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America Gasps for Breath in the R&D Marathon

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America will soon find its grip on the levers of international commerce slipping as we turn our backs on a proud tradition of technology innovation. The stewards of our national destiny are busily tightening the tap on the federal R&D budget, the most important source of funding for programs that seek to answer fundamental questions of science and technology.

In real terms, the total federal R&D portfolio could decline for the first time since 1996 if the recommendations in the president's FY 2006 budget proposal survive budget season in Washington. Even some federal agencies nominated for real increases in funding are shifting their priorities. Perhaps the most troubling example lies in the Pentagon's Defense Advanced Research Projects Agency (DARPA), which over the decades has supported research leading to some of the most valuable technological developments of the past 50 years.

In the 1960s and '70s, a collection of academics and private-sector technologists, including a co-author of this piece, used findings funded by the Pentagon's Advanced Research Projects Agency (now DARPA), to participate in implementation of the first wide-area packet switched network (the ARPANET) and the subsequent integrated collection of packet-switched networks (the Internet).

Now DARPA officials have revealed a shift in focus away from its history of open-ended long-range research, which typically has been performed in universities and nonprofit institutions. According to recent news reports, DARPA funding for university researchers in computer science has fallen from $214 million to $123 million from 2001 to 2004. Moreover, the focus of DARPA R&D is more near-term and more immediately defense-oriented than before. While this is defensible in some ways, the largest impacts of long-term research funded in the past by DARPA have been in areas that have wider or dual application to defense and the civilian sector.

The U.S. is already lagging behind in R&D funding. Our total national spending on R&D is 2.7% of our GDP, and now ranks sixth in the world, in relative terms, behind Israel (4.4%), Sweden (3.8%), Finland (3.4%), Japan (3.0%) and Iceland (2.9%). The federal government's share of total national R&D spending has fallen from 66% in 1964 to 25%.

Some of the outright cuts in the president's proposed R&D budget include the following:

-The Department of Energy's Office of Science would see its R&D funding fall 4.5% to $3.2 billion.

-The Department of Agriculture would see its R&D funding decline 14.6% to $2.1 billion.

-Funding for all three multi-agency R&D initiatives would decline in FY 2006, a category that includes programs such as the National Nanotechnology Initiative and the Networking and Information Technology R&D initiative.

The proposed cuts come at a time when other nations have fixed their sights firmly on overtaking our technological lead, especially in information technology. For those of us in industry and academia, this shift in policy represents a major detour in the marathon race for global economic leadership.

The list of entrants in that race is long and growing longer, now including the likes of China, Japan, India and the European Union. And they are not taking any wrong turns. These nations are graduating more science and technology specialists, spending more on Information and Communications Technology (ICT), filing for more U.S. patents for foreign inventions, and generally executing specific high-tech policy agendas aimed at unseating the U.S. Looking at the number of degrees awarded, for example, one finds that India graduates approximately 184,000 engineers per year, and China more than 200,000. The U.S. graduates no more than 60,000.

Among the top 10 nations in ICT spending, China is projected to be the fastest growing, with a compound annual growth rate of 13.9% during the years 2003 through 2007. It will be sixth fastest among all nations, including many in the developing world that are starting from near zero. India, meanwhile, ranks 10th in growth overall at 13.44%.

As for the implications of these cuts, we can only predict that the price will be dear. While the open-ended nature of basic research forces us to look to the past for specific examples, present indicators are clear. National Science Foundation data show that from 1989 to 2001, applications for U.S. Patents from China, India and Japan have grown from 5% of all applications to 19%. The number of U.S. scientific publications has remained essentially flat since 1992.

A decline in the federal R&D funding makes a troubling situation worse still. Fewer articles mean fewer findings for industry to apply in new products. Fewer products mean fewer jobs, less capital for investments and, in general, less new wealth for the U.S. and its citizens.

The facile solution is to turn to private industry and academia to make up the difference. But R&D funding from private industry is currently growing above inflation. It is susceptible to general economic cycles, and by its nature it is focused on the here and now. Meanwhile, many academic institutions are battling lagging enrollment and turning to unconventional fund-raising means merely to stay afloat. The difficulty in obtaining visas for foreign scientists has also restricted an important source of talent in the research community.

In a very real sense, today's R&D agenda determines where America will find itself in the future. The benefits of vigorous, federally funded academic R&D programs reaped by American society at large have been enormous. Our domestic and global economies thrive on the results of such work. Private sector programs alone cannot produce comparable results, in part owing to an ethical obligation to deliver bottom-line business results for their stockholders. The U.S. government needs a long-term strategy for continued economic growth. A strong and thriving academic R&D program is critical to that strategy. To choose otherwise is a recipe leading to irrelevance and decline.

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