Mr. Chairman, thank you very much for the opportunity to address this distinguished committee.

As most of you know much better than I, the fundamental concept that research universities should play a key role in national security goes back over half a century. It was the vision of Vannevar Bush, a former MIT professor and Dean, that our national security and well-being would best be served by continual advance toward the endless frontier of science and technology, and that federal support was important to fuel that advance. Although this vision has evolved to some extent, its essentials remain relatively unchanged.

At MIT, Bush’s vision was embodied by the radiation labs during WWII, and the subsequent formation of the on-campus Research Laboratory of Electronics and Lincoln Laboratory.

MIT’s mission is often characterized as resting on four pillars:

Education, or the transmission of new knowledge  
Research, or the creation of new knowledge  
Service to the nation  
Service to humanity.

These pillars, however, are not stovepipes – they are very much interrelated, intertwined, and interdependent. The unique value of university participation in DoD sponsored basic research is precisely that it does involve all four elements.
MIT considers itself a university polarized around science and engineering. We have a population of 4000 undergraduates and 6000 graduate students, 10,000 students in total. There are just under 1000 faculty, and an on-campus research and technical staff of nearly 3000.

In addition, MIT operates Lincoln Laboratory for the Department of Defense as an off-campus, Federally Funded Research and Development Center. Although MIT/Lincoln Lab is under an Air Force contract, it is very much a “joint-services” laboratory under the purview of the Director of Defense Research & Engineering in the office of the Secretary of Defense. Lincoln Lab has about 2400 employees.

In round numbers, the total annual research volume of MIT is ~$1B, roughly equally divided between campus and Lincoln Lab. At present, DoD funds support approximately 18% of the on-campus research at MIT (this includes both direct and third party funding), and nearly 90% of Lincoln Lab.

Campus conducts only “fundamental research,” comprising “basic research” (6.1) and some “applied research” (6.2). In contrast, 90% of the Lincoln Lab funds are for development and demonstration (6.3 or 6.4). Though much smaller, the 6.2 and 6.1 funding is critically important in seeding new technologies that can be leveraged into new capabilities for national security.

Let me mention just very few examples of DoD funded basic research at MIT:

On campus research includes MIT’s new Institute of Soldier Nanotechnologies (ISN), which was founded in 2002 with a five-year $50M contract from the U.S. Army (this is 6.1). It is an interdisciplinary center with strong ties to industry whose goal is using nanotechnology to dramatically improve the survivability of individual soldiers. One team of chemical and mechanical engineers is exploring the possibility of creating “dynamic armor” by using magneto-rheological fluids to engineer a material that automatically changes from flexible to stiff when a ballistic threat is detected. Another interdisciplinary team is studying fluid flows in micro-reactors than might lead to clothing-embedded chemical sensors.

At Lincoln Lab, fundamental research in microelectronics led to very fast, photon-counting, avalanche photodiodes, which enabled the development and field-testing of 3-D laser imaging devices and of high-bandwidth ground-to-space optical communications. And basic research in rapid biological agent sensors is being incorporated in devices for the battlefield and for homeland security.

There are, however, areas of significant concern regarding basic research, none of which will be new to you. I will mention three:

1) the roughly flat federal funding for the physical and engineering sciences, and its relative decline compared to biology and medicine.
2) the relative shift toward applied and away from basic research, particularly within the funding for physical science and engineering

3) the increased attempts by federal agencies to apply inappropriate restrictions on fundamental research thereby undermining the unrestricted research environment that MIT and most universities view as an irreducible core principle.

The first item, the relative decline in federal funding for the physical and engineering sciences, has been well documented (e.g. by the AAAS), and has been an area of considerable concern for MIT’s president, Charles Vest. At MIT the trends can be seen in the on-campus DoD research support: in absolute, actual then-year dollars, DoD direct funding declined by 5% over 5 years, from $66M in MITFY 1999 to $63M in 2003 (figures for indirect funding through subcontracts are not available). Expressed as a fraction of MIT’s total research volume, the DoD share declined is 25% over the 5 years. DOE and NASA funding show comparable declines. The fraction for NSF has grown. Lincoln Lab funding in recent years has been strong and is not an issue.

An important by-product of the relative decline in funding for physical sciences and engineering on campus is the consequent decline in support for graduate students in areas that are of great importance for national security. Vannevar Bush, in his report to President Roosevelt, noted that the key ingredient governing the pace of scientific advance is the availability of a highly skilled workforce, and federal funding of university research plays a key role in educating that workforce. MIT’s Institute for Soldier Nanotechnologies, which I mentioned earlier, involves 75 graduate students, 30 postdocs, and a host of undergraduates.

The second concern, the relative shift toward applied and away from basic research within the funding for physical science and engineering, is harder to document. For on-campus research, the MIT administration and the principal investigator often do not know whether DoD funds are 6.1 or 6.2; our estimate is that 75-80% of on-campus DoD sponsored research is 6.1.

The strong perception of our Vice President for Research, Alice Gast, and others in the administration is that the overall federal support for basic research is being eroded in favor of applied or at least “application driven” research. This appears true for DoD and for other agencies. NSF’s increased reliance on topical “research centers”, NASA’s new focus on research that supports exploration and even the recent NIH “roadmap” represent similar trends. Within DoD, several of our most relevant research centers report increasing difficulties in obtaining basic research support from DARPA, which appears increasingly to emphasize short-term projects and application-driven projects led by industry.

No doubt a good case can be made for each individual decision to narrowly target a given research opportunity. But taken in the aggregate, it is troubling to those of us
who are convinced that relatively unfettered basic research is the essential seed corn for future applications and for the training of our science and engineering workforce.

The third concern is the continual and increasing pressure on research universities by the federal government to compromise their open, unrestricted research environment. Some such pressure has always been present, and all of us recognize the need for increased caution after 9/11. But this is reminiscent of a similar barometric upsurge that occurred in the waning years of the cold war, in the early 1980’s. Then, even in the face of an adversary whose technical sophistication was much closer to our own, the Reagan administration recognized the paramount value of an open university environment. President Reagan’s National Security Decision Directive 189, issued in 1985, affirmed that “our leadership position in science and technology is an essential element in our economic and physical security. The strength of American science requires a research environment conducive to creativity, an environment in which the free exchange of ideas is a vital component.” In November 2001, just months after the September attack, National Security Advisor Condoleezza Rice reiterated and reaffirmed this Directive. At MIT, a faculty panel chaired by Prof. Sheila Widnall, former Secretary of the Air Force, forcefully concluded “that retaining an open research environment with free flow of research results and information on the MIT campus is the best way for MIT to fulfill its public service responsibility.” MIT does not shy away from classified research, but all of that is conducted off-campus, at Lincoln Laboratory.

Despite NSDD189 and Dr. Rice’s reaffirmation, the university community is fending off an increasing number of attempts by contracting officers to insert inappropriate restrictions on unclassified, fundamental research. Also, we are weathering an increasingly chilly climate caused by the attempt to apply export controls to activities that, in our opinion, clearly fall under the fundamental research exemptions spelled out in the relevant regulations, ITAR and EAR. The latest cold snap came in the form of a recent report on export controls by the DoD’s Inspector General, whose only reference to the fundamental research exemption is in a single footnote (the Department of Commerce IG report even more problematic).

The effort to fend off these troublesome contract clauses is a new and growing barrier to university participation in basic research. At best, a long negotiation to modify or remove the restrictive language can delay the start of research by 6 months to a year. At worst, the contract is rejected and the project never starts at all. Universities also fear increased use of so-called “Other Transaction Authority,” which, I believe, was intended for non-traditional contractors. At best, OTA will significantly exacerbate the negotiation process, since none of the usual university-specific acquisition regulations apply.

MIT, and most research universities, have been adamant at holding the line on this issue, and we intend to continue doing so even at the expense of some areas of research. But a few institutions have succumbed to pressures to do otherwise. I question whether the federal government should consider it a victory when a contracting agent is
successful in getting a university to compromise the principle of free and open basic research.

In summary, there is much to celebrate in the half-century long participation of universities in DoD basic research. But there is also much to be concerned about, and we are very hopeful that this panel can address and help ameliorate some of these issues. The individual researchers and the students who could become future researchers are, by definition, creative and innovative people who can move in a number of different directions. If difficulties persist or even grow, more and more of them will eventually chose not to participate in DoD basic research. How many may have already made that choice is unknown.
DoD Sponsored Basic Research

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Committee on the Assessment of Defense Basic Research
National Research Council

Washington, D.C.
May 6, 2004
MIT’s Mission

- Education - transmission of knowledge
- Research - creation of new knowledge
- Service to the nation
- Service to humanity
MIT People

• Undergraduates: 4000
• Graduate students: 6000
• Faculty: 1000
• Research/technical staff: 3000

• MIT/Lincoln Lab: 2400
MIT Research Volume

- Total Research  ~$1B
- On-campus  ~$0.5B
- MIT/Lincoln Lab  ~$0.5B
- DoD On-campus  ~18%
- DoD Lincoln Lab  ~90%
Example of DoD Research @ MIT Campus

Dynamic Armor

Example of DoD Research @ MIT
Lincoln Laboratory

Focal Plane Array

GeoLITE Free Space Optical Communication Subsystem

Biological Agent Warning System
Concerns

• Flat funding in physical sciences & engineering

• Shift from basic to applied research

• Attempts to restrict free and open basic research
obligations in billions of constant FY 2002 dollars

“…our leadership position in science and technology is an essential element in our economic and physical security. The strength of American science requires a research environment conducive to creativity, an environment in which the free exchange of ideas is a vital component.” President Ronald Reagan, 1985, National Security Decision Directive 189

“...NSDD-189 shall remain in effect and we will ensure that this policy is followed.” Dr. Condoleeza Rice, November, 2001

“...retaining an open research environment with free flow of research results and information on the MIT campus is the best way for MIT to fulfill its public service responsibility.”

Prof. Sheila Widnall et al., 2002, In the Public Interest, MIT