Protecting Hearing: Spinout Advances Innovative Noise-Filtering Device

Dartmouth College

Members of a flight crew work in a dangerous job environment — it's chaotic and deafening.

Loud jet engines generate noise levels that can exceed an excruciating 130 decibels (dB), a measurement of the loudness or strength of sound vibration. This is well above the 90 dB that may cause vibration intense enough to damage the inner ear and, according to the National Institute for Occupational Safety and Health, the threshold of 100 dB for more than 15 minutes where hearing loss is likely. The U.S. Department of Veterans Affairs (VA) spends more than $1 billion per year for hearing-loss cases.

To survive this job environment, flight crews must keep a constant vigil, wear protective ear plugs or earmuffs, and primarily communicate via hand signals. But what if there was a headset that enabled communication while shielding flight crews from ear-damaging noise?

That's the challenge from the VA and branches of the military, one willingly picked up by Sound Innovations Inc., a privately held corporation in White River Junction, Vt. Launched in 2004, the spinout from Dartmouth College started

with:

• The desire to develop a noise-filtering device

• A small team of engineering and business graduates and researchers from the private college in Hanover, N.H., whose expertise complemented one another

• $300,000 in early funding from industry and government, including the U.S. Army and the U.S. National Science

Foundation, to advance the academic research, which had been supported by earlier rounds of research funding to Dartmouth from the U.S. Air Force, the VA and the Lemelson Foundation of Portland, Ore.

• A letter of intent from a flexible Dartmouth Technology Transfer Office for an exclusive license with delayed royalties for the faculty-developed innovative digital-signal processing control algorithms

Dartmouth Spinout Delivers First Product

Today, thanks to more than $4 million in development contracts from the U.S. Army and the U.S. Air Force, Sound Innovations has its first product, the ACE — an earplug for aircrew that incorporates an active noise reduction module that protects hearing and improves communication in high-noise environments.

> *Based on mathematics that successfully conjoin noise-control algorithms, this highly stable, hybrid system is undergoing qualification testing by the U.S. Air Force with expected market entry in 2010.*

"Looking back over the last several years, this has been one of the most exciting things I've ever done," says Dartmouth's Laura Ray, Ph.D., who worked out the groundbreaking mathematics behind the proprietary algorithms. "I wear many hats now, so it's very different than my life as a professor, where I do research, publish and find funding."

The professor in the Thayer School of Engineering at Dartmouth co-founded Sound Innovations with fellow Professor Robert Collier, Ph.D., who died in 2009 shortly after the earplugs were flight tested at more than a half-dozen air force bases. Together, they were assisted on the project by two former Dartmouth students, David A. Cartes, Ph.D., and Alexander Streeter. Today, Cartes is an assistant professor of mechanical engineering, Department of Mechanical Engineering, at the Florida Agricultural and Mechanical University–Florida State University's College of Engineering in Tallahassee, Fla. Streeter is an engineer at DEKA Research and Development Corp. in Manchester, N.H.

Ray recalls how serendipity played a big role in early successful formation of the startup. She and Collier, a retiree who specialized in acoustics, hearing protection and environmental noise control, ran into each other at Thayer where they combined their interests in signal processing and developed their innovative technology. Their efforts to commercialize their discovery really took off when they started working with the Technology Transfer Office staff, which helped them develop a technology disclosure, secure U.S. patent protection and locate funding for their new venture.

"We marketed this technology in the usual way but had little success in attracting interest," says Glennis Gold, assistant director, Dartmouth Technology Transfer Office. "Then we started recognizing the inventors were enthusiastic about the possibility of starting a company."

Next, they met someone who helped them solidify their thoughts about founding a company. At the time of the encounter, Chris Pearson, a graduate of the Tuck School of Business at Dartmouth with a master's in business administration, was focused on finding a startup opportunity through the Dartmouth Entrepreneurial Network (DEN).

According to Ray, Sound Innovations might never have taken off without Pearson because he brought a business sensibility that complemented the two professors' academic focus, and this critical contribution has helped the new company avoid a lot of the problems that cause startups to stumble.

"I knew I wanted to start a business so I was working with several teams at DEN," says Pearson, who is now the chief executive officer at Sound Innovations. "Since I was focused on finding a startup company through DEN, I was introduced to Dr. Ray. We started to work together, built a small team and matured an early stage technology into a product and other technologies."

Elements of Success

Both Ray and Pearson credit the successes to date to some key elements:

• A common willingness to take risks

• The ability to make the right contacts and attract students/employees at the right time

• An early link they established between the business and scientific side of their endeavor

"Dr. Ray isn't caught up with control, and I'm willing to spend time on developing a company," says Pearson. "These key ingredients don't always come together in an academic spinout company.

"It's important to remember that commercialization and research are two different worlds. Unless you've been involved on the business side of taking a product to market, it can be a difficult process for academic professors to understand."

But learning about the commercialization process is exactly what Ray finds so interesting — it's a new level of knowledge that she feels will help make her a more valuable resource to her students at Dartmouth.

"I feel like the many hats that I wear at Sound Innovations keep me connected to the real world," she says. "For example, it's been a true learning experience to understand our customers — 17- and 18-year-old soldiers aren't interested in their hearing when they need to focus on survival. Our challenge has been to find a way to enable them to focus and protect their hearing, all at the same time."

The Sound Innovations team is well on its way to developing the next generation of aviation communications headsets that rely on their patented digital-signal processing methods for active noise reduction that cancel noise by producing diametrically opposed sounds. They're also developing proprietary chip and electronic designs and innovative mechanical designs for advanced noise reduction and communication products. These products are expected to improve the work environment of active-duty soldiers and industrial workers by protecting and enhancing their hearing, allowing clear, two-way communication in noisy environments and enabling them to effectively listen to sounds from a distance.

"In the case of Sound Innovations, we were right to support this spinout that needed latitude to build a business and it's worked out so beautifully," Gold says. "The inventor was able to pair herself with the right manager and team to help commercialize this licensed Dartmouth technology that shows great promise of benefiting the public, exactly the kind of realization envisioned in the Bayh-Dole Act."

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