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Strategic Computing Research and the Universities

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Abstract

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Introduction

The Strategic Computing Initiative offers the potential of new research funds for university computer science departments. As with all funds, they bring benefits and can have unwanted strings attached. In the case of military funding, the web of attached strings can be subtle and confusing. The goal of this paper is to delineate some of these entanglements and perhaps provide some guidance for loosening and eliminating them.

The issues are not peculiar to the Strategic Computing Initiative, and it will be useful to point out other examples that illustrate them, especially as they have emerged in the SCI's successor, the Strategic Defense Initiative. In fact, military research funding is so commonplace in major universities in the United States that it appears to be a basic, permanent fact of academic life. I will focus on the funding of computer science research, but a similar pattern holds in many areas of both science and engineering. In computer science, the SCI represents a particularly noticeable step in a progression towards more direct military involvement by scientists in universities.

1. History

We can gain some useful perspective by looking at the history of military support for science. Although technology has been developed for military ends throughout history, the modern form of research funding developed during the years leading up to World War II. The first R&D contract was with Westinghouse in 1937[1], and the universities developed substantial research programs during the war years (such as MIT's work on radar and navigation). After WWII, the technology demands of the Cold War put the relationship on a permanent footing, and introduced it on a massive scale.[2]

The American reaction to the launching of Sputnik in 1957 led to a substantial increase in government funding for scientific research. One impact was the creation by the Department of Defense of an Advanced Research Projects Agency (ARPA, later rechristened as DARPA). ARPA was chartered to do the most basic and visionary research in a number of areas, including materials sciences and behavioral sciences, but its most visible impact in the academic community has come from early and substantial support of the fledgling field of

computer science. During the sixties and seventies, ARPA sponsored a bread spectrum of high-quality basic research, often put forward as a positive example of what can be done with "enlightened" military funding.

During the Vietnam War, general campus resistance to the war effort was reflected in attacks on military-sponsored research. In some cases, laboratories doing large amounts of such research (such as the Stanford Research Institute and MIT's Draper Lab) were reorganized into quasi-independent institutes that were no longer considered an official part of the university. Also during that period, the Mansfield Amendment to the 1969 military funding authorization stipulated that "none of the funds authorized by this act may be used to carry out any research project or study unless such a project or study has a direct and apparent relationship to a specific military function or operation." The intent of this requirement was to get the military out of the business of funding the general work of the universities—to limit its range of activities.

Although the goal was to move the military out of non-military areas, the effect was more complex. In the absence of equivalent alternative sources of funding, researchers were pressed to make their work fall under the umbrella of relevance. At times this could be done in a very general way. For example, computer research could be justified as increasing the cost-effectiveness of computing in the military services. In other cases there was conscious or unconscious duplicity in the portrayal of research projects.

In 1971, a group of students and faculty at Stanford, under the auspices of the Stanford Workshop on Political and Social Issues (SWOPSI), examined the "Work Unit Summaries" that the DoD published as justification for research projects. They compared them to statements that researchers made about their own work on campus and asked researchers to comment on them. In some cases there were serious discrepancies. For example, one professor had a contract for research on "High-power broadly tunable laser action in the ultraviolet spectrum," which he justified to the campus in terms of medicine. The DoD title was "Weaponry—lasers for increased damage effectiveness." Another project on "Dynamic behavior and stability of solids and structures" was described in the work unit summary as relevant to "weapon delivery and reconnaissance... knowledge of landing fields and silo interaction with missiles.'3

During the 1970s, military funding continued at a relatively stable level in most areas of science. More recently, there has been a renewed growth in support, at a time when financing from other agencies that were mainstays of scientific research in the 1970's—the Department of Energy, the National Aeronautics and Space Administration, and the Department of Agriculture-has leveled off or declined. Pentagon spending on campuses grew to $930 million in the 1985 fiscal

year, an 89% increase over the $495 million spent in 1980, while Health and Human Services' increase over that period was 34%. Counting approximately $230 million spent off-campus at MIT's Lincoln Laboratories, DoD university research funding now exceeds that of the National Science Foundation.4

Computer science in particular has always been heavily dependent on military support, especially through DARPA and the ONR (Office of Naval Research), but here too the amount is increasing. The DoD proportion of federal funds for basic research in academic computer science climbed from 28% in 1977 to almost 60% in 1983, while the NSF portion declined from 69% to under 40%. As of 1984, the DoD supplied about 40 percent of all computer-related R&D funds in the nation, and this is likely to increase with the massive computer-related spending on SDI.5

To put this in perspective, we must realize that university basic science research funding is a tiny drop in the bucket compared to the overall DoD budget or even to its R&D expenses alone (proposed as $42 *billion* in the 1986 budget). While a program like SCI offers lucrative possibilities to individual departments, it is but a fraction of the funds allocated to research and development on computing.

It is relatively unimportant, therefore, to focus on whether the money is well-spent or wasted in simple economic terms. If it were all a total waste, it would still pale before the much larger items in the Pentagon budget. But the effects of military spending in academe are more subtle and more significant- There is a "leverage" effect, in which the money serves to influence the conduct of the university and to promote the public attitudes that are required for the continuation of military spending. The remainder of this paper will examine those effects more closely.

2. The Problems for the University

The first question is why university involvement with the military is a problem at all. My own understanding rests on a global assessment that national security will not be gained by creating more weapons technology, and that the current policies of the DoD lead to unrealistic expectations that political problems can be solved through military means.

Programs like the SCI (and even more so, the SDI) represent a general trend towards proposing high-tech systems to solve military and political problems. Constructive alternatives are often sidetracked by promises that the technology will make diplomatic or political solutions unnecessary, while the long development times and shifting goals of the high-tech programs make it difficult

to give clear demonstrations of their ultimate futility. Along with this goes a general "militarization" of the society, in which the methods and values of the military are in ascendance over the more open and nonauthoritarian values traditional to the university. As an employer, a purchaser, a lobbying group, a trainer of people, and in its many other capacities, the military has a strong influence on attitudes and practices. Although, of course, not everyone would agree with this perspective, it is clear that the majority of academic researchers (in computer science and in other fields as well) are reluctant to do weapons-related work unless they can justify it on other grounds. They go to some lengths to characterize their work as "basic research" which, although it may have military applications, will have a wide range of potentially beneficial applications as well.

Some of the problems described below only appear as problems from this overall perspective. Others, such as the imposition of secrecy on research results, are recognized as problematic even by those who support the overall objectives of the military. The goal of presenting them is not to argue for one side or the other, but to point out and clarify the possibilities.

2.1. Direction of Research Content

The most direct impact of funding is on the direction of the research work itself. The proverb that says "he who pays the piper picks the tune" is just as true here as elsewhere, but it is often denied in the context of computer science research support. There are some standard forms of denial, as illustrated in the response of one of my colleagues to an appeal to sign a pledge refusing funding from the SDI Office. He said, "I think you are barking up the wrong tree. Discussions I have had with SDIO folks let me believe that:

1. They are interested in funding the sort of research that NSF funds, in the areas of their interests.
2. They are interested in some really interesting problems of a general nature, e.g. implementation of very high-level languages and parallel languages.
3. The work they propose to support is going to be done anyway."

The thrust of the argument is that it does not matter who funds it, since the work itself remains the same. This belief is based on two unstated assumptions:

(a) The researchers come up with the proposals, so it is they, not the funders, who choose the topics.

(b) Most of the support is for basic research, not militarily-oriented projects, so it is not biased by its military sources.

The first of these contentions is either deceptive or naive. It simply ignores the realities of human decision-making. DoD sponsors are fully aware of how the overall research direction in a field can be "guided" by selective choice of what to support. It is not necessary to tell someone what to work on. One has only to make known which kinds of work will find funding. There is nothing inherently wrong or devious about this, when it is open and acknowledged. For example, the document describing "Office of Naval Research Selected Research Opportunities (SRO IV)" for fiscal year 1985 states the purpose of the program as the promotion of "...increased involvement of the U.S. academic research community in selected fundamental research areas and, by fostering stronger linkages between this community and the Navy, . ..to attract new investigators to Naval research programs."[6] The document on the DOD-University Research Instrumentation Program FY 84/85 lists over 300 areas of interest, some as specific as "Armor materials" and "Synthesis of advanced propellant and explosive materials" and others as general as "Better fundamental insight into phenomena of known or potential practical utility" (listed under Chemistry).7

One might take the attitude that researchers will only accept such funding if they decide on independent grounds that the proposed programs are the best direction for research. But again this is unrealistic, given the exigencies of modern university financing. At Stanford, for example, all engineering school faculty have for many years been expected to raise at least 20% of their salary from research contracts. This situation places pressure on researchers to obtain funding for their research-even those who could otherwise manage their research quite well with no outside funding. It causes a skewing of research towards fundable topics, and therefore towards the defense establishment. In addition, universities have developed a pattern of charging various parts of their normal expenses to research overhead and also to direct research costs wherever possible. For example, graduate students are supported on research assistantships rather than university funds, and are expected to use research-supported computer facilities For the bulk of their computing needs. Thus when schools lose research funding, other sectors of the institution are jeopardized.

There is also a multiplier effect. Money provided to a few researchers at elite institutions can have a powerful impact on the field as a whole, leading to conferences in new areas, shifts in emphasis in selection of journal articles, channeling of the best new students into particular research subareas, and so on. For example, the field of artificial intelligence developed almost entirely under

the guidance of ARPA-supported researchers at three elite universities (MIT, Stanford, and Carnegie-Mellon). In addition to supporting the research itself, ARPA provided the funds that made conferences possible in this new area, and held annual "contractors' meetings" at which the principal investigators came together to discuss overall research directions.

The second argument—that most of the support is for basic research-is more believable in computer science than in many other disciplines, but still leaves many questions. First, as mentioned above, basic research can be "steered" even without pushing it into specific applications. Second, there has been a continuing shift away from the former policy of support for basic research. Since 1983, DARPA has begun to shift from a wide dispersal of basic research funding towards more narrowly focused projects, such as the SCI. Much of its support for artificial intelligence has been reassigned from category 6.1 (the most basic) to 6.2 (more applied), with corresponding shifts in the requirements imposed on researchers. In the plans for the SCI, there was a good deal of explicit concern with "pulling" the technology in accord with specific near-term application goals. The plan states, "We are initially concerned with the development of appropriate military applications that will pull the technology base."8 The result has been to shift the emphasis from basic research towards specific military applications. Once a dependency on military funding has been established, it is difficult for researchers to resist its pressures.

In a highly publicized incident at the California Institute of Technology in 1984, President Marvin Goldberger was called to task by the faculty for his role in establishing a classified "think tank," called the Arroyo Center, for the Army. A few years earlier, after seeing its money from the National Aeronautics and Space Administration begin to dry up, the Jet Propulsion Laboratory (a major research wing of Caltech) had asked Caltech for authority to get up to 30% of its budget from the Department of Defense. The faculty was told at the time that this was the only way to keep together the unique teams that had been assembled at the lab and to continue its basic research on aeronautics and astronautics. When the Arroyo Center was created as a major new part of JPL, its organizers had abandoned this justification and argued instead that a new role and mission in military policy analysis was necessary in order to maintain funding for the laboratory. When pressed by the faculty, Goldberger admitted "...serious concern about the appropriateness of JPL as a part of Caltech operating an Army analysis program. It is not consistent with the high-technology and systems engineering capabilities of the laboratory." Although the faculty overwhelmingly passed a resolution that "Caltech divest itself of the Arroyo Center expeditiously and in a responsible fashion at the earliest possible time," contracts had been signed and

it was impossible to back out. Vague commitments were made to phase the center out over a period of years.9

2.2. Shifting the Focus of the University

The university is much more than a producer of specific research results. As the center of higher education, what goes on there shapes the society in direct and subtle ways. Military funding affects the balance of activities and priorities within the university in a way that can have a deep impact outside specific research areas.

Within a scientific discipline, it can distort the distribution of funds, people, and educational opportunities. A number of prominent university leaders have raised this issue in conjunction with the SDI. President Donald Kennedy of Stanford said that SDI funding "throws the balance of science research all out of whack." Marvin L. Goldberger, president of the California Institute of Technology, held that "the infusion of such a large amount of money can distort activities within the university. It can draw people into research areas they might not otherwise pursue."[10] Similar objections have been raised about the effect of projects such as the SCI on computer science research.

The DOD-University Research Instrumentation Program (FY 1984/85) offered **$150** million to universities to "acquire research equipment at universities to address DoD basic research needs," stating:

> The goal of this program is to improve the capability of universities to perform research in support of national defense. Specifically, it is a program to provide funding for the acquisition of research equipment at universities for the stimulation and support of basic research which supports the technology goals of the Department of Defense.... Instrumentation requested must be for use in research in areas of priority concern to the military services.11

In a separate program, called the University Research Initiative Program, DoD states:

> The... programs are designed to increase the number of science and engineering graduate students; to increase the investment in major pieces of research equipment at universities; to increase the investment in higher risk basic scientific research in support of critical Navy and DoD technologies; and to provide more opportunities for contacts between universities, industry, and Navy and other DoD laboratories.12

These program goals are broader than specific military applications. They are part of a larger pattern of the past few years, in which for the first time since the Vietnam War, the DoD is proposing to fund a variety of programs designed more to enhance the health of the universities than to meet short-term defense needs. But the political significance of the new initiative is that it sends a strong message that the Pentagon now considers broad support of university programs a legitimate part of its mission. As in the past, research-justified equipment will end up playing a large role in the university, beyond the specific research projects. It is commonplace for such equipment to be used unofficially for a wide variety of academic and instructional purposes, and in many cases such sources are the only way to fund new general-use facilities.

The net effect will be to strengthen certain departments (those that "support the technology goals of the Department of Defense") at the expense of others. Those that bring in new equipment will be in a better position to acquire new faculty slots, to attract bright students, and in general to compete in the world of academic resources. One obvious impact is the further strengthening of the "hard sciences" and engineering (including computer science), at the expense of the social sciences and humanities.

Another is an increase in the advantage of the elite universities (the grants come in chunks of up to $20 million). In fact, the creation of this advantage has been a significant effect of military computer science funding in general over the last thirty years. It has resulted in a highly unequal situation in which a few schools have received almost all the resources. Although this may have led to more effective research in the short run, it has also been a factor contributing to the significant long-term shortage of trained computer researchers.

The issue here is not whether any of these policy decisions are right or wrong. Debates about the balance between science and the humanities, for example, are central to the ongoing life of the university. The problem is that they are being decided not on the basis of what will constitute a good educational system for our nation, but on the basis of what will most effectively satisfy military research goals.

2.3. Restrictions on the Exchange of Ideas

Independent of the actual research topics, there are hidden costs associated with military funding. One major area of concern has to do with the fundamentally divergent attitudes of the two institutions toward the public dissemination of knowledge. The university has a long tradition as a forum for the open exchange of ideas. One of its highest values is openness to sharing,

criticism, and transmission of knowledge. For the military, knowledge is power in a very direct sense, and its elaborate system of classification and secrecy is designed to prevent others from finding out what our side knows.

This has long been a bone of contention, and for many years (since the Vietnam war) a large number of universities have had a policy of prohibiting classified research. On this view, all work done in a university should be open to scrutiny. But this attitude is shifting, as pressure has been applied to allow classified research in order to obtain general defense funding. For example, the Georgia Tech Research Institute, on the campus of the Georgia Institute of Technology, carried out about $60 million in sponsored research in 1985, 80 percent of it government-financed. The flow of Defense Department research funds to the campus has increased ninefold since 1976, spurred greatly by the Institute's willingness to take on classified work. Unlike most universities, it allows students to obtain security clearances to participate in the work. The university takes few foreign students—in part, officials say, so that its classified work will not be jeopardized.[13] Other universities (such as Brown) have recently reversed previous anti-secrecy policies, in order to compete for funds.14

However, even without accepting classified research, a University can find itself at odds with DoD secrecy policies. A 1982 memo from the Stanford administration to the faculty stated:

> Although both ITAR [International Traffic in Arms Regulation] and EAR [Export Administration Regulations] have been in effect for some time, the government has only recently attempted to apply them to unclassified university research activities. The potential effect of these new interpretations on universities is far-reaching: not only would certain research results be subject to government approval prior to publication, but laboratories and classrooms would have to be 'closed' and monitored to prohibit research participation by certain foreign scholars. Indeed, an export license could be required for a Stanford faculty member to deliver a scientific paper at a conference at another American university.15

In January 1984, Jeffrey T. Richeison, a polìtìcal scientist at American University in Washington, D.C., was threatened by Air Force officials as he prepared to give a speech on satellite systems for verifying arms control agreements. They did not deny his statement that everything in the talk was gathered from public sources, but argued that it was possible for unclassified material to be put together into a classified whole. The Los *Angeles Times* reported that "for its part, the Air Force says it did not mean to prevent Richelson

from speaking; it only wanted to advise him that his paper might be classified and that he might be in serious trouble if he delivered it."[16]

In March 1985, the DoD blocked the presentation of 43 out of 219 technical papers just before they were to be delivered at the annual symposium of the Society of Photo-Optical Instrumentation Engineers. Although only 13 were deemed to contain classified information, the rest were judged to be "militarily sensitive." At an earlier meeting in 1982, some 100 papers scheduled to be presented at a conference by the society in San Diego were withdrawn at the last moment, following Defense Department objections. [17]

Although occurrences like these are not commonplace and there has been a good deal of resistance by university officials, it is likely that the general pattern will increase. The 1985 contract with the Air Force establishing the Software Engineering Institute at Carnegie-Mellon University specifies that "distribution will not be made of technical data" that either the contractor or the government finds "to have classified or potentially classified military end-item applications." In case of doubt, Carnegie-Mellon must obtain Pentagon permission for publication. [18] Even outside of such agreements, the fact that secrecy clampdowns are possible will lead to increased self-censorship by researchers eager not to attract the DoD's ire.

Secrecy concerns go beyond publication, to issues such as the selection of students. In the summer of 1985, the DoD announced plans to prohibit certain foreign students from access to four university supercomputer facilities specifically intended for nonclassified research. Georgia Tech may not be the only school that finds it convenient to shift admissions policies in order to forestall potential problems.

Finally, more subtle but potentially more dangerous is the effect of military funding on the open political activity of students and faculty within the universities. University administrators know that an atmosphere of student antimilitary activism may well lead military sponsors to fear the disruption of research activities, or at least to see the university as a less congenial environment for the research. Although direct pressure is rarely applied against student activities, it would be naive to think that university administrators were immune to such important financial considerations.

At the individual faculty level, such pressure has been more overt. In his Senate confirmation hearings in 1985, Undersecretary of Defense Donald Hicks (the head of research for the Pentagon) sharply criticized opponents of the Strategic Defense Initiative and stated: "I am not particularly interested in seeing department money going someplace where an individual is outspoken in his rejection of department aims, even for basic research." Hicks was later

quoted in Science as saying, "Those who want to accept the money to help us with programs we need, we want to have. But I don't particularly view it as appropriate when somebody says we don't like the way you're running the department, but we sure like your money." He said later that he was principally upset by computer scientists who depend in part on DoD support, but voice skepticism about the feasibility of the software demanded by a comprehensive missile defense. "If they want to get out and use their roles as professors to make statements, that's fine, it's a free country," Hicks said. "But freedom works both ways. They're free to keep their mouths shut...[and] I'm also free not to give them money. . . I have a tough time with disloyalty."[19]

3. The Problems for Society

The previous section focused on problems within the university. Now, taking a less parochial standpoint, we can ask how military funding in the universities can have an adverse impact on the larger society.

3.1. Legitimization of Projects

Once dependent on military support, the university can be used to justify and legitimate military projects. Scientists enjoy a high degree of public respect, and their reputations can be enlisted to support military objectives both with the public and in Congress. The most blatant example of this strategy has been the attempt to use the promise of research funding as a way of marshalling support for SDI. Even before Congress began serious deliberations on the budget, project officials were already seeking proposals from scientists, reversing the usual sequence of events. SDIO Director James Ionson stated, "It's probably something that's never been done, but this office is trying to sell something to Congress. If we can say that this fellow at MIT will get money to do such and such research, it's something real to sell. That in and of itself is innovative."[20]

In announcing the first university consortiums, the Defense Department listed a host of "participating institutions," although only one or two researchers were involved on many campuses. Paul E. Gray, president of the Massachusetts Institute of Technology, charged that the involvement of MIT professors in the research, though limited, was being cited by the Administration in a '*manipulative effort to garner implicit institutional endorsement" of the project.[21] The success of this tactic is illustrated by a comment of Congressman Ed Zschau (whose district included Stanford University and much of Silicon

Valley): "If all this money were going to the Lockheeds of the world, I wouldn't feel as good about it as I do about a program that's going to the universities."[22]

Some researchers were enlisted in this hard sell without their knowledge, or under duress. One computer scientist at the University of Washington was called by a reporter regarding his participation in SDI research. He denied having SDI funding, and only later discovered that his previous grant from the Office of Naval Research had been shifted without his knowledge to the SDI Organization. In that shift it had also been listed as a more applied project than in the original grant. One Stanford researcher described his decision to convert his DARPA funding to the SDI as necessary "in order to avoid a 40% Gramm-Rudman cut in the funds."

More direct support for military projects can be encouraged through funding as well. When David Parnas resigned from the panel of scientists investigating the feasibility of the SDI computing requirements, he noted the fact that all of the panelists stood to benefit from large research contracts if the project were well funded. Given such conflicts of interest, one can question the objectivity with which the "scientific experts" advise the public.

3.2. Legitimization of Military Control

Above and beyond any particular program, the DoD seeks public support for its overall function and for the levels and types of resources it desires. University funding can contribute to a general picture of what role the military should take in society as a whole. Everyone would agree that the DoD has responsibility for direct defense activities, but there is much less agreement about whether it should play an active role in determining the relative numbers of scientists being trained, the fields in which they are trained, or how they are educated. All military funding of research, regardless of particular projects, contributes to an increased military voice in educational policy and practice.

In computer science one often hears assertions that DARPA funding has been much better and more effective than the funding provided by civilian agencies such as the NSF. Although DARPA-sponsored research has produced many valuable results in a relatively cost-effective way, this argument needs to be examined more closely.

It is true that obtaining funding through NSF can be a frustrating and time-consuming process, and that the choice of scientific goals is influenced by many more political considerations. This is due to the nature of the peer review process (both slow and political) and the sensitivity to Congressional scrutiny (which includes special interests and pressures for geographical distribution of

funding). The compensations lie along two dimensions. First, NSF has to be responsive to a broader set of concerns. One example mentioned above was that the concentration of military funding in elite schools has served to inhibit the development of educational programs on a broader base. NSF has put more resources into providing facilities at a larger number of universities. This may pay off not in immediate research, but by building the body of researchers that will make future advances. In a similar vein, the heavy military funding of Very High Speed Integrated Circuits (VHSIC) may have produced useful results for military hardware, but there is a serious possibility that it could actually hurt U.S. chances for commercial success in the semiconductor markets of the future.23

A further benefit is the democratic nature of the peer-review process. Like all democratic processes, it can be slow and frustrating, but that same inertia can also prevent abuses. To some extent DARPA was for many years a relatively benevolent dictator in its funding of basic computer science research. Recent trends (such as the direct military applications "pulling" the SCI research, and the shift of funds to more applied categories) indicate that this policy is changing. Once the dependency on military funds is established, it will not be easy to reverse it.

4. Responses

The issues raised above have been noted and discussed by researchers at a large number of institutions. They have responded in a variety of ways.

The most direct action that individual researchers or institutions take is to refuse military funding (either in general, from particular sources, or for particular projects). Many universities have a policy of refusing classified research, and some research institutes do not, on principle, accept funding for applied military research, although they will accept it for what they consider basic research. There are individuals, including myself and Professor Joseph Weizenbaum of MIT[24], who reject all military funding. For the reasons discussed above, the cost of refusing funding (to both the individual researcher and his or her institution) can be high, and often it is not feasible without dropping out of the research area altogether. In many cases there are no alternate sources of support, and in others nonmilitary sources cannot provide the amount or kind of resources necessary. In order to make this strategy a viable alternative, pressure needs to be brought to bear on a larger scale—to change the overall pattern of how government research spending is managed.

As a step in this direction, criticism of military research funding has been taken up by larger groups. The Stanford **SWOPSI** report, mentioned above, was an attempt by a group of students and faculty to raise the issue of research funding on a larger scale and to affect public opinion. More recently, there has been a growing campaign among researchers around the country (and the world) seeking pledges that they will not accept SDI funding. As of summer **1986, over** 3,800 university faculty members (mostly in physics and computer science) had signed this pledge, representing majorities in **110** research departments. They are concerned with the direct effects of the funding on campus (especially the skewing of research priorities and the potential for imposition of secrecy) and also with opposing the SDI project on the grounds that it is not feasible or effective in increasing national security.

In the case of the Strategic Defense Initiative, this refusal has had **a** visible impact on the program. In discussing the decision by many scientists not to work on SDI research, Lt. Col. David Audley (head of the battle management and command, control, and communications program for the SDI) told of some code used in an astronomy project that "had just what we needed, but the guy who owned the code restricted it so it couldn't be applied for SDI... It hurts. We need all the talent that we have."[25]

Other groups have taken public education about military research goals as a primary activity. For example, Computer Professionals for Social Responsibility has issued informational papers on several issues, including the SCI and the SDI.[26] It has also worked with universities to sponsor public debates on the technical merits of the SDI, in order to give the public a more balanced view in which computer science experts argue both sides. As an organization of computer professionals, CPSR **provides** expert testimony to counteract the "enlistment" through funding of university scientists into the debate over projects and strategies.

Those of us doing computer science research in the universities must acknowledge the fact that computer technology plays a major role in modern military development. We have the obligation to ourselves and to our students to seriously examine the consequences of our actions, in all of the domains I have discussed, and to make informed and responsible decisions about our work and the ways in which it is supported.

Notes

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