United States Government Accountability Office

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Report to the Chairman, Subcommittee on Tactical Air and Land Forces, Committee on Armed Services, House of Representatives

March 2005

DEFENSE MICROELECTRONICS

DOD-Funded Facilities Involved in Research Prototyping or Production

GAO-05-278

March 2005

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DOD-Funded Facilities Involved in Research Prototyping or Production

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Highlights

Highlights of GAO-05-278, a report to the Chairman, Subcommittee on Tactical Air and Land Forces, Committee on Armed Services, House of Representatives

Why GAO Did This Study

The Department of Defense's (DOD) ability to provide superior capabilities to the warfighter is dependent on its ability to incorporate rapidly evolving, cutting-edge microelectronic devices into its defense systems. While many commercial microelectronics advances apply to defense systems, DOD has some unique microelectronics needs not met by industry. Therefore, to maintain military superiority, DOD has the challenge of exploiting state-of-the-art commercial microelectronics technology and focusing its research investments in areas with the highest potential return for defense systems.

Given the importance of advanced microelectronics to defense systems and the rapid changes in these technologies, you asked GAO to (1) identify and describe DOD and federally funded research and development center (FFRDC) facilities that receive funding from DOD for microelectronics production or research prototyping and (2) describe how DOD coordinates investments in microelectronics research.

www.gao.gov/cgi-bin/getrpt?GAO-05-278.

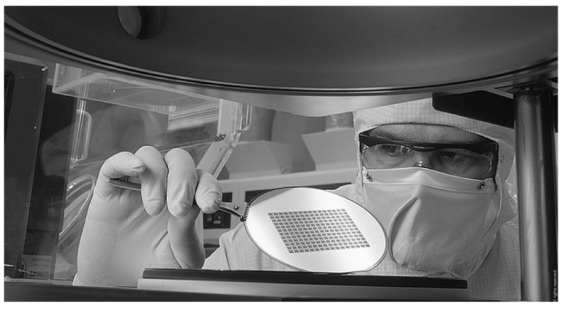
To view the full product, including the scope and methodology, click on the link above. For more information, contact Ann Calvaresi-Barr at (202) 512-4841 or calvaresibarra@gao.gov.

What GAO Found

At the time of our review, eight DOD and FFRDC facilities that received funding from DOD were involved in microelectronics research prototyping or production. Three of these facilities focused solely on research; three primarily focused on research but had limited production capabilities; and two focused solely on production. The research conducted ranged from exploring potential applications of new materials in microelectronic devices to developing a process to improve the performance and reliability of microwave devices. Production efforts generally focus on devices that are used in defense systems but not readily obtainable on the commercial market, either because DOD's requirements are unique and highly classified or because they are no longer commercially produced. For example, one of the two facilities that focuses solely on production acquires process lines that commercial firms are abandoning and, through reverse-engineering and prototyping, provides DOD with these abandoned devices. During the course of GAO's review, one facility, which produced microelectronic circuits for DOD's Trident program, closed. Officials from the facility told us that without Trident program funds, operating the facility became cost prohibitive. These circuits are now provided by a commercial supplier. Another facility is slated for closure in 2006 due to exorbitant costs for producing the next generation of circuits. The classified integrated circuits produced by this facility will also be supplied by a commercial supplier.

DOD has several mechanisms in place aimed at coordinating and planning research conducted by the military services and defense agencies. One key mechanism is identifying defense technology objectives—the specific technology advancements that will be developed or demonstrated across multiple joint capabilities and technology areas. As of February 2004, there were almost 400 defense technology objectives; five of these were identified as microelectronics. DOD also collaborates with industry to review and assess special technology areas and make recommendations about future electronics and microelectronics research.

Microelectronics Worker in Clean Room Processing Area



Source: Defense Microelectronic Activity.

Contents

Abbreviations

DMEA	Defense Microelectronics Activity
DOD	Department of Defense
FFRDC	federally funded research and development center
NSA	National Security Agency
SPAWAR	Space and Naval Warfare Systems Command
S&T	science and technology

GAO
Accountability * Integrity * Reliability

United States Government Accountability Office
Washington, DC 20548

March 11, 2005

The Honorable Curt Weldon
Chairman, Subcommittee on Tactical Air
and Land Forces
Committee on Armed Services
House of Representatives

Dear Mr. Chairman:

Advanced microelectronics are an enabling technology for many U.S. defense systems. Satellites and communications equipment, for example, are reliant on advanced microelectronics that must meet stringent military requirements such as withstanding radiation and extreme-temperature environments, operating for longer periods of time, and performing at higher power levels. The Department of Defense's (DOD) ability to provide superior capabilities to the warfighter is dependent on its ability to incorporate rapidly evolving, cutting-edge microelectronic devices into its defense systems. While many commercial advances are applicable to defense systems, DOD has some unique microelectronics research and production needs not met by industry. Therefore, to maintain military superiority, DOD faces the challenge of exploiting state-of-the-art commercial microelectronics technology while focusing DOD research investments in areas with the highest potential return for defense systems.

Given the importance of advanced microelectronics to DOD's defense systems and the rapid changes in these technologies, you asked us to (1) identify and describe DOD and federally funded research and development center (FFRDC)[1] facilities that receive funding from DOD for microelectronics production or research prototyping and (2) describe how DOD coordinates investments in microelectronics research.

We visited and toured all DOD and FFRDC facilities identified by DOD as having capability to produce or prototype microelectronics, interviewed

[1]FFRDCs meet some special long-term research or development needs of the government and are operated, managed, and/or administered by either a university or consortium of universities, other not-for-profit or nonprofit organization, or an industrial firm, as an autonomous organization or as an identifiable separate operating unit of a parent organization.

facility officials, and obtained documentation to describe each facility. We interviewed the Executive Staff of the Defense Science and Technology Reliance process and other DOD officials and obtained and reviewed applicable documentation to determine how DOD coordinates investments in microelectronics research. Because microelectronics is a part of a much broader area of research, we looked at DOD's overall research coordination in addition to microelectronics-specific areas. We performed our review from November 2003 to January 2005 in accordance with generally accepted government auditing standards.

Results in Brief

At the time of our review, eight DOD or FFRDC facilities that received funding from DOD were involved in microelectronics research prototyping or production—three focused solely on research, three primarily focused on research but had limited production capabilities, and two focused solely on production. The research conducted ranged from exploring potential applications of nonsilicon materials in microelectronic devices to developing a process to improve the performance and reliability of microwave devices. Production efforts generally focused on devices that are used in defense systems but not readily obtainable on the commercial market, either because their requirements are unique and highly classified or because they are no longer commercially produced. One facility that focused primarily on research but which produced microelectronic circuits for DOD's Trident program closed on October 31, 2004. Officials from the facility told us that without the funds from the Trident program, operating the facility became cost prohibitive. These circuits are now provided by a commercial supplier. Another facility—which produces classified integrated circuits—is slated for closure in 2006 because it would cost an estimated $1.7 billion to produce the next generation of integrated circuits. These circuits will also be supplied by a commercial supplier. Additional changes to other facilities could occur pending the review of DOD's Base Realignment and Closure Commission.

DOD has several mechanisms in place aimed at coordinating and planning research conducted by the Air Force, Army, Navy and defense agencies. One key mechanism is annually identifying defense technology objectives—the specific technology advancements that will be developed or demonstrated across multiple joint capabilities and technology areas. As of February 2004, there were almost 400 defense technology objectives; five of these were identified as microelectronics. DOD also periodically collaborates with industry to review and assess special technology areas and make recommendations about future electronics and microelectronics research.

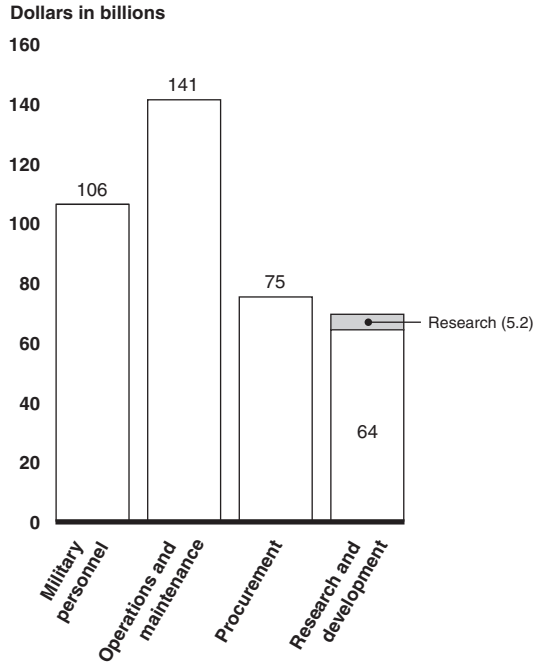
Background

Microelectronics focuses on the study and manufacture of micro devices, such as silicon integrated circuits, which are fabricated in submicron dimensions and form the basis of all electronic products. In DOD research, microelectronics extends beyond silicon integrated circuits and cuts across scientific disciplines such as biological sciences, materials sciences, quantum physics, and photonics. DOD research also covers many different types of materials, devices, and processes. For example, DOD service laboratories conduct research in materials other than silicon, such as gallium nitride, indium arsenide, and silicon carbide—materials that could provide higher performing or more reliable devices to meet DOD needs.

DOD's overall budget authority for fiscal year 2005 was approximately $400 billion. About $69 billion, or 17 percent of the overall budget, was directed toward research and development activities.[2] The vast majority of this funding goes to development programs for major systems such as the Joint Strike Fighter and the Space Based Infrared System High. About $5.2 billion, or about 1.3 percent of the overall budget, was directed toward research (see fig. 1). Because DOD tracks funding by funding category, not by specific technology area, the microelectronics portion of this funding category cannot be broken out.

[2]Research is the systematic study directed toward fuller scientific knowledge. Development is the systematic application of knowledge directed toward the production of useful materials, devices, and systems. Development categories range from advanced technology development, including prototypes and scaled models, to operational systems development.

Figure 1: DOD Budget Authority in Billions, by Major Category for Fiscal Year 2005



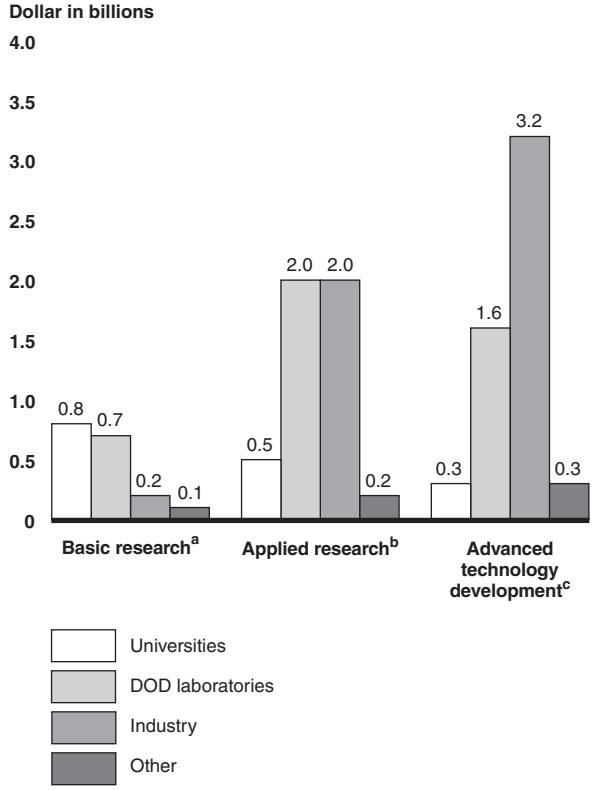
Source: DOD.

DOD research and technology development is conducted by universities, DOD laboratories, industry, and other organizations.[3] Universities and DOD laboratories are primarily involved in research. Once a new device is proven and has potential application for DOD, the technology is transferred to industry to further develop and ultimately produce and integrate into defense systems. These organizations may collaborate on microelectronics projects through various arrangements, such as cooperative research and development agreements and collaborative technology alliances. Figure 2 shows the distribution of DOD research and advanced technology development funding by performing organizations.[4]

[3]Other organizations include nonprofit institutions, international organizations, and FFRDCs.

[4]Fiscal year 2003 is the most recent data available on the distribution of funds by organization.

Figure 2: Recipients of DOD Research and Advanced Technology Development Funds for Fiscal Year 2003



Source: National Science Foundation.

Note: Data from National Science Foundation, *Federal Funds for Research and Development, Volume 51* (Washington, D.C.: March 2004).

[a]Basic research is directed towards greater understanding of fundamental aspects of phenomena related to long-term national security needs without specific applications to processes or products.

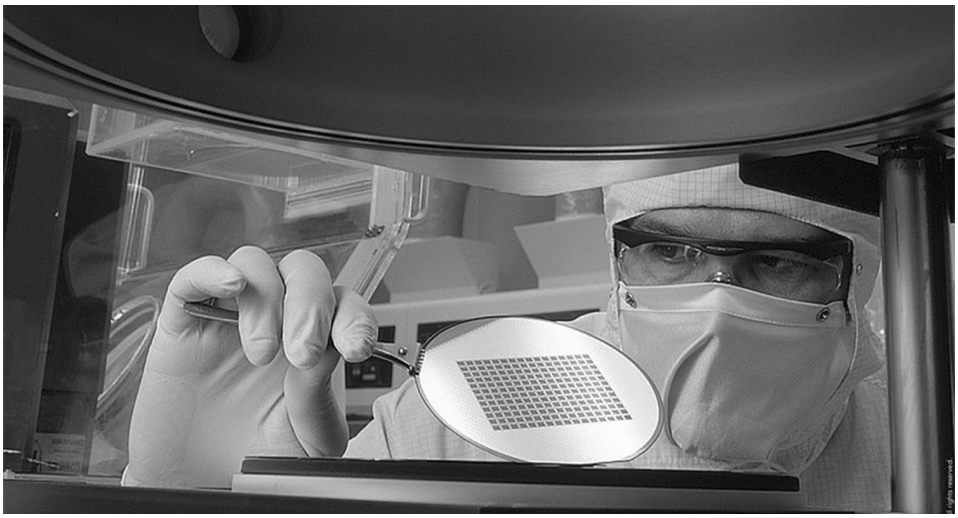
[b]Applied research translates promising basic research into solutions for broadly defined military needs that are short of system development.

[c]Advanced technology development involves development of subsystems and components and efforts to integrate subsystems and components into system prototypes for field experiments and/or tests in a simulated environment.

Microelectronics production and research prototyping require specialized equipment and facilities. To prevent flaws in production, microelectronic devices are produced in clean rooms where the air is constantly filtered, and temperature, humidity, and pressure may be regulated. Clean rooms are rated according to a federal standard. For example, a class 1000 clean room has no more than 1000 particles larger than 0.5 microns in a cubic foot of air, while a class 100 clean room has no more than 100 particles.

The people who work in clean rooms wear special protective clothing that prevents workers from contaminating the room (see fig. 3).

Figure 3: Microelectronics Worker in Clean Room Processing Area



Source: Defense Microelectronic Activity.

The equipment found at research facilities and at production facilities are similar but are used for different purposes. Because research facilities focus on developing new device concepts, materials, and processes, the equipment is set up for flexibility because it is used for different experiments to prove concepts and validate theories. Once a technology is sufficiently developed, a small quantity is prototyped in a production environment to prove the design. Production facilities are set up to produce higher volumes of microelectronics and have more automation and multiple sets of equipment to increase productivity.

DOD and FFRDC Facilities Receiving DOD Funding Have Varying Microelectronics Research and Production Focuses

At the time of our review, eight DOD and FFRDC facilities that received funding from DOD were involved in microelectronics research prototyping or production. Three military facilities focused solely on research; three primarily focused on research but had limited production capabilities; and two focused solely on production (see fig. 4).

Figure 4: DOD and FFRDC Facilities with Microelectronics Research Prototyping and/or Production Capabilities That Receive Funding From DOD

Source: GAO based on DOD data.

Note: MIT Lincoln Laboratory and Sandia National Laboratories are FFRDCs.

The three military facilities provide basic and applied research covering a wide spectrum of microelectronic devices and materials. For example, the Naval Research Laboratory facility is conducting basic research on the potential application of nonsilicon materials in microelectronic devices. Through its applied research, the Air Force Research Laboratory facility

developed a process to improve the performance and reliability of microwave devices needed for military radar and communications systems. This technology was ultimately transferred from the Air Force to various contractors and used in a number of systems, including the Joint Strike Fighter. The Army Research Laboratory facility conducts both basic and applied research, primarily on multifunction radiofrequency, optoelectronics, and power conversion.

Three other facilities also conduct research but can produce prototypes or limited numbers of devices if commercial sources are not available. For example, the Lincoln Laboratory's facility—which primarily focuses on applied research in sensing and signal processing technologies—has developed components for the space-based visible sensor because no commercial source was available to meet this DOD need.[5] Sandia's facility primarily focuses on research and design of radiation hardened microelectronics.[6] However, because the number of commercial producers able to meet the radiation requirements of the Department of Energy and DOD has dwindled to two suppliers, Sandia maintains limited in-house production capability to fill near-term critical needs. According to Sandia officials, they have not been called upon to produce microelectronics for DOD in recent years. The SPAWAR facility, which recently closed, primarily conducted research on radiation-hardened microelectronics, but at one time produced these devices for the Navy's Trident missile system. When production of these devices was transferred to a commercial supplier, the facility maintained capability to produce microelectronics as a back-up to the commercial supplier.

Two facilities focused only on production—one on leading edge technology and one on lagging edge technology.[7] NSA's microelectronics facility focuses on producing cryptographic microelectronics—devices not readily obtainable on the commercial market because of their unique and highly classified requirements. DMEA fills a unique role within DOD by providing solutions to microelectronics that are no longer commercially

[5]The prototypes were demonstrated on the Midcourse Space Experiment satellite.

[6]Sandia primarily operates for the Department of Energy; in fiscal year 2003, only about 1 percent of Sandia's microelectronics research funding came from DOD.

[7]According to DOD officials, "lagging edge" technology generally refers to unprofitable process lines for fabricating technologies that are abandoned by commercial firms.

available.[8] DMEA acquires process lines that commercial firms are abandoning and, through reverse-engineering and prototyping, provides DOD with these abandoned devices. In some cases, DMEA may produce the device.

The type and complexity of research conducted or device produced largely determines a facility's clean room class and size and its equipment replacement costs.[9] For example, to produce cryptographic electronics, NSA has a 20,000 square foot class 10 clean room facility. In contrast, the Naval Research Laboratory conducts research in a 5,000 square foot class 100 clean room facility, with some class 10 modules where greater cleanliness is required. In general, research does not require state-of-the-art equipment to prove concepts, and tools can be purchased one at a time and are often second-hand or donated.

Table 1 summarizes the eight facilities' microelectronics focus, clean room class and size, and equipment replacement costs.

[8]While DOD typically supports defense systems for many years or decades, microelectronics have limited product life cycles.

[9]Replacement costs generally include the equipment for clean room processing, testing, characterization, and materials growth used primarily for microelectronics.

Table 1: Summary of DOD and FFRDC Facilities Receiving Funding from DOD with Research Prototyping or Production Capability through Fiscal Year 2004

Facility	Microelectronics focus	Processing clean room (class: size)	Equipment replacement cost[a]
Research only			
Air Force Research Laboratory, Sensors Directorate Dayton, Ohio	Applied research: sensors (radiofrequency, electro-optical); automatic target recognition and sensor fusion	100: 6,000 sq. ft. 10: modules	$13 million
Army Research Laboratory, Sensors and Electron Devices Directorate Adelphi, Md.	Basic and applied research: multifunction radiofrequency electronics, optoelectronics, power conversion	100: 10,000 sq. ft. 10: 4,800 sq. ft.	$42 million (includes $9 million for materials growth equipment)
Naval Research Laboratory, Electronics Science and Technology Division Washington, D.C.	Basic research: wide bandgap, narrow bandgap, group IV materials	100: 5,000 sq. ft. 10: modules	$20-$30 million
Research with limited production capability			
MIT Lincoln Laboratory, Solid State Division Lexington, Mass.	Applied research: sensors, signal processing Production: experimental sensors and imagers not commercially available	100: 10,000 sq. ft. 10: 8,100 sq. ft.	$40 million
Sandia National Laboratories (Department of Energy), Microelectronics Development Laboratory Albuquerque, N.M.	Basic and applied research: microscale and acoustic sensors, radiation-hardened applications Production: backup radiation-hardened producer to BAE Systems and Honeywell[c]	1: 12,500 sq. ft.	$250 million[b]
SPAWAR, Integrated Circuit Fabrication Facility (closed October 31, 2004) San Diego, Calif.	Applied research: radiation-hardened circuits, radiofrequency/analog mixed signal Production: backup radiation-hardened producer to Honeywell due to similar processes	100: 7,900 sq. ft. 10: modules	$30 million
Production only			
National Security Agency (NSA), Special Processing Laboratory Fort Meade, Md.	Production: cryptographic electronics	10: 20,000 sq. ft.	$1.7 billion[d] (phasing out the Special Processing Laboratory in 2006)
Defense Microelectronics Activity (DMEA) Sacramento, Calif.	Sustainment prototyping and production: Provides DOD-wide microelectronics solutions for sustainment issues (when parts are no longer commercially available)	100: 5,500 sq. ft. 5-10: modules	$12 million[e]

Source: GAO based on information provided by each facility.

[a]These are self-reported data from each facility.

[b]Higher equipment replacement cost is due to a requirement to maintain production capability.

[c]BAE Systems and Honeywell recently received capital funding under the Defense Production Act, Title III Program to assist in technology upgrades for their fabrication facilities that produce radiation-hardened devices.

[d]This figure includes facility and equipment upgrade costs.

[e]DMEA has lower equipment costs because it uses older technologies and buys used, less expensive equipment.

Since we began our review, the SPAWAR facility closed on October 31, 2004, making Sandia the only backup to the two remaining commercial radiation-hardened suppliers to DOD. Officials from the facility told us that without funds from the Trident program, operating the facility became cost prohibitive. Further, NSA's microelectronics facility is slated for closure in 2006. NSA estimated that it would cost $1.7 billion to upgrade its equipment and facility to produce the next generation of integrated circuits. NSA is contracting with IBM to take over production of the microelectronic devices produced at its facility. Part of the contract costs includes security requirements for IBM to produce classified circuits. There may be changes to other facilities pending the review of the Base Realignment and Closure Commission for 2005.[10] As a result of prior commission recommendations, the Army constructed a new facility to consolidate Army specialized electronics research into one location.

DOD Has Several Mechanisms for Coordinating Research

DOD has several mechanisms in place aimed at coordinating and planning research conducted by the Air Force, Army, Navy, and defense agencies. In electronics and microelectronics research, DOD works with industry to review special technology areas and make recommendations about future research.

Defense Reliance Process is the Central Mechanism for Coordinating Research across DOD Organizations

DOD's Defense Reliance process provides the Department with a framework to look across science and technology (S&T)[11] efforts of the Defense Advanced Research Projects Agency, Defense Threat Reduction Agency, and the Missile Defense Agency as well as the Army, Navy, and Air Force. Each service and defense agency updates its own S&T plans with the needs of each organization in mind. The Defense Reliance process is

[10]The Base Realignment and Closure Commission is periodically established to review DOD facilities, including laboratories, for potential closure or realignment. The National Defense Authorization Act for Fiscal Year 2002 (Pub. L. No. 107-107 § 3001 (2001)) established the commission for 2005.

[11]S&T includes basic and applied research and advanced technology development.

intended to improve coordination and determine if the overall DOD S&T vision and strategy are being met. The *Defense Science and Technology Strategy* document is updated periodically to provide a high-level description of what the science and technology programs aim to accomplish. The Defense Reliance process includes the development of three planning documents, which taken together provide a near-, mid-, and long-term look at DOD specific research needs (see table 2).

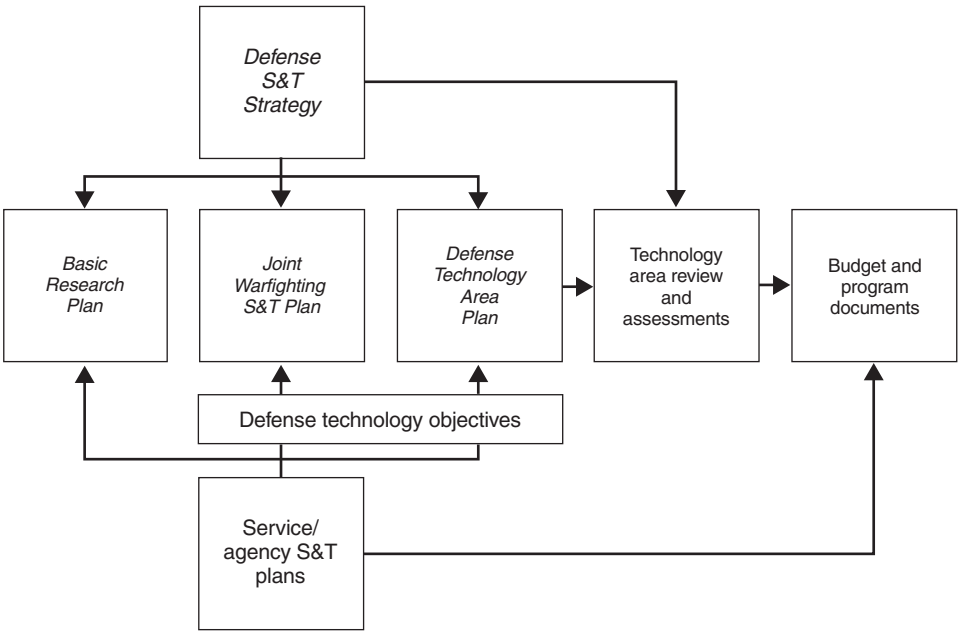
Table 2: Defense Reliance Process Planning Documents

Plan	Description
Basic Research (Updated biennially)	Presents DOD's objectives and investment strategy for DOD-sponsored basic research performed by universities, industry, and service laboratories.
Joint Warfighting Science and Technology (Updated annually)	Looks at the applied research, advanced technology development, and advanced concept technology demonstration portions of the services' and defense agencies' science and technology plans to ensure that the S&T program supports priority future joint warfighting capabilities.
Defense Technology Area (Updated biennially)	Presents DOD's objectives and the applied research and advanced technology development investment strategy for technologies critical to DOD acquisition plans, service warfighter capabilities, and the Joint Warfighting Science and Technology Plan. It also takes a horizontal perspective across service and defense agency efforts, thereby charting the total DOD investment for a given technology.

Source: DOD Defense Reliance Executive Staff.

The planning documents present the DOD S&T vision, strategy, plan, and objectives for the planners, programmers, and performers of defense S&T and guide the annual preparation of the defense program and budget. Figure 5 illustrates the relationship between the planning documents and overall reliance process.

Figure 5: Defense Reliance Process



Source: GAO based on DOD data.

Note: Defense technology objectives identify a specific technology advancement that will be developed or demonstrated.

Science and technology efforts are planned and funded through service and defense agency plans. To obtain a perspective across DOD, a portion of the service and agency efforts are represented in the various Defense Reliance planning documents. DOD's goal is to have about half of the investment in service and agency efforts[12] represented in defense technology objectives.[13] According to DOD officials, this goal is aimed at balancing flexibility—which services and defense agencies need to pursue research that is important to their organizations—with oversight and coordination. DOD officials stated that looking at a portion of the efforts provide an adequate perspective of the S&T research across the services and defense agencies to help ensure the goals of DOD's S&T strategy are

[12]Efforts pertain to applied research and advanced technology development projects.

[13]The actual percentage fluctuates from year to year as defense technology objectives are completed and new ones are added. DOD officials estimate that approximately 36 percent of its funded projects in 2004 were represented in defense technology objectives.

being met. These projects are generally considered high priority, joint efforts, or both.

Defense Technology Objectives and Technology Area Review and Assessments

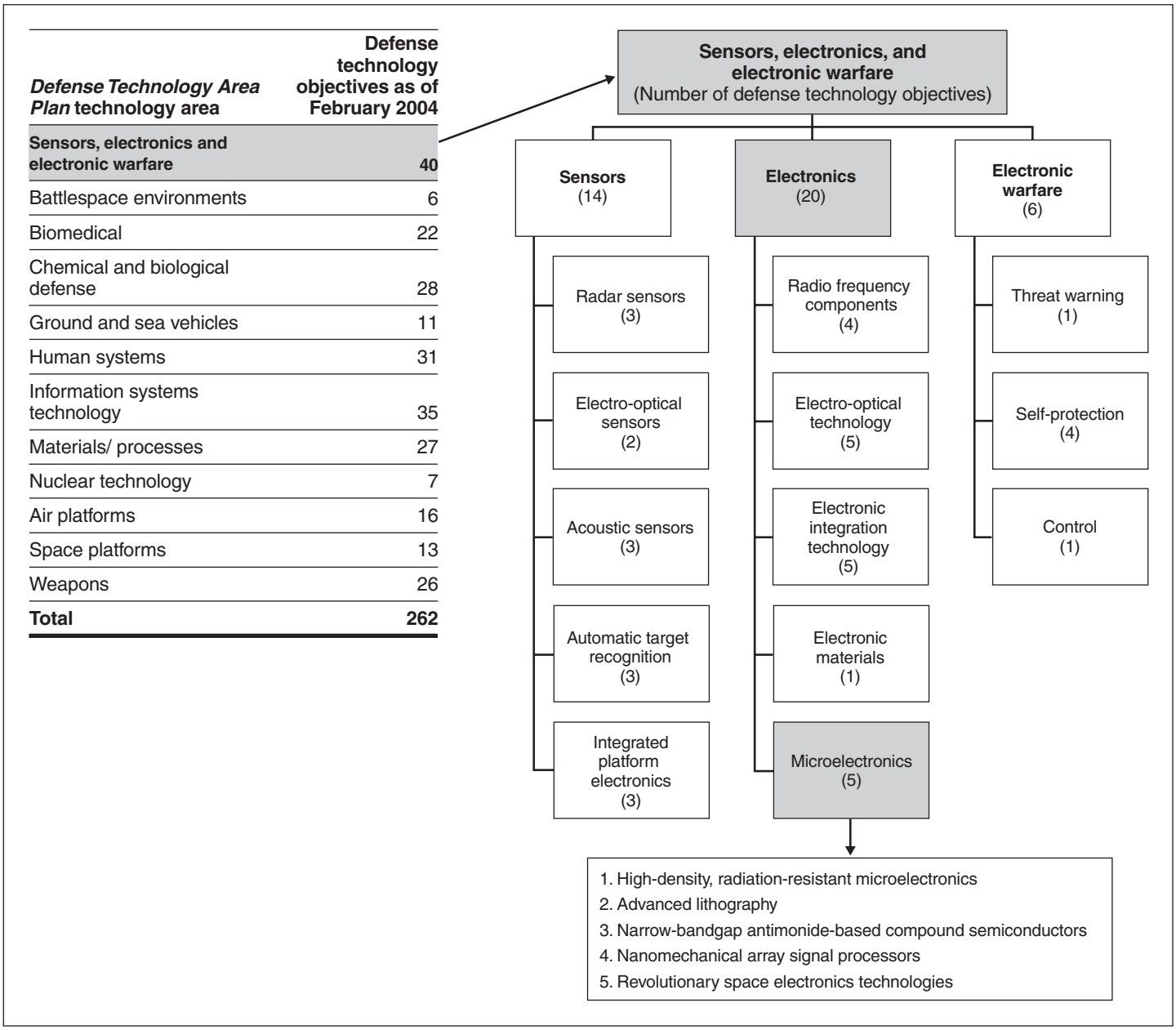
Two key components in the Defense Reliance process are the defense technology objectives and technology area review and assessments. Defense technology objectives are intended to guide the focus of DOD's science and technology investments by identifying the following

- objectives, the specific technology advancements that will be developed or demonstrated;
- payoffs, the specific benefits to the warfighter resulting from the technology advancement;
- challenges, the technical barriers to be overcome;
- milestones, planned dates for technical accomplishments, including the anticipated date of technology availability;
- metrics, a measurement of anticipated results;
- customers sponsoring the research; and
- funding that DOD estimates is needed to achieve the technology advancements.

Both the *Joint Warfighting* and *Defense Technology Area* plans are comprised of defense technology objectives that are updated annually. In its 2004 update, DOD identified 392 defense technology objectives —130 in the *Joint Warfighting Science and Technology Plan* across five joint capabilities, and 262 in the *Defense Technology Area Plan* across 12 technology areas. Microelectronics falls within the sensors, electronics, and electronic warfare area. There are 40 defense technology objectives in this area; five were identified as microelectronics (see fig. 6). However, according to DOD officials, research relating to microelectronics is not limited to these five defense technology objectives because microelectronics is an enabling technology found in many other research areas. For example, research in electronic warfare is highly dependent on microelectronics.

Figure 6: Defense Technology Objectives by Technology Area

Defense Technology Area Plan technology area	Defense technology objectives as of February 2004
Sensors, electronics and electronic warfare	**40**
Battlespace environments	6
Biomedical	22
Chemical and biological defense	28
Ground and sea vehicles	11
Human systems	31
Information systems technology	35
Materials/ processes	27
Nuclear technology	7
Air platforms	16
Space platforms	13
Weapons	26
Total	**262**



Source: DOD.

To provide an independent assessment of the planned research, DOD uses Technology Area Review and Assessment panels. DOD strives to have a majority of the Technology Area Review and Assessment team members from outside DOD, including other government agencies, FFRDCs, universities, and industry. Most team members are recognized experts in their respective research fields. The Technology Area Review and Assessment panels assess DOD programs against S&T planning guidance, defense technology objectives, affordability, service-unique needs, and technology opportunities; and provide their assessments and recommendations to the Defense Science and Technology Advisory Group.

Other Coordination Mechanisms for Electronics Research

For the electronics research area, additional industry and university insight is obtained through the Advisory Group on Electron Devices. DOD established this advisory group to help formulate a research investment strategy by providing ongoing reviews and assessments of government-sponsored programs in electronics, including microelectronics. The advisory group is comprised of experts representing the government, industry, and universities, who provide DOD with current knowledge on the content and objectives of various programs under way at industry, university, and government laboratories.

Periodically, the advisory group conducts special technology area reviews to evaluate the status of an electronics technology for defense applications. The advisory group also serves as a bridge between electronic system and component developers within DOD by establishing regular, periodic interactions with system program offices, industry system developers, and government and industry components developers.

Agency Comments

We provided a draft of this report to DOD for review. In its response, DOD did not provide specific written or technical comments (see app. II).

We are sending copies of this report to interested congressional committees; the Secretary of Defense; and the Director, Office of Management and Budget. We will make copies available to others upon request. In addition, this report will be available at no charge on the GAO Web site at http://www.gao.gov.

Please contact me at (202) 512-4841 if you or your staff has any questions concerning this report. Major contributors to this report are listed in appendix III.

Sincerely yours,

Ann Calvaresi-Barr
Director
Acquisition and Sourcing Management

Appendix I: Scope and Methodology

To identify and describe DOD and FFRDC facilities that receive funding from DOD for microelectronics production or research prototyping, we visited all eight facilities identified by DOD as having capability to produce or prototype microelectronics. Using a set of structured questions, we interviewed officials at each facility to determine their microelectronics focus, clean-room and equipment characteristics, and types of research, production and/or research prototyping the facility provides. We also obtained and analyzed supporting documents and toured the facilities. We did not include in our scope universities or commercial firms that also conduct DOD research and have microelectronics facilities.

Because microelectronics is a part of a much broader area of research, we looked at DOD's overall research coordination in addition to microelectronics-specific areas. To determine how DOD coordinates its research investments, we interviewed officials from the Executive Staff of the Defense Science and Technology Reliance process; the Office of the Deputy Under Secretary of Defense for Science and Technology (Space and Sensor Technology); and the Advisory Group on Electron Devices. We also obtained and reviewed DOD's defense research planning-documents—including the *Basic Research Plan*, the *Defense Technology Area Plan*, *Joint Warfighting Science and Technology Plan*, and the *Defense Technology Objectives* document. We also met with Defense Advanced Research Projects Agency officials to discuss their role in sponsoring DOD research and development activities. In addition, at the DOD service laboratories that we visited, we obtained information on microelectronics related research projects.

We performed our review from November 2003 to January 2005 in accordance with generally accepted government auditing standards.

Appendix II: Comments from the Department of Defense

OFFICE OF THE DIRECTOR OF
DEFENSE RESEARCH AND ENGINEERING
3040 DEFENSE PENTAGON
WASHINGTON, DC 20301-3040

2 March 2005

Ms. Ann Calvaresi-Barr
Acting Director, Acquisition and Sourcing Management
U.S. Government Accountability Office
441 G. Street, N. W.
Washington, DC 20548

Dear Ms. Calvaresi-Barr,

This is the Department of Defense (DoD) response to the GAO draft report, GAO-05-278 "Defense Microelectronics: DoD Funded Facilities Involved in the Research Prototyping or Production," dated February, 2005 (GAO Code 120300).

The GAO offered no recommendations. The Department appreciates the opportunity to review and comment on the draft report.

Sincerely,

Charles J. Holland
Deputy Under Secretary of Defense
(Science & Technology)

Appendix III: GAO Contact and Staff Acknowledgments

GAO Contact

Anne-Marie Lasowski, (202) 512-4146

Acknowledgments

In addition to the individual named above, Bradley Terry, Lisa Gardner, Karen Sloan, Hai Tran, Brian Eddington, and Steven Pedigo made key contributions to this report.

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