

► development firms are unproductive. With a history of SBIR awards going back two decades, PSI has flown an instrument on the space shuttle to study gas release and ionization, put a fuel-quality monitor into a US Navy aircraft carrier and developed a helicopter-like device for the US Department of Defense that is the size of a human hand and can fly a reconnaissance camera at up to 89 kilometres per hour.

The problem with asking agencies to measure commercialization, says Green, is that it can take many forms besides selling on the open market. To him, commercialization also includes selling prototypes to the government agencies that initially funded their development, filing and licensing patents, and spinning off technologies — something PSI did with an earlier generation of the ophthalmic device, which is now being sold to hospitals. Although the effect of the new reporting requirements and benchmarks has yet to be seen, some SBIR-supported scientists fear that the changes will strongly favour companies that bring products to market, an approach that is at odds with PSI's business model. "Our goal is not necessarily that we build a product," says Green, "but that someone builds it."

Justifying the research focus of certain SBIR companies has always been tough. Some critics call the companies 'mills', a pejorative reference to the number of grant applications they crank out each year. About 1% of companies receiving SBIR support get 13% of the funds, according to *Nature's* analysis. The top award holder in 2011 was Physical Optics Corporation in Torrance, California, which specializes in integrating components into working systems, such as data recorders for the Navy's T-45 aircraft. In 2011 it won 94 awards worth \$32 million, which made up 63% of its annual revenue of \$51 million. Company spokesman Rick Shie says that these numbers are not the whole story: Physical Optics has a strong commercial side that since 1985 has shipped products worth more than \$200 million.

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However, there is little doubt that it and others retain a strong research focus. "The mills exist," says Zoltan Acs, an expert on entrepreneurship at George Mason University in Fairfax, Virginia, who used to work at the Small Business Administration. "If you want to defend the system, you have to defend the mills."

The companies argue that they are using government dollars to fulfil crucial US research needs, even if they are not pioneering consumer products. For example, the company that won the second-largest slice of grant money in 2011 — Create in Hanover, New Hampshire — has provided important equipment to NASA. It developed vacuum pumps for a sample-analysis instrument on the Curiosity Mars rover and built cooling systems

### SMALL BUSINESS, BIG AWARDS

Just 1% of the companies receiving grants from the US Small Business Innovation Research (SBIR) programme get 13% of the money. Some companies depend on the awards for most of their revenue, indicating that they do not generate much money from commercial products. Here are the top ten award winners in 2011.

Company	Number of SBIR awards in 2011	Total award amount (US\$)	Approximate number of employees	Approximate annual revenue
Physical Optics Corporation	94	\$32,048,692	235	\$50,800,000
Create	51	\$14,746,902	118	\$23,000,000
Intelligent Automation	63	\$14,567,686	130	\$27,000,000
Radiation Monitoring Devices	32	\$14,358,266	92	\$31,000,000
Infoscitex Corporation	28	\$12,987,429	140	Not available
Combustion Research and Flow Technology	22	\$10,936,637	39	\$9,000,000
Lynntech	38	\$10,789,277	135	Not available
Physical Sciences Inc.	33	\$10,533,749	180	\$35,000,000
CFD Research Corporation	32	\$10,298,027	90	\$17,000,000
Agiltron Corporation	33	\$9,382,591	100	\$27,000,000

SBIR awards can exceed revenues because awards can be out of sync with companies' fiscal years and because monies can be routed to subcontractors. Award totals also include monies from the Small Business Technology Transfer programme.

for the Hubble Space Telescope. However, the market for such technology will always be small because of the limited number of space missions and the unique nature of components such as the Hubble cooling system. "It was a one-off, but it was fantastic," says Charles Wessner, a policy expert at the US National Academy of Sciences in Washington DC who commends the SBIR programme.

Charles River Analytics has a few non-government clients, although it specializes in developing command and control software for the military. Zacharias says the last time his company sold a commercial product was in the 1990s, when a website personalization tool it developed was sold to another company that in turn sold it to the software developer Adobe. "If someone asked us what was the commercial output of that, it would take a bunch of forensic accountants," he says.

How exactly commercialization should be measured will become clearer when government agencies define their commercialization benchmarks, but Matthew Portnoy, programme coordinator for the SBIR at the National Institutes of Health, says the principle behind them will be clear. "We're always interested in a product ultimately getting to market," he says. Although programme managers have been working to measure commercial success in a nuanced way, they do have to honour Congress's apparent desire to shift the programme's direction away from research, he adds.

When the SBIR programme was conceived in 1982, fulfilling governmental research needs was seen as an end in itself, and a goal that could exist alongside the commercialization of

products. And agencies have always preferred to steer money to their own priorities, says Ann Eskesen, a technology-transfer expert in Swampscott, Massachusetts. The real value of SBIR companies, she says, is as a reservoir of distributed research and development that can serve US business. With the decline of research and development laboratories at corporations, larger firms that have sudden scientific need often buy up several SBIR companies to solve their research problems. Her tally of SBIR acquisitions shows that General Electric has bought 12 SBIR-supported companies, defence giant Lockheed Martin has bought 10 and biotechnology company Genzyme has bought 6.

PSI is unlikely to be bought, says Green, although he says that the company will continue to try to spin off technologies. Still, he likes the analogy to a corporate research and development department. The difference is that in many companies, product commercialization makes the researchers who did the work redundant. At PSI, when work is spun off or licensed, researchers stay on the payroll and turn to a new research problem — and a new SBIR award. "We're a research company and proud of it," he says. "Researchers don't get along in product companies." ■

### CORRECTION

The News Feature 'The quantum company' (*Nature* **498**, 286–288; 2013) should have noted that researchers at the University of Southern California worked with Lockheed Martin on D-Wave's debugging algorithm.