Defense Technology Strategy: Changed Requirements

YESTERDAY	TODAY	FUTURE
• **Soviet threat drives DoD R&D** [with imperative for highest technical capabilities to compensate for USSR quantity] • **US leads in all key technologies** • **US dominates most industrial & hi-tech markets worldwide** • **DoD develops & uses advanced tech ahead of commercial sector** • **DoD R&D defense focused w/ spinoff orientation**	• **Soviet threat gone – unclear focus for R&D** [imperative for highest capabilities gives way to affordability] • **US technology leads dissipated – particularly in application and processing** • **US position declining in industrial & hi-tech markets worldwide** • **Commercial sector leads in using advanced dual-use technology** • **DoD looking for spin-on of technology from commercial**	**?**

Against this historical perspective we can see the fundamental changes in the nature of DoD's technology requirements and the ability to produce capabilities to meet these requirements. For the first time in 50 years the basic tenets of DoD's technology strategy have come into question. DoD now is trying to understand and respond to a changed, but highly unclear and uncertain environment. Key givens of the past 50 years have changed. The problem is that they have changed simultaneously and challenge some of the basic policies and predispositions within DoD and the larger political arena.

Our study delves explicitly into Defense and Technology Strategy. It assesses national security as the driver of U.S. technology policy and presents our views on what the key issues regarding technology policy that need to be addressed from a national security perspective.

Defense & Technology Policy

DoD's technology strategy needs to be integrated
into an overall national technology strategy

This should address the following concerns:

- DoD's role in supporting the nation's technology infrastructure
- Relationship between DoD R&D programs and the civilian and commercial availability and applications of technology
- Changing requirements for DoD to access and integrate its procurement and production with the overall national industrial base to meet its low volume requirements, but also provide for possible rapid surge production in crisis or wartime
- Growing dependence of commercial manufacturers on foreign sourcing for critical subsystems, components, materials, and precision tooling – can DoD accept the degree of foreign content for its systems that now exists in many commercial industries?
- The need to more rapidly and effectively transition technology into application and to transition commercial technology into defense systems

In 1957 the orbiting of the Sputnik satellite by the USSR raised the specter of the Soviet Union as a technological, as well as political, threat to the United States. The "surprise" of Sputnik evidenced a lack of attention to Soviet technological capabilities and priorities in space and missiles, and their implications for national security. The Soviet threat symbolized by Sputnik raised the issue of scientific and technological expertise at high levels in DoD, providing the impetus for the creation of the Advanced Projects Research Agency, ARPA, and the creation of the position of Director, Defense Research and Engineering. These developments were to have substantial impact on the evolution of technology policy and programs within DoD.

ARPA was specifically a creation of the Sputnik challenge. Our study pays special attention to ARPA, as it evolved into DARPA, as a key element of our current technology strategy debate. In many ways the role of DARPA as the vanguard of Defense R&D crystalizes the issue of DoD technology policy in the changing world. <u>ARPA was created in response to a very clear threat, and then evolved and adapted as the threat changed. We raise the question: what should be DARPA's focus in the new world environment that we are facing?</u> Is DoD and DARPA strategy addressing key technology issues that affect DoD today? Is a refocusing of priorities and programs required? Are new mechanisms needed for DoD to address its interests and involvement in technology competitiveness? What should they be?

Defining DoD's technology future role

DIRECTIONS FOR DEFENSE TECHNOLOGY PLANNING

Given the uncertainties facing DoD today, toward what military needs should DoD orient its work?

- Non-weapon system needs, e.g., surveillance, training, communications

- Alternatives to high-cost systems—affordability through technology and affordable technology

- Replacing high cost troops and man-operated systems through more autonomous capabilities

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Not all "competitiveness" problems in the military or civilian arenas are technology problems. Not all technology R&D problems are necessarily those that DARPA and its "unique style" are best suited for. In viewing the efforts that have already sought to expand and refocus DARPA, and those that recommend even greater re-orientation in the future, our suggestion is prudence and caution in revamping or redirecting DARPA.

Arguments have been put forward that the changing environment provides a substantially reduced security threat, and therefore DARPA should be focused on broader economic and technological competitiveness concerns. The Brown Panel states that DARPA should emphasize dual use technology. The Carnegie Commission suggests changing DARPA to NARPA. It is our view that changing DARPA to NARPA raises serious concerns and may not be advisable. In our view the primary question is not with what DARPA does, but how should what it does be properly integrated into an overall national technology strategy.

The Soviet threat is replaced now by an uncertainty of where threats to this nation's security will arise in the future. This places premiums on DARPA's more enduring programs—surveillance, information processing for command and control, training for rapid response—and it also increases the importance of bringing technology to bear on achieving very rapid but effective responses to threat situations. The changing world situation also raises the need for redirecting technology away from providing the "most advanced" technology to meet the threat, toward using technology to make effective defense less costly. This provides DARPA a new thrust or motif—technology for affordability and achieving affordable technology.

DARPA should focus efforts on issues of weapons systems costs, and the related time it takes to design, develop, and produce weapons systems. This puts greater emphasis on its programs associated with manufacturing technology and the more generic programs in information systems that could affect the industrial production infrastructure. Based on DARPA's sustained support for the development of infrastructure technologies, particularly materials and information processing, DARPA might champion "manufacturing science" in a similar manner.

DIRECTIONS FOR DEFENSE TECHNOLOGY PLANNING

What should be DoD's involvement with civilian technology world?

- Supporting technological infrastructure vs. advanced R&D
  - Problem of compatibility with and compromise of DoD charter and mission

- DoD-DARPA and university research – search for new "disciplines" to meet national needs?

- DARPA role as "technology incubator" and the changing economic-technological environment: still valid, still work, need to modify?

Such a program would build a base in the research universities and other research institutions, push technology demonstration programs, seek ways to encourage "bootstrapping" amongst programs, and provide incentives for early application of the research. Making this an attractive prospect is that two key areas important to advancing manufacturing technology are materials and information processing—thus, such an emphasis could be seen as an extension of some of DARPA's most successful efforts.

DARPA could foster the development and legitimization of manufacturing as an academic research field. By providing the funding and imperative for this research, DARPA could hope to achieve the type of self-propelling technology developments that were characteristic of the information processing area, where technology developments fed back and enabled one another. Like information processing, manufacturing science is an integrative field, combining the knowledge of more basic and accepted disciplines toward a particular type of application. For information processing this application was the integrated processing of different types of data through an array of electronic hardware and associated software medium into useful information. For manufacturing science a similar paradigm would be the integrated processing of material and component inputs through an array of production medium into useful products. Just as in information processing, manufacturing entails not just the physical equipment, but an array of nested, interlinked support and infrastructure technologies. The result of DARPA's investment in information processing has been an explosion of knowledge transforming the uses of information in both civilian applications and military operations. The goal would be that a similar, sustained effort in manufacturing could provide substantial benefits for DoD's ability to affordably develop, produce and upgrade weapons systems to support its future requirements.

DoD and Technology Transfer

Providing mechanisms for commercial application of DoD developed technologies benefits DoD directly. Such cooperation can extend the application base of DoD R&D, and thus reduce the cost of defense applications and make available a broader base of experience regarding application potentials. However, for DoD to benefit from such relationships, new approaches to the _development_ of the technologies themselves are needed.

DIRECTIONS FOR DEFENSE
TECHNOLOGY PLANNING

DoD and Technology Transfer / Transition:

DoD facing new imperatives for decreasing time to product at reduced costs

An integrated approach to the development / transfer / transition of technology within programs, within organizations, and across organizations is key to _improving the timeliness_ of achieving applications.

The relationship between military and civilian R&D must be considered as part of the defense technology development process, rather than being a post hoc program in which DoD attempts to "spinoff" research that commercial industry can use. A two-way street that is mutually supportive must be developed, or else the so-called technology transfer program will be primarily contrived and ineffective.
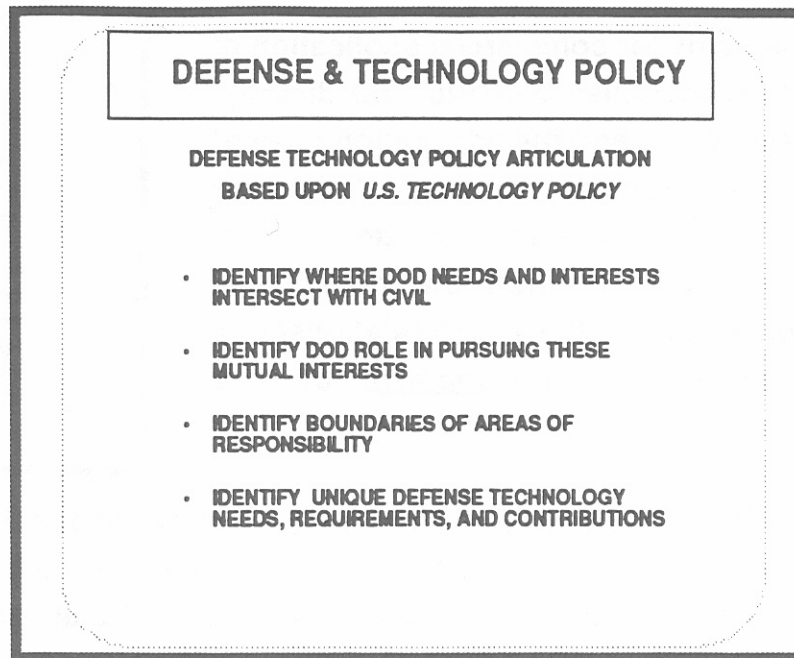
DoD's concerns regarding the transition of technology to application are broader and much more fundamental than those contained in technology transfer legislation. In fact, the "tech transfer" concept embedded in the legislation continues an emphasis on "spin-off" approach to DoD-civilian relationships, which becoming less important, and less relevant to overall technology competitiveness. This concept presumes DoD's R&D enterprises are developing technologies that [i] lead the developments of the commercial sector, and [ii] have commercial potential. These assumptions, perhaps true in the 1960s and 70s, are decreasingly valid today.

Moreover, DoD has a strong interest in commercial industry's ability to transition technology to practice and DoD can benefit by learning and adapting commercial industrial practices in its own developments. In commercial industry there have been major efforts to redefine the interrelationships between product development and transition to production. In our view

- DoD has a stake in U.S. industry learning how to do this better. What programs should DoD foster to see this happens?

- What can DoD do to improve transfer of technology FROM industry TO DoD developments and applications?

Congress required the mission agencies to actively foster technology transfer -- Our assessment is that it is in DoD's interest to define and develop a technology strategy that embraces technology transfer, but places it within the broader need to expedite the application of technology to meet security needs.

DoD & A <u>National</u> Technology Strategy

DEFENSE & TECHNOLOGY POLICY

DEFENSE TECHNOLOGY POLICY ARTICULATION
BASED UPON *U.S. TECHNOLOGY POLICY*

- IDENTIFY WHERE DOD NEEDS AND INTERESTS
  INTERSECT WITH CIVIL

- IDENTIFY DOD ROLE IN PURSUING THESE
  MUTUAL INTERESTS

- IDENTIFY BOUNDARIES OF AREAS OF
  RESPONSIBILITY

- IDENTIFY UNIQUE DEFENSE TECHNOLOGY
  NEEDS, REQUIREMENTS, AND CONTRIBUTIONS

For over forty years DoD has played a key role in fostering technology development and has exercised this role effectively. In doing so, DoD has been innovative and flexible. <u>However, with the radically changed threat environment, and the shift in the relative technological leadership of the U.S. -- particularly regarding the ability to effectively bring technology to fruition as new, competitive products -- DoD must re-evaluate the basic premises it has used to foster technology development.</u>

DoD must work to formulate a <u>cooperative</u> strategy within the national government overall and with U.S. industry—a NATIONAL technology strategy. DoD needs to emphasize that while it depends upon the NATIONAL technology and industrial base, it cannot be unilaterally responsible for its health and well-being. Congress and the Executive branch must appreciate the limits of scope and effectiveness of DoD as it moves beyond its mission-specific role. As we showed in our review of DARPA, DoD can be effective in selectively and judiciously supporting technology development beyond DoD's immediate charter. But, there are clear limits to its effectiveness and clear costs to DoD being asked to assume too large a role.

In our view, from a national security perspective, a national technology strategy is necessary if DoD is to be effective in defining and meeting its needs. Without a broader strategy, DoD is buffeted in an incoherent, often contradictory mode of operation, being pulled by Congressional mandates one way and Executive dictates the other.