

Elements of Technology Strategy

Technology Strategies: How The Government Can Make a Difference

- I. Supporting the Tech Base and Infrastructure
- II. Advanced R&D – creating & catalyzing technology opportunities
- III. Technology planning & assessment
- IV. Implementing technology Initiatives -- government role as demand driver
- V. Overcoming Impediments to technology leadership
 - Financial resources: Industry needs capital to capitalize on technological opportunities
 - Overcoming "market failures" in technology exploitation
 - Subsidization: technology infrastructure as a public good
 - Risk dampening: government support for long-term perspective

The U.S. needs to establish a technology strategy that is responsive to the technological and economic realities of what others in the world are doing. We do not have to copy their programs or policies, but we do have to be realistic about their implications, and take actions regarding them that support U.S. competitiveness. This list presents the elements of technology strategy. All of these have been pursued and applied effectively by the U.S. for specific technology developments and needs. While often the rationale for employing these measures was national security, often the rationale was broadly applied. This is true of the use of federal funds for supporting the highway infrastructure, and the National Defense Education Act. While national security was the rationale for government support for developing information processing technology, the strategy explicitly realized that success required civilian and commercial development. When technologies are "dual-use," or perhaps more aptly "omni-use," the role of the federal government in supporting their development and movement toward application becomes increasingly justified in itself. The fact that the technology is pervasive, and thus likely to substantially improve capabilities broadly, implies that the government ought to care about the competency and capability of its institutions and firms in developing and using the technology.

DoD & TECHNOLOGY STRATEGY: NEED FOR OSD FOCAL POINT

- Provide focus in DoD for subsystem technology development and insertion
 - DDR&E S&T Thrusts focus heavily on these areas
- Promote production and process technologies by supporting application demonstrations and measures to transition into industry
- Oversee DoD role in national technology infrastructure including manufacturing, information network, technical education and training
- Engage Industry-DoD dialogue on technology strategy and policies to foster technological competitiveness

DoD is in the process of developing an S&T strategy focusing on subsystems and components, as opposed to systems. This is seen, in times of scarce resources and uncertain threats, as a more efficient way to inject needed capabilities into military systems. The thrusts emphasize non-systems capabilities including surveillance, precision strike, training, and affordability. Conceptually these S&T thrusts are a fundamental part of an S&T strategy, but are not themselves a complete strategy. What we are seeing is the beginning of a process that first asks what are the key applications capabilities do we think we need in the future, and then asks: what do we need technologically to achieve these. It is in asking the second level of questions that DoD confronts the technology base. What is the capability of the country to develop and produce -- and produce efficiently -- the advanced components and subsystems that will be needed. Will the technology infrastructure be there that can deliver these components competitively?

DoD's broader technology strategy must move toward addressing the national technology base and find ways to drive applications that foster the overall national capability -- dual-use capabilities -- that give DoD a reasonable expectation that there will be a strong, economically competitive industry to draw upon. DoD must find an effective way to interact with industry and with the rest of the federal government to realistically appraise this nation's technological capabilities and seek to support those technology developments that underpin productivity and innovation within U.S. industry. Throughout the past 50 years the DoD has taken on a role of responsibility, stewardship, for key technologies that were identified as intrinsically important to future national security needs. Today, as technology spreads rapidly throughout the world, and as commercial applications often outstrip DoD's ability to employ technology, DoD must integrate its technology strategy with a broader national strategy.

Technology Strategies: Information and Communications

Country: USA	Technology Area: Computer Processing	Time Frame
I. Supporting Tech Base and Infrastructure	NSF University research; DARPA funding of advanced computing concepts & architectures; DARPA MOSIS program for university IC fabrication	1960-1991
II. Advanced R&D – tech opportunities	DARPA funding of time-sharing & interactive computing; NSA & National Labs support of large-scale computation and parallel processing; DARPA funding for massively parallel architecture prototypes	1960s 1970s 1980s
III. Technology planning & assessment	NSA, DARPA, NSF program planning; DARPA Strategic Computing; FCCSET: HI-Performance Computing	1970s 1980s 1990s
IV. Government as demand driver	DoD-DoE National Labs large-scale computer needs; NSA needs for advanced processing; DARPA support for university acquisition of advanced computers for AI, CAD, & computer technology research	1960-1991

The federal government has supported information processing technology in the U.S. for over thirty years with the objective of assuring U.S. industry remains paramount. Where there were seen to be impediments, "market failures," to the development of technology – particularly into products that potentially obsoleted vested products of existing firms — the federal government provided a range of opportunities and incentives for their development, including the first demand for the products themselves. Federal government support has built an infrastructure of technical capabilities and knowledge, particularly within the universities, that has been instrumental in developing new product areas and applications. Importantly, the strategy itself has not been static, but has responded to opportunities and changed as the technologies and the information industry itself has changed.

This national security-based strategy for information processing technology now confronts new realities—substantial international competition in a range of the technologies important to future information processing. Key aspects of the U.S. information processing industry no longer are in a position where the domestic private sector can be counted upon to further develop and apply the technologies fostered with federal funding. Increasingly, the technologies are being developed, and more importantly turned into products, by foreign enterprises. This raises issues that directly link the national security-based rationale to broader concerns regarding economic competitiveness. The national technology strategy must address these issues, define what role DoD should play in trying to respond to them, and lay out an overall, coordinated plan of for the the government's support for the information processing technology and its application.

**National Technology Strategy
SUPPORT FOR NATIONAL TECHNOLOGY BASE**

Government's Role as Technology Steward

- **Technology management as well as technology innovation**
- **Issue for future: ability of different countries to adapt and respond**

From the US perspective need to ask: Are we adapting sufficiently?

The government role as "technology steward" extends well beyond that of national security. We have had the comfortable, and uncontroversial rationale of national-security to provide a basis for the technology policy that we have pursued for the past 40 years. This has given us reasonable basis to pursue fairly broad, and often very innovative technology support. Our ability to innovate and create new technology developments remains excellent—we invested in it. Yet, the collapse of the Soviet threat, while our economic competitors have progressively dominated industries and now are paramount in many aspects of commercial high technology electronics, exposes a major weakness in our policies and strategies. That weakness is that it has paid little attention to mechanisms and approaches for transferring technology innovation into application. In essence, with a vibrant domestic market, and a dominant capability to innovate, we relied upon market forces, via venture capital and equity capital, to propel technology into product. Where "market failures" appeared to impede technology transition, the government provided the opportunity "seed bed" for ideas to develop outside of large corporations—often through universities and small start up ventures.

But, this was in an environment that did not include strong foreign participation and presumed that the infrastructure of technology development—the suppliers, the equipment makers, and the financiers—was intact. Today that environment is very different, and technology policy and strategy must recognize these differences. Dealing with technology innovation as a *system* rather than some discrete problems that must be individually "fixed" is perhaps the key challenge for U.S. technology strategy.

NATIONAL TECHNOLOGY BASE: Need for Focal Point?

- Concerns regarding national abilities to channel technology developments into application
 - Mission agency charters
 - Something else needed?
- Production and process technologies need applications champions within Federal government
 - Initiatives for manufacturing extension and cooperative R&D coupled with those linking technology to civil needs
- Federal role in technology infrastructure including
 - Technical education – technology for educational productivity
 - Support for world-class manufacturing capabilities throughout domestic production base
 - Development and support for implementing productivity enhancing technology

In our work we have concluded, as have others who have looked at the issue of technology policy, that some sort of broader focal point is needed. The ability of the U.S. economy to compete in leading edge technology is intrinsically important to national security and defense. Yet, despite this interest, DoD has limited capabilities and a limited charter to affect this competitive capability. More importantly, there are legitimate and important reasons other than defense to support technological competitiveness. A key question is how to best identify, formulate and implement technology policies and strategies that deal with those aspects of technology that are of greatest concern. Mission agencies all have charters that overlap in the area of advanced technologies. Their responsibilities for implementation become murky where such overlaps occur. Moreover, implementation generally requires the participation of the private sector, and the role of government agencies in guiding and providing incentives for industry's activities is often not clear. Inter-agency coordination, along the lines of the FCCSET, provide one mechanism to determine priorities and to avoid duplication. The Science Advisor and the PCAST provide a mechanism for identifying important issues and channeling national attention on the resolution. But these organizations cannot implement.

With the Brown Panel report of the National Academies, the Carnegie Commission, and the Competitiveness Policy Council, we have new ideas and concepts being generated for a national-level technology policy and strategy. Congress is formulating legislation that addresses many of the concerns laid out here. Acceptance of a new federal role in technology development and application appears to be emerging. The question remains are we adapting enough and sufficiently quickly?

