The Pentagon Is Not Eating Engineers

Contrary to conventional wisdom, a report for the Academy of Engineering finds no evidence that the defense buildup is draining talent from the civil sector

THE United States is now in its third major military buildup since 1950, but the current boom is the smallest of the three, and it does not appear to be draining talent away from the civil sector, according to a report issued by the National Research Council.*

If the defense buildup is having any impact on high-tech careers, the report says, it is serving to counteract a decline in the recruitment of engineers by nondefense industries. People who might have looked for work in civilian projects—as many did in the energy business in the 1970's—are now turning to defense work.

The growth in military spending today (1980–1985) is about one-fourth as steep as it was during the Korean War period (1950–1953) and half as steep as during the Vietnam War (1965–1968). The increase in defense spending in constant dollars for the Korean War was $157 billion, as compared with $56 billion during the recent surge. While the military booms of the 1950's and 1960's did alter career patterns by diverting more people into the government's path, the present one is not doing so, according to the report. The study also notes that the current boom appears to have played itself out and settled into a plateau. For this reason, the greatest impact in terms of increasing demand for engineers is "behind us."

"I was not surprised" by these findings, said Harrison Shull, chairman of chemistry at the University of Colorado at Boulder and chairman of the study panel. He spoke at a press conference on 24 October. "Several years ago, I'd have said there would be a surplus of engineers at this time." In his view, the defense boom has employed engineering graduates who otherwise might not have had work.

The study was commissioned last year by the National Academy of Engineering after some of its senior members expressed concern about the possible detrimental impact of a rapid defense buildup on U.S. industrial competitiveness. This quick look at the issue took 6 months to write and cost about $30,000.

It was inspired by the Administration's plans for defense spending, which at the outset seemed hugely ambitious. As new weapons projects were launched and civilian programs were cut, the Pentagon's share of federal R&D expenditures grew from around 50% to over 70%. Leaders at some of the nation's best universities, including the Massachusetts Institute of Technology, worried that this dramatic shift in federal spending might portend a shift in technical talent, diverting engineers away from commercial endeavors and leaving U.S. companies short of the talent they need to compete with foreign firms.

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As a corollary, some critics focused particularly on an item added to the defense budget in 1983, the Strategic Defense Initiative (SDI). Because of its lavish budget (now reduced) and its large demands for scientists and engineers skilled in frontier technologies, SDI was seen as a sponge that would soak up the best and brightest graduates. The authors of the study said they were unaware of a way to measure the quality of engineers in different fields. However, anecdotal evidence suggests that SDI has not become a talent sponge.

A survey of engineering school placement officers, conducted last spring by Robert Weatherall of MIT, found that schools were seeing no bias for or against SDI among the most talented graduates. "Some of the placement officers said that the best [students] go to graduate school," Weatherall reported. "Many directors thought the best students sorted themselves no differently than the generality. More than one pointed out that the most esteemed place to go in terms of the quality of its R&D was Bell Laboratories. They thought that the pull of such places as Murray Hill [Bell] and Yorktown Heights [IBM] was more than a match for the defense laboratories. . . . "

In reviewing hiring trends, the panel did not look specifically at SDI, Shull said. "Traditionally, 20% to 30% of engineers go into defense industries, and we foresee no change in the overall pattern." However, there may be shortages or surpluses of skills within specialized areas, as in the past. The report identified optics, an area of great interest for SDI, as one where a temporary shortage of talent may appear. But Shull said that he would not expect a shortage to last long because capable people are moving in from all directions. He likened the interest in optics to the passion for radar after the Second World War. "When we began the war," Shull said, "there were no radar experts. But within a few years there were thousands," most of whom had had no formal training in the field.

The panel was reluctant to make any predictions about the demand for engineers in the future. It found severe weaknesses in all the forecasting models, and Shull said he saw no point in "spending money on grinding out projections when they won't tell us what is really going to happen." The report was skeptical of even the best analytical tools, saying they are not reliable for anticipating events more than 2 years ahead. It recommended that the models be improved.

In general, the report found "little cause for concern about engineering bottlenecks arising from the current [military] buildup." But it noted that in the past, the government invested more heavily in subsidizing the education of talented students who wanted to become engineers through such programs as the National Defense Education Act. Because these subsidies are smaller now, and because the number of engineering undergraduates is declining, the report did not rule out the possibility for bottlenecks in the future.

Shull ended the press conference with a personal plea for changing the model on which the engineer's career is patterned. Students who want to become engineers should first receive a general education in the sciences, Shull said, and should not be required to master more specialized professional skills until they reach graduate school. The fact that biologists, physicists, and chemists defer much of their professional

*"The Impact of Defense Spending on Nondefense Engineering Labor Markets," a report to the National Academy of Engineering by the Panel on Engineering Labor Markets, National Academy Press, Washington D.C. 20418

education until graduate school, the report says, may make their professions "less susceptible to intense swings in supply/demand relationships characteristic of engineering today."

At present, Shull said, industry relies heavily on engineers who hold only a baccalaureate degree, and, as a result, undergraduate engineering courses are overspecialized. If companies and universities could cooperate in bringing about a change, Shull said, the cyclical peaks and valleys in the job market might be smoothed out. In times of high demand for engineers, many young people holding only an undergraduate degree would go straight to work. In times of low demand, they would continue their education. ■ ELIOT MARSHALL

Mathematicians Look to SDI for Research Funds

A briefing organized by the National Academy of Sciences provided an opportunity for mathematicians to make a pitch for SDI money

MATHEMATICIANS came to a recent briefing with directors of the Strategic Defense Initiative program, "with their hands open and their pockets empty," observed Donald Austin of the Department of Energy. The briefing, held at the National Academy of Sciences on 7 October, was billed as an opportunity for mathematicians to hear how the Innovative Science and Technology program of the SDI program could use their talents. Instead, it turned out to be an opportunity for mathematicians to tell SDI administrators why they should receive SDI funds.

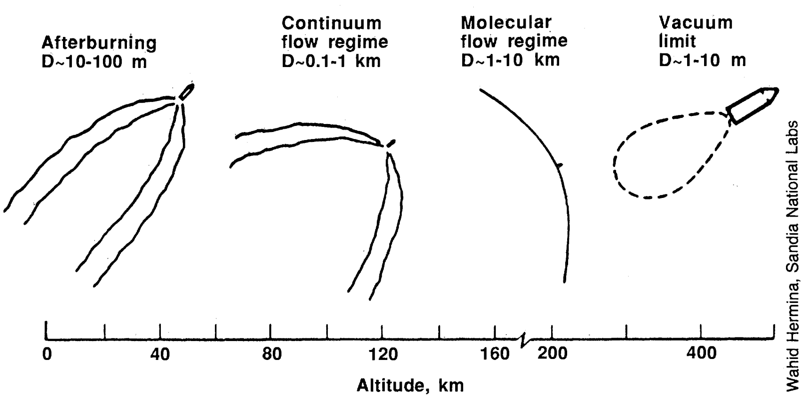
And the SDI responded. James Ionson, director of SDI's Innovative Science and Technology Program, said that "we probably will put a couple of million dollars" in mathematics. The program invests about $1 to $1.5 million on mathematics now; in 1987 that figure most likely will be $2.3 to $3 million, according to Ionson. The National Science Foundation spends about $50 million a year on basic math research.

The briefing was the idea of the Conference Board on Mathematics. It is, says Ionson, the first time the mathematicians have come, as a group, to discuss receiving more SDI funds. Until now, they have filed into the SDI office as individuals and, says Leonard Caveny of the SDI, "they may think they communicated with us, but they really haven't." Only a few are receiving SDI funds. In the past, the mathematicians were not specific enough about how what they do is really SDI work in other guises. Work on fast ways to solve problems on computers, for example, may be directly applied to SDI computer problems. The recent briefing was different.

Ionson said that math research on optimization, or finding best solutions to complex computer problems, and spatial statistics are "high on my list" of projects to fund. Both are areas of mathematics that are crucial for the design of systems meant to work in what the SDI euphemistically calls a "stressful environment," meaning a nuclear attack.

David Shanno of Rutgers University, who spoke on optimization at the briefing, pointed out that the problems the SDI program faces include designing a communications network in which "nodes [communications points] of the system may disappear. How do you establish a communications network? If the missiles are independent, you may end up firing them all. If you have a central communications center, what if it is knocked out? These are really *fascinating* mathematics problems and they are not thoroughly addressed," he remarked. Shanno pointed out that although a number of scientists have said that the computations involved seem impossible—or at least impossible to do quickly enough—mathematicians recently discovered several very fast methods that can quickly cut computer time. In particular, there is the algorithm discovered by Narendra Karmarkar of AT&T Bell Laboratories (*Science*, 21 September 1984, p. 1379) and one discovered by John Reif of Harvard University and Victor Pan of the State University of New York at Albany (*Science*, 14 June 1985, p. 1297). "By looking at the mathematics differently, mathematicians can devise new concepts that can blow away preconceived notions," he said.

Spatial statistics, explained Jerome Friedman of Stanford University, is crucial for surveillance. It is needed "to detect and identify rocket launches and to tell how fast and in what direction the rockets are moving." Statistics also tells "how well we know what we seem to have measured," he continued. "The problems are fascinating and difficult because you are looking for a needle in a haystack—the signal is small above background and you are looking for unusual events. There also will be jamming by natural and deliberate noise in the system and deliberate misinformation, or decoys." The Soviets, or whoever is attacking, will try to slip by our defenses, perhaps by making their missiles invisible to the SDI shield. To Friedman, this makes the statistics problems even more intriguing. "Since the enemy is providing us with the information, they will



Find the target. *As a rocket ascends, its plume changes dramatically, flattening out so that, by the time the rocket is above 200 km in altitude, the plume is as much as 10 km wide. The math problem is to find a way to locate the relatively tiny rocket in the plume.*