Military Control of Over Half of Computer Science Research is Excessive

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> "To the extent that academic research is correlated with military objectives, academic freedom suffers. . . . Academic research and development thrives on openness."

Computer science is not a branch of military science.

But the Department of Defense (DoD) now directs over half of academic research in computer science. This is too much.

Civilian applications are suffering because of excessive military spending on research and development (R&D). For example, the people of the United States are unable to take full scientific and commercial advantage from the research sponsored by the DoD on the communication network of the Advanced Research Projects Agency (known as the ARPANET). For the past five years, most federal funding for networking has gone into transforming the concepts of the ARPANET into a military product, called MILNET. Civilian networking has therefore become a low funding priority, despite the great advantages that would accrue to industry and science.

Lacking strong federal support, the development of a national network will be left to private industry. Most likely, we'll endure a tower of Babel: VAXes running UNIX that can't talk to PC/XTs running PC/DOS, and much more. The National Science Foundation (NSF) or the National Bureau of Standards (NBS) would have to spend hundreds of millions of dollars to hire the talent necessary to prevent this. But only military R&D projects command major federal attention these days.

In scientific terms alone, there would be more payoff from a national network development project than from several Star Wars. All scientists and engineers could be in immediate contact with each other. We could circulate our manuscripts and journals online. (This is already starting to happen in computer science, but we are hampered by the lack of a standard typesetting language.) With sufficient funding, all scientists might even get convenient access to on-line libraries.

Instead of working toward civilian or broad scientific goals, most of our academic software experts work on projects of military need. In the recent past, their talents were devoted to a crash program to develop the Ada language. In the immediate future, this expertise will be mobilized to work on the Strategic Defense Initiative. There will be little beneficial "fallout" to civilians from these projects, especially in view of the inability to transform ARPANET into a civilian product.

Statistical Evidence of Military Dominance

Comparing the academic R&D computer funding situation of today to that of a decade ago, civilian applications are lagging. In 1976, most basic research in academic computer science was funded by NSF, 69%. In 1985, NSF's funding share was about 31%, significantly less than DoD's. When applied research money is added in, DoD's preeminence is even more marked. Allowing \$25 million for industrial, state, institutional, and other academic computer science (CS) research support in 1985, most academic CS research is now directed by military agencies.

It's surprising that NSF has even 31% control over academic computer science research, when one considers how military R&D budgets have mushroomed over the last decade. In 1976, half (\$10 billion) of all federal R&D funds were allocated to national defense. The proposed 1986 federal budget allocates almost three-quarters (\$42 billion) of its R&D to military purposes. The outlook for federally-funded R&D for civilian applications is poor by comparison. Federal military R&D will rise by \$8 billion from 1985 to 1986. This single-year funding increment is more than five times NSF's total budget, \$1.4 billion. Among other things, this means NSF will continue to lose control over academic CS research.

According to Dr. Leo Young of DoD, his agency will spend 25% of its 1985 R&D budget on electronics and computer science. DoD's \$10.5 billion on electronics and computers R&D in 1985 is comparable to the combined \$10.8 billion spent by the "information technology" industry in 1983. Assuming a 20% growth rate for industrial R&D expenditures, these figures indicate that DoD now supplies about 40% of all computer-related R&D funds in the nation. When one considers that a significant fraction of industrially-funded R&D is aimed at the military market, it is safe to conclude that well over half of all computer-related R&D in the United States is directed toward military goals.

Effects of Military Control of Academic CS R&D

The harmful effects of military control of academic computer science research are as follows: it exacerbates a shortage of trained personnel; it has a chilling effect on academic freedom; it threatens the development of our scientific foundations; and it does not serve the national interest. Similar concerns have been voiced by many persons.

Personnel Shortage

The current shortage of computer scientists is widely felt. The Association for Computing Machinery (ACM) lists hundreds of unfilled academic positions. According to Jack McCredie of DEC, industrial R&D projects are limited by personnel, and not by internal R&D funds. Meanwhile, DARPA is sewing up the academic R&D market. According to a recent brochure, "the number of graduate students and faculty working in [Strategic Computing] has increased. The number of graduate students working on DARPA research projects in each of the next two fiscal years [1986 and 1987] is expected to double."

Academic Freedom

To the extent that academic research is correlated with military objectives, academic freedom suffers. It's not hard to find the reason why. Academic R&D thrives on openness, but militarily-sensitive data must be withheld from the enemy. For academicians doing basic research with military implications, the price is clear. We are ordered not to divulge our results to colleagues overseas, especially if those colleagues happen to live in the Soviet Bloc. A case in point: a full professor refused to send a copy of his student's Ph.D. dissertation to my co-author on a recent research paper. His reason was that he didn't want to risk offending his military sponsor by sending a technical report to Czechoslovakia. Ironically, the report was classified "distribution unlimited".

Over the last few years, I have noticed other areas of friction. DoD keeps tightening the screws on pre-publication review clauses. These were enforced for the first time, as far as I know, in the Strategic Computing project. Papers must be submitted to one's funding agent thirty, sixty, or even ninety days in advance of publication, presumably to give DoD time to react to any disclosure of sensitive information. In August 1985, a tighter restriction was announced by the director of the Strategic Defense Initiative, Lt. General James A. Abrahamson. He stated that SDI researchers at universities may publish papers only after the subject matter passes "sensitivity checks" by SDI officials.

In 1981, DARPA asked the academic VLSI (very large scale integration) community to keep non-citizens (and especially one-year visiting faculty) away from our research equipment. CalTech agreed to do so, but fortunately the Berkeley, Stanford and MIT faculty refused to comply.

A final area of tension is that of technical conferences, the lifeblood of scientific communication. DoD (and NSA) reserve the right to cancel whole conferences on rare occasions, to "pull out" individual papers, and to require conference attendees to sign non-disclosure agreements. Again, concerted collective action has so far saved the day. The presidents of Institute of Electric and Electronic Engineers, American Physical Society, and ten other major technical organizations sent a letter to Caspar Weinberger that resulted in some reassurances. (It is humiliating to report that the ACM was not a signatory to this letter.)

To sum up, we are collectively holding the DoD at bay in its attack on academic freedom. It is possible to live with the duplicity of individuals who have informal, and ultimately unenforceable, understandings with their military patrons. My main worry is about the future. How long can our scientists and our organizations continue to resist the pressures that come with dependence on military funding?

Scientific Foundations

This year, most of the theoretical CS faculty here at Berkeley took a 15% cut in their NSF grant. I presume similar things happened across the nation. The message is clear: even theoretical researchers must apply for DoD grants. If individuals have to modify their research program somewhat, that's not so bad. If the whole field has to march to a military drum, that's a different matter altogether.

Because of the Mansfield amendment, if for no other reason, we cannot rely on the DoD to support basic science. The DoD's mission-oriented goals, and its boom-or-bust funding cycles, do not provide a good basis of support. A much more stable base could come from NSF's mechanism of peer review, if it were adequately funded.

Once upon a time, a DoD blanket grant could support a whole spectrum of academic activities, from artificial intelligence (AI) to hardware to software to theory. Now DoD's computer research is more closely directed. Strategic Computing couples AI to hardware, leaving traditional software in the lurch. Strategic Defense (Star Wars) may support software and a fragment of theory.

NSF has now been relegated to a role of "filling in the gaps" in DoD funding of academic computer science. It is not completely successful in this role, judging by the recent cuts in funding for CS theory.

The National Interest

Most scientists believe that their research is worthwhile, no matter who pays the bills. The fact that DoD currently pays the bills is usually viewed by academicians as a slightly unfortunate accident of history.

One problem with this state of affairs is that we are reluctant to criticize major R&D initiatives like Strategic Computing and Strategic Defense. To criticize one of these initiatives is, at least in the short run, destructive to our field of research. We're financially dependent on these major DoD initiatives.

As a result, we can rationally support any major R&D initiative. DoD's academic R&D initiatives are "blue sky" projects. Almost certainly, they won't deliver what was promised to Congress. They will, however, produce something: some scientific knowledge, some funding for us, some military payoffs, and perhaps even something of use to civilians.

Our support for military R&D initiatives is not in the national interest. Most of us realize we could do more for the nation if we spend less time on military projects. Too many of us are developing Ada and devising algorithms, software, and hardware for advanced radar systems. Not enough of us are worrying about what the nation should do to maintain its commercial strength in the fields of computer design and software engineering. Neither are we developing enough cross-disciplinary ties with other scientists and engineers. It's not entirely our fault: the funding just isn't there.

A Call for Change

We, as computer scientists, must prod our National Science Board out of its institutional lethargy. With our help, it could lobby Congress effectively for multi-billion dollar R&D projects of broad-based scientific and civilian interest.

We, as a nation, must somehow revitalize our Commerce Department. Our government's responsibility for promoting the nation's commerce is at present fulfilled only for the military-related industries. For example, Commerce should undertake a multi-billion dollar initiative in standardizing network protocols, operating system interfaces, and typesetting languages. It should also provide economical and efficient on-line access to the keywords, abstracts, and contents of all federally-funded technical reports and journal articles. With careful guidance from academics, the results would be beneficial to industry and the nation as a whole.

Finally we, as citizens, must prevail upon DoD to stop throwing our tax money at grandiose and impossible R&D initiatives. Our scientists and engineers do not have to be on a military dole; there is plenty of useful work for us to do.

References

For further information, more statistical evidence, and detailed references, please write to the author.

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