Climbing the 'power ascension' market

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Atlas Device's APA-5 weighs roughly 20 pounds and can lift upwards of 600 pounds, up a rope, at speeds of several feet per second. Credit: Atlas Devices

Since MIT spinout Atlas Devices' flagship product, the Atlas Powered Rope Ascender (APA), first hit the market in 2007, it's been touted by media as a real-world version of Batman's famed utility-belt grappling gun: At the pull of a trigger, the handheld device can hoist two people about 30 stories up a rope in 30 seconds.

Exciting, for sure. But despite its appeal as what Atlas co-founder and APA co-inventor Nathan Ball '05, SM '07 calls a "gee-whiz gadget"—with seemingly limitless, and sometimes fantastical, applications—the device is becoming a practical tool for motorized

scaling (or "power ascension") in the military and other fields.

Roughly the size of a small shoebox, the aluminum-cased APA—which began as a prototype for MIT's Soldier Design Competition in 2005—has a handle with direction control switches (up or down) and a trigger.

An innovative rope-feeding, capstan-based mechanism ensures that the battery-powered device can lift two soldiers—sometimes carrying 80 to 100 pounds of equipment—swiftly along an attached rope, without jamming. A lightweight, interchangeable battery capable of hundreds of feet of hoisting per charge snaps into the front.

The latest version, released in 2010, dubbed the APA-5—developed with funding from the Office of Naval Research's Tech Solutions Program—weighs roughly 20 pounds and can lift up to 600 pounds at speeds of up to several feet per second.

First designed for soldiers who plunged into caves and wells in Iraq and Afghanistan, the APA is now being used by all four military branches on the battlefield and in training to climb mountains, buildings, and ships. It's even being used in helicopter extraction and rescue missions.

Finding steady success with its military customers, Atlas is now expanding its Charlestown, Mass., headquarters with a new 10,000-square-foot facility featuring advanced manufacturing and testing equipment.

Popular Mechanics, NPR, "MythBusters," and other media have covered the APA over the years. Since 2007, Ball has hosted the PBS show "Design Squad Nation," which teaches children about engineering.

Dialing in the specs

The novelty of the APA lies in its rope-grabbing mechanism, invented primarily by Ball, who won the 2007 Lemelson-MIT Student Prize for his work (providing $30,000 that further funded APA prototyping).

Instead of spooling, as with conventional pulleys and winches, the rope fed through the APA weaves between a series of rollers that sit on top of a turning, battery-powered spindle. (Think of a cordless drill that spins to pull a rope instead of driving a drill bit.) As the spindle rotates, it continuously pulls the rope through the device. This relies on the capstan effect, which—similar to lowering and raising a ship's anchor—produces a tighter grip as more line wraps around a cylinder and more weight is added.

A mechanical engineering alumnus, Ball started building the device with Atlas co-founders—Bryan Schmid '03, SM '05, Tim Fofonoff SM '03, PhD '08, and Daniel Walker '05, SM '09—for the annual MIT Soldier Design Competition, which challenges student teams to invent technologies based on military requests.

Original specifications for the invention called for a device that weighed less than 25 pounds and could hoist 250 pounds 50 feet vertically in five seconds—a remarkably high power-to-weight ratio exceeding that of a Dodge Viper's, the team calculated. Using drill batteries and other custom-designed equipment, the team completed a working prototype that achieved a 50-foot lift in seven seconds.

Taking third place, and $3,000 for further prototyping, the four-man team co-founded Atlas Devices in Boston to develop and launch their first product, the APA-3. (Weighing 28 pounds, the first APA could lift up to 350 pounds at 5 feet per second, and was adopted by several U.S. military groups.)

As one of the few companies in the relatively new—but

growing—power-ascension market, Atlas has needed to continually hone APA specifications to meet field and customer expectations. It's a balancing act, Ball says.

Originally, for instance, when power ascension was more novel, users requested an ascension pace of 10 feet per second. But Atlas found that as soon as you maneuver over, say, more dangerous terrain or over edge of a wall, going that fast could mean crashes and injuries. So for some customers that operate in dangerous terrain, they compensated with slower speeds, but a higher lifting capacity—which was, in fact, beneficial, Ball says. The device can also now be submerged in water for maritime use.

"Dialing in the specs has been a continual process, as customers have got more and more experience using power ascension devices," he says. "All the specs have tradeoffs. When you care about several things, like any engineering system, you have pick and choose which ones win."

Innovation also occurs at the material level, Ball says. For example, Atlas recently made the switch to more advanced ropes that have higher textile strength, with smaller diameters. "To carry a 200-foot section of rope was up to 15 pounds; now it's closer to 8 pounds," Ball says. "We're always trying to find better ways to accomplish things."

Important piece of the equipment locker

In its early days, MIT's Venture Mentoring Service played a role in Atlas' development, helping the team network and refine its business plan. (In fact, Atlas still uses the program for networking and mentorship.)

Additional help came from MIT's Institute for Soldier Nanotechnologies. Ball specifically credits former technology transfer specialist Lisa Shaler-Clark as instrumental in taking the APA "from the

lab bench to the field."

She walked the Atlas team through startup basics, such as legal and financial work, and doing business with the government. "Lisa gave us a lot of those nuts and bolts" of building a business, says Ball, who comes back to speak at MIT classes from time to time.

MIT helped in one other capacity: The Institute was Atlas's first customer, soliciting the APA to help maintain the scoreboard above the pool in the Zesiger Sports and Fitness Center. It's still being used.

Today, Atlas is aiming for wider adoption of the APA. "Like any good 'gee-whiz gadget,' it's easy to think of places it can be used," Ball says. "But the real gratification comes from when customers start thinking of it less as just a gadget, and instead as an important component in their equipment locker."

That's true of the APA, Ball says, for rescue missions. A conventional mission, using standard equipment, Ball says, can take five to 10 rescuers several hours to complete, while an APA-aided rescue can take only one to two rescuers much less time.

Also, the APA can function as a backup for a helicopter if something goes awry with the primary hoist: Instead of flying the helicopter back to base for a working hoist, rescuers can store the APA in a seat compartment, as it won't compromise the chopper's weight capacity.

Extraction and rescue missions have become some of Ball's favorite applications. "It's always appealing to develop technology that can make a difference in those scenarios and make jobs easier," Ball says. "And when you get the chance to enable something you couldn't do before—like continue a helicopter rescue operation when a hoist fails—that's exciting."

Other potential uses include cave exploration and recreational climbing; hoists for workers at dams, buildings, bridges, and massive wind turbines; as well as for first responders.

"There's a broad spectrum of users—people who use rope access as part of their work—for whom this technology would make a lot of sense," Ball says. "We want to make that true for as many places as possible to benefit from it."

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