necessarily recognized by the user as a requirement. The Military Departments characterized those S&T projects as early advanced technology development-funded efforts that had not been well defined and therefore were not ready for coordination with a planned technology recipient. The Handbook emphasizes that coordination is a best practice and should begin early in the process to ensure that the technology will be properly received and incorporated by the planned user.

The Handbook states that IPT charters provide the best way to minimize team misunderstanding. The Handbook does not make a distinction between early or later advanced technology development projects and it states that coordination should begin even before the technology reaches the advanced development phase. The Handbook provides that the charter for each IPT should include:

- mission and objectives of the team,
- metrics to evaluate the team's progress,
- scope of the team's responsibility,
- relationship of the team with other teams,
- authority and accountability of the team,
- resources available for the team, and
- team membership list.

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The Director, Defense Research and Engineering needs to emphasize to the S&T community the importance of IPTs and IPT charters for all advanced technology development projects to ensure that the organizational agreements are established.

## Planned Technology Recipient

To improve the likelihood of technology transition, the planned technology recipients, in many cases acquisition program managers, must make a firm commitment to transition the technology to their programs. The commitment should include a formal and up-to-date memorandum of agreement or technology transition plan between the S&T product manager and the planned technology receiver(s). Each memorandum should specify the relationships and responsibilities of the S&T product manager and the planned technology receiver(s). The agreement should address system requirements, funding, personnel support, exit criteria, and TRLs.

**Formal Agreements.** Formal agreements are recognized in the Guide and the Handbook as an important element for technology transitioning because they establish a “meeting of the minds” between the S&T community and the recipient. The table on page 5 shows that formal agreements between the S&T manager and the acquisition program manager (or other planned technology recipient) were not being established for most of the projects. The formal agreements need to include TRLs and exit criteria as a basis for evaluating technological maturity. The inability to establish a formal agreement can be an indicator to management that the emerging technology may not transition, either because the technology has not been endorsed or because the receiving community has not budgeted for the technology. To better implement the practices in the Guide and the Handbook, the Director, Defense Research and Engineering should issue policy to formalize the requirement for these agreements.

**Technology Readiness Levels.** DoD adopted TRLs in response to the General Accounting Office Report, “Best Practices: Better Management of Technology Development Can Improve Weapon System Outcomes,” issued in July 1999. A TRL is an assessment of the technical maturity of an S&T project. The TRLs range from one through nine, with more mature S&T projects having a higher TRL and therefore a higher expectation of transitioning to an acquisition program. See Appendix C for a more detailed description of TRLs. In July 2001, the Deputy Under Secretary of Defense for Science and Technology issued a memorandum to the Military Departments and Defense agencies that emphasized the development of TRLs; however, agreement on TRLs still needs to be stressed. For example, at the time of the audits only 19 of 97 recipients had formally agreed to exit TRLs.<sup>5</sup> To increase the agreement on TRLs, the Director, Defense Research and Engineering should issue policy to formalize the requirement for their establishment.

**Exit Criteria.** Exit criteria describe the capabilities, the expected performance parameters and conditions of measurement, the range of acceptable performance improvements, and the test conditions and verification methods for measuring performance. The table on page 5 indicates that S&T managers were not

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<sup>5</sup>Although 89 technology projects were reviewed, some technologies had more than one planned recipient.

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successful in establishing exit criteria because formal agreements on exit criteria were established for only 36 of the 108 primary recipients (some of the technologies had more than 1 primary planned recipient). The Director, Defense Research and Engineering should issue policy to require the establishment of exit criteria for advanced technology development-funded projects.

**Technology Receiver Funding.** The planned technology recipients (usually acquisition programs) were not providing the funding required to transition technology. As shown in the table on page 5, 32 of the 89 projects reviewed had 44 acquisition recipients. Of the 44 recipients, only 9 had identifiable funds for transitioning technologies for near-term planned transitions. As a requirement for continued research expenditure, technology recipients should be required to specifically identify transitioning funds, particularly for near-term transitions, to ensure that adequate funds are available.

## Technology Push

The S&T community is responsible for providing technology capabilities for known military needs and for providing innovative technologies for future military needs. Developing innovative technology for future needs not yet recognized by the acquisition community is known as technology push. Technology push research is usually initiated by the S&T community and provides a military capability or counters a threat that the potential user has not yet recognized or acknowledged as a potential threat. In response to the Army audit report, officials asserted that technology push efforts have led to innovative technology capabilities that otherwise would not have been developed. Most technology push projects are early stage development efforts and are not characterized as advanced technology demonstrators and therefore, S&T officials do not believe technology push projects warrant the same level of coordination with the planned recipients as the more mature advanced technology demonstration projects.

The technology push projects represent a significant portion of the Military Departments' advanced technology development in the research, development, test, and evaluation appropriation. The Army, Navy, and Air Force identified what they considered as technology push. For FY 2003 and FY 2004, the Army reported that it had about \$151 million (24 percent) and \$341 million (41 percent), respectively, of advanced technology development funds allocated to technology push research (identified in the Army as science and technology objectives). The Navy reported that it had approximately \$241 million (41 percent) for FY 2003 and \$186 million (38 percent) identified as technology push projects in the 12 FNCs. The Air Force reported approximately \$70 million (15 percent) for FY 2003 and \$86 million (15 percent) for FY 2004 as technology push projects.

The "Manager's Guide to Technology Transition in an Evolutionary Acquisition Environment," January 31, 2003, sponsored by the Office of the Under Secretary of Defense for Acquisition, Technology and Logistics, states that ATDs should have a finite program duration, agreed-upon exit criteria, and transition plans. It was unclear when technology push (non-advanced technology demonstration) projects are required to be coordinated with planned technology recipients because a clear

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distinction between these non-advanced technology demonstrations projects and the more advanced development projects had not been established. To improve technology transition, the Director, Defense Research and Engineering should issue policy to clarify the level of advanced technology development funds that should be associated with technology push projects. The policy should provide the S&T community guidance as to what extent technology push projects should implement best practices to ensure coordination during technology development.

## **Personnel Performance Assessments**

The Handbook states that one of the keys to successful transitioning is an S&T personnel assessment process that is based on technology transitioning, in addition to an individual's technical achievements and published technical papers. Our prior audits shown in Appendix A of the Military Departments' processes showed that the performance plans for S&T personnel who are responsible for developing advanced technology development-funded projects did not include the performance requirements necessary to rate S&T personnel on transition technology efforts. We recommended from those audits that the personnel performance plans for officials who are responsible for advanced technology development-funded programs should explicitly require a supervisor's assessment of the manager's performance with planned technology users.

The recommendation in the Handbook should be a requirement for such S&T managers. The performance plans for S&T personnel should include an assessment regarding the manager's establishment of project-level IPTs with all planned technology users, creation of IPT charters, coordination and acceptance of quantitative metrics and key exit criteria with all planned users, development of transition plans that are formally agreed to by all planned users, and development and maintenance of up-to-date memorandums of agreement or understanding, or technology transition plans. Therefore, the Director, Defense Research and Engineer should issue policy that requires S&T officials who are responsible for advanced technology development projects to have a rating element for technology coordination that evaluates the official's effectiveness in establishing project-level IPTs with all planned recipients, in creating IPT charters, in coordinating and agreeing upon quantitative metrics and key exit criteria with all planned recipients, and in developing and maintaining up-to-date memorandums of agreement or technology transitions plans.

## **Financial Management Regulation**

The DoD Financial Management Regulation, June 2002, defines advanced technology development under the research, development, test, and evaluation appropriation as efforts that prove technology feasibility and assess subsystem and component operability and producibility rather than efforts that develop hardware for services. The Financial Management Regulation states that projects funded with advanced technology development resources must be directly related to an identified military need. The projects demonstrate the general military utility or cost-reduction

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potential of the technology when applied to different military equipment or techniques. The Financial Management Regulation also states, “. . . projects in this category do not necessarily lead to subsequent development or procurement phases.” During our individual Military Department audits, an S&T official defended the lack of coordination by stating that a definition in the Financial Management Regulation allows expenditure of advanced technology development funds on projects that do not necessarily lead to subsequent development or procurement. We believe that this interpretation is contrary to the goals of advanced technology development.

To improve technology transitioning, the Under Secretary of Defense (Comptroller) definition in the DoD Financial Management Regulation for using advanced technology development funds should be modified to emphasize that the goal of advanced technology development projects should be to transition during the future years defense program (a 6-year period) beginning from the initial year of funding.

## Conclusion

The Guide, Handbook, and the Manager’s Guide provide advice on best practices for the S&T community to consider when managing advanced technology development projects. The audit results showed that the advisory guidance was partially implemented, but that implementation varied based on the maturity of the technology and whether the technology was initiated as a technology push effort. In addition, the personnel assessment process does not adequately evaluate whether S&T officials established a coordination process and whether coordination enhanced the likelihood of technology transition. The Director, Defense Research and Engineering needs to issue policy that requires adherence to best practices and incorporates the implementation of those practices in personnel evaluations.

The Under Secretary of Defense (Comptroller)/Chief Financial Officer needs to revise the DoD Financial Management Regulation definition for using funds for advanced technology development under the research, development, test, and evaluation appropriation to emphasize the Department’s goal of transitioning technology to recipients.

## Recommendations, Management Comments, and Audit Response

**1. We recommend that the Director, Defense Research and Engineering issue guidance that:**

**a. Establishes criteria for advanced technology development-funded projects that are developing innovative technology for future needs (technology push). The criteria should establish Military Department goals on the proportion of advanced technology development funds that should be associated with technology push and requirements pull as part of amounts budgeted for advanced technology development.**

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**b. Requires the establishment of project-level integrated product teams and charters for all advanced technology development-funded projects that include the planned technology recipients and their prime contractors, where applicable.**

**c. Requires the establishment of formal memorandums of agreements that include technology readiness levels and exit criteria for all advanced technology development-funded projects, and the identification of the necessary technology receiver funding.**

**d. Requires the Military Department to include a rating element in science and technology personnel evaluations on the effectiveness of the manager for advanced technology development-funded projects in establishing project-level integrated product teams with all planned recipients, creating integrated product team charters, coordinating and obtaining agreement on quantitative metrics and key exit criteria with all planned recipients, and developing and maintaining up-to-date memorandums of agreement or technology transitions plans.**

**e. Requires that advanced technology development-funded projects should have the goal of transitioning science and technology development into the acquisition process within the future years defense program.**

**Management Comments.** The Deputy Under Secretary of Defense for Advanced Systems and Concepts provided comments for the Director, Defense Research and Engineering. The Deputy Under Secretary stated that the definition of advanced technology development (budget activity three in the DoD Financial Management Regulation) is “projects in this category do not necessarily lead to subsequent development and procurement phases.” This is because S&T projects may not be technically mature enough for commitment to the next development phase or procurement. The Deputy Under Secretary stated that the audit’s premise is that advanced technology development projects should have procurement commitments. The Deputy Under Secretary stated that advance technology development projects may still need to be conducted without the commitment to compare and contrast competing technologies before committing to an acquisition program. Requiring an acquisition commitment for advanced technology development projects will lead to fewer systems being evaluated, increased risk, and less optimal solutions. The Deputy Under Secretary concluded that existing guidance encourages the focus of technology on the ultimate procurement objectives as soon as possible and; therefore, the guidance is sufficient to achieve that objective. The Deputy Under Secretary nonconcurred with the recommendations because they would require the use of advanced technology development funds (budget activity three) to be redefined.

**Audit Response.** Management comments provided by the Deputy Under Secretary of Defense for Advanced Systems and Concepts were nonresponsive to the report and do not address the recommendations. This report focuses on the management process for coordinating advanced technology development projects between the S&T community and the planned acquisition community so that technology projects that use advanced development funds (budget activity three) have a goal of transitioning some or all of the emerging technology into the acquisition process in the Future Years Defense Program. Otherwise these projects should be replaced with more

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viable candidates. Having a management process that requires goals for technology transitioning, integrated product teams, memorandums of understanding for technology development, and funding to transition technology as it matures increases the likelihood that some or all technology being funded with advanced development funds will transition to the warfighter for use. In reference to the Deputy Under Secretary comments that the recommendations would require the use of advanced technology development funds (budget activity three) to be redefined, the recommendation to revise the definition to emphasize the goal of transitioning technology (Recommendation 2. below) was concurred with by the Deputy Comptroller, Office of the Under Secretary of Defense (Program/Budget). Accordingly we request that the Deputy Under Secretary of Defense for Advanced Systems and Concepts provide additional comments on the final report.

**2. We recommend that the Under Secretary of Defense (Comptroller)/Chief Financial Officer revise the DoD Financial Management Regulation definition for using advanced technology development funds under the research, development, test, and evaluation appropriation to emphasize that projects funded with this appropriation should have the goal of transitioning to the planned technology receiver within the future years defense program.**

**Management Comments.** The Deputy Comptroller, Office of the Under Secretary of Defense (Program/Budget) concurred with the recommendation.

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## Appendix A. Scope and Methodology

This report summarizes the results of three audit reports issued from April 2001 through May 2003 by the Inspector General of the Department of Defense on the Military Departments' transition of advanced technology development projects to military applications (see Prior Coverage for a list of the reports). We conducted analysis of financial policy and interviewed officials from the Offices of the Under Secretary of Defense (Comptroller) and the Director, Defense Research and Engineering. We used our analysis and the results of the three previous reports to develop our finding, conclusions, and recommendations.

We performed this audit from June through December 2003 in accordance with generally accepted government auditing standards. However, we did not review the management control program for this report or perform required steps for determining illegal acts because this audit focused on summarizing previous audit results.

**Use of Computer-Processed Data.** We did not rely on computer-processed data in preparing this summary report. However, we relied on computer-processed data for each of the prior reports summarized in this report.

**General Accounting Office High-Risk Area.** The General Accounting Office has identified several high-risk areas in DoD. This report provides coverage of the Improving DoD Weapon System Acquisition Process high-risk area.

### Prior Coverage

During the last 5 years, the General Accounting Office (GAO) and the Inspector General of the Department of Defense (IG DoD) have issued four reports discussing technology transitioning. Unrestricted GAO reports can be accessed over the Internet at <http://www.gao.gov>. Unrestricted Inspector General of the Department of Defense (IG DoD) reports can be accessed at <http://www.dodig.osd.mil/audit/reports>.

### GAO

Report No. NSIAD-99-162, "Best Practices: Better Management of Technology Development Can Improve Weapon System Outcomes," July 30, 1999

### IG DoD

IG DoD Report No. D-2003-132, "Air Force Transition of Advanced Technology Programs to Military Applications," September 12, 2003

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IG DoD Report No. D-2003-053, "Navy Transition of Advanced Technology Programs to Military Applications," February 4, 2003

IG DoD Report No. D-2002-107, "Army Transition of Advanced Technology Programs to Military Applications," June 14, 2002

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## Appendix B. Advanced Technology Guidance Background

The following paragraphs discuss guidance on best practices issued by various proponents to enhance technology transitioning as discussed in this report.

**Addressing Affordability in Defense Science and Technology (S&T): A Handbook for S&T Managers.** In October 1999, the DoD S&T Affordability Task Force issued a Handbook that stresses the importance of early involvement of all candidate acquisition programs in advanced technology projects. The Handbook states that early involvement of advanced technology candidate acquisition programs in research, development, design, test planning, manufacturing, training, logistics, financing, and contracting are essential to address key issues that lock in a majority of the life-cycle costs of programs. The Handbook states that management tools for ensuring effective technology transitioning include establishing integrated product teams (IPTs), creating IPT charters, identifying quantitative metrics and key exit criteria, and developing a formal transition plan that is officially signed by the technology manager and the “customer” (usually an acquisition community member). Additional management tools include preparing an approved memorandum of agreement that identifies roles and responsibilities of the various participants, and a funding strategy that commits the acquisition community to transition the technology.

**Technology Transition for Affordability: A Guide for S&T Program Managers.** In April 2001, the Deputy Under Secretary of Defense for Science and Technology issued a Guide to provide S&T managers with strategies to transition technology to the acquisition community. The Guide states that the transition of technology should be timely (get the technology in the hands of the warfighter as soon as possible) and cost-effective (provide the best technology at the lowest possible cost). The Guide states that a key strategy for transitioning technology is early coordination between the S&T project manager and the receiving acquisition manager to promote a mutual understanding between the two parties.

The Guide states that IPTs should include the S&T product manager, the S&T contractor, the acquisition manager(s) and the respective contractor(s), and test and evaluation representatives. It specifies that an IPT should be formed early in the life cycle of a technology’s development to address key issues that can greatly affect life-cycle cost and the eventual acceptance and implementation of the technology. Issues that the IPT should address include defining and agreeing upon quantifiable metrics, such as cost, performance, and schedule; exit criteria; and the maturity of the technology at transition identified as technology readiness levels (TRLs) (the various levels are described in Appendix C). The Guide states that those issues and others should be agreed upon in formal documentation such as a memorandum of agreement and a technology transition plan.

**Under Secretary of Defense for Acquisition, Technology, and Logistics Report to Congress.** In June 2001, the Under Secretary of Defense for Acquisition, Technology, and Logistics provided a Defense Advanced Research Projects Agency report on technology transitioning to congressional defense committees. The report provided Congress with the results of a review of the transition of research to the

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Military Departments from the Defense Advanced Research Projects Agency and addressed issues that also applied to the transition of research technology to acquisition program managers and, ultimately, to the warfighter. The report stated that a key reason for difficult technology transition was the need for collaboration among three diverse groups: the S&T researcher, the acquisition program manager, and the military user. Effective transition requires the groups to work together as a team, which is frequently difficult. In addition, for a technology to transition successfully, the acquisition program manager's prime contractor must support the technology insertion, and the technology must demonstrate a greater return than the existing capability.

**Manager's Guide to Technology Transition in an Evolutionary Acquisition Environment.** In January 2003, the Under Secretary of Defense for Acquisition, Technology, and Logistics reemphasized that the guidance in the Handbook and Guide was intended to be a source of information to promote collaboration among team members. It provides an overview of the processes, communities, programs, and challenges associated with technology transition.

## Appendix C. Technology Readiness Levels and Their Definitions

The Deputy Secretary of Defense issued interim acquisition guidance on October 30, 2002, which provided a matrix of technology readiness levels and descriptions from a systems approach for both hardware and software as shown below.

<b>Technology Readiness Level</b>	<b>Description</b>
1. Basic principles observed and reported.	Lowest level of technology readiness. Scientific research begins to be translated into applied research and development. Examples might include paper studies of a technology's basic properties.
2. Technology concept and/or application formulated.	Invention begins. Once basic principles are observed, practical applications can be invented. The applications are speculative and there may be no proof or detailed analysis to support the assumptions. Examples are limited to analytic paper studies.
3. Analytical and experimental critical function and/or characteristic proof of concept.	Active research and development is initiated. This includes analytical studies and laboratory studies to physically validate analytical predictions of separate elements of the technology. Examples include components that are not yet integrated or representative.
4. Component and/or breadboard validation in laboratory environment.	Basic technological components are integrated to establish that they will work together. This is relatively "low fidelity" compared to the eventual system. Examples include integration of "ad hoc" hardware in a laboratory.
5. Component and/or breadboard validation in relevant environment.	Fidelity of breadboard technology increases significantly. The basic technological components are integrated with reasonably realistic supporting elements so it can be tested in simulated environment. Examples include "high fidelity" laboratory integration of components.
6. System/subsystem model or prototype demonstration in a relevant environment.	Representative model or prototype system, which is well beyond that of TRL 5, is tested in a relevant environment. Represents a major step up in a technology's demonstrated readiness. Examples include testing a prototype in a high fidelity laboratory environment or in a simulated operational environment.
7. System prototype demonstration in an operational environment.	Prototype near, or at, planned operational system. Represents a major step up from TRL 6, requiring the demonstration of an actual system prototype in an operational environment such as an aircraft, vehicle, or space. Examples include testing the prototype in a test bed aircraft.
8. Actual system completed and qualified through test and demonstration.	Technology has been proven to work in its final form and under expected conditions. In almost all cases, this TRL represents the end of true system development. Examples include developmental test and evaluation of the system in its intended weapon system to determine if it meets design specifications.
9. Actual system proven through successful mission operations.	Actual application of the technology in its final form and under mission conditions, such as those encountered in operational test and evaluation. Examples include using the system under operational mission conditions.

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## Appendix D. Summary of Audit Results in Prior Audits of the Military Departments' Advanced Technology Programs

### Army

#### Summary of Science and Technology Objectives (STOs) and Advanced Technology Demonstrations (ATDs) Examined (ratio shows positive responses to total examined)

	Number of Occurrences		Percent of Occurrences	
	<u>14 STOs</u>	<u>6 ATDs</u>	<u>14 STOs</u>	<u>6 ATDs</u>
<u>IPT at the product level</u>				
Team established	7 of 14	6 of 6	50	100
Charter approved	3 of 7 <sup>1</sup>	4 of 6 <sup>1</sup>	43	67
Acquisition program manager included	9 of 16 <sup>2</sup>	4 of 11 <sup>2</sup>	56	36
Acquisition program prime contractor included	7 of 16 <sup>3</sup>	5 of 11 <sup>3</sup>	44	45
<u>Acquisition Program Manager</u>				
MOA/MOU	3 of 29 <sup>4</sup>	2 of 11 <sup>4</sup>	10	18
Exit TRLs formally agreed	0 of 26 <sup>5</sup>	0 of 3 <sup>5</sup>	0	0
Exit criteria formally agreed	1 of 29 <sup>4</sup>	2 of 11 <sup>4</sup>	3	18
Funding by acquisition user to transition	4 of 20 <sup>6</sup>	0 of 6 <sup>7</sup>	20	0

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<sup>1</sup> Charters were established for projects that had IPTs.

<sup>2</sup> S&T projects that established IPTs applied to more than one existing acquisition program.

<sup>3</sup> S&T projects that established IPTs applied to more than one existing acquisition program prime contractor.

<sup>4</sup> The 14 STOs and 6 ATDs applied to 29 and 11 existing acquisition programs, respectively.

<sup>5</sup> The two STOs that applied to three acquisition programs and two ATDs that applied to eight existing acquisition programs were completed before the requirement for TRLs.

<sup>6</sup> The number of STOs that should have funding was 20 instead of 29 because for 9 STOs funding documentation was unavailable, the technology was a manufacturing improvement, or the user had not been defined.

## Navy

### Summary of Science and Technology Products and Advanced Technology Demonstrations (ATDs) Examined (ratio shows positive responses to total examined)<sup>8</sup>

	Number of Occurrences		Percent of Occurrences	
	<u>33 Products</u> <sup>9</sup>	<u>6 ATDs</u> <sup>10</sup>	<u>33 Products</u>	<u>6 ATDs</u>
<u>IPT at the product level</u>				
Team established	30 of 33	3 of 4 <sup>10</sup>	91	75
Charter established	0 of 30	0 of 3	0	0
Acquisition program manager included	30 of 35 <sup>11</sup>	3 of 3	86	100
Acquisition program prime contractor included	21 of 25 <sup>12</sup>	3 of 3	84	100
<u>Acquisition Program Manager</u>				
MOA/MOU/TTA	23 of 35 <sup>11</sup>	3 of 4	66	75
Exit TRLs formally agreed	12 of 35	0 of 4	34	0
Exit criteria formally agreed	20 of 35	2 of 4	57	50
Funding by acquisition user to transition	0 of 5	0 of 0	0	

<sup>7</sup> The number of receiving acquisition programs for ATDs that should have had funding was 6 instead of 11 because Aviation Applied Technology Directorate officials stated that, for five programs, only pieces of the Rotocraft Pilots Association technology were to transition.

<sup>8</sup> Draft documents were not considered as a positive response.

<sup>9</sup> Reviewed 33 products: 14 of Knowledge, Superiority and Assurance; 6 of Littoral Antisubmarine Warfare; 5 of Organic Mine Countermeasures; and 8 of Fleet Force Protection.

<sup>10</sup> We reviewed six ATDs. Of the six ATDs, four were scheduled for transitions to acquisition programs. Two were scheduled for transition to an FNC, but with the same manager. As such, no coordination between parties is necessary for these two efforts.

<sup>11</sup> Thirty-three products identified 35 primary acquisition program recipients for the developing technologies (1 product in Fleet Force Protection had 2 additional prime recipients identified). Thirty of the 33 recipients were included in the working-level IPTs.

<sup>12</sup> Of the 30 acquisition program recipients included in working-level IPTs, 25 had contractors identified. Twenty-one of the 25 contractors were participating in the working-level IPTs.

## Air Force

### Summary of Science and Technology Advanced Technology Demonstrations (ATDs) and Critical Experiments (CEs) Examined (ratio shows positive responses to total examined)<sup>13</sup>

	Number of Occurrences		Percent of Occurrences <sup>14</sup>	
	<u>24 ATDs</u>	<u>6 CEs</u>	<u>24 ATDs</u>	<u>6 CEs</u>
<u>IPT at the product level</u>				
Team established	19 of 22	4 of 6	86	67
Charter established	1 of 19 <sup>15</sup>	1 of 4 <sup>16</sup>	5	25
Acquisition program manager included	19 of 20 <sup>17</sup>	4 of 4	95	100
Acquisition program prime contractor included	18 of 19 <sup>15</sup>	3 of 3 <sup>15</sup>	95	100
<u>Acquisition Program Manager</u>				
MOA/MOU/TTP <sup>18</sup>	11 of 22	1 of 6	50	17
Exit TRLs formally agreed	7 of 23 <sup>17</sup>	0 of 6	30	0
Exit criteria formally agreed	10 of 23 <sup>17</sup>	1 of 6	43	17
Funding by acquisition user to transition	5 of 13 <sup>19</sup>	0 of 0 <sup>19</sup>	38	

<sup>13</sup>Draft documents were not considered a positive response. Responses deemed “not applicable” were not included in the base.

<sup>14</sup>The percentage of occurrences represent the results of projects examined and may not necessarily represent the results of all projects in the AFRL advanced technology demonstration funded universe.

<sup>15</sup>Nineteen of the 24 ATDs reviewed had working-level IPTs. The base for the CEs was reduced by one because one project did not have an identified acquisition program contractor.

<sup>16</sup>Four of the six CEs had working-level IPTs.

<sup>17</sup>One technology had two identified users, therefore the base was increased by one.

<sup>18</sup>Memorandum of Agreement, Memorandum of Understanding, Technology Transition Plan.

<sup>19</sup>Twelve of the 24 ATDs had near-term transitions dates (one of the ATDs has two recipients, therefore the 12 is 13). AFRL does not require CEs to have a transition path and therefore the CEs do not have an established scheduled to transition.

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## **Appendix E. Report Distribution**

### **Office of the Secretary of Defense**

Under Secretary of Defense for Acquisition, Technology, and Logistics  
  Director, Defense Research and Engineering  
    Deputy Under Secretary of Defense for Advanced Systems and Concepts  
Under Secretary of Defense (Comptroller)/Chief Financial Officer  
  Deputy Chief Financial Officer  
  Deputy Comptroller (Program/Budget)

### **Department of the Army**

Assistant Secretary of the Army for Acquisition, Logistics, and Technology  
Assistant Secretary of the Army (Financial Management and Comptroller)  
Auditor General, Department of the Army

### **Department of the Navy**

Assistant Secretary of the Navy (Research, Development, Acquisition)  
  Chief of Naval Research  
Naval Inspector General  
Auditor General, Department of the Navy

### **Department of the Air Force**

Assistant Secretary of the Air Force for Acquisition  
Assistant Secretary of the Air Force (Financial Management and Comptroller)  
Commander, Air Force Materiel Command  
  Commander, Air Force Research Laboratory  
Auditor General, Department of the Air Force

### **Non-Defense Federal Organization**

Office of Management and Budget

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## **Congressional Committees and Subcommittees, Chairman and Ranking Minority Member**

Senate Committee on Appropriations  
Senate Subcommittee on Defense, Committee on Appropriations  
Senate Committee on Armed Services  
Senate Committee on Governmental Affairs  
House Committee on Appropriations  
House Subcommittee on Defense, Committee on Appropriations  
House Committee on Armed Services  
House Committee on Government Reform  
House Subcommittee on Government Efficiency and Financial Management, Committee on Government Reform  
House Subcommittee on National Security, Emerging Threats, and International Relations, Committee on Government Reform  
House Subcommittee on Technology, Information Policy, Intergovernmental Relations, and the Census, Committee on Government Reform

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# Under Secretary of Defense (Program/Budget) Comments



COMPTROLLER  
(Program/Budget)

OFFICE OF THE UNDER SECRETARY OF DEFENSE  
1100 DEFENSE PENTAGON  
WASHINGTON, DC 20301-1100

FEB 26 2004

MEMORANDUM FOR DEPUTY INSPECTOR GENERAL FOR AUDITING DIRECTOR,  
ACQUISITION MANAGEMENT DIRECTORATE

SUBJECT: Summary Report on the Military Departments' Transition of Advanced Technology  
Programs to Military Applications (Project No. D-2003AB-0121)

Thank you for the opportunity to comment on the subject report. I have no issue with your recommendation to the Under Secretary of Defense (Comptroller) that the upcoming revision to the Financial Management Regulation (FMR) emphasize the goal of transitioning advanced technology development projects to the planned technology receiver within the Future Years Defense Program (FYDP). That has always been the implicit goal for those projects funded within the advanced technology development program, although, clearly, not fully achievable due to the dynamics of science and technology and constantly evolving program requirements.

We will ensure that the FMR wording is revised to emphasize the goal of transitioning promising advanced technology development efforts identified in the current and future budget years to acquisition programs within the FYDP.

A handwritten signature in black ink, appearing to read "John P. Roth".

John P. Roth  
Deputy Comptroller

Attachment:  
As stated

# Under Secretary of Defense for Acquisition, Technology and Logistics Comments



ACQUISITION,  
TECHNOLOGY  
AND LOGISTICS

## OFFICE OF THE UNDER SECRETARY OF DEFENSE

3000 DEFENSE PENTAGON  
WASHINGTON, DC 20301-3000

MAR 28 2004

MEMORANDUM FOR PROGRAM DIRECTOR, ACQUISITION MANAGEMENT  
DIRECTORATE, OFFICE OF THE INSPECTOR GENERAL

THROUGH: DIRECTOR, ACQUISITION RESOURCES AND ANALYSIS 12/15/04

SUBJECT: Summary Report on the Military Departments' Transition of Advanced Technology Programs to Military Applications (Project No. D-2003 AB-0121)

After reviewing the above report, I am providing responses to the general content and recommendations contained in therein.

### General Content:

The definition of Advanced Technology Development in the DoD financial management regulation specifically states "Projects in this category do not necessarily lead to subsequent development or procurement phases." (DoD Financial Management Regulation; Volume 2B, Chapter 5, para 050201). This is because many Science and Technology projects may not be technically mature enough for a commitment to further develop and procure, yet we need to demonstrate them to decide which technology to pursue. The basic premise of the audit is that Advanced Technology Development, budget activity three, projects should have such procurement commitments.

The fundamental question is when in the RDT&E cycle is it best to require follow-on development or acquisition commitment. Budget activities one through five provide a logical progression of the RDT&E effort prior to acquisition. A budget activity three is still needed to conduct advanced technology demonstrations to compare and contrast competing technologies before committing to a specific acquisition program.

Upon completion of budget activity three effort, technologies that have the maturity for further commitment may transition to budget activity four. Budget activity four requires the commitment to follow-on development and acquisition recommended in the audit.

Requiring budget activity three projects to have an acquisition commitment will lead to less systems being evaluated, increased risk, and less than optimal solutions for the acquisition community.

### Recommendation:

The audit cites several guidance documents that encourage the focus of science and technology efforts on the ultimate procurement objectives as soon as possible. The Department feels this guidance is sufficient to achieve our shared objectives and there is no need to redefine the existing budget activities.

DUSD AS&C non-concurs with all recommendations in the report as written because they would require re-definition of budget activity three.

Sue C. Payton  
Deputy Under Secretary of Defense  
Advanced Systems and Concepts



## **Team Members**

The Acquisition Management Directorate, Office of the Deputy Inspector General for Auditing of the Department of Defense prepared this report. Personnel of the Office of the Inspector General of the Department of Defense who contributed to the report are listed below.

Bruce A. Burton  
Roger H. Florence  
Rudolf Noordhuizen  
Jacqueline N. Pugh