OFFICE OF THE SECRETARY OF DEFENSE
3140 DEFENSE PENTAGON
WASHINGTON, DC 20301-3140

DEFENSE SCIENCE
BOARD

MEMORANDUM FOR UNDER SECRETARY OF DEFENSE (ACQUISITION, TECHNOLOGY & LOGISTICS)

SUBJECT: Defense Science Board Report on the Adequacy of the DoD Science & Technology (S&T) Program

Attached is a letter report responding to the request of Section 212 of the FY2000 Defense Appropriation Report that the Defense Science Board provide an assessment regarding the proper level of funding for the FY2001 DoD Science and Technology (S&T) Program.

The response is in the form of a summary of the 1998 Report of the DSB Task Force on the DoD S&T Program. A copy of the report is also attached.

The Summary concludes, based on current practices of high technology industries, that the DoD S&T Progam should be funded at a level of approximately $8.7 billion rather than the $7.5 billion proposed by the Department.

Craig I. Fields
Chairman

OFFICE OF THE SECRETARY OF DEFENSE
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DEFENSE SCIENCE
BOARD

1 June 2000

MEMORANDUM FOR CHAIRMAN, DEFENSE SCIENCE BOARD

SUBJECT: Defense Science Board Report on the Adequacy of the DoD Science and Technology Program

In response to the Terms of Reference from Dr. Gansler dated 18 May 2000 which requests the views of the DSB concerning the appropriate funding level for the DoD Science and Technology Program, I am submitting the attached Summary which is based on the Report of the 1998 DSB Task Force on *Defense Science and Technology Base for the 21st Century*.

The Summary concludes, based on the practices of high technology industries, that the DoD S&T Program should be funded at a level of about $8.7 billion rather than the $7.5 billion proposed by the Department.

Yours truly,

Walter E. Morrow, Jr.
Task Force on Adequacy of the
DoD Science & Technology Program

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DEFENSE SCIENCE BOARD

Summary of the Defense Science Board Recommendations on DoD Science and Technology Funding

1 June 2000

Walter E. Morrow, Jr.
Director Emeritus, MIT Lincoln Laboratory

This Summary is in response to the Congressional Language in Section 212 of the FY2000 Defense Appropriation Report. That Section requests the views of the Defense Science Board on the adequacy of the Department's FY2001 Science and Technology Program budget requests. Since a Defense Science Board Task Force studied the Department's Science and Technology Program in 1998 under the Chairmanship of Walter Morrow, it was decided by the OSD and DSB leadership that a summary should be prepared based on the report of the 1998 Study of the Department's Science and Technology Program. (A copy of which is attached.) The Terms of Reference for this Summary are also attached.

In this Summary, comments will be presented on three topics:

- The Task Force's views on the proper level of DoD Science and Technology Program funding which it believes should be the order of $8.7 billion.
- The importance of an adequate S&T Program to future U.S. military capabilities
- Suggestions on ways of increasing the output of the Department's S&T Program aside from increases in funding.

I. Adequacy of the S&T Program Funding

Table I shows, in then year dollars, the DoD S&T budget requests along with the final S&T Congressional Appropriations for the current and past few years. Also shown are the total DoD appropriations and the S&T funding as a percentage of the total DoD funding.

In examining trends of the S&T Program funding shown in Table I, it is evident that the budget requests of FY97 to FY01 have not been keeping up with inflation much less increasing at 2% over inflation. Furthermore, the S&T budget request, as a percentage of total budget request, has dropped from about 3% to a little below 2.6%.

Until FY00, less than inflation increases in the S&T Appropriations are observed. In that fiscal year, the DoD S&T Program Appropriation increases significantly as a result of Congressional actions.

Table I
DoD Science and Technology Funding

	FY97	FY98	FY99	FY00	FY01
Budget Submitted	7,220,569	7,391,930	7,181,271	7,386,251	7,543,232
Increase Over Prior Year	-0.67%	2.36%	-2.84%	2.85%	2.12%
% of Total Budget Request	2.96%	2.93%	2.78%	2.73%	2.58%
Appropriation	7,470,086	7,675,864	7,574,104	8,397,178	?
Increase Over Prior Year	-0.67%	2.74%	-1.32%	+10.87%	?
% of TOA	2.89%	2.97%	2.72%	3.00%	?

The next issue is whether the current levels of the DoD S&T Program funding are adequate. In response to this issue, the 1998 DSB Task Force obtained data on research funding for leading U.S. high technology industries. This data indicates that such industries typically spend somewhat over 3% (3.4% to be precise) of total revenue on research. The total for research and product development averages over 15% of revenue for these industries. (See pages 18 and 19 of the Task Force Report.)

Based on this observation, it would appear that if the Department of Defense wants to continue to have a high technology military capability in the future, the DoD should be requesting higher levels of funding for the S&T Program.

In particular, to match the industry practice of 3.4%, the S&T budget requests for FY2000 should have been on the order of $9.0 billion and for FY2001 should have been nearly $10 billion.

Even under more conservative guidance of 3% of total funding, $8.1 billion should have been requested in FY2000 and $8.7 billion in FY2001. Fortunately, the Congress appropriated $8.5 billion for the S&T Program in FY2000. It has yet to act on FY2001 S&T funding.

II. Importance of the DoD Science and Technology Program

Over the past century, dramatic increases in military capabilities have occurred as the result of science and technology investments made in this and foreign countries. Page 9 of the S&T Task Force Report indicates some of the more notable military *technology innovations over the past century. On page 10, Figure 2 shows the impact of* these advances on selected military capabilities over that same period of time. The chart is reproduced here as Table II.

Table II
Impact of Technology on Selected
Military Capabilities in the 20th Century

	Approximate Capabilities					
	1900	1925	1950	1975	2000	
Aircraft Range	-	200	2,000	4,000	8,000	Miles
Aircraft Speed	-	150	500	2,000	2,000	Miles/hr
Aircraft Payload	-	500	20,000	80,000	100,000	Pounds
Ballistic Missile Range	1	10	200	6,000	12,000	Miles
Radar Range	-	2	200	20,000	100,000	Miles
Radar Resolution	-	-	1,000	1	0.1	Feet
Navigation Precision	10	20	0.1	0.01	0.001	Miles
Radio Communication Range	-	500	3,000	10,000	10,000	Miles
Radio Communication Capacity	-	10	10,000	107	109	Bits/sec
Weapon Precision	100	100	100	10	1	Feet

These is no reason to expect that similar technology advances will not be made in the 21st century with corresponding advances in military capabilities. If the DoD does not pursue a strong forward looking S&T Program, it runs the danger of ultimately falling behind potential challengers employing novel unsymmetrical military capabilities.

In pursing advanced capabilities, the DoD should not depend on civil sector research for all its needs. Much of current industrial research has a very short time horizon and, in addition, tends to be focused on incremental improvements of current civilian products. It is not focused on major new military capabilities such as stealth or precision weapons.

III. Improving the Output from the DoD Science and Technology Program

In the first section of this Summary, the issue of DoD S&T funding levels was discussed. Equally, or perhaps more important, is the matter of the effectiveness of such expenditures. The 1998 DSB S&T Task Force Report also addresses this issue. In particular, it found:

- Concerning Professional Laboratory Personnel

The current Civil Service Personnel System has a very negative impact on the capabilities and morale of the DoD and Service Laboratory and Center technical personnel. These personnel are responsible for carrying out a significant portion of the DoD S&T Program and also for supervising the remainder of the program which is carried out by universities and industry.

In spite of recent modest changes in the government personnel system, it continues to fail to provide salary levels sufficient to compete with those of the civil sector (by $10,000 or more per year). the result is that DoD laboratory directors are unable to obtain or retain the services of not only the "best and the brightest" scientists and engineers but even those of average capability.

An additional serious problem with the Civil Service System is the extreme difficulty of terminating unsatisfactory or unproductive professionals. Over the years, the result is an accumulation in the laboratories of greater and greater numbers of unproductive professionals.

The DSB Task Force recommended, as a solution to these personnel problems, the use of the private sector, both universities and industries, to provide the majority of professional personnel for the DoD and Service Laboratories and not to depend any more on the Civil Service System for such personnel.

- Concerning Program Focus

The focus of the current DoD S&T Program is primarily on incremental improvements in current capabilities. While such incremental improvements are important, the current program does not place sufficient emphasis on innovative technology initiatives leading to entirely new military capabilities. Such capabilities include important abilities such as the ability to:

- Rapidly deploy, within a day, very capable ground and tactical air forces to counter potential or actual surprise attacks by an aggressor
- Detect and identify aggressor forces concealed under foliage, in buildings, and in underground facilities.
- Detect and characterize weapons of mass destruction that may be in the process of being deployed against the U.S. homeland.

- Concerning Facilities

The current DoD and Service laboratory and center research facilities are located in a large number of locations many of which are physically disconnected from Service weapon development and procurement organizations. In addition, a number of these facilities are very old and badly equipped. The practice of leading high technology industries is to employ integrated modern facilities encompassing their research, product development, and prototype production activities. The Task Force recommended that the DoD and the Services consolidate and modernize their research and development facilities.

Summary

Based on the earlier work of the DSB Task Force on the DoD S&T Program, two main points are evident:

1. DoD budgeting for science and technology is deficient by more than $1 billion dollars based on current practices of high technology industry and the current level of the DoD overall funding.

2. Substantial increases in the productivity of the S&T Program can be made by significant changes in the provision of professional staff, program focus, and facilities.

THE UNDER SECRETARY OF DEFENSE
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ACQUISITION AND
TECHNOLOGY

MAY 18 2000

MEMORANDUM FOR CHAIRMAN, DEFENSE SCIENCE BOARD

SUBJECT: Terms of Reference -- Defense Science Board Report on the Adequacy of the DoD Science & Technology Program

In accordance with Section 212 of the National Defense Authorization Act for Fiscal Year (FY) 2000 (PL 106-65), you are requested to report the views of the Defense Science Board (DSB) concerning DoD's proposed FY01-05 Science & Technology (S&T) program. This report should assess the effect of the Department's decision to not program for at least two percent above the rate of inflation in its S&T budget for FY01-05. Specifically, the report should present the DSB's views on:

a. The FY01 S&T budget submission to Congress, including the Military Departments' submissions.

b. The effects on the current and future technology base.

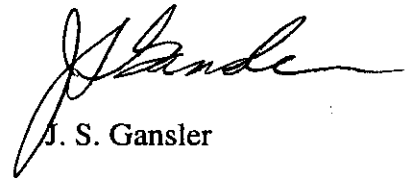
c. The effects on the warfighter of not meeting the two percent goal.

d. Opportunities for increasing output from the S&T program.

Section 212 notes Congress' concern that the Department has failed to comply with the funding objective for the Defense S&T program, especially the Air Force S&T program, thus potentially jeopardizing the stability of the defense technology base and increasing the risk of failure to maintain technological superiority in future weapons systems. Furthermore, Congress believes the Department should increase the S&T budget by at least two percent above the rate of inflation over the next eight years. Section 212(c)(2) further requires the DSB to submit to the Secretary and Congress a report assessing the effect such failure is likely to have on defense technology and the national defense.

The study will be co-sponsored by the USD(AT&L) and the DDR&E. Dr. Walt Morrow will prepare the report based on the 1998 DSB study entitled "Defense Science and Technology Base for the 21st Century." A report will be submitted to the Secretary of Defense and Congress not later than 60 days following the Department S&T budget certification IAW Section 212. Mr. Stanley Trice, Office of the Deputy Under Secretary of Defense for Science and Technology, will serve as the Executive Secretary. Lieutenant Colonel Scott McPheeters, USA, will serve as the Defense Science Board Secretariat Representative.

The Task Force will operate in accordance with the provisions of P.L. 92-463, the "Federal Advisory Committee Act," and DoD Directive 92-463, the "DoD Federal Advisory Committee Management Program." It is not anticipated that this report will need to go into any "particular matters" within the meaning of Section 208 of Title 18, U.S. Code, nor will it cause any member to be placed in the position of acting as a procurement official.



J. S. Gansler

SEC. 212. SENSE OF CONGRESS REGARDING DEFENSE SCIENCE AND TECHNOLOGY PROGRAM.

(a) **Failure To Comply With Funding Objective.**--It is the sense of Congress that the Secretary of Defense has failed to comply with the funding objective for the Defense Science and Technology Program, especially the Air Force Science and Technology Program, as stated in section 214(a) of the Strom Thurmond National Defense Authorization Act for Fiscal Year 1999 (Public Law 105 261; 112 Stat. 1948), thus jeopardizing the stability of the defense technology base and increasing the risk of failure to maintain technological superiority in future weapon systems.

(b) **Funding Objective**.--It is further the sense of Congress that, for each of the fiscal years 2001 through 2009, it should be an objective of the Secretary of Defense to increase the budget for the Defense Science and Technology Program, including the science and technology program within each military department, for the fiscal year over the budget for that program for the preceding fiscal year by a percent that is at least two percent above the rate of inflation as determined by the Office of Management and Budget.

(c) **Certification.**--If the proposed budget for a fiscal year covered by subsection (b) fails to comply with the objective set forth in that subsection–

(1) the Secretary of Defense shall submit to Congress–

(A) the certification of the Secretary that the budget does not jeopardize the stability of the defense technology base or increase the risk of failure to maintain technological superiority in future weapon systems; or

(B) a statement of the Secretary explaining why the Secretary is unable to submit such certification; and

(2) the Defense Science Board shall, not more than 60 days after the date on which the Secretary submits the certification or statement under paragraph (1), submit to the Secretary and Congress a report assessing the effect such failure to comply is likely to have on defense technology and the national defense.