Science agencies must bite innovation bullet

Before research can rebuild the US economy it must learn from the prosperous heyday of the military–industrial complex, says **Daniel Sarewitz**.

In January's State of the Union address, President Barack Obama said that the United States had reached "our generation's Sputnik moment", and to respond to international competition he placed science and innovation at the centre of his policy agenda. Amid extraordinary budget pressures, he has called for a US$7-billion (11.6%) increase in government spending on research for 2012 to help "rebuild" the economy. More money for science is always welcome, but can it deliver on the president's promises? Not necessarily. The post-Sputnik research enterprise that delivered innovation and prosperity is not the same as the one the President is counting on today.

After the Second World War, the United States was the only major world power with a flourishing scientific and industrial base; the country led the world because it had no competitors. It preserved this advantage during the cold war through the Department of Defense's (DOD's) central role in technology development, and through close and persistent ties between the DOD and private industry. Huge procurement budgets cemented these links, creating early markets for technologies such as computers, jet aeroplanes and satellites. To support this technology base, the DOD invested in emerging fields such as computer science, sub-atomic and solid-state physics, and materials science. Resulting waves of innovation created whole industries that helped to fuel the US economy.

Meanwhile, the main civilian science agencies — the National Institutes of Health (NIH), the National Science Foundation, NASA and the Department of Energy (DOE) — developed roles in training scientists and creating knowledge that accelerated innovation. But such agencies were mere booster rockets for the DOD's main engine of innovation. They lacked, and continue to lack, the attributes that accounted for the military's successes — in particular, its focused mission, enduring ties to the private sector and role as an early customer for advanced technologies.

For decades, the DOD's legacy of innovation and economic growth concealed weaknesses in the civilian agencies, which is why so many people still believe that putting more money into civilian research and development is the panacea for what ails US innovation. Former presidential science adviser John Marburger publicly blew the whistle on this simple-minded notion in 2005, when he noted "how primitive the framework is that we use to evaluate policies and assess strength in science and technology". Partly in response to Marburger's provocation, the National Science Foundation initiated its Science of Science and Innovation Policy programme, with the explicit aim of guiding effective science policy-making by creating a foundation of data, theory, methods and models. This worthy goal carries an uncomfortable implication: that the nation's civilian research and development enterprise had been built on a foundation of hidden assumptions and unsubstantiated claims.

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That foundation is beginning to collapse. In 2006, NASA launched its commercial cargo and crew initiative, which funds the private sector to "develop and demonstrate safe, reliable, and cost-effective space transportation capabilities". The programme thus concedes that NASA cannot mount new missions at affordable costs or within reasonable time-frames. Indeed, in January the agency announced that the $16 billion and six years allocated by Congress for it to build a new heavy-lift vehicle was insufficient, yet a month earlier, SpaceX Corporation in Hawthorne, California, had completed the first orbit and recovery of a commercial spacecraft, for a total cost of less than $1 billion. In 2007, Congress, having lost confidence in the DOE, decided that the country needed a new organization to catalyse innovation in energy technology. The result is the Advanced Research Projects Agency-Energy (ARPA-E), which is designed to "bring a freshness, excitement, and sense of mission to energy research" — virtues apparently absent from the existing department. ARPA-E's focus is on high-risk R&D and collaborations between universities and private firms to move promising technologies into the marketplace (see page 145).

Even the NIH, flagship of the nation's health-research system, is now showing signs of self-doubt. The agency receives half of all US government money spent on civilian research, and owes its powerful political and scientific reputation to the widespread belief that spending billions on cutting-edge basic biomedical science is the best route to better health. Yet public-health indicators in the United States continue to lag behind those in many other nations. The NIH's leaders hope to turn this around with a new National Center for Advancing Translational Science (see page 135).

These changes signal an uncoordinated but government-wide reaction to an inescapable reality. The civilian research agencies were designed as temples of scientific excellence and technological prowess, but they lack the institutional architecture of the cold-war military–industrial complex, and are ill-structured to create and sustain essential links between knowledge generation, technological innovation and desired social outcomes. It is not a matter of basic versus applied research, but of insular versus integrated approaches. If this is truly our generation's Sputnik moment, it will take more than money. The United States must transform its science enterprise to enhance links between research and its application to national needs. ■

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