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Pentagon Redirects Its Research Dollars
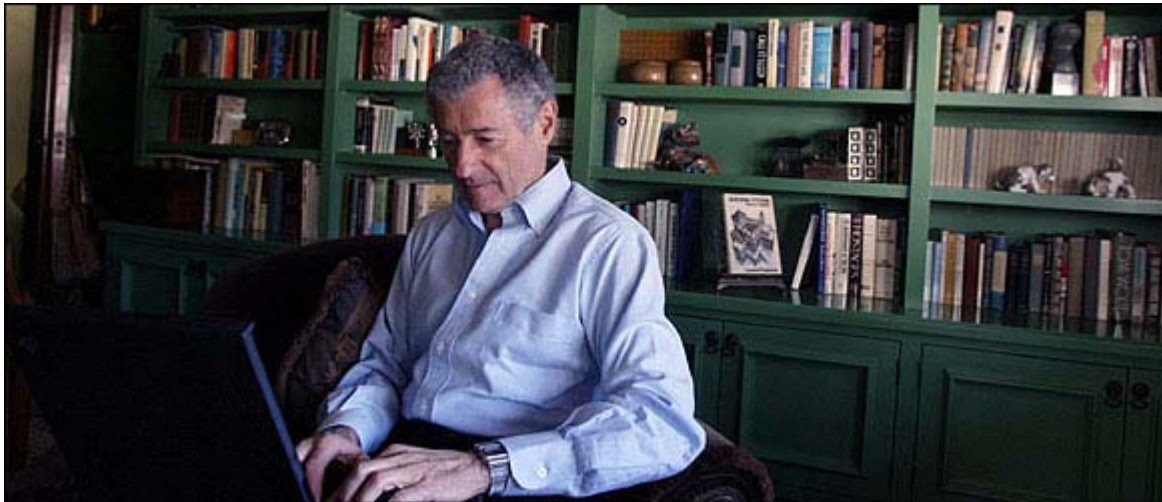
J. Emilio Flores for The New York Times

Leonard Kleinrock of U.C.L.A. declined Darpa money when he learned that his assistants had to be American citizens.

By **JOHN MARKOFF**

Published: April 2, 2005

S AN FRANCISCO, April 1 - The Defense Advanced Research Projects Agency at the Pentagon - which has long underwritten open-ended "blue sky" research by the nation's best computer scientists - is sharply cutting such spending at universities, researchers say, in favor of financing more classified work and narrowly defined projects that promise a more immediate payoff.

Hundreds of research projects supported by the agency, known as Darpa, have paid off handsomely in recent decades, leading not only to new weapons, but to commercial technologies from the personal computer to the Internet. The agency has devoted hundreds of millions of dollars to basic software research, too, including work that led to such recent advances as the Web search technologies that Google and others have introduced.
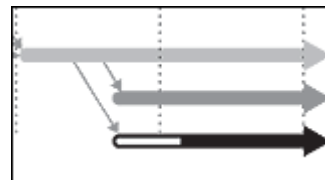
The shift away from basic research is alarming many

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leading computer scientists and electrical engineers, who warn that there will be long-term consequences for the nation's economy. They are accusing the Pentagon of reining in an agency that has played a crucial role in fostering America's lead in computer and communications technologies.

"I'm worried and depressed," said David Patterson, a computer scientist at the University of California, Berkeley who is president of the Association of Computing Machinery, an industry and academic trade group. "I think there will be great technologies that won't be there down the road when we need them."

University researchers, usually reluctant to speak out, have started quietly challenging the agency's new approach. They assert that Darpa has shifted a lot more work in recent years to military contractors, adopted a focus on short-term projects while cutting support for basic research, classified formerly open projects as secret and placed new restrictions on sharing information.

This week, in responding to a query from the staff of the Senate Armed Services Committee, Darpa officials acknowledged for the first time a shift in focus. They revealed that within a relatively steady budget for computer science research that rose slightly from $546 million in 2001 to $583 million last year, the portion going to university researchers has fallen from $214 million to $123 million.

The agency cited a number of reasons for the decline: increased reliance on corporate research; a need for more classified projects since 9/11; Congress's decision to end controversial projects like Total Information Awareness because of privacy fears; and the shift of some basic research to advanced weapons systems development.

In Silicon Valley, executives are also starting to worry about the consequences of Darpa's stinting on basic research in computer science.

"This has been a phenomenal system for harnessing intellectual horsepower for the country," said David L. Tennenhouse, a former Darpa official who is now director of research for Intel. "We should be careful how we tinker with it."

University scientists assert that the changes go even further than what Darpa has disclosed. As financing has dipped, the remaining research grants come with yet more restrictions, they say, often tightly linked to specific "deliverables" that discourage exploration and serendipitous discoveries.

J. Emilio Flores for The New York Times
Deborah Estrin, also of U.C.L.A., said it was the first time in 15 years that she had no Darpa financing.

Many grants also limit the use of graduate students to those who hold American citizenship, a rule that hits hard in computer science, where many researchers are foreign.

The shift at Darpa has been noted not just by those researchers directly involved in computing technologies, but by those in other fields supported by the agency.

"I can see they are after deliverables, but the unfortunate thing is that basic research gets squeezed out in the process," said Wolfgang Porod, director of the Center for Nano Science and Technology at the University of Notre Dame.

Francis Specker/Associated Press
The transformation of Darpa has been led by Anthony J. Tether.

The concerns are highlighted in a report on the state of the nation's cybersecurity that was released with little fanfare in March by the President's Information Technology Advisory Committee. Darpa has long focused on long-term basic research projects with time horizons that exceed five years, the report notes, but by last year, very little of Darpa's financing was being directed toward fundamental research in the field.

"Virtually every aspect of information technology upon which we rely today bears the stamp of federally sponsored university research," said Ed Lazowska, a computer scientist at the University of Washington and co-chairman of the advisory panel. "The federal government is walking away from this role, killing the goose that laid the golden egg."

As a result of the new restrictions, a number of computer scientists said they had chosen not to work with Darpa any longer. Last year, the agency offered to support research by Leonard Kleinrock, a computer scientist at the University of California, Los Angeles who was one of the small group of researchers who developed the Arpanet, the 1960's predecessor to today's Internet.

Dr. Kleinrock said that he decided that he was not interested in the project when he learned that the agency was insisting that he employ only graduate assistants with American citizenship.

Darpa officials, who declined repeated requests for interviews, disputed the university researchers. The agency, which responded only in writing to questions, contended that the criticisms leveled by the advisory committee and other researchers were not accurate and that it had always supported a mix of longer- and shorter-term research.

"The key is a focus on high-risk, high-payoff research," Jan Walker, a Darpa spokeswoman, stated in an e-mail message. Given the threat from terrorism and the demands on troops in Iraq, she wrote, Darpa is rightly devoting more attention to "quick reaction" projects that draw on the fruits of earlier science and technology to produce useful prototypes as soon as possible.

The Pentagon shift has put added pressure on the other federal agencies that support basic information technology research.

At the Directorate for Computer and Information Science and Engineering of the National Science Foundation, the number of research proposals has soared from 2,000 in 1999 to

6,500 last year. Peter A. Freeman, its director, said that the sharp rise was partly attributable to declines in Pentagon support.

"Darpa has moved away from direct funding to universities," Mr. Freeman said. "Even when they do directly fund, some of the conditions and constraints seem to be pretty onerous. There is no question that the community doesn't like what the head of Darpa has been doing, but he has his reasons and his prerogatives."

The transformation of Darpa has been led by Anthony J. Tether, a Stanford-educated electrical engineer who has had a long career moving between executive positions at military contractors and the Pentagon.

Last year, Dr. Tether's new approach led to a series of cutbacks at a number of computer science departments. Program financing for a Darpa project known as Network Embedded Sensor Technology - intended to develop networks of sensors that could potentially be deployed on battlefields to locate and track enemy tanks and soldiers - has been cut back or ended on as many as five university campuses and shifted instead to traditional military contractors.

"The network has now become as vital as the weapons themselves," Dr. Tether said in an appearance before the advisory committee last year, testifying that secrecy had become more essential for a significant part of the agency's work.

That has created problems for university researchers. Several scientists have been instructed, for example, to remove previously published results from Web sites. And at U.C.L.A. and Berkeley, Darpa officials tried to classify software research done under a contract that specified that the results would be distributed under so-called open-source licensing terms.

"We were requested to remove all publicly accessible pointers to software developed under the program," said Deborah Estrin, director of embedded network sensing at U.C.L.A. "This is the first time in 15 years that I have no Darpa funding."

At Berkeley, Edward A. Lee, who was recently named chairman of the computer science department, agreed not to publish a final report at Darpa's request, even though he told officials the data had already become widely available.

Despite the complaints, some pioneering researchers support the changes being driven by Dr. Tether and say they are necessary to prepare the nation for a long battle against elusive enemies.

"There are pressures and demands on Darpa to be relevant," said Robert Kahn, a former Darpa administrator who is now president of the Corporation for National Research Initiatives in Reston, Va. "People think it should stay the same, but times have changed."

Still, a number of top scientists argue that the Pentagon's shift in priorities could not have come at a worse time. Most American companies have largely ended basic research and have begun to outsource product research and development extensively even as investments in Asia and Europe are rising quickly.

And many computer scientists dispute Darpa's reasoning that fighting wars demands a shift away from basic research. During the Vietnam War, they say, Darpa kept its commitment to open-ended computer research, supporting things like a laboratory in the

hills behind Stanford University dedicated to the far-out idea of building computing machines to mimic human capabilities.

John McCarthy founded the Stanford artificial research lab in 1964, helping to turn it into a wellspring for some of Silicon Valley's most important companies, from Xerox Parc to Apple to Intel.

"American leadership in computer science and in applications has benefited more from the longer-term work," Mr. McCarthy said, "than from the deliverables."

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Flow of Information

Federally sponsored information technology research programs have led to the development and creation of several billion-dollar industries. As illustrated in the example below, the development of the Internet and the World Wide Web were spurred by universities, the government and industry sharing information with one another.
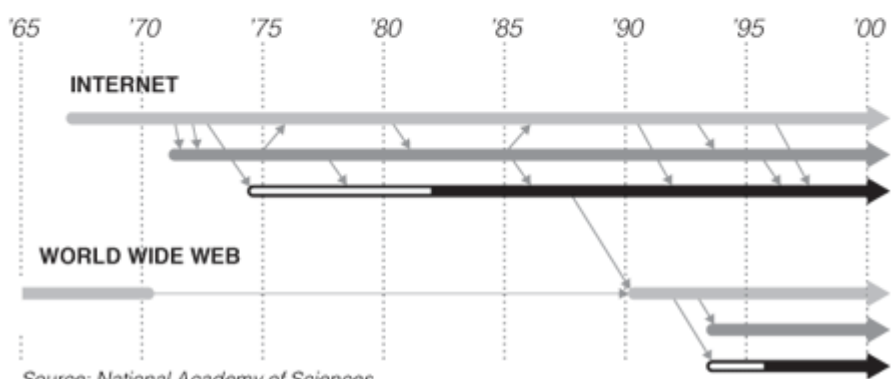
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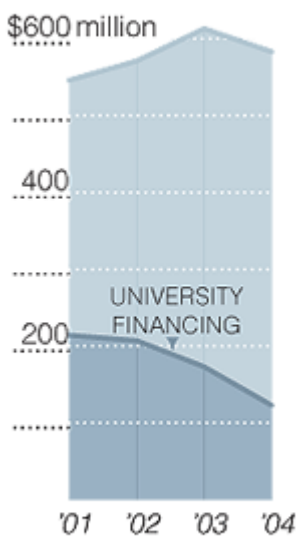
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2005**

**Darpa total
computer science
financing**

$600 million

400

UNIVERSITY
FINANCING

200

'01   '02   '03   '04

Source: Darpa

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