Defense Science Board documents collapse of U.S. technology base

by Charles B. Stevens

It was not so long ago that, for better or worse, the primary reservoir of advanced U.S. science and technology was to be found in the so-called military-industrial complex. In October of this year, the Pentagon's Defense Science Board (DSB) issued a general report on the deterioration of the U.S. industrial and technological base, and a report on the U.S. failure to take the lead in the development of a crucial new technology, high-temperature superconductors. When combined with Marsha Freeman's report on the Avtex Fibers case, these reports and studies document both the collapse of existing technological capabilities, and with them, America's potential for future technological leadership.

In the following report, *EIR* presents an analysis of and major excerpts from the DSB report, *Military System Applications of Superconductors*, and the more general study, *The Defense Industrial and Technology Base*, together with Marsha Freeman's analysis of the Avtex case.

'The defense industrial and technology base'

The *Final Report of the Defense Science Board 1988 Summer Study on The Defense Industrial and Technology Base*, reports, "In the eight years since the last Defense Science Board (DSB) study of the industrial base, the global political, economic, and technological scenes have changed considerably. America's technological superiority has diminished. Many countries, including Japan and the Soviet Union, challenge our leadership in technologies essential to defense."

Among the principal findings of the DSB study are:

"● Of greatest importance is the fact that the continued deterioration of the industrial and technology base diminishes the credibility of our deterrent. It is a national problem requiring a coordinated response by government and industry. If our nation is to ensure its security for the coming decade and beyond, it must adopt a strategy which links military strategy with a policy to ensure the availability of the industrial and technological resources on which operations plans rely. . . .

"● A pattern of inadequate long-term investment by prime and subtier suppliers is a primary cause of the increasing deterioration of the defense industrial and technology base. This inadequate investment can be attributed to: . . . .Pressure . . . to provide short-term returns. . . . Uncoordinated effects of . . . acquisition policies. . . . Increasing uncertainties surrounding the defense budget and acquisition process. . . .

"● The maritime industries have deteriorated to the point where they cannot support national security objectives. . . . Members of the subcontractor and supplier portion of industry, ranging from very large manufacturers down to small high technology companies, either refuse defense business or segregrate older technology and older production lines from their commercial business to apply to defense. DoD acquisition policies engender this behavior. . . ."

In terms of specifics, the DSB gives the following cases: "Consider the examples of computer and semiconductor technology. While American computer technology is still competitive with foreign systems, we are losing out in the semiconductor field. Because of this, foreign computers could surpass us in the immediate future. Those technologies are the foundation of every defense system, either as a part of the system itself or in its design and development.

"Other critical technologies further demonstrate our loss of leadership. The numerically controlled machine tool industry is now led by Japan. Their lead in flexible manufacturing systems, a key to many complicated manufacturing tasks, is growing each year. Similarly, America has lost its leadership in precision optics in the past two decades. We cannot retain battlefield superiority without assuring we have access to technological leadership in those fields.

"This loss of technological leadership can be attributed to many political and economic factors. Too often, both government and industry ignore the effects of their own management philosophies. Recent studies, such as the one being conducted by Professor Bruce Scott, of Harvard, point out the disadvantages of those philosophies in comparison with those of countries such as Japan, the European Economic Community, and Korea.

"Professor Scott's works characterize America's loss of technological leadership in terms of competitiveness and is demonstrated in **Figure I-1**" from page 14 of the report. "The overall problem, one of short-term planning, manifests itself in emphasizing:

"● Products over productivity

"● Short-term profits over long-term competitiveness

"● Return on investment over market share.

"The effect of combining the short-term planning philosophy with America's uncoordinated policy-making mechanisms is best stated in the *Data Resources Report on U.S. Manufacturing Industries*: 'The decline of position of manufacturing is a major industrial development for this country. . . . There are so few exceptions to the decline of the international positions of U.S. manufacturing industries that one must seek . . . general causes that act on the entire economy.'

". . .The result is the short-term planning which now dominates industry investment decisions. With short-term planning, the DoD cannot be assured of the advancement of technology on which our deterrence depends. There is danger in the contrast with our adversaries whose stable, long-term planning may permit them to overcome technological advantages. The loss of this advantage is the loss of the industrial element of our deterrent."

By contrast, the Defense Science Board reports, "The Soviet priority attached to military power has required a national commitment to a dedicated and militarily oriented industrial system. During the past 35 years, there has been a tremendous growth in all sectors of Soviet military industries and the tightly integrated national strategy of military production, from mining of raw materials to the fabrication of finished weapons systems.

"Defense industrial requirements receive the highest priority in economic planning. . . . Soviet defense planning is based upon a strong, coordinated industrial premobilization structure.

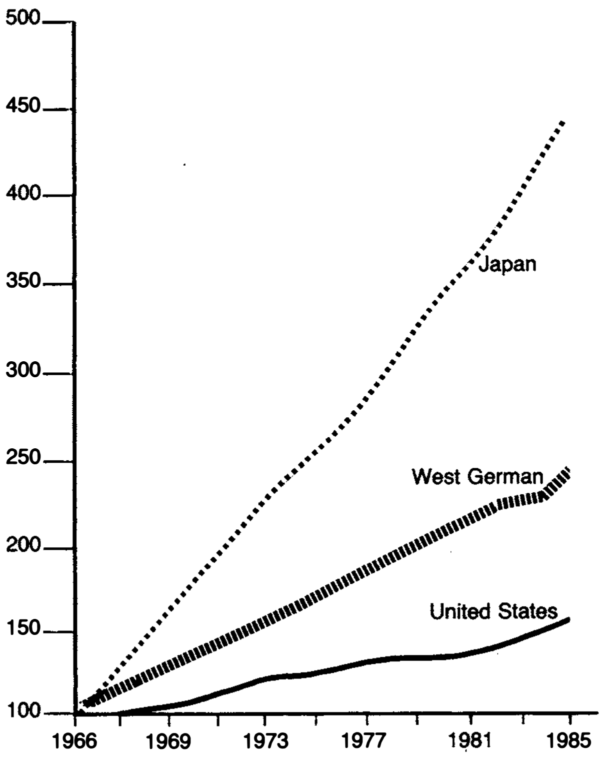
"As a further indicator of shortfalls in DoD technology base funding, **Figure V-4**" from page 38 of the report, "compares U.S. versus Soviet military RDT&E spending levels for almost 20 years.

"This deficit can be tied to the relative trends in U.S./U.S.S.R. standing in the 20 most important basic technology areas found in **Figure V-5**" from page 39 of the report. "While the U.S. is in the lead, the arrows indicate the relative technology level is changing in favor of the Soviets.

"The importance of technology as a factor in weapon systems deployment is shown in **Figure V-6**" from page 39. "The chart indicates the relative U.S./U.S.S.R. standing in strategic and tactical forces. The arrows once again indicate significant changes in relative superiority of the U.S. versus the Soviet Union in key military systems."

FIGURE I-1

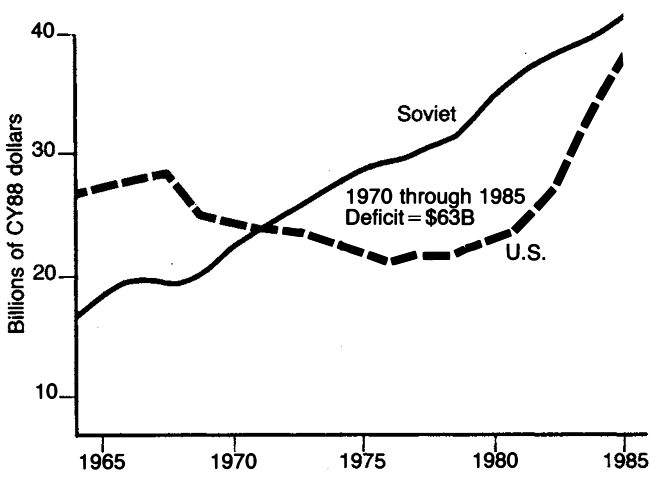
Manufacturing productivity, 1965-85 (1965=100)



Source: Final Report of the Defense Science Board 1988 Summer Study on The Defense Industrial and Technology Base, October 1988, Vol. I, Office of the Under Secretary of Defense for Acquisition, Washington, D.C.; U.S. Dept. of Labor Bureau of Labor Statistics, Office of Productivity and Technology: 1986.

FIGURE V-4

U.S. vs. Soviet military research, development, test, and evaluation



Source: Final Report of the Defense Science Board 1988 Summer Study on The Defense Industrial and Technology Base, October 1988, Vol. I, Office of the Under Secretary of Defense for Acquisition, Washington, D.C.

The DSB report on *Military System Applications of Superconductors* gives a specific case study of how the United States is currently falling increasingly behind in the race to develop frontier technologies and industries. It is not only the fact that, given the recent realization of high temperature superconductors, which promise to revolutionize every aspect of science and technology, the United States has failed to rise to this challenge, but also, as the DSB emphasizes, the fact that this recent experimental breakthrough has uncovered the failure of the United States to vigorously pursue the immense potentials of already existing high temperature superconductors.

As documentation, we excerpt from the DSB report its "Executive Summary" and "Recommendations" together with other selections. From the body of the superconductor report, it is clear that high temperature superconductors (HTS) prom-

FIGURE V-5

Relative U.S./U.S.S.R. standing in the 20 most important basic technology areas

Basic technologies	U.S. Superior	U.S./ U.S.S.R. Equal	U.S.S.R. Superior
1. Aerodynamics/fluid dynamics	X		
2. Computer & software	X		
3. Conventional warhead (Including all chemical explosives)		X→	
4. Directed energy		X→	
5. Electro-optical sensor (including IR)	X→		
6. Guidance & navigation	X		
7. Life Sciences (human factors bio-technology)	X→		
8. Materials (Lt. Wt. High strength, high temperature)	X→		
9. Micro-electronic materials & integrated circuit manfacturing	X		
10. Nuclear warheads		X	
11. Optics		X→	
12. Power sources (mobile) (includes energy storage)		X	
13. Production manufacturing (includes automated control)	X→		
14. Propulsion (aerospace and ground vehicles)	X→		
15. Radar sensor	X		
16. Robotics & machine intelligence	X		
17. Signal processing	X		
18. Signature reduction	X→		
19. Submarine detection	X→		
20. Telecommunications (includes fiber optics)	X		

Source: Final Report of the Defense Science Board 1988 Summer Study on The Defense Industrial and Technology Base, October 1988, Vol. I, Office of the Under Secretary of Defense for Acquisition, Washington, D.C.

FIGURE V-6

Relative U.S./U.S.S.R. technology level in deployed military systems

Deployed system	U.S. Superior	U.S./ U.S.S.R. Equal	U.S.S.R. Superior
Strategic			
ICBMs		X	
SSBNs	X		
SLBMs	X—		
Bombers	X→		
SAMs			X
Ballistic missile defense			X
Anti-satellite			X
Cruise missiles		←X	
Tactical			
Land forces			
SAMs (including naval)		X→	
Tanks		X→	
Artillery	X		
Infantry combat vehicle		X	
Antitank guided missiles		X→	
Attack helicopters	X→		
Chemical warfare			X
Biological warfare			X
Air forces			
Fighter/attack and interceptor aircraft	X→		
Air-to-air missiles	X→		
Air-to-surface missiles	X→		
Airlift aircraft	X→		
Naval forces			
SSNs	X→		
Torpedoes		X	
Sea-based aircraft	X		
Surface combatants	X→		
Naval cruise missiles		X→	
Mines			X
C3I			
Communications		X	
Electronic countermeasures	X→		
Early warning	X		
Surveillance and reconnaissance	X→		
Training simulators	X		

IR—InfraRed
ICBM—InterContinental ballistic missile
SSBN—Ballistic missile nuclear submarine
SLBM—Submarine launched ballistic missile
SAM—Surface-to-air missile
SSN—Nuclear attack submarine
C3I—"C-cubed-I," or command, control, and communications; intelligence
ECCM—Electronic countercounter measures

Source: Final Report of the Defense Science Board 1988 Summer Study on The Defense Industrial and Technology Base, October 1988, Vol. I, Office of the Under Secretary of Defense for Acquisition, Washington, D.C.

ise to revolutionize computer, electronic sensor, and electrical technology. More significant is what the report leaves unsaid. From the data presented, it is clear that low temperature superconductors (LTS) will revolutionize the recently developed radio frequency weapon technology and other types of directed energy weapons. Furthermore, there are strong indications that the U.S.S.R. has not ignored these possibilities, either in the case of the existing low temperature superconductors (LTS) or the recently demonstrated HTS.

The MHD submarine

A good case in point is that of the application of superconductors to development of advanced MHD propulsion systems. The DSB report notes:

"The quickest payoff in high-power applications will come from the exploitation of superconductor materials in rotating electrical machinery. Substantial weight savings can be realized by eliminating magnetic circuit materials and customary field windings. Already, an experimental 3-megawatt superconducting DC motor has been built for ship propulsion and tested at sea. This motor was 33% smaller than the equivalent conventionally air-cooled AC motor.

"Substantially greater motor size reductions are possible with conventional LTS materials. A superconducting homopolar DC motor of 40,000 h.p., employing superconducting shielding, could be built at about one-fourth the size and weight of a contemporary AC motor. The decreased size and weight and increased electrical efficiency reduce fuel requirements and lead to an overall reduction in propulsion system demand on the ship's resources. A superconducting generator, which may be located remotely from the ship drive motor, will provide an efficient, flexible ship propulsion system. The effect on a destroyer-class ship's performance would be to reduce ship displacement by 14 percent and increase its range by 30 percent. If the propulsion were mounted in an external pod, the ship's displacement could be decreased by 25 percent and its cruising range increased by 40 percent.

" . . . High temperature, high field materials would allow further decreases in weight and size. At this point, the propulsion system would be a negligible fraction of overall ship displacement, and multiple redundant drive systems could be installed.

"While the first high-power propulsion applications are likely to be in ships . . . high field superconductors could also provide light-weight generators and motors for armored vehicles and, more speculatively, for aircraft propulsion. It must be emphasized that if these systems are to come about, the necessary cryogenic support systems must be developed to withstand the rigors of an operational environment.

"Other superconductor propulsion systems are clearly foreseeable. In Japan, Magneto Hydrodynamic (MHD) drives have been built and tested at scale-model level by Kawasaki Heavy Industries. By 1990, Mitsubishi Heavy Industries, in partnership with Toshiba and Kobe Steel, plans to have a 120-ton ship with MHD drive in operational test. In addition to surface ships, MHD drives can also find use as quiet propulsion systems for submarines and torpedos. Speculating about further term applications, an MHD collector-diffuser and an MHD magnetic nozzle may make feasible a 'a scramjet' propulsion system for space bodies traveling in an ionized medium."

Do the Soviets have it?

In 1986, *Jane's Fighting Ships* put forth the thesis that the Soviets had developed a wide range of advanced submarine systems, including super-cold, absolute-zero cryogenic electric superconducting motors and propellerless propulsion based on electromagnetic and MHD drive. Except for *EIR*, this thesis was almost universally ignored at the time. Now, with the advent of HTS, this thesis no longer sounds so wild, particularly if the Soviets had run across HTS some years before scientists in the West.

The *Jane's* thesis was "based on an hypothesis which is, in turn, based on freely available literature published over the last 25 years. It will, inevitably, be described as muddled thinking with little, if any, basis in fact. But the truth of the matter is that there is a possibility of some of it being right. . . . In 1963, the U.S. Bureau of Ships published Friauf's papers on magnetohydrodynamic propulsion. Nearly 30 years ago, Dr. Stewart Way suggested the principle of electromagnetic thrust and, 10 years later, produced a working model. The principles of cryogenics have been available for a long period in the West. . . . Contemporary to much of this work were efforts of Soviet scientists and engineers. . . . In 1965, a volume entitled *New Sources of Electrical Energy* was published in Leningrad under the name of A.P. Baranov, and it was then that it was forecast that magnetohydrodynamic (MHD) generators would be available for use by Soviet ships in the 1980s. About the time of publication of this book, civilian applications of the MHD principle in *Traveling Wave Pumps* had been investigated in the West and it had also been proposed as a means of torpedo propulsion. The energy required to push an object through the water is, in MHD, produced by pulsating magnetic fields causing sympathetic pulsations of ferro fluid surrounding a tube, open at both ends to the sea. Thus, a travelling wave is set up in the enclosed fluid and the water is expelled at the rear, resulting in thrust. There are numerous advantages to such a system: no radiated noise from cavitation or moving mechanical parts, improved thrust for a given power and less wake turbulence. The last of these would probably mean a reduction in detectable magnetic flux variations."

In summary, it should be noted that these MHD applications of high temperature superconductors also have revolutionary implications for radio frequency weapons.

Next week: The Report of the Defense Science Board Task Force on Military System Applications of Superconductors.