American Weapons, Alien Parts

Like computers and cassette players, the brains of U.S. missiles may soon be made in Japan. Some see this as a risky business

THE brains of America's smart weapons have a hidden vulnerability, according to a report by a committee of the National Academy of Engineering.* Missile guidance systems, radars, communications gear, satellites, air navigation instruments, and other sensitive devices have come to depend on foreign parts and manufacturing expertise. The problem has crept in so quietly, the committee says, that the Pentagon does not know how big it is.

The report was written last spring by the Board on Army Science and Technology (BAST), but it fell afoul of military censors and was not cleared for release until September.

This is the first of several studies to be issued this fall on the threat to national security posed by electronic imports. Others are being written for the National Security Council and the Defense Science Board (DSB).

All three express alarm at the United States' decline as an electronics power, noting that Japan has overtaken the United States in many areas and is furthest ahead in the most advanced technologies. The draft DSB report urges the Pentagon to take steps that will "assure the reversal of present trends and preserve U.S. leadership in semiconductor technology."

Among the steps being considered are (i) strictly enforcing the Pentagon's "buy American" rules, (ii) creating a new Semiconductor Manufacturing Institute to be run by a consortium of companies and funded by the military, and (iii) establishing centers of excellence for applied industrial research at universities.

Policy-makers face a dilemma. Two forces push weapons builders in the direction of greater dependence on imports. One is the budget-driven need to lower costs and increase efficiency. The other is the political desire to involve allies in producing new weapons. In the past, the Defense Department has encouraged "offset" agreements in which a foreign ally agrees to buy a part of a weapons line from the United States, lowering production costs while showing solidarity. The U.S. weapons company in turn agrees to buy parts from the ally. For example, the Raytheon Company (United States) agreed in 1985 to buy $65 million worth of electronic equipment and $50 million in logistical services from the Fokker company (Netherlands) for the Patriot antiaircraft missile. This pattern of joint military production is now pervasive. A new crop of agreements is taking shape under the Strategic Defense Initiative, whose directors hope to win the help of Japan's advanced electronics industry.

The trend in military systems is strongly toward using more imported parts.

At the same time, there are risks in relying too heavily on foreign expertise. Although these suppliers are located in friendly countries and many are controlled by U.S. corporations, they are thought to be more vulnerable than domestic factories. A few well-placed bombs, or even acute political pressure, might be enough to interrupt shipments. The DSB also asks whether foreign companies can be relied upon to make their latest devices available to military contractors when they compete with the same companies in the civilian market.

Some industry observers, like Kenneth Flamm, an economist at the Brookings Institution, are skeptical about the fuss over weapons parts because it appeared just as the semiconductor industry began to ask for protection from Japanese competition. "This military concern was used as a way of getting political support for import restrictions," Flamm says. He agrees that the military's reliance on foreign electronics is not a good sign, but he thinks that it should be treated as a symptom of a deeper malady, not as an isolated issue.

"The first question to ask is: do we have a problem?" says Jacques Gansler, a member of BAST's study team and author of the book *Defense Industry*. He and BAST's other experts could give no clear answer because the Pentagon keeps almost no data on foreign parts used in weapons. "In the absence of such information," the report says, "it is impossible to plan ways to protect the Army's ability (or that of the other services) to obtain critical electronic components in the event of supply disruptions."

BAST relied on two kinds of evidence to support its view that the problem is real and growing. It examined tear-down studies of a dozen conventional weapons, and, looking toward future problems, it reviewed broader trends in commercial electronics. The first approach was straightforward. As Gansler says, "Every time we opened up a weapon and looked inside, we saw [foreign parts]."

The Sparrow III, a small Navy missile, was the subject of one of the few careful studies the committee found. The guidance system had been taken apart for the Defense Joint Oversight Committee on Foreign Dependency in 1985 and had been found to contain integrated circuits and transistors from Japan, a ferrite phase-shifter from West Germany, a memory chip assembled in Thailand, ball bearings made of raw materials from "various" sources—16 alien elements in all. If shipments of these import-dependent parts were stopped, the study said, it would be impossible to continue making the missile. If American-made substitute parts were used, the paper said, the Sparrow could return to production within 18 months, providing it did not have to be redesigned.

The Sparrow's brain is typical of the innards of the present generation of weapons, according to BAST. It is no longer true, as it was in the early 1960's, that U.S.

*"Foreign Production of Electronic Components and Army Systems Vulnerabilities" was written by the Committee on Electronic Components, Board on Army Science and Technology, National Academy of Engineering, 2101 Constitution Avenue, NW, Washington DC 20418. The members were William Hittinger (chairman), formerly of RCA, Willis Adcock of Texas Instruments, David Barbe of the University of Maryland, Robert Burmeister of Hewlett-Packard, Robert Cattoi of Rockwell International, Joseph Feinstein of Stanford University, William Finan of Quick, Finan & Associates, Jacques Gansler of the Analytic Sciences Corporation, C. Lester Hogan formerly of the Fairchild Camera and Instrument Corp., August Witt of MIT, and Charles Wolfe of Washington University.

Sparrow in flight. *The guidance system of one of these Navy antiaircraft missiles contained 16 imported parts or materials, including devices made in Japan, Thailand, and West Germany.*

military purchases set the pace of development in the electronics field. Military requirements lag behind civilian capabilities, and even programs designed to accelerate the pace, such as the Very High Speed Integrated Circuit (VHSIC) program, barely keep up with the civilian world. Today, the pace is set in the open commercial market, with Japanese manufacturers beginning to lead the Americans in many areas. Foreign products are often not just cheaper, but better. According to BAST, the trend in military systems is strongly toward using more imported parts.

Already, "certain electronic components used in Army systems are supplied exclusively by foreign sources." Among these are electronic countermeasure tubes, liquid crystal and electroluminescent video displays, magnetic bubble memories, and certain raw materials.

The BAST study group became more concerned when it looked at general trends in the marketplace. "I don't worry so much about the present generation of weapons," Gansler says. But if the pattern does not change, he thinks the next generation will be seriously compromised. "All I am crying for is to have someone look at the problem" and for us not to "close our eyes and say, 'We don't have enough data.' "

"Open up an IBM computer," suggests August Witt, a materials expert at MIT who sat on the study panel. "There's almost nothing in it that's made in the United States except the chassis." U.S. weapons are headed in the same direction because America's most sophisticated manufacturers are moving overseas. Witt cites the example of Monsanto, by far the most important U.S. manufacturer of silicon wafers for electronics. The company has been expanding its production abroad but not at home. This fall it will open two new plants in Asia and one in England, so that most of its plants will be foreign. The two domestic facilities, one more than 25 years old, may come under increasing pressure if the U.S. semiconductor sales do not revive. Monsanto has lost $80 million in this division over the last 18 months, according to a spokesman.

There are several risks in allowing this expertise in materials manufacturing to move overseas, Witt says. "The complication is that if anybody wants to disrupt the technology, it becomes much simpler." And once the skills and the equipment depart, they cannot easily be brought back. "Until quite recently, I was an optimist" about the chances for reviving the domestic electronic materials industry, Witt says. But he has grown discouraged after hearing industry and government leaders propose only weak and partial solutions.

One acute problem is the production of semiconductors made of gallium arsenide. These devices have several qualities that interest the military: they can convert electronic signals to laser light (and vice versa), they can operate faster than silicon, and they resist radiation damage better. They will be important in radiation-hardened guidance systems, in new radar and communications satellites, in optical computers, and in "interpreter" devices that will enable present electronic technology to "speak" to optical systems of the future. The Strategic Defense Initiative Office is interested in gallium arsenide for high-speed computers and laser systems.

Several years ago the Japanese government identified optoelectronics as an important field and launched an intense research and development program aimed at producing high-quality gallium arsenide. That commitment has begun to pay off. According to the BAST report, the Sumitomo company last year produced 75% of the free world's supply of gallium arsenide substrate crystal, the basic material used in making such components. Sumitomo has constructed a fully automated plant capable of making 10 tons of crystal annually, and it plans to expand this capacity fivefold. American companies still dominate the market in gallium arsenide devices, but none has made an investment in production capacity on this scale.

On the contrary, says Richard Brown of Monsanto's electronic materials division, the American companies are taking a "wait-and-see" approach. Demand for gallium arsenide has not grown as rapidly as had been predicted, and the U.S. companies have been unwilling to jump in as deeply as the Japanese. Ironically, Monsanto bailed out of the gallium arsenide business in the mid-1970's, selling its foreign rights to Mitsubishi. As Japanese gallium arsenide products began to look interesting, Monsanto sought and won an agreement to serve as Mitsubishi's marketing agent in the United States. Reviewing the field known as optoelectronics (of which gallium arsenide is an important part), BAST concludes: "The Japanese companies will probably come to dominate this market, leaving the military dependent on foreign sources."

The BAST study offers three broad recommendations for bringing the vulnerability into sharper focus and resolving it: (i) learn the extent to which foreign electronic parts actually are used in weapons, (ii) take immediate steps to limit their use in existing systems, and (iii) begin far-reaching programs that will rebuild U.S. self-sufficiency in key areas.

A vast new bookkeeping chore would be added to the Pentagon's tasks if these recommendations are put into effect. BAST concedes that the first parts survey will require "considerable effort," but argues that the file could be kept current by making the weapons contractors provide the informa-

tion. At the outset, however, a special office would have to track down the origins of all materials and components in existing weapons. It is crucial that the sources be traced "all the way back, so, for example, an American distributorship is not listed if the source is actually a foreign supplier"—a common error in present records. Having traced parts to the first origins, the new data-keepers would attempt to identify a domestic source, if any. If there were none, the item would be carried on a "critical parts list." After the initial chore of building a file, the parts office would watch for patterns of growing dependence, taking action only if an item turned up in many systems or in increasing volume.

The report is less exact in proposing remedies. Gansler said the vagueness is deliberate, for he thinks it would be a terrible mistake to impose blanket restrictions on imports. As much as the U.S. semiconductor companies might like it, it would be expensive and unnecessary, Gansler says. To succeed, new restrictions will have to be selective, and the terms of selection cannot be set in the abstract.

However, the BAST report suggests some remedies, such as stockpiling critical parts, creating standby U.S. production capacity, lining up substitute sources, and redesigning weapons to exclude foreign parts. These precautions should be taken only if analysis shows that their cost is outweighed by the need for security. BAST estimates that these measures could add 1% to the price of a weapon.

Over the long term, it may be necessary in some cases to "stimulate a totally new technology to ensure that the United States is in the forefront of a field." Candidates for this treatment are gallium arsenide semiconductors, advanced display screens, and lithium batteries. In such critical fields, according to BAST, the Defense Department may have to consider making "significant investments" in capital equipment or advanced production processes, even to the point of creating an entire "subsector of an industry."

This could grow into a major program to subsidize electronics manufacturing. It would certainly cost "tens of million of dollars," the report estimates.

Some members of Congress may shrink from spending so much for insurance against unlikely supply shortages. But in BAST's view, the price for boosting key domestic manufacturing processes looks "extremely small" when taken in the context of the entire budget at the Pentagon, "where acquiring a new weapon typically costs more than $100 billion annually." By this measure, almost any price is insignificant. ■

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Gene Splicing Dominates Review of Weapons Pact

Fears of the military applications of biotechnology have prompted signatories of the Biological Weapons Convention to strengthen its verification procedures

Geneva

INTERNATIONAL agreement was reached in Geneva late last month on a series of steps aimed at reducing the possibility that genetic engineering techniques will be used to develop a new generation of biological weapons.

These steps, which have been approved both by the United States and the Soviet Union, will include an exchange of information about all high-containment facilities where genetic engineering research is being carried out, and a requirement that details of unusual outbreaks of toxin-related diseases be reported to international authorities. There will also be greater encouragement given to scientists to publish the results of research into protection against such diseases, and to arrange exchange visits between their laboratories.

Pugwash has argued that fears that biotechnology will be used for weapons purposes are "largely misplaced."

The list of procedures was agreed to at the end of a 3-week conference held in Geneva to review the operation of the 1972 treaty banning the development, production, and stockpiling of bacteriological and toxin weapons—usually referred to as the Biological Weapons Convention.

A special meeting of scientists and technical experts will be held in Geneva next spring to decide on the precise form in which information and data on current research programs related to the convention will be exchanged. The information will eventually be reported to the United Nations Department of Disarmament Affairs in New York.

U.S. officials doubt whether the new provisions will, in themselves, be sufficient to prevent signatory states from carrying out clandestine research programs into new biological weapons if they wish to do so. They remain convinced, for example, that the Soviet Union has a number of institutions carrying out such research, a charge the Soviet officials have consistently denied.

This is primarily because of the difficulties of verification. "The convention, in our judgment, cannot be made effective through amendment or design," H. Allen Holmes, assistant secretary of state responsible for the Bureau of Political-Military Affairs, recently told a congressional committee.

The United States also shares with most other Western nations the feeling that opening the convention up to new amendments risks weakening the effectiveness of what has already been agreed, and could interfere with separate negotiations on achieving a chemical weapons treaty.

The hope, however, is that the new procedures will reinforce what Holmes described as the "international norm" against biological weapons represented by the treaty, and that the new investigatory procedures will make it easier to establish a consensus behind claims that the treaty is being violated. The United States has so far been unable to establish any consensus over allegations that mycotoxins have been used in Southeast Asia.

The Biological Weapons Convention came into force in 1975 and has attracted 103 signatories. It is widely quoted as "the world's first disarmament treaty," since it is the only one that outlaws the production and use of an entire class of weapons of mass destruction.

One of the factors that made it easier to reach agreement on banning biological weapons (in contrast to their chemical counterparts) is that their effects are more difficult to control on the battlefield, making them less attractive as military devices. And the consequent lack of military interest was, in turn, the principal reason why it was not felt necessary at the time to include detailed verification procedures.

Over the past decade, however, advances in genetic engineering have led to a general revision of this perspective. Theoretically at