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COLUMN

THE SQUEAKY WHEEL GETS THE GREASE!

FOCUS ON SAFETY // **GEOFF GOODYEAR**

The title of this column brings to mind the common belief that if an issue is laid before us loudly and aggressively enough, it will get attention. This is not that.

This column is about that simple, yet complex, act of receiving and following instructions. Indeed, our careers in aviation begin with instruction and the receive/interpret and absorb process continues throughout our days. It sounds simple enough, but we have all encountered situations where poorly communicated instructions were not given the assessment they deserved, and ended up causing chaos.

I have cited my grandfather previously in several columns. He was quite a guy. Having served in the Royal Newfoundland Regiment and survived the Battle of the Somme, he returned to Newfoundland to help run the family construction business with his surviving brothers. No small accomplishment during the Great Depression. In his spare time, he took up boxing, and subsequently retired as the province's undefeated heavyweight champ. He had a very imposing physical presence and a booming voice to match. He was known to society as "Skipper Ken," and he owned every room he entered.

I mention all this to set the stage for an encounter the Skipper had at his own maintenance depot in Grand Falls-Windsor. Back in the day, trucks and heavy equipment were not blessed with the permanently lubricated bearings of today. Every mechanical component that came in close proximity to another component always had a grease fitting that required constant feeding. A couple of dollars' worth of grease could save thousands in repairs downstream. As you can imagine, this thing with grease became an empirical fixation with the Skipper.

A newly-minted mechanic had just started work at the maintenance depot, and was still getting the lay of the land, when out of nowhere the Skipper appeared to observe his progress. Our junior employee had the front wheels off a truck at the time, and was servicing the brakes. The Skipper dispensed with any pleasantries or platitudes and immediately launched into a treatise on the virtues of grease.

Of course, such a sermon was not to be wasted on one junior mechanic, but was delivered with such passion and volume as to engage all on the work floor. The poor mechanic was in a state of terror. He knelt beside the wheels of the truck as the Skipper mantled over him like a falcon over its prey just before consumption. As the Skipper closed off his presentation to the troops, he instructed the young mechanic to ensure "everything is greased!"

The Skipper moved on to some other workstation in search of fresh prey. So ended the first workday for our young mechanic.

In the depot the next morning, there was a lot of excitement as one of the truck drivers was having a rather animated discussion with the shop supervisor. Apparently the brakes on his freshly-serviced truck did not work — no matter how hard he pressed on the brake pedal.

In came the truck to have the wheels removed to see what was going on. It was clear from the onset that our young mechanic had taken the Skipper's instructions well to heart. The wheel bearings had indeed been greased… along with the brake pads, brake drums and liners! No amount of grease was spared, as per the Skipper's instructions.

> *Receiving, understanding, and executing instructions are critical processes essential to not only safety, but every aspect of our jobs.*

Fast forward to my own career, where I once encountered a site manager who had his own stories of poorly executed instructions. He recounted how a brand new 5,000-US gallon fiberglass tank was emptied of its contents without a vacuum release valve being opened. The tank imploded and then shattered into "a million different itty-bitty pieces!" He then lamented that, "if it is not idiot proof… they will zero in on it!" Of course, there was no mention as to whether or not the workers had been instructed to open the offending valve. All of us in the industry know that good quality transmission is absolutely necessary for clear and complete reception.

Receiving, understanding, and executing instructions are critical processes essential to not only safety, but every aspect of our jobs. To prevent unintended consequences, managers must ensure that instructions to colleagues are clear, concise, and without fear of human sacrifice. Those getting instructions need to speak up if something does not make sense to prevent those greased wheels from coming off the bus.

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COLUMN

NAVIGATION AND THE QUEST FOR LONGITUDE

FOCUS ON TRAINING // **ANDY ROE**

The notional graticule of horizontal (latitude) and vertical (longitude) lines that span the Earth's surface serves many functions, but most crucially, it is a major aid to navigation. Move the cursor over the screen on Google Earth and you will see all of the latitude and longitude coordinates displayed at the bottom in degrees, minutes and seconds.

Helicopter students seldom need to refer to parallels of latitude and meridians of longitude when planning simple navigation exercises on a chart from one topographic land feature to another. Specific latitudes and longitudes would only need to be found and plotted if they were the sole references given in a navigation exercise from A to B.

But even though latitude and longitude play a subdued role in helicopter training these days, students might be interested in the fact that latitude and especially longitude position were difficult to determine for early ocean explorers and merchant seamen. For centuries, heading out into the vast open sea was a risky venture, with countless ships foundering on rocks or reaching an unexpected landfall.

Early navigation with no terrain features on which to monitor progress was difficult. One's latitude could be roughly determined by the sun's position or by star and planetary arrangement, but longitude position was a baffling unsolved mystery. Imagine a helicopter setting out for an oil rig 1,000 nautical miles offshore — if that were even possible — with only basic flight instruments, and you get an appreciation of the orientation problems early seafarers faced.

Heading west from Europe towards what he thought would be India in 1492, Christopher Columbus monitored his progress with a magnetic compass, a sandglass to measure time, and an instrument called an astrolabe to make celestial observations. The latitudes were conveniently pointing him in the right direction (west) and could be determined by measuring the declination of the sun, weather permitting.

Columbus used dead reckoning to determine distance travelled (longitude) by calculating speed from the time objects thrown overboard took to travel the known length of the ship. The speed could then be applied to the number of days at sea to give a rough idea of distance travelled. Columbus maintained a magnetic course for weeks with the occasional correction for wind and currents. Like student pilots today, he was easily distracted and he veered left several times because of false land sightings to the southwest. When land was finally sighted he was on the 20th parallel (Caribbean) and not the 40th parallel he read on his instruments. His landfall was nowhere near India, but undoubtedly a welcome relief.

> *It is amazing to think that all of today's advanced technological achievements began with the invention of an accurate timepiece to solve the problem of determining longitude.*

For seafarers, navigating north or south was a challenge. British navy captain Sir Cloudesley Shovell, returning to Portsmouth from Gibraltar after a successful military campaign in 1707, was on one of four Royal Navy ships that foundered on rocks by the Isles of Scilly, off the southwestern tip of England. An estimated 2,000 men, including Shovell, died in the disaster, which was later blamed on an inability to accurately calculate the fleet's longitude. The sailors had thought they were off the French island of Ushant, on the southern side of the English Channel.

Navigating using astronomical charts and observations was inaccurate and time consuming. It was known that time could be used to determine longitude position, but an accurate maritime timepiece did not exist — and the astronomical community scoffed at the idea anyway. In the mid 18th century, Englishman John Harrison invented an accurate sea clock that kept near perfect time, even when subjected to vast temperature differences and the rolling seas. Recording the time at the port of departure and comparing it with the local time while at sea gave sailors the number of degrees of longitude between the two, which would then pinpoint the meridian of longitude you were on or closest to.

The earth rotates 15 degrees every hour, or 360 degrees in 24 hours. If your time at sea is noon, and the time back at port is five hours ahead (5 p.m.) then your position would be at 75 longitude degrees west of port (5 hours x 15 degrees = 75). On a trial run to Jamaica in 1761, landfall was accurately predicted after 81 days at sea, with an error in longitude of approximately one nautical mile.

James Cook was the first prominent explorer to use a chronometer for navigation on his second voyage of exploration in 1772, although the celestial method of navigation continued to be used for decades. Accurate time eventually became the dominating form of navigation with the advent of affordable marine chronometers and the invention of wireless telegraph time signals.

Two centuries later in 1973, American physicist Roger Easton invented a space-time method for determining position over the Earth's surface from a series of satellites, which we now know as the Global Positioning System. GPS technology accurately displays location, speed and time, and is very much a part of our daily lives. Navigation has also spread out well beyond the Earth's surface. The NASA spacecraft New Horizons, which visited Pluto in 2015, five billion miles from Earth, is now a further billion miles beyond.

Soon, space exploration missions will carry NASA-developed, ultra-precise, mercury-ion atomic clocks for navigation, replacing outdated Earth-based signal transmissions to and from the spacecraft to determine location, velocity and path. It is amazing to think that all of today's advanced technological achievements in navigation began with the invention of an accurate timepiece to solve the problem of determining longitude.

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COLUMN RESEARCH & DEVELOPMENT

FOCUS ON MAINTENANCE // **JOHN CARINHA**

Research and Development (R&D) can sometimes be synonymous with trial and error, something entrepreneurial, yet front-loaded with risk. Pioneering minds can be found throughout our industry, from the larger OEMs who can (and do) invest huge sums into developing new and exciting technology to enhance their product lines, to independent businesses who think up new solutions to longstanding industry problems.

In a past issue, I wrote about having spent a span of almost three years on a large heavy jetliner program, which involved designing a multi-tank system for dispersing a fluid in the event of an environmental disaster or spill. The system was complex, requiring the ability to control filling and discharging tanks at different times to enable the aircraft's center of gravity envelope to be maintained. Discharging such a high volume of fluid over a set period of time required large diameter (six-inch) interconnecting plumbing, which eventually terminated at a discharge valve before exiting the airframe through a fixed nozzle.

> *As our industry moves forward, pushing and testing the limits of technology and the human interface, I truly tip my hat to those risk-takers who say "let's try."*

On the day of our inaugural test of the system, the client had sent their top brass to visit our site and walk through the hangar to visually and aurally understand the system as it sat before them. Clad in their two-piece business suits, the executives with their significant others came primed to see what years of work had culminated in. Laid out, the system was impressive — very industrial and very functional, but yet to be proven. With cameras at the ready and an energy that was palpable in the surrounding air, the system was brought to life. Its diesel pump was started, the tanks filled and all visual indications on the respective control panels were indicative of a system that was enabled and ready.

Large collection tanks had been set up, into which the tanks would discharge their fluid. With a thumbs up from the project's foreman, I initiated the discharge sequence with the press of a button. One by one, the tanks' indicating lights began their expected sequence of changing colors, which corresponded to changing fluid levels. It was synchronous and harmonious as the lights danced across the panels, giving assurance that all was as it should be. The outflow nozzles had to be strapped down and held back with a forklift, as the resulting thrust they were creating would have sheared them from their attachment points. One by one, the tanks emptied and as the last neared its cycle of discharge, I was given the command to close the discharge valve, ending the cycle. With a confident mind and steady finger, I reached for the switch and toggled it closed… and then all hell broke loose.

The 120-foot-long pipe was filled with water weighing close to 3,000 pounds (1,360 kilograms), which was moving at a high rate. By closing the valve, all flow was quickly cut off — and it became a quick lesson in basic physics that would have left Sir Isaac Newton holding his hands to his face. As that large volume of water hit what was essentially a brick wall, it created a reaction in the opposite direction, causing all flex couplings between the tanks to mechanically come apart. It was like a self-induced earthquake centered solely in the footprint of our hangar. Water flowed to all four corners of the building. Women in high heels stepped gingerly, aiming not to slip and fall. There was shock and wonder all around, but a huge large elephant sat squarely in the room. The system had delivered as designed with one massive exception. The effect of water hammer had not been considered.

As we retreated into the confines of our office and our design team each took a seat and let out a collective sigh, we quickly turned to our dry erase board. This was the place on which most ideas were born. Short of a pep rally to boost morale, we knew we couldn't die on the sword at this late stage. We had come so far and despite a massive setback that required repair and redesign, we knew we had to persevere. Over the next few hours, a time delay control circuit was conceptualized and eventually proven over the following weeks. The system was delivered and certified as hoped — but not necessarily as planned.

As our industry moves forward, pushing and testing the limits of technology and the human interface, I truly tip my hat to those risk-takers who say "let's try." These are the people who take steps without fear, and do so with (hopefully) an eventual monetary reward for their enterprising thoughts, benefitting our industry with new and safer technologies.

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COLUMN

IS YOUR SAFETY CULTURE BUILT TO LAST?

FOCUS ON LEADERSHIP // **KIM HUTCHINGS**

I live in the great state of Texas. I haven't always lived in Texas, only for the past 2.5 years. I'm originally a Southern California girl, growing up in what I call the concrete jungle.

There are many differences between Texas and California, one of them being the dirt (or where I live, the mud)! When it rains, it turns thick and heavy like clay. You sink when you walk in it and your shoes get caked in a mud so thick it looks like you are wearing moon boots. In the summer, the scorching sun burns any moisture in the ground away, leaving a rock-hard cracked earth. Some cracks are so wide and deep you could drop a golf ball down them.

When we bought our house two years ago, we were told by the insurance company that they didn't cover certain things with the foundation or cracks in the walls, because in Texas, the ground expands and contracts quite a bit. Wait, what? You don't cover the foundation of a house? That's the strongest part! It's what makes the house "solid." But, on reflection, it made sense — the ground isn't solid where I live, so how could the foundation remain solid over time? If we get a ton of rain or experience drought, the ground beneath and surrounding my house is moving; not in the dramatic way earthquakes threaten to shake the ground out in California, just a tiny amount each day, as the sun or the rain take their toll.

Growing up in California, you learn fairly early on how important it is to have a strong foundation, because you never know when things can come crashing down around you. Following my move to Texas, I have learned that small movements over long periods of time can have an equally destructive result, just not as catastrophic as a large earthquake.

A safety culture is like the foundation of your house. It needs to be solid, because if not, there will be shifting outside influences that will impact you. While it's true that there will also be changes within your organization, if you start with a healthy safety culture, you will remain much stronger and better able to ride out the challenges you encounter. Even if a metaphorical tornado comes through, you need your foundation to be strong enough to remain intact. You can't reach a true "just culture" if you don't have a solid foundation in place, and that foundation is built on effective leadership and strong emotional intelligence.

> *Without a strong foundation in leadership and emotional intelligence, safety culture can be like the ground in Texas; small cracks and movements can ultimately result in the structure breaking.*

Oftentimes, safety tools —such as risk analyses, briefings, or programs like safety management systems — are mistaken for actually having a safety culture. These are things we do or have in place for people to use, whereas emotional intelligence and leadership is a set of skills a person must possess. In other words, doing versus being. Most importantly, for the organization to create a just safety culture, it takes everyone to possess a certain level of these skills. Obviously, the executive management, directors and safety leaders should have very strong leadership and emotional intelligence skills, but every single person involved in an aviation operation somehow touches safety in some way — especially the pilots and maintenance technicians. It is just as important for them to possess these skills as it is for management.

Most people have a basic understanding of what constitutes leadership qualities, but what is emotional intelligence and why is it important to safety culture?

According to Multi-Health Systems' definition, emotional intelligence is a set of emotional and social skills that influence the way we perceive and express ourselves, develop and maintain social relationships, cope with challenges, and use emotional information in an effective and meaningful way.

The easiest way to explain why this is important to the foundation of safety culture is to give an example. Imagine, as a maintenance technician, that you and your crew are given a strict timeline as to when some scheduled maintenance has to be completed. As you work to meet the deadline, you are running into issues with parts availability, but your boss is keeping the pressure on you to get the job done no matter what. Your team works longer days to try to make up for the lost time, and everyone starts to feel the pressure to meet the deadline. How do you handle it? How does the crew handle it? Does everyone pull together to find an efficient way to deal with it? Do you communicate with your boss that the parts situation is out of your and the crew's control and ask if there is something he can do to help? Or, do you and the crew begin to argue and point fingers? Do you and the crew avoid the boss so that he can't ask how the maintenance is coming along?

How you and the crew cope with this challenge will affect safety, either directly or indirectly. Mistakes happen when things become too stressful and tense. At this point, a checklist or a procedure does not override the way we cope with stress or the way we work to overcome challenges. We return back to the doing versus being. We can follow the checklist (doing) but how are we coping with the stress (being)?

Without a strong foundation in leadership and emotional intelligence, safety culture can be like the ground in Texas; small cracks and movements can ultimately result in the structure breaking. Or, it can be like California, where things are going along smoothly and then out of nowhere the ground makes a hard-jolting shift beneath you, disaster strikes, and things come crashing down around you.

So, ask yourself: how strong is the safety foundation in your organization?

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COLUMN WHERE HAS ALL THE TALENT GONE?

FOCUS ON OPERATIONS // **COREY TAYLOR**

We argue a lot in this business. It's usually a safe bet that the number of opinions on any given issue is roughly equal to the number of people in the room, especially when the room has in excess of a dozen beer taps.

There are only a few things that bring unanimity to discussion among operators. Besides everyone being convinced they're underpaid, all seem to agree there is a chronic shortage of both pilots and maintainers, rapidly approaching crisis if the retirement projections are to be believed.

Unanimity dissolves as soon as the topic veers from the problem to the solution. The sad fact is, there doesn't seem to be an easy one — or at least nothing obvious that can solve the various issues without a lot of effort and time.

Pilot licences are very expensive, but even were they free, it would not solve the shortage. The fact is we need experienced pilots that instil in us the confidence of a safe flight, each and every time. This takes years to achieve, long after the ink has dried on that piece of paper.

With maintenance staff, the time constraints are even more apparent, since it takes years of apprenticing to get that licence, and we compete with the airlines and other companies for the product of the schools.

Since the constant in all discussed solutions revolves around time, there seems to be none of it to waste if we're to avoid crisis, and perhaps even swell our ranks to where we can find something else to worry about — maybe we can even go back to the topic of being underpaid!

To solve the pilot issue, we need to understand the problem. Simplified, we can say that client demands, often driven by insurance or prescriptive standards, make it next to impossible for a pilot to achieve the experience they need to become proficient and safe. Jobs we once viewed as perfect for a pilot with a few hundred hours now require thousands of hours. Often, the pilots who have enough hours to do these jobs view them as mundane and don't want to do them, while the pilots who would donate a limb to get in that seat aren't allowed to do so due to client strictures.

> *If we continue to poach experienced crew from each other, we will continue to decline until we're an endangered species.*

A multi-tined approach can help solve this, but time is still of the essence. If operators would employ more low-time pilots, intending to help them advance in their careers (as opposed to using them as indentured servants while dangling an unreachable carrot), these pilots would be exposed to more opportunity to build those hours. When your dispatcher is a pilot and that 10-hour ferry flight comes up, that dispatcher is available and, I daresay, more than willing to do the flight. Yes, there are some additional costs, but they are minor if you produce a pilot and a long-term employee at the back end.

Another tine, and one I have seen work with some success, is to embrace a competency-based training program and sell it to your clients. I have seen a client that insisted on 2,000 flight hours reduce that to 500 hours based on the training put into the pilot and the supervision and oversight they were assured. A 500-hour pilot quickly becomes a 1,000-hour pilot when they are actually allowed to fly. Especially when they're paid for it.

When it comes to maintainers, there are various reasons why the shortage exists, but much has to do with where helicopters work and where mechanics want to live. People who grow up in cities with broadband Internet and a Starbucks on every corner often aren't interested in exploration camps or chasing fires around the continent. They like to be in their own bed at night. The airlines are a good choice for a lot of those people. Well, if their own bed is an attractant, then find them in their beds where the work is! Instead of seeking fully-baked personnel that you don't know and might not mesh with, find good young people where you need them, and take them in raw form. Nurture them, develop them, excite them about the work we do, and then train them! There are programs that mesh perfectly with this model, so you can take a kid from high school and have a fully capable maintenance engineer in just a few years. It's very likely you'll have them for the long term when you take this approach, and your employee turnover may be near zero in an average year.

If approaches like the ones above were adopted by enough operators, we would start to fill those empty seats. If we continue to poach experienced crew from each other, we will continue to decline until we're an endangered species.

New regulations may further reduce available pilots and drones may reduce demand, but those eventualities are not yet in front of us. The only thing we know for sure is we don't have enough people now and there are a great number of us soon to leave the industry for the golf course. Time is precious and there's none to waste.

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PJ Helicopters pilot Tommy Levanger at work in a Sikorsky UH-60A in the Sierra Nevada mountain range in California. **DOUG HATCHER PHOTO**

An Aérospatiale Alouette III, NHIndustries NH90, and Westland Sea King are captured after takeoff in formation. **MICHAEL MOORS PHOTO**

A Bell 206L-1 LongRanger operated by Wild West Helicopters is surrounded by rocky Arizona terrain, with Spirit Mountain in the background. **RICK SÁ PHOTO**

Vertical DAILY NEWS TOP10

Here's a recap of our 10 most popular online stories since our last print edition was published.

01 **SURVIVING PILOT INCAPACITATION**
How an Air Evac Lifeteam crew survived a pilot incapacitation event.

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Bell's Nexus VTOL aircraft was the star of the company's booth, appearing in the form of a full-scale mockup, complete with tilting ducts.

Heli-Expo touches down in Atlanta

PHOTOS BY ANTHONY PECCHI & ROB REYNO

The global helicopter community convened in the Georgia World Congress Center March 4 to 7 for the industry's biggest show, as Helicopter Association International (HAI) Heli-Expo made its debut in Atlanta, Georgia.

The show typically draws about 18,000 attendees, and HAI said this year's event was "comparable to prior years" in terms of numbers. In addition to walking a bustling show floor that spanned over one million square feet (92,900 square meters), visitors took part in over 150 education courses, technical briefings, workshops, forums, meetings, and seminars.

The show had 57 aircraft of a wide variety of type and size on display, from the debut of Unical/Coulson's CH-47 Chinook, to a special R22 in a heritage livery to mark the type's 40th anniversary.

HAI's professional education courses drew 480 attendees, while over 200 attended the military-to-civilian transition workshop. All told, 2,880 people took HAI's rotor safety challenge and over 400 sat in on manufacturer technical briefings.

HAI said exhibitors and attendees expressed "very positive feedback" for the show experience, as well as the host facility and city.

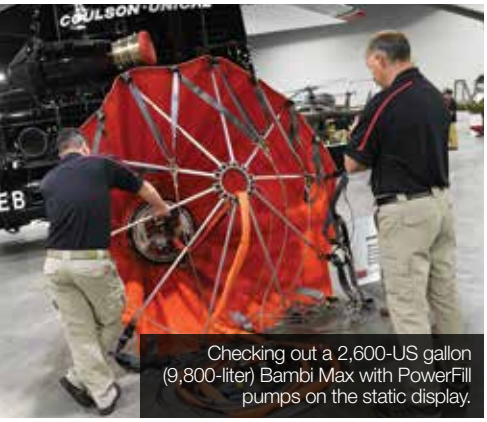
As usual, *Vertical* had a large representation at the show, and we'd like to say a very sincere thank you to all those who stopped by our booth to say hello.

You can see some of the highlights from the three-day exhibit over the next few pages.

Next year's show will be earlier than usual, running from Jan. 27 to 30, 2020, in Anaheim, California. We hope to see you there!

Visitors to the Robinson Helicopter booth take a look inside the company's R66 Turbine.

MD Helicopters' CEO Lynn Tilton gives her annual media briefing on the company's booth.

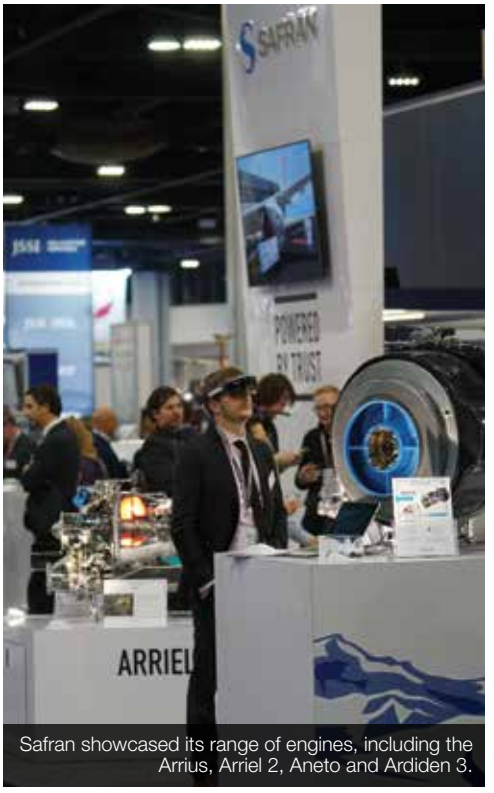


Checking out a 2,600-US gallon (9,800-liter) Bambi Max with PowerFill pumps on the static display.

Kopter, creators of the upcoming SH09 light single, brought the type in the livery of U.S. operator Grand Canyon Helicopters. It believes the flightseeing sector will prove a popular market for the aircraft with its high-visibility cockpit and cabin.

As always, Vertical had a large presence at the show.

Sikorksy had an S-92 on its stand in the livery of Tanzanian-based operator Everett Aviation.



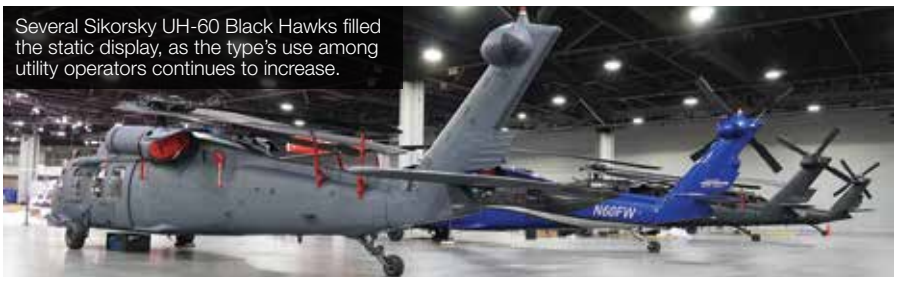
Safran showcased its range of engines, including the Arrius, Arriel 2, Aneto and Ardiden 3.

HAI said attendance numbers were comparable with previous years, with the good connections to Atlanta's airport proving popular with visitors.

Attendees came in all shapes and sizes. Not many came in a flight suit and helmet, though.

Bell drew a crowd with its panel discussion on the Nexus. The panel was moderated by *Vertical's* special projects editor, Elan Head (left)

Potential customers check out a Guimbal Cabri G2.

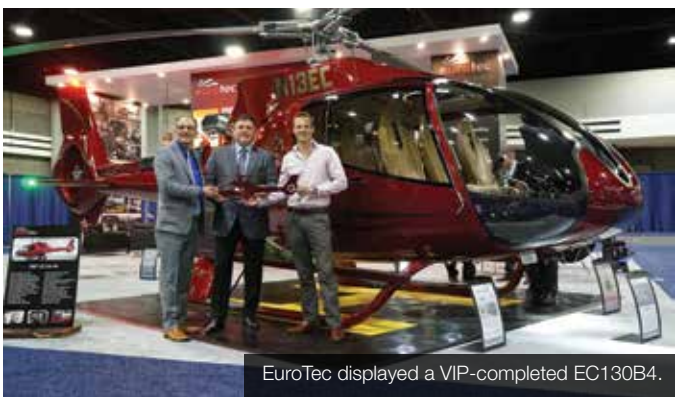


Several Sikorsky UH-60 Black Hawks filled the static display, as the type's use among utility operators continues to increase.

Bart Stevenson, president and general manager of Forest Helicopters Inc. (left), and Romain Trapp, president of Airbus Helicopters Canada and COO of AHNA (center) at a presentation marking Forest Helicopters' order for a new H125.

Schweizer RSG saw a steady stream of visitors to its booth, keen to take a look at the owners of the S-300's type certificate.

Shreveport, Louisiana-based Metro Aviation featured an EC145e for Children's Healthcare of Atlanta on its booth.

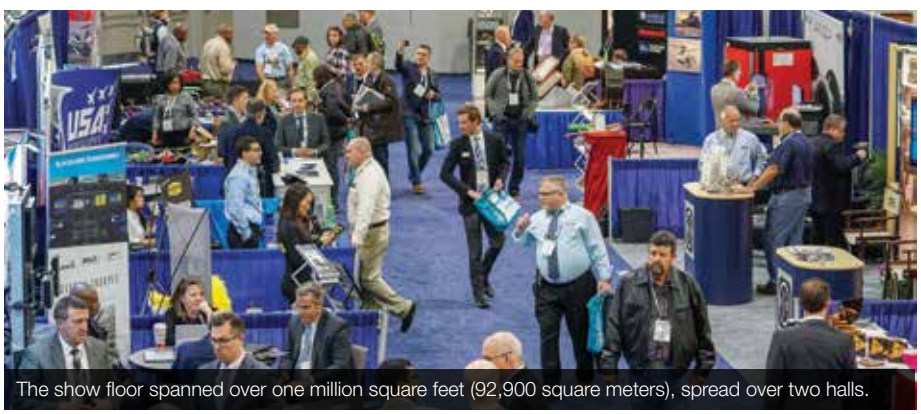


EuroTec displayed a VIP-completed EC130B4.

There were 57 helicopters at this year's show, spanning a huge range of size and manufacturer.

As well as taking a look at the various products and services in the exhibit hall, visitors had the opportunity to attend some of the 150 education courses, technical briefings, workshops, forums, meetings, and seminars held during the show.

Among the aircraft on Leonardo's booth was an AW169 in a VIP configuration.



The show floor spanned over one million square feet (92,900 square meters), spread over two halls.

WATCH VIDEO

RotorBits

LEONARDO BULLISH ON CONTINUED GROWTH

Leonardo has released its financial results for 2018, where it appears helicopter deliveries have increased significantly and the division made a key contribution to the parent company's improved performance.

The OEM grew its share of the global civil helicopter market in terms of the value of deliveries, which it mainly attributed to growth in the medium segment, from 3.2 to 10 metric tons — namely, the AW169, AW139 and AW189.

Deliveries of military and civil helicopters reached 177 units, up from 149 in 2017. The helicopter division's revenues amounted to €3.8 billion ($4.3 billion), an 11 percent improvement. The company emphasizes AW139 and AW101 deliveries drove revenues.

The division met its key targets, according to a Leonardo statement. Orders increased by 97 percent in value, at €6.2 billion ($7 billion). The backlog, as of Dec. 31, 2018, stood at €12 billion ($13 billion).

ROLLS-ROYCE ANNOUNCES SUCCESSFUL HYBRID PROPULSION TESTS

Rolls Royce Image

Rolls-Royce has taken a significant step towards realizing its ambition to provide hybrid-electric propulsion systems for the next generation of aviation, with successful ground tests of a hybrid system using its M250 gas turbine. The tests pave the way for experimental flights on aircraft in 2021.

The M250 hybrid is slated for use as a propulsion plant with power ranging from 500kW to 1MW. The system will be used across a range of transport platforms to enable distributed electric propulsion, including eVTOLs (hybrid electric vertical takeoff and landing vehicles), general aviation aircraft and hybrid helicopters.

Sikorsky launches S-92B

Upgrade will see the first commercial application of Sikorsky's Matrix autonomous technology

Fielded S-92s will be able to take advantage of the upgrade in the form of the S-92A+ kit. **Mike Reyno Photo**

BY OLIVER JOHNSON

The S-92 is to receive a major upgrade, becoming the first production aircraft to incorporate Sikorsky's Matrix autonomous technology, as the manufacturer seeks to cut the aircraft's operating costs and boost its competitiveness against the growing fleet of super medium helicopters.

The upgraded aircraft, which will be known as the S-92B, will also receive a new main gearbox, enlarged cabin windows, and a new cabin door that will be suitable for both offshore transport and search-and-rescue (SAR) operations.

But it's the incorporation of Phase One Matrix technology that perhaps most represents a step change for the type, bringing advanced computing power to the aircraft to take it further along the road towards autonomy.

"That's going to be the infrastructure that allows us to start that autonomy portfolio suite and introduce it into the commercial market," David Martin, Sikorsky's market segment leader for oil and gas, told *Vertical*. "We see a real evolution in the cockpit where the crew is [performing] very, very capable systems process monitoring, managing the system. The aircraft can take care of a lot more of the mundane tasks."

Sikorsky announced the launch of the Matrix Technology program in 2013, and has been maturing it on the Sikorsky Autonomy Research Aircraft *(see our flight report on p.56)* and an an optionally piloted UH-60A Black Hawk.

In the S-92B, the technology is present in the form of Rig Approach 2.0, an evolution of the Rig Approach available for the existing S-92, and SuperSearch, which works in tandem with the aircraft's SAR automatic flight control system (AFCS).

Rig Approach allows a crew to plan and program their offshore mission and destination before they take off, with the aircraft then flying that mission profile up to a half mile from a helideck. With Rig Approach 2.0, the aircraft will be certified to fly to within a quarter mile of the helideck. "Ultimately, the future plan for that product is to — when we get the right . . . certification and customer comfort level — go all the way down to an automated landing on the helideck," said Martin.

SuperSearch uses an advanced algorithm, developed by Sikorsky's Innovations lab, to search within a designated block for an object, such as a life raft or a boat. According to Sikorsky, its simulations have shown SuperSearch can find these objects up to 50 percent faster than a traditional search pattern.

"It is amazing to watch these simulations run, and it always works — they're always finding these objects faster," said Martin. "This is an example of where autonomy brings value."

In terms of future applications for Matrix technology, Martin said "the market will determine how and when" it appears in other platforms.

The S-92B's new Phase IV gearbox provides a further boost to the aircraft's safety, having demonstrated extreme run-dry capability. During testing witnessed by the Federal Aviation Administration, all primary lubrication system oil was removed before the gearbox was operated for the equivalent of over 500 nautical miles (925 kilometers) at an airspeed of 80 knots.

The gearbox is made from aluminum (the S-92's current gearbox is magnesium), which allows for greater strength, durability and corrosion resistance, said Martin. "The new gearbox will have the case life and the overhaul period aligned due to the new material," he added. "The manufacturing technology that's gone into it . . . will reduce things like magnetic particle chip events by up to 70 percent."

While newly-produced aircraft containing the upgrade will be marketed as the S-92B, fielded S-92s that are modified through a kit will be re-designated as S-92A+ aircraft. The difference between the A+ and the B will be the latter's cabin windows and cabin door. The windows will be about two or three inches larger than those in the existing aircraft, while Martin said Sikorsky is working on "a couple of competing concepts" for the door — but that it would most likely be some form of sliding door.

Both the S-92B and S-92A+ will have the SAR AFCS as standard, and a newly-designed lightweight interior.

Finally, General Electric's CT7-8A6 engine will be available as an option for the two aircraft, promising enhanced performance in hot and high conditions.

"For most customers that are in a hot environment, it may prove beneficial, but that's an option that we'll leave available to the customer to make, because some people operate only in colder climates," said Martin.

AN ECONOMIC CHOICE?

Sikorsky believes the enhancements will position the S-92 favorably against the new-generation super medium aircraft — including the Leonardo AW189, Airbus H175, and the upcoming Bell 525 Relentless. The new technology offered by these aircraft, and their promise of economical operation, has led to them becoming an increasingly popular choice among offshore operators during the ongoing downturn in the oil-and-gas market.

"We have, I think, talked with our customers more over this downcycle in the oil-and-gas space than we normally do, because the products are changing, [and] the market's changing," said Martin.

A conference with S-92 operators in December 2017 helped inform the type's product roadmap.

"We really listened to their concerns about the market, [and] how things were going," said Martin. "Where we were focused on technology, they brought a new element to this around the pricing pressures and the cost pressures that they were under in the market space."

This feedback helped inform the requirements for the S-92B, which incorporates several technologies that were maturing at the same time, and is pitched as a mid-life upgrade for the type.

"This collective package is really intended to focus on reliability, durability, and cost improvement of the aircraft platform," said Martin.

The S-92A+ package will also reset some of the aircraft's maintenance intervals, and Martin said such improvements, along with last year's certification of a modification to allow fielded S-92s to operate at an increased maximum gross weight of 27,000 pounds/12,250 kilograms (adding 1,200 pounds/545 kilograms of payload), have allowed the manufacturer to take another look at how it supports the aircraft.

With the various improvements offered by the upgrade, Sikorsky will launch a new by-the-hour maintenance program for it that will target a 20 to 30 percent reduction in overall operating cost improvement, Martin said.

"To us, that starts to feel like a home run," he said. "When you can add performance, increase capability, durability, reliability, and bring all that to market at a lower price, that's something that usually is very attractive to the market."

The availability of the upgrade will be determined by market interest, said Martin, but Sikorsky is currently aiming to begin deliveries of the new type in 2022. Until that point, the existing S-92 will still be offered.

"That's part of what we want to determine with the customers over the course of the next six to 12 months, is what's the appetite for A's to A+'s, and what's the appetite for new production B's, to help us determine when that production cut-in will happen," he added.

When it is available, the S-92B will be offered at a lower price point than historical S-92 prices, the manufacturer said, while the S-92A+ kit will have "an economical" targeted price.

"That's one of our focuses . . . is to gauge that initial customer interest and get that [pricing] mix correct," said Martin. "That'll allow us to balance the supply chain capability, our capability to deliver the right mix of A+ install kits as well as new aircraft out of the factory."

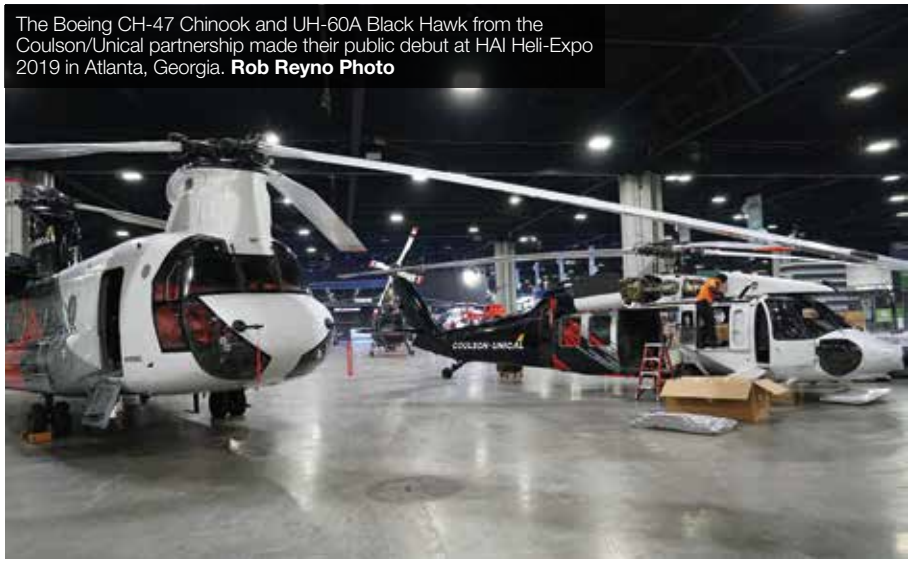
While the S-92 has not suffered in terms of flight hours during the downturn in the oil-and-gas sector — it actually grew its global flight hours by seven percent last year — a dearth of new orders of any heavy aircraft in recent times suggest it might be a bold time to launch a new variant. However, Martin argued that the upgrade will "keep the existing fleet relevant in the space," and make the type more competitive against super mediums in the offshore market.

"If you're trying to make a decision between an existing S-92 or a super medium and you're looking at a new asset acquisition that's going to cost you in the neighborhood of $20 million, you can get better technology, with way more capability, for the price of an A+ upgrade," said Martin. "You'll have an asset that's going to have a very long useful life at a lower operating cost. I think that's going to be a really attractive position for people in the market to consider."

Sikorsky has delivered more than 300 S-92s since the model's debut in 2004. This global fleet has flown nearly 1.5 million hours, with 175,000 of those recorded in 2018 alone.

NEXT-GEN FIREFIGHTERS

Coulson Aviation & Unical partner to create firefighting Chinooks and Black Hawks



The Boeing CH-47 Chinook and UH-60A Black Hawk from the Coulson/Unical partnership made their public debut at HAI Heli-Expo 2019 in Atlanta, Georgia. **Rob Reyno Photo**

BY DAYNA FEDY

Coulson Aviation is expanding its rotary-wing capabilities and has entered into a joint venture with Unical Aviation to bring what they claim will be the most advanced firefighting Chinook and Black Hawk helicopters to the market.

Unical, based in Industry, California, currently owns a fleet of 12 Boeing CH-47 Chinooks and more than 30 Sikorsky UH-60A Black Hawks — with plans to purchase additional UH-60s as they become available. The company has also purchased numerous Black Hawk parts inventories, as well as the entire Canadian Forces CH-47D Chinook parts inventory. Unical will provide the aircraft, parts and heavy maintenance in the joint venture, and Coulson Aviation will take on the modifications planned to significantly upgrade the aircraft for firefighting and utility operations.

"[Unical was] looking for a company in our field — in firefighting — that had the same level of commitment and dedication to excellence that they have in their aviation supply chain, MRO, and CRO business," said Britt Coulson, Coulson Aviation's vice president.

The Black Hawk and Chinook modifications follow Coulson Aviation's recently-completed, large-scale project to modify Boeing 737s into multi-use air tankers; Coulson Aviation is the first in the world to modify the 737 into what it is calling the Fireliner. The company, headquartered in British Columbia, has acquired 737s from Southwest Airlines and also operates a Sikorsky S-76B, a fleet of S-61 helicopters, Lockheed C-130 Hercules, and Bombardier Challengers.

"I've got our design team here that just did the biggest mod ever done to a 737," Britt Coulson said, "so we thought with [Unical's] huge fleet of 47s and Black Hawks, it'd be a great opportunity to take a look at this project and work together to create the best helitankers in the industry."

Han Tan, CEO of Unical Aviation, said, "We wanted to partner our fleet of UH-60s and CH-47s with the best, most innovative aerial firefighting outfit we could find. Coulson was the clear choice, and we're delighted to be teaming with them."

Currently, all Chinook and Black Hawk helicopters that have internal tanks for firefighting drop water or retardant through the square, and relatively small, hook well, which Britt Coulson said restricts the tank's flow rate and degrades the drop pattern.

Coulson Aviation plans to use the same design of its own proprietary advanced suppressant tank that is used on the Hercules and 737, known as the Retardant Aerial Delivery System, or RADS, and adapt it for the Chinook and Black Hawk. The tank features a linear door system — a longer, rectangular hole — that releases water or retardant in a stretched out, curtain-like form.

The company plans to modify the fuselage on the CH-47, cut the floor of the aircraft, and install a 3,000-US gallon (11,350-liter) tank, called the RADS-L (large). "It's going to be a newer generation Skycrane tank," Britt Coulson said, adding that the tank in the Chinook can be removed in two hours.

The company will do the same modifications on the Black Hawk, but with a smaller, 800- to 1,000-US gallon (3,030- to 3,785-liter) removable tank, called RADS-M (medium).

Coulson Aviation's RADS series of tanks feature a common touchscreen SMART delivery system controller, which allows for automated target drops for the company's night vision goggle firefighting program. The touchscreen technology also provides the ability to adjust flow rates based on speed and altitude.

To further enhance the helicopters' firefighting capabilities, the company is also designing, from scratch, a new retractable snorkel, which Britt Coulson said will be "the largest of its kind out there." The retractable snorkel will be installed on both the Chinooks and the Black Hawks and will allow the helicopters to taxi in and out of air tanker bases, as well as to fly with no speed restrictions to and from a fire.

"L.A. County's Firehawk tanks have proven how well a retractable snorkel works," Britt Coulson said. "And one of the leading design objectives for all our programs is not to have any aircraft restrictions after modification."

To offset the extra weight from the tanks, the company is running electric snorkels on the aircraft rather than adding heavy hydraulic pumps. "Why put on another hydraulic pump when you could use an electric motor that's already industry proven?" Britt Coulson said.

Coulson Aviation is also removing the hoist, among other things, from the Chinooks to save weight.

Unical is working with Coulson Aviation on their own supplemental type certificate (STC) to outfit the aircraft with brand new electronic flight instrument system (EFIS) cockpits. The joint venture is installing the Garmin G500H TXi synthetic vision displays, Garmin's dual GTN

750 touchscreens with ADS-B, and Howell Instruments' digital engine display system on all of the Chinooks and Black Hawks. Britt Coulson said the upgraded avionics also offer additional weight savings.

EVS cameras will be installed on the front of the aircraft and additional cameras at the snorkel system and rear of the aircraft to assist pilots during firefighting operations. Britt Coulson said the helicopters will be certified for night vision goggle (NVG) operation "right out of the gate," as well as instrument flight rules (IFR)-certified.

The modified UH-60As and CH-47s are to be known as the CU-60 and the CU-47; both aircraft will be type certified and Federal Aviation Administration-approved.

Britt Coulson said the various modifications and upgrades will make the Coulson-Unical Chinooks and Black Hawks the most advanced firefighting helicopters on the market. In comparison to the S-64 Aircrane, for example, which he called "the premier Type 1 heavy helitanker" on the market, Britt Coulson said the Coulson-Unical Chinooks will have the ability to fly faster, hold more suppressants, and will have a lower fuel burn. The Aircrane cruises at 100 knots, while the Chinook cruises loaded at 130 to 135 knots.

"This partnership with Unical Aviation is the future of aerial firefighting, combining the best of both companies as we introduce the CU-60 and CU-47 next-gen helitankers," said Wayne Coulson, CEO of Coulson Aviation. "The foundation of our company was built on the premise of offering the customer better value, which both of these aircraft types will provide."

In addition to the helicopters' firefighting capabilities, Coulson Aviation also wants the Black Hawks and Chinooks to be usable for utility missions. The company is designing its tank to be able to sling loads when installed on the helicopters.

Unical and Coulson Aviation are working to field a total of 12 Chinooks and 15 Black Hawks, complete with all the modifications and avionics upgrades. The companies have not yet released names for their modified aircraft, but Britt Coulson told *Vertical* the plan is to name the aircraft after significant U.S. Army military missions that each fleet type completed.

He said the tank and cockpit installations will take roughly a month to a month-and-a-half per aircraft. The goal is to have eight to 10 aircraft completed between the two fleets by 2020.

To support the modification projects and timelines, Coulson Aviation has increased its staff two-fold. "We believe we've hired the best people for the 47 and the best people for the Black Hawk," said Britt Coulson. "But there are still going to be challenges."

In preparation for any growing pains after dispatching the first few completed helicopters later this year, Britt Coulson said Unical's inventory of parts/spares, which will include everything except gearboxes and engines, will be stored in a 53-foot trailer and will be "inspected, tag serviceable, and ready to go on [the aircraft] if we have an issue."

The first CH-47 Chinook from Unical has arrived at Coulson Aviation's facility in B.C. for modifications, with a Black Hawk due to follow shortly afterwards.

CHC RESCUES HUNDREDS FROM NORWEGIAN CRUISE SHIP

Two CHC aircraft arrive over the Viking Sky cruise ship on March 23. The operator helped evacuate 470 of the 1,373 people on board the luxury liner after it lost power during a storm. **Eva Frisnes Photo**

Nearly 500 cruise ship passengers were evacuated by helicopter in a dramatic rescue operation off the coast of Norway on March 23, after the ship issued a mayday distress signal as it lost power during a brutal storm.

CHC Helicopter played a key role in the rescue, helping to airlift 470 of the 1,373 people on board the Viking Sky, which was getting buffeted by 25-foot waves.

The cruise liner had been traveling south from Tromsø to Stavanger when it began experiencing engine problems during a storm with winds gusting at 45 knots. At the time, it was transiting a stretch of sea known for rough, frigid water dotted with reefs and small islands that posed a major threat to the safety of the passengers on board.

Fearing the ship would run aground, its crew managed to anchor in Hustadvika Bay, between the Norwegian cities of Alesund and Trondheim, in order for evacuations to begin to take place.

CHC's involvement began at 2 p.m. local time, when its team in Norway received a call for assistance from the country's national rescue service (Hovedredningssentralen, or HRS) to support the rescue effort.

Within 30 minutes of the call for assistance, the first CHC aircraft, an Airbus AS332 L1 on contract with the Norwegian Ministry of Justice, arrived on the scene. It began hoisting injured passengers, initially one at a time, off the cruise ship. A second CHC helicopter, an AS332 L on an offshore search-and-rescue (SAR) contract with Equinor at Heidrun, soon joined the effort.

"The two helicopters worked seamlessly together in a rescue pattern that ensured one aircraft was hoisting passengers at all times," CHC said in a statement. During each mission, 15 to 20 passengers were hoisted to an aircraft and then transported to safety.

With the increasing likelihood of the rescue becoming an extended operation, CHC's operations center began to prepare for two fully-crewed SAR Sikorsky S-92s to be flown to the Kristiansund base to support the evacuations.

Eighteen hours into the extended operation, Viking Sky's crew was able to restart three of its four engines and, accompanied by two tug boats, navigate into the port of Molde, where the remaining passengers and crew disembarked.

The Viking Sky wasn't the only vessel that ran into trouble during the storm. At one point during the cruise ship evacuation, two helicopters were diverted to rescue nine crewmembers from the Hagland Captain cargo ship, which also lost engine power.

All told, six crews from CHC's Florø, Heidrun, Statfjord and Sola bases were involved in the operation. The effort was manned by 12 pilots, six hoist operators, seven rescue swimmers, one system operator, and two ground support engineers, with support from CHC's operations center in Stavanger and its global integrated operations center in Dallas, Texas. Along with the two S-92s and two AS332s flying the rescue mission, CHC also used another S-92 to transport extra crewmembers, volunteering to participate on their free time, to a nearby airport.

A Norwegian Sea King helicopter also took part in rescue operations, while a Leonardo AW139 air ambulance helicopter was used to fly injured passengers from the receiving area onshore to area hospitals.

"This is what we train for and can execute when we are called upon," said Patrick Gerritsen, chief pilot search and rescue, Norway for CHC Helicopter. "The challenges of such a large, complex rescue operation with all of its coordinating aspects were handled very well, in close collaboration with the Joint Rescue Coordination Centre [HRS] and our customers. This was an outstanding team effort in Norway."

Per Andre Rykhus, general operations manager, Norway for CHC Helicopter, said he was proud of the way his team worked during the effort. "Their ability to quickly collaborate with the HRS team ensured we provided a well-organized and effective air operation that helped keep these passengers safe in challenging conditions."

FAA CERTIFIES GE CT7-2F1 ENGINE

The Bell 525 has been in Yellowknife, Northwest Territories, for cold weather flight testing. All told, the program has now flown more than 1,000 flight hours. **Stephen Fochuk Photo**

GE Aviation's CT7-2F1 has achieved type certification from the Federal Aviation Administration (FAA), marking another milestone in the path toward certification of the aircraft it powers — the Bell 525 Relentless.

The 2,000-horsepower-class turboshaft will provide the 525 with up to 2,129 horsepower for emergencies and 1,979 horsepower for takeoff, according to GE. The engine is the latest member of the powerplant manufacturer's CT7/T700 family, which has recorded more than 100 million flight hours on civil and military turboshaft and turboprop aircraft.

The engine has a new, improved-life high pressure turbine, engine electronic control unit, and a health and usage monitoring system (HUMS).

"Achieving FAA certification is a great accomplishment for the CT7-2F1 program and the dedicated team involved," said Elissa Lee, GE Aviation executive product manager. "We are proud to support the Bell 525 Relentless with an engine designed to meet its performance objectives."

The engine will be available with GE's TrueChoice Flight Hour program — a comprehensive service offering for maintaining commercial helicopter operations.

Bell is targeting the end of 2019 for certification of its fly-by-wire super medium helicopter, and has now accumulated more than 1,000 flight hours and over 1,350 hours of total turn time with the type.

The FAA joined the Bell 525 flight test team in November 2018 and has been involved in Bell's certification flight testing in Yellowknife, Northwest Territories, and the recent completion of snow testing certification in Rome, New York.

"The last month has been the most successful to date, in terms of completion of certification milestones for the Bell 525 program," said Byron Ward, vice president, Bell 525. "FAA certification for the aircraft's engine is another major achievement, and we are that much closer to bringing the most advanced helicopter to market."

As *Vertical* went to press, the final Bell 525 flight test vehicle was finalizing ground-based certification testing, and was scheduled to take its first flight imminently. It will then join the three other 525s in the flight test program.

KOPTER PICKS LAFAYETTE FOR U.S. HQ

BY OLIVER JOHNSON

Swiss manufacturer Kopter, creator of the upcoming light single SH09, has revealed Lafayette, Louisiana, will be the home of its U.S. subsidiary.

The move, announced by Louisiana Governor John Bel Edwards and Kopter Group CEO Andreas Löwenstein at Helicopter Association International Heli-Expo 2019, will see Kopter take up residence in the 84,700-square-foot (7,870-square-meter) production facility at Lafayette Regional Airport vacated by Bell in August 2018.

Löwenstein said the site was chosen "for several reasons," including its proximity to well-established operators and supporting companies, easy access to a qualified workforce, and for the facility itself.

"We have here a turnkey solution," he told media following the announcement. "We have to do some transformation — it's quite limited — but it's a facility which has been built to assemble and deliver helicopters. We have basically all the main features of the facility that are already in place, which makes us gain a lot of time for the industry setup."

The company's manufacturing headquarters in Mollis, Switzerland, will produce SH09 subassemblies — particularly those relating to dynamic components, with the Lafayette facility serving as a final assembly and customization line for the aircraft. It will also be responsible for all North American deliveries and customer support.

"We are delighted that Kopter chose Louisiana and Lafayette for the assembly of a dynamic new aerospace product," said Governor Edwards. "The SH09 helicopter will be highly competitive in the marketplace and provide outstanding performance, great passenger and cargo capacity, and superior engineering and design."

Currently, Kopter has 25 orders from U.S. customers for the aircraft, which is set for certification in 2020, with first deliveries scheduled for later that year. Kopter believes the U.S. market will represent about 50 percent of SH09 sales for the first decade of production.

"We consider the U.S. market [as] being the core light [helicopter] market; it will be very important for us," said Löwenstein. "This is the reason why we will set quite an important facility here."

Kopter revealed the creation of a fully owned U.S. subsidiary, Kopter North America LLC, in July 2018. Christian Gras is the CEO of this subsidiary — in addition to his responsibilities as executive vice-president for Kopter Group — and Larry Roberts is the president of sales, marketing and customer support.

The manufacturer began its search for a location to base its U.S. subsidiary with a lengthy list of 38 possibilities, said Löwenstein, and this was aggressively refined. "Louisiana was by far the most attractive place," he said. "All in all, the attitude of the authorities, the facility, the localization, the access… In the equation, Louisiana was getting out the clear winner."

Hiring and training of the facility's workforce will begin this year, with the final assembly line set up to essentially mirror the one Kopter is creating in Mollis.

"There is a lot of upfront work to be done, and we will progressively gear up the personnel," said Löwenstein. The first fully U.S.-assembled SH09 will be delivered from Lafayette in 2021.

Louisiana Governor John Bel Edwards (second from right) and Kopter Group CEO Andreas Löwenstein (third from right) jointly cut a ribbon to officially mark the start of Kopter's tenancy in Lafayette, Louisiana. **Kopter Photo**

Kopter said the facility will create at least 120 new jobs by 2025, when production should reach around 100 SH09s per year.

"The jobs are a center of our preoccupations," said Löwenstein. "The [120] jobs we will create in the facility, probably many more, are the baseline for the whole arrangement we have taken."

As part of the agreement between Kopter and Louisiana Economic Development (LED), the state will be providing about $2.5 million in economic incentives to the manufacturer to help it establish its presence in Louisiana. The incentives will be split between funding to help Kopter renovate the Lafayette facility, and lease support for the building.

"We can take a portion of that financial burden off their shoulders, so they can establish quickly and efficiently towards manufacturing and assembly, which is where we want to see those jobs," said LED secretary Don Pierson.

Regarding the building's previous tenants, Pierson said the LED was "still in ongoing litigation" with Bell to resolve a dispute as to who owes what to whom following the closure of Bell's facility in 2018.

At the time, Bell said it was closing the plant after LED announced it was cancelling its contract with the manufacturer to support the project, with the state accusing Bell of failing to meet its obligations.

The $25.3-million facility was funded by the State of Louisiana, with Bell committing to creating 115 new jobs as it broke ground at the center — originally slated to hold the final assembly line for the new 505 Jet Ranger X — in August 2014.

The manufacturer moved into the facility in 2015, but negotiated a change to the Cooperative Endeavor Agreement (CEA) it had signed with LED in 2017 to switch production to cabin subassembly for the 525 Relentless. It also reduced Bell's commitment to creating 95 jobs. But Bell closed the facility just 12 months later.

LEONARDO FOCUSES ON FIRST AW609 DELIVERY

BY DAYNA FEDY

Leonardo is focusing on the first delivery of the AW609 tiltrotor in 2020, as the aircraft enters the mass production phase at Leonardo's Philadelphia, Pennsylvania, facility. At a press conference during HAI Heli-Expo 2019 in March, the company said airframe components of the tiltrotor will enter the assembly phase in the coming weeks, ahead of the AW609 receiving Federal Aviation Administration (FAA) civil certification.

"I think [the AW609 program] has made a lot of progress," said Gian Piero Cutillo, Leonardo Helicopters' managing director. "We can now see the light at the end of the tunnel. We are now focusing on delivery next year of the first 609."

The company also signed a memorandum of understanding (MoU) at Heli-Expo with Nakanihon Air Service, Co., Ltd. of Japan to study the requirements for introducing the AW609 tiltrotor into service in the country.

Leonardo is deploying a global campaign for the aircraft, which will become the world's first multi-role commercial tiltrotor, and will work with Nakanihon Air Service over the next 12 months to identify opportunities for it in Japan.

The manufacturer said it is offering the AW609 for a range of roles, such as emergency medical services, search-and-rescue, and transport. "Some of [the AW609 missions] will be offshore-related, but not uniquely related to the oil-and-gas specific operations," added Roberto Garavaglia, senior vice president of competitive analysis and strategy at Leonardo.

"At Nakanihon Air Service we operate about 80 aircraft, both fixed-wing aircraft and helicopters, and we are very interested in the new tiltrotor category," the company said in a press release. "Through this joint working group with Leonardo, we would like to explore the applications of the AW609 to future aeromedical services, disaster emergency response and news coverage as well as new areas of business."

The AW609 tiltrotor has a range of 1,240 miles (2,000 kilometers) and can fly at an altitude of 25,000 feet (7,620 meters). It also features a pressurized cabin for patient comfort during medical treatment in the air.

Leonardo has also started production of the world's first AW609 Level D full-flight simulator (FFS), which is being developed in collaboration with CAE, Inc. Cutillo added that Leonardo is planning to build a FFS in Philadelphia for the AW169 in early 2020 — which would be the first AW169 FFS in the U.S.

The AW609 and AW169 simulators will be housed at Leonardo's new 60,000-square-foot (5,575-square-meter) Helicopter Training Academy in Philadelphia, which is currently being developed. In addition to the simulators, the new training academy will have maintenance training bays, virtual enhanced training devices, and classrooms.

Cutillo also said the company is continuing development of the Clean Sky 2 NextGen Tiltrotor. "We expect to fly a demonstrator by 2023, [and] in its final configuration we expect to fly it in the 2030-35 period."

The next-gen tiltrotor is larger than the nine-seat AW609, capable of carrying 20 passengers.

AIRBUS TO BRING CRFS TO OLDER AS350/EC130 TYPES

From 2020, AS350 B3 operators will have more options in terms of where they source their crash resistant fuel systems. **Lloyd Horgan Photo**

BY OLIVER JOHNSON & ELAN HEAD

Airbus Helicopters is to expand certification of its Crash Resistant Fuel System (CRFS) to the AS350 B3 and EC130 B4 helicopters, and when certified, the kit will be offered at cost to operators.

Airbus will also be expanding its policy of installing the CRFS in newly-produced H125s. Currently, this is only standard in H125s manufactured in the U.S.; operators taking delivery of the aircraft from the company's production line at its headquarters in Marignane, France, have the CRFS installation available as an option. Standard installation on all newly-produced H125s will begin with aircraft manufactured in 2020.

The Airbus CRFS is already certified for the latest generation of the AS350 — the H125 — and is part of a standard production H130, the most modern variant of the EC130. But those who operate legacy variants of the types are currently reliant on a third party if they want to install a CRFS; Robertson Fuel Systems and StandardAero certified their CRFS for use in the models in December 2017.

While Airbus said there is a global fleet of around 1,500 AS350 B3s and 400 EC130 B4s, the company estimates that as few as 200 CRFS have been purchased for installation on these types.

Airbus will be offering its CRFS for the H125, AS350 B3 and EC130 B4 for $44,000.

"We found that the main barrier for customers to install the CRFS was price — it was cost," said Axel Aloccio, head of Airbus's intermediate single program. "So we are doing our best to incentivize our customers to go for the CRFS."

The company's announcement comes just over a year after five sightseeing passengers died following the fiery crash of a Papillon Airways-operated EC130 B4 in the Grand Canyon, bringing the issue of post-crash fires back into sharp focus.

In the following weeks, the parents of one of the passengers filed a lawsuit against the operator and Airbus, highlighting the lack of a CRFS in the accident aircraft.

The lawyer in that case had also represented David Repsher, the Flight For Life nurse who was severely burned following the crash of an H125, and who later received a $100 million settlement from Airbus and Air Methods Corporation.

However, Aloccio said the key driver behind Airbus's decision to expand the CRFS certification and offer it at cost was simply a desire to improve the safety of the AStar fleet.

"We want to encourage our customers to make sure that they equip their aircraft with a CRFS because, beyond the legal action or the bad publicity for us, we are convinced it's a good safety feature to invest on the aircraft," he said. "We are not them. We cannot invest for them into a CRFS, but we feel that we have to do whatever is in our hands to make sure that they take the right decision, and so we are doing our maximum, which is to offer [the CRFS] at cost."

Airbus hopes to have secured European Aviation Safety Agency certification of the CRFS for the AS350 B3 and EC130 B4 by the end of this calendar year, with approval from the Federal Aviation Administration to follow shortly afterwards. Deliveries of the CRFS will begin in the first quarter of 2020.

The manufacturer also announced plans to introduce an energy-absorbing crash resistant four-seat bench for passengers in the rear of the H125.

"This is something that we are doing because we want to, again, promote more safety for our operators, for our people flying the H125," said Aloccio.

The type's front seats, and those in the front and rear of the H130, are already crash resistant.

Airbus hopes to certify the bench "as early as possible," but said that would likely be in 2020. The weight increase of the new bench would be "a few kilos" at most, said Aloccio, but the team's target is to have no weight penalty at all.

The development of the bench represents something of a victory for Chris Emerson, the president and CEO of Airbus Helicopters' U.S. subsidiary, Airbus Helicopters, Inc., who told *Vertical* at last year's Heli-Expo that he would push the company to develop energy-absorbing seats for rear passengers.

"Anything is possible and I do believe that it is possible to find a better solution on the AStar back seats than we have today," he said at the time.

Airbus is still to determine whether the bench will be a standard installation or offered as an option, but is leaning towards the former. The ability to retrofit the seat into fielded aircraft is still being explored, due to the need to determine whether structural reinforcements would be required below the seats.

In other moves aimed at improving safety in the H125 and H130, Airbus is developing a rotor strike alerting system and a wire detection system.

The rotor strike alerting system will work similarly to a parking radar on a car, with sensors that alert pilots if they are approaching an obstacle. The wire detection system would work in a similar manner.

HONEYWELL TOUTS BENEFITS OF HYBRID HTS900

BY ELAN HEAD

Honeywell's investment in a hybrid electric version of its HTS900 turboshaft engine could eventually pay off for its conventional helicopter customers, too.

That's according to Bryan Wood, senior director of Honeywell's hybrid electric and electric propulsion programs. Wood spoke to *Vertical* in advance of HAI Heli-Expo 2019 in Atlanta, Georgia, where the company displayed a prototype HTS900 turbogenerator in early March.

The 1,000-shaft horsepower class HTS900 is an evolution of the LTS101 engine originally developed by Lycoming. It's currently installed on the Eagle 407HP — a re-engined version of the Bell 407 — and the Kopter SH09 helicopter now undergoing certification flight testing in Europe.

Denver, Colorado-based XTI Aircraft Company also intends to use the HTS900 in its hybrid electric TriFan 600 vertical takeoff and landing (VTOL) aircraft. That's the first confirmed hybrid electric application for the HTS900 turbogenerator, although "there are definitely more [companies] than that that we're currently working with," Wood said.

To adapt the engine for hybrid electric applications, Honeywell modified the engine control unit and gearbox and added two compact, 200-kilowatt generators. Now, the company is in the process of pairing the prototype with electric motors, motor controllers, and batteries for a more complete demonstration model.

These are the only modifications that Honeywell has made to the engine to date. However, Wood said the company is also evaluating potential modifications to the core that could alter some engine shutdown requirements.

Currently, HTS900 operators are required to perform a two-minute engine cool down at idle, followed by a 10-second post-shutdown "purge" that relies on the aircraft battery to power the starter motor. The procedure is a legacy of instances in which carbon build-up on oil jets led to distress of the number 2/3 bearing pack in LTS101 engines.

Honeywell has retained the procedure despite intervening design changes to the rear bearing support housing.

When asked about this purge requirement in the context of hybrid electric operations, Wood said, "We're looking at potential modifications to eliminate that." Any such changes could "absolutely" flow back to conventional helicopter operators, he said, although he could not speculate on a timeframe for this.

Contemplating entry into the urban air mobility (UAM) space has also forced Honeywell to evaluate its manufacturing capabilities in ways that could eventually yield benefits for all HTS900 operators, he said. UAM proponents forecast an eventual need for tens of thousands of electric or hybrid electric VTOL aircraft to serve as air taxis in crowded cities.

As Wood pointed out, "We're not used to dealing with manufacturing volumes of that size in the aerospace industry. So we are currently looking at changes in regards to how we source material, how we manufacture our engines, different design flow changes even to our shop floor, to really figure out how we'll be able to handle the level of volume we're talking about in this space."

While many companies are pursuing fully electric VTOL aircraft for UAM applications, Wood said that Honeywell expects hybrid electric models to dominate for at least the next 15 to 20 years, based on current and projected battery technology and Federal Aviation Administration fuel reserve requirements (currently 20 minutes for helicopters operating under visual flight rules).

"Beyond that, even if you do have significant leaps in battery technology and there's some lax that's shown on behalf of regulatory bodies in regards to mission reserves, you can only most likely complete a 50- to 60-mile round trip without having to recharge," he said. "We've talked to quite a few [aircraft developers] that are interested in doing . . . San Diego to L.A., or Silicon Valley to San Francisco for example, and that will be very difficult to do that with an all-electric vehicle. So I think there will always be a market for hybrid."

ROBINSON BEATS 2017 DELIVERY NUMBER

Robinson helicopters have flown more than 40 million miles over the last 40 years, the company said. **Skip Robinson Photo**

BY GUY R. MAHER

Robinson Helicopter Company (RHC) delivered 316 helicopters in 2018, marking the second year in a row the manufacturer has increased its sales numbers. The figure was revealed by company president Kurt Robinson during a press briefing at Helicopter Association International Heli-Expo in Atlanta, Georgia, in which he proudly spoke of the "iconic" R22 that celebrated its 40th anniversary in March. In those 40 years, all Robinson-produced types have flown a collective 40 million hours, he said.

The previous year saw the approval of some highly-anticipated options for the R66, including the 1,200-pound (545-kilogram) capacity cargo hook, lithium-ion battery, heated seats, wire strike kit, and the 43-US gallon (162-liter) auxiliary fuel system installed in the baggage compartment. This adds another two hours of endurance to the R66.

The company is also working on a smaller 22-US gallon (83-liter) tank. Although only adding an extra hour of endurance, the profile of the smaller tank will allow for considerable space remaining in the baggage compartment, so as to minimize the need for removal when less fuel and more baggage capacity is required.

The Garmin GTX-335 transponder is now standard on all Robinson aircraft, thus assuring ADS-B compliance for the 2020

mandate. And for the R44 and R66, two variants of the Garmin 500H PFD/MFD are now available: the 700L TXi, designed especially for RHC, and the larger 1060 TXi. Both require the use of a Garmin GTN series navigator.

Robinson also reported that 70 percent of all R66s delivered incorporate the Genesys HeliSAS, which is approved on all RHC models except for the R22.

In the final stages of development and certification are a cockpit video/audio recorder, and for the piston ships, a flight data recorder. Both systems are expected to be market ready by this summer.

"[The data recording system] has been a bigger project than we anticipated for the piston ships due to the instrumentation," said Kurt Robinson. This is because all of the piston instrumentation is being converted to a digital format so that the recorder can capture the data.

RHC is also expanding its customer support program by nearly quadrupling its floor space dedicated to factory overhaul and kit production, with the intent to lower lead times for overhaul kits and turnaround times for factory overhauls. The company currently has a production rate of one R22, four R44s and two R66s each week, and it is approaching the delivery of its 13,000th helicopter.

EAGLE CERTIFIES ENHANCEMENT FOR EAGLE SINGLE

There are now 13 Eagle Singles in operation around the world. Eagle hopes the new performance enhancement will lead to further sales. **Skip Robinson Photo**

BY OLIVER JOHNSON

Eagle Copters has gained certification of new performance charts for the Eagle Single that it says provide the single-engine aircraft with the same performance as other single- or twin-engine legacy Bell mediums.

The most substantial impact can be seen in the aircraft's hover out of ground effect at takeoff power. Here, the Eagle Single — a single-engine Bell 212 powered by a Honeywell T53-17A or B — gains nearly 400 pounds (180 kilograms) in allowable gross weight at 20 C/7,000 feet pressure altitude (from 9,600 lb. to 9,950 lb./4,355 kg to 4,515 kg).

"This is where most of our concentration fell and where we had the most gain," Spyke Whiting, Eagle's vice president of technical sales, told *Vertical*. "The goal with the efforts was to get performance charts on par with other Bell medium platforms, which is exactly what we did."

Barry Kohler, Eagle's president and CEO, said the Federal Aviation Administration and Transport Canada had originally certified the Eagle Single conversion with "initially conservative" performance charts, but the performance enhancement certification process has allowed the aircraft to fully prove its capabilities on paper.

"Three years ago, we realized that because of the [Eagle Single's] certification path, we were at a competitive disadvantage, and so we decided to invest the money in flying the aircraft in Leadville [Colorado] and Peru to verify the performance was what we thought it would be," he said. "We also had to make sure that the data body was sufficient enough to put it into an STC [supplemental type certificate] in the form of a flight manual supplement."

To operate at the levels stipulated in the new performance charts, operators need to install the BLR Aerospace FastFin and Strake kit, as well as use the flight manual supplement.

"One of our customers in Indonesia operates between 10,000 and 14,000 feet [3,050 and 4,270 meters], and he's been itching to get this upgrade," said Craig Swayne, manager of sales and support at Eagle Australasia. "And we have customers operating in Cuzco, Peru, and that airport is at 12,000 feet [3,660 meters]. Between the operators in those two countries, it became evident we needed a little change."

First certified by Transport Canada in 2010, there are now 13 Eagle Singles in operation around the world, around half of which already have the FastFin and Strake kits installed. For those that don't, Eagle is working with BLR on securing "commercially favorable pricing" for retrofits.

Kohler said he hoped the enhancement would drive further demand for the type. "I easily see us doing one or two a year now for the short term future as a result of this," he said. "We'll probably even build one on spec within the next 12 months."

In terms of regional growth, Eagle is working with potential customers in Europe and China to put the Eagle Single — and the Eagle 407HP — in those jurisdictions. Kohler said the 407HP, in which the Bell 407's existing Rolls-Royce 250-C47B engine is replaced with a 1,021-horsepower Honeywell HTS900-2, is "absolutely perfect" for the Chinese market.

"It's a developing aviation infrastructure and there are a lot of people operating at 3,000 to 4,000 meters [9,840 to 13,120 feet]," he said. "We are specifically building a 407HP to put in China to do flight test demonstrations, and our plan is that somebody is going to buy it when they see what it does. And more people are going to want it, because in those conditions, it absolutely smokes a 407 or a AS350 B3e [H125]."

Light single-engine helicopters make up more than half of planned purchases over the next five years, according to Honeywell's survey. **Mike Reyno Photo**

HONEYWELL FORECASTS MODERATE MARKET GROWTH

BY GERRARD COWAN

North America is set to be the bright spot in the civil helicopter market in the coming years, with Latin America on the other end of the scale, according to Honeywell's new "Turbine-Powered Civil Helicopter Purchase Outlook."

A projected 4,000 new civilian-use helicopters will be delivered worldwide from 2019 to 2023, slightly down from the 4,200 cited in last year's five-year forecast, Honeywell stated. Overall, 15.1 percent of operators surveyed said they expect to acquire at least one new helicopter over the next five years, compared with more than 18.6 percent last year, said Gaetan Handfield, senior manager for marketing analysis at Honeywell.

The survey of operators was conducted from December 2018 to the beginning of February. Honeywell interviewed about 1,000 operators with a combined fleet of 3,330 turbine-powered helicopters, or around 13 percent of the global fleet, said Handfield.

The picture varies considerably depending on the region in question, Handfield told *Vertical*. In North America — which represents about 40 percent of the worldwide helicopter market — purchase plans for the five-year period have increased from 13 percent in 2018 to 18 percent this year. The Middle East and Africa is also up, with 15 percent of respondents there anticipating new acquisitions by 2023, compared with 10 percent last year.

However, Latin American respondents "see a significant drop in purchasing plans," Handfield said, plummeting from 35 percent in 2018 to just nine percent now. Europe is also down, from 22 percent to 15 percent, while Asia has fallen from 18 percent to 13 percent.

Handfield said it is important to consider the timeframe in which operators plan to make their purchases within the five-year window, as this is an indication of the current level of confidence in the market. Again, the results vary widely. About 43 percent of purchase plans in North America were expected to occur in the first two years of the period. But in Latin America, just 21 percent were expected to take place in these years.

"Not only is this region lower overall, but it is very pessimistic and conservative when it comes to purchase plans this year," Handfield said.

While the forecast for new deliveries is somewhat down, it would still represent an increase on the numbers recorded in the five years to 2019, he added. Deliveries of 4,000 new civil helicopters by 2023 would be an increase of about 15 percent on the previous five years, when the market was reeling from the crash in oil and gas prices. Honeywell expects an average annual growth rate of three to four percent in the period, with deliveries supported by a production ramp-up of new models. It believes that more favorable exchange rates and improved oil prices could boost the market in years four and five, Handfield noted.

Light, single-engine helicopters are the most popular class, making up 51 percent of planned purchases, compared with 48 percent last year. Intermediate and medium twin-engine helicopters were up by four percentage points to 31 percent, while light twins fell by seven percentage points to just 13 percent this year. Heavy helicopters remain steady at five percent of planned purchases.

In terms of usage, it was bad news for the corporate and private domain, with a fall of seven percentage points to 19 percent of planned purchases. The long-suffering oil-and-gas sector saw a rise of three percentage points, to 10 percent, which Handfield said is largely being driven by demand in the Middle East and Africa. Law enforcement recorded a significant boost, from 15 percent to 20 percent, while emergency medical services and search-and-rescue are steady at 21 percent of planned usage. The remaining 30 percent is taken up by general utility and other work.

Honeywell asked the operators to outline their planned utilization rates over the next year. Overall, 14 percent of users expect their platforms to fly more hours in 2019 compared with 2018. However, this once again changed depending on region: in North America, the figure is well above the global level, at 20 percent.

When it comes to model choice, 92 percent of operators point to brand as their major reason for acquiring a platform, a jump on the 72 percent recorded last year. Cabin space was cited by 34 percent of all respondents, while payload was number three at 31 percent. Customer support is also key, rising from 25 percent to 30 percent.

Although the projection is slightly more pessimistic than last year, Honeywell pointed to the continuing expectations for growth as a reason to be positive.

"Despite respondents having a slightly less positive view of the global economic outlook in this year's survey compared with 2018, new helicopter platforms will support an expected three to four percent annual growth rate in overall deliveries," it said. "The predicted increase in deliveries signals an overall healthy helicopter market poised for moderate growth."

The Asset Protection Eagle Single is operated by EPS Helicopter Services, and is co-owned by the company in partnership with NRMA Insurance. **Eagle Australasia Photo**

'ASSET PROTECTION' EAGLE SINGLE REVEALED

BY OLIVER JOHNSON

A pioneering project in Australia has seen the creation of a helicopter able to shoot fire retardant gel from the air to protect assets under threat from wildfires.

The "Asset Protection" aircraft is an Eagle Single — a single-engine Bell 212 powered by a Honeywell T53-17B — that was then customized by Eagle Australasia to be able to spray Thermo-Gel fire retardant with extreme accuracy at up to 230 feet (70 meters).

The project was the brainchild of Geoff Sprod, chief pilot and general manager of Sydney-based operator EPS Helicopter Services, and was brought to fruition through a partnership with NRMA Insurance.

The Asset Protection Eagle Single allows a person seated in the rear of the aircraft to spray the fire retardant gel at an appropriate ratio to water through a fire monitor — the type of nozzle that is commonly used by firefighters on the ground to shoot jets of water at a fire. The system includes the fire monitor housed on a Meeker Aviation mount, a 370-US gallon (1,400-liter) Simplex belly tank, a modified DART basket that contains a 170-psi diesel pump, and a standard 90-US gallon (340-liter) auxiliary fuel tank converted to house the Thermo-Gel. Excluding the belly tank, the system weighs about 300 pounds (135 kilograms).

Sprod told *Vertical* he originally had the idea to create a helicopter specifically designed for asset protection a decade ago, but due to the complexity of the technical challenges that needed to be overcome, it was only over the last two or three years that he seriously explored developing the idea. Once he had a proof of concept utilizing EPS's Airbus AS350, NRMA joined the project as a partner, and Eagle Australasia set to work making the system a reality on an Eagle Single.

"We needed an aircraft that had reasonable payload," said Sprod. "But I was mindful that going for a big twin [-engine aircraft] really wouldn't work with the [aircraft's] rotorwash. So, after talking with Grant [Boyter] and the team there at Eagle, they certainly have excellent product knowledge on the Bell mediums, and that instilled a lot of confidence in me with moving forward with the Eagle Single and that they were equipped to develop my idea into reality for me."

According to Grant Boyter, director of Eagle Australasia, Sprod arrived with a concept for the system and requirements that included the ability to shoot the gel at a two percent ratio of gel to water, and fire it 165 feet (50 meters).

While Eagle Australasia had experience both in performing firefighting operations and outfitting aircraft for firefighting, developing a system that was capable of shooting retardant from a fire monitor was a step into the unknown.

All told, the system took about six months to create and certify, said Boyter — a process that was made easier by using many pieces that had already received supplemental type certificates.

The system works by feeding the water from the back of the belly tank through the diesel pump, which pushes it forward to the fire monitor. The gel is then added through a special connection just before the tip of the monitor.

The person controlling the monitor sits on a

converted aeromedical seat in the aircraft's cabin. To their left is a control panel that allows them to turn the diesel pump on and off (as required by Australian aviation regulations), and adjust the ratio of gel to water and the pressure of the system. To their right is a joystick that moves the monitor. Eagle added stops to the monitor to restrict its movement so that it can only fire within a certain radius of direction away from the aircraft. In operation, the pilot holds a hover while the person applying the gel moves the monitor to spray up and down the asset they're protecting.

The system also required the modification of the aircraft's right hand cargo door, which remains open during applications. The forward part of the door normally remains in place as the larger rear portion slides backwards, but this setup impaired the vision of the monitor operator. The modification allows the entire door to be moved backwards.

New avionics were also installed, including Eagle's Generation II Digital Audio System, which supports up to 32 control panels, 20 transceivers and 12 full headsets with no external audio matching required. It also has Garmin G500H, GTN750 and GTN635 navigation, communication and GPS systems, and an AEM MCP01-100N NVIS master caution panel. Finally, the aircraft is fitted with BLR Aerospace's FastFin System.

The water in the spray system flows at a rate of about 350 liters (90 US gallons) a minute, giving about three to five minutes of spraying time, said Craig Swayne, manager of sales and support at Eagle Australasia, who was heavily involved in the project's development.

"The ideal scenario was to be able to apply Thermo-Gel to two houses with one load, which we have achieved at the 350-liters-a-minute mark," said Swayne. "And it's ideal with the downwash, because the spray sprays it and gives you some direction, but the downwash just takes this Thermo-Gel and puts it everywhere — under the eaves, and in and around the windows. It just coats everything with the downwash's assistance."

He said the biggest challenge in developing the system was achieving the spraying distance Sprod required.

"The key to the whole system is definitely the tip that we came up with and the means of which it injects the gel into the stream of water causing the least bit of turbulence," he said. "Turbulence in the stream affects the distance."

ENTERING OPERATION

Sprod, who owns patents for the system in Australia, the U.S., and Canada, said he has been extremely impressed with the performance of the Eagle Single and the support from Eagle Australasia so far.

"What the Eagle Single can lift and how it performs, it's just fantastic," he said. "It is just the perfect platform for this capability. And I can't speak highly enough of Grant's team at [Eagle Australasia]. The workmanship on that aircraft is just superb. Both EPS and NRMA are very happy with the final delivered aircraft, and also the support that we've received since then."

The Asset Protection Eagle Single is currently capable of shooting the gel about 165 feet, but Sprod and Eagle believe further enhancements to the pump and monitor could increase that to as far as 275 feet (85 meters).

How accurate is the system? "We can get it through the window of a car," said Sprod. "It is absolutely precise."

The current Southern Hemisphere fire season represents the first time the aircraft has

Eagle found that injecting the fire retardant gel at the tip of the fire monitor's nozzle helped maximize the range of the spray. **Eagle Australasia Photo**

been used for asset protection by the Rural Fire Service (RFS). Having trialed shooting different products through the fire monitor last year, the RFS has settled on using Thermo-Gel.

"The system is really at its peak shooting gel," said Sprod.

The product used in the system is Thermo-Gel 300, which is fully biodegradable. Approved by fire agencies in Australia, the U.S., and Canada, among others, the gel is designed to be sprayed either directly onto an asset — such as a (non-live) powerline pole or a house — or applied in containment lines around assets. Once sprayed, it will last up to seven hours.

According to Sprod, the aircraft is treated like any other asset available to the RFS during fire seasons.

"We can perform direct attack, we can perform every role or function that all the existing water bombing aircraft do, and then we also have the ability to protect assets," he said.

Sprod said the feedback from the RFS has been good so far.

"We haven't sprayed it directly onto any assets on a fire at this stage," he said. "We were recently deployed on the Snowy Mountains and we were performing direct application onto the fire edge. We were also dispatched to protect some main supply powerlines. They did want us to spray the powerlines to protect them from radiant heat, but unfortunately they couldn't get confirmation from the utility provider that the powerlines had been de-energized."

The novelty of the system and the approach meant that its use has also required a degree of education for those working below.

"For people on the ground, it's all a bit foreign," said Sprod. "On the handful of fires it's been on, people have been getting used to it, what it can do and how it performs. So I think the first few seasons [are] really going to be just getting it out there and exposing it to people and displaying what it can and can't do."

That learning curve extends to those most intimately involved in the project, as they develop the best uses and most effective application of the aircraft and system.

"We've only had around 20 to 25 days on fires this season, and we've learned a lot," said Sprod. "The more time we spend on the fire ground, the more we use, refine it and fine tune the system, the more likely we'll be able to achieve the maximum out of it."

Eagle's Swayne said the system will really prove its worth once its has the opportunity to be deployed in an asset protecting role.

"Once Geoff is provided with the opportunity to prove the system, everyone will see its value. I think he's really got something," he said. "You look at places like California where you lose extremely high value assets in densely populated areas like L.A. overrun by wildfires every year, I think there's some serious potential [for the Asset Protection system], once its provided with the opportunity to prove itself."

If you would like to submit a press release or if you have a new product or service that you believe is newsworthy, please email our news editor at news@verticalmag.com.

RotorBits

GENESYS TO CERTIFY HeliSAS ON BELL 505

Genesys Aerosystems has begun the supplemental type certification process for its visual flight rules version of the Helicopter Stability Augmentation System (HeliSAS) autopilot for the Bell 505 Jet Ranger X.

"Genesys Aerosystems has already worked with the previous models of Bell Helicopters such as the 206B, 206L, and 407 to offer the benefits of HeliSAS as a retrofit option, and we want to extend the enhanced capabilities to owners currently enjoying the versatility of the 505," said Jamie Luster, Genesys Aerosystems director of sales. "The stability augmentation is ideal for the lightweight Bell platform, and decreases the workload significantly."

The system weighs less than 15 pounds (6.8 kilograms), and Genesys Aerosystems said it reduces single-pilot workload, while providing precise "hands-off" control of the aircraft during all modes of flight — regardless of wind conditions or shifts in the aircraft's weight. The company expects to receive Federal Aviation Administration approval in the third quarter of 2019.

AIRBUS ANNOUNCES MPVK PARTNERSHIP

Eurotec Photo

The Maximum Pilot View Kit (MPVK) will now be offered as an option during manufacture of the Airbus H125, following a new partnership agreement between Airbus Helicopters and MPVK developer Swiss Rotor Solutions.

The MPVK includes a single-piece right-hand-side bubble door and lower vertical window, cut into the right-hand floor of the fuselage. It is designed to help aerial work operators, increasing their field of view below by a factor of 10.

The partnership, announced during Helicopter Association International Heli-Expo 2019 in Atlanta, Georgia, will also see the MPVK offered through Airbus as a kit for retrofit.

ALPHA

BRAVO

COLLINS

DELTA

ECHO

FOXTROT

GOLF

HOTEL

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JULIET

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HELI-EXPO PRODUCT LAUNCHES

HAI Heli-Expo, the industry's largest annual tradeshow, has long been seen as the ideal launching pad for new helicopter-focused products and services. Here's a selection of those unveiled at this year's show in Atlanta, Georgia.

BY DAYNA FEDY

SERASTAR
VELO COMMUNICATIONS SYSTEM

Serastar Technologies Corporation is bringing its VELO global video/data down link and distribution system to the aviation market.

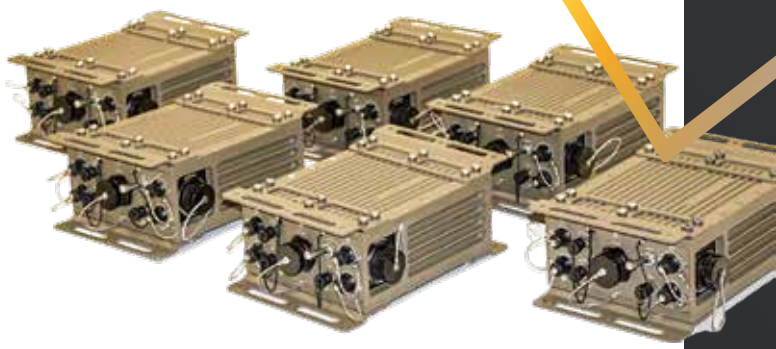
VELO, which is derived from the words "Vehicle" and "hELOcopter," is a shoebox-sized network that takes video or data from any source, including helicopters, and relays it to any smart device through a feed. The company refers to VELO as a single tactical information distribution network.

"On the output side . . . we use LTE, we use satellite, we use military radios, [and] we use WiFi; it's all happening at the same time — what we like to say is simultaneous and redundant," said Gary Higman, president of Serastar.

The company, through its primary integrator AeroBrigham, was educating showgoers on the VELO network at this year's HAI Heli-Expo. The first civil customer, Marion County Sheriff in Ocala, Florida, has been using VELO since January 2018 with "great success," said David Brigham, president of AeroBrigham.

VELO is a non-line-of-sight, secure LTE network that cannot be hacked, which Higman said is important for law enforcement operators. The network is currently being used by the U.S. Border Patrol.

"Our feed is a real-time global feed," he said. "If you have a helicopter



flying in Toronto, and you happen to be on the beach in Hawaii, [you can] take your phone and see what that helicopter is looking at. There's about a second-and-a-half latency, but it's a secure feed all the way to your phone on the beach in Hawaii. We've tested feeds to Israel, Jakarta, South Korea, [and] Australia."

Serastar has been working a lot with the U.S. military, with the VELO network meeting Mil-Spec 810G standards. The VELO network is relatively easy to install and does not require STC certification because it is a "bolt-on" box.

"It's a very unique downlink solution; we're excited about it," Higman said.

PS ENGINEERING
PAC45A AUDIO CONTROLLER

PS Engineering displayed the latest edition of its PAC45 series audio controller at Heli-Expo 2019, the PAC45A.

PAC45A interfaces to eight com radios and eight switched receiver inputs; accommodates up to four individual control heads; has the flightmate recording system with nine customizable audio alerts, and features two built-in speaker amplifiers, all with a single interface hub.

The PAC45A audio controller features the company's patented digital MultiTalker technology — a three-dimensional sound placement system that helps pilots differentiate the numerous radios they monitor simultaneously.

The company said with most audio controllers, pilots can hear many coms at once. PS Engineering's MultiTalker technology allows pilots to mentally separate the coms, as each one sounds like it is coming

from a different direction. When the brain has a sense of direction to go along with various forms of audio, it allows the listener to focus on one sound much more easily than trying to distinguish between them all at once.

"MultiTalker is the ability to place the radios that the pilot or the observers are listening to in unique positions within a stereo headset," said Mark Scheuer, PS Engineering's founder and CEO. "We were the very first to provide a certified system with True Dimensional Sound specifically designed for special mission aircraft — it's a game changer."

And being all-digital, Scheuer said the cost of installing the MultiTalker technology is "significantly lower because all of the radios, navigation systems, alerts, etc. go to the hub, and then just one wire goes to each control head."

The PAC45A allows pilots to connect up to eight coms at once, and focus on the most important information while tuning other information out. PS Engineering said that a lot of aerial law enforcement, firefighting and medevac pilots monitor six to eight coms at a time; PAC45A will allow these pilots to keep all audio going at once and pick between the audio they want to hear without having to touch the audio panel to turn controls up or down. The company said this technology will reduce pilots' workload and allow for improved situational awareness.

LIFE SUPPORT INTERNATIONAL
VARIABLE LOAD CONTAINER

Life Support International (LSI) demonstrated its brand-new Variable Load Container at this year's Heli-Expo. Developed on request for a large helicopter operator, the Variable Load Container was designed to safely and securely hold and transport the MK/KC/SC series of marine location markers in an efficient way.

"Initially it was developed out of request because the smoke canisters were put loosely in bags in aircraft. . . . Nothing was really secure," said Nicole Stefanoni, LSI's domestic sales coordinator.

The Variable Load Container is made of fire- and weather-resistant Kydex and stainless steel hardware. Each of the four compartments is stackable and can interlock using latches, as it is designed to be as compact as possible when space is limited in a helicopter.

Each compartment also features a multi-point tiedown hook to secure the container inside an aircraft.

While it was originally developed for location markers, the company said the container can be used for anything. Gregory Yerkes, LSI's president, said: "Anything can go in them — survival kits, water, ammunition, [or] any type of pyrotechnic, because it's fire-rated material itself."

Yerkes said each container can also be made into a specific kit. At the show, LSI used one of the stackable containers as a portable oxygen kit that contained an oxygen bottle along with masks and hoses that attach to the bottle. "This type of kit is commonly found with a lot of medevac or SAR [search-and-rescue] helicopters," he said.

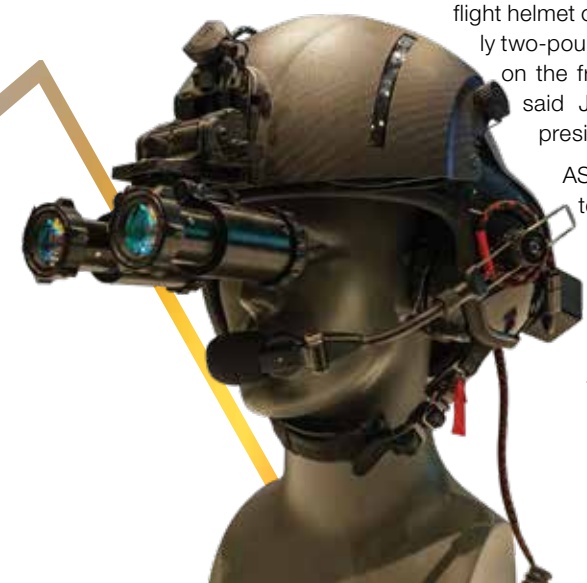
The inside of each container has a unique shelving system. The tracks of the shelves allow various items of different heights and diameters to be safely stowed and retained in the container. "You can put more than one smoke canister, for example, into one container," said Stefanoni. "Then you can actually stack within the stackable box. I think that really puts it into a category [of its own].

"There was definitely a need on the market. We kind of played off the original requests and made it so that anybody can really use it for any application that they have," she added.

AVIATION SPECIALTIES UNLIMITED
E3 LIGHTWEIGHT ANVIS GOGGLE

Aviation Specialties Unlimited (ASU) introduced an advanced lightweight night vision goggle (NVG) system at Heli-Expo 2019 to help reduce pilots' neck strain and fatigue. The E3 Lightweight ANVIS Goggle is 30 percent lighter than other currently fielded goggle systems, weighing roughly 14 ounces (400 grams).

ASU decided to introduce the E3 because "it's time that somebody came along, who has aviation experience, who really understands what it's like to operate at night for hours on end with NVGs, with a flight helmet on, and with a nearly two-pound device mounted on the front of their head," said Jim Winkle, ASU's president.



ASU focused on material as the primary way to reduce the weight of the goggle. Switching to high-grade aluminum and titanium made the goggle system lighter without compromising its durability. The E3 goggle system also has fewer parts, which helps reduce weight and maintenance.

Traditional NVG systems have a counterweight system, which is typically about nine ounces, but ASU found there was no need for one with the E3 goggle being that much lighter.

"The overall weight saving is significant," said Justin Watlington, ASU's director of operations, who has experience flying with the E3. "You note it immediately when you put it on.

"That reduction in weight is going to equal things that we can't quite quantify. Any attempt that we make to reduce that fatigue in the aviator is an improvement in safety," he added.

ASU's chief technology officer, Joe Estrera, said the company intends for the main production line of the E3 goggle system to start at its facility in Boise, Idaho.

While there may be a slight increase in cost to build the goggle, Winkle said the company intends to make the E3 "affordable for everybody that is considering purchasing a new goggle." He added that ASU will not increase the price of the goggle beyond the standard market price for NVGs.

COBHAM
SB-HELO X-STREAM SATCOM

Receiving a strong, clean signal in a helicopter can often be a challenge as the rotor shadow can interfere with connectivity. At this year's Heli-Expo, Cobham officially released the SB-Helo X-Stream, a new satcom product that has been tested and approved to provide better connectivity in a helicopter.

"The rotor typically distorts the signal about 40 percent — it's a lot of packet loss," said Jeff Saucedo, sales manager at Cobham. "What we did in our satellite data units [SDUs] is we put in a new modulation scheme that actually rebuilds itself through the main rotor. Packet loss was zero to two percent, so significant savings."

The SB-Helo X-Stream is tailored specifically for helicopters, and uses Cobham's satellite hardware called Aviator SP with Inmarsat's satellite network. It is geared towards intelligence, surveillance and reconnaissance (ISR)-type applications where pilots and crews are trying to get a lot of information from the helicopter to the ground.

SB-Helo X-Stream accepts any Internet interface and provides high-speed connectivity and streaming at up to 1.5 megabits per second.

"What [SB-Helo X-Stream] does is it gives you a significantly higher reliability; when you're transmitting data you're not losing, for example, packets of video," Saucedo said. "When a video just constantly tries to rebuild or it gets freeze-framed… in mission-critical applications, it's really a detriment to the overall mission."

Saucedo said the SB-Helo X-Stream is useful for numerous helicopter operations such as aerial firefighting to find hotspots for water drops. "The medical field is another good example," he said. "Crews want to transmit patient results and records — a host of things come to mind."

The company rented a Mil Mi-8 helicopter for product testing, and ground testing was completed in November 2018. Inmarsat network approvals followed in early 2019.

Cobham's SB-Helo X-Stream will be supported in all of its Aviator SP SDUs, and Saucedo said any existing customers can be field upgraded for free. Existing customers can also send their SDU to Cobham's facility for a firmware update via return material authorization.

TRUE BLUE POWER
Gen5 LITHIUM-ION BATTERIES

True Blue Power unveiled its fifth-generation lithium-ion battery family at Heli-Expo 2019, consisting of three batteries of different sizes. The Gen5 lithium-ion batteries are available in 20-amp power (the TB20), 30-amp power (the TB30), and 40-amp power (the TB40).

"This new family of batteries builds upon the great advantages of the previous four generations — with exceptional hot-and-high operating temperatures, built for rugged environments, light weight and ultra-long life," said Eric Ritzman, True Blue Power's director. "Through customer feedback and decades of experience, we've eliminated every possible headache [with] on-condition and maintenance-free batteries."

The company said the batteries are "extremely intelligent," as they communicate real-time state-of-charge and state-of-health data that can be downloaded and reviewed.

The Gen5 batteries also "weigh up to 60 percent less than lead-acid and NiCad batteries," Ritzman said, adding that the TB20 is 23 pounds (10 kilograms) lighter, the TB30 is 33 lb. (15 kg) lighter, and the TB40 is 47 lb. (21 kg) lighter. True Blue Power's lightweight batteries will mean helicopter operators can increase their useful load and allow the opportunity to "add a FLIR system, add utility hooks, or even [add] an auxiliary fuel tank to your aircraft," Ritzman said.

While the Gen5 batteries can fully charge in 15 minutes, they last for eight hours or more. The batteries also "deliver more amps per pound than any other battery out there," said Ritzman. "This is going to translate to cooler and faster [engine] starts with less wear on the engine."

"We're out there to help our customers, [and] we're out there to improve aviation; that's what we live for," said Todd Winter, True Blue Power's president and CEO. "We've looked for innovations out there in the world, and we've tried to think of ways we can bring those innovations into aviation to make aviation better and more competitive."

The company said it expects certification of the Gen5 batteries in the second quarter of 2019.

ESSEX INDUSTRIES
ERGONOMIC COLLECTIVE GRIP

Essex Industries introduced its new Ergonomic Collective Grip at Heli-Expo 2019 for the Sikorsky UH-60 Black Hawk. A patent-pending collective grip has a unique design that allows a pilot's hand to rest on top of the collective while still being in control. Essex designed the grip this way to provide long-range comfort and reduce fatigue during flight. The grip, designed for the Black Hawk, features eight different control switches.

"[With] the traditional collective, which is square, pilots — when they're flying straight and level cruise — always rest their hand on top of the collective. They don't hold it like a grip," said Bob Hale, business segment manager of aerospace and defense at Essex. "With our grip, their hand can just stay there the entire flight; it's in the most comfortable position."55

While the Ergonomic Collective Grip was originally designed for the Black Hawk, Hale said it can be modified for any rotary-wing platform.

The grip incorporates additional functionality on the collective with numerous customizable switches that allow the pilot to complete various tasks. Switches can be changed as needed to include uses such as sensor control.

Also featured on the grip is a cargo emergency release button, which is strategically placed at the top of the grip to avoid accidental actuation, as well as a go-around button.

The functionality and shape of each switch can be tailored to the helicopter and the operator's needs, and the number of switches on the grip can be reduced.

The grip uses additional switches to eliminate dual-seat inputs. "From some of the current configurations, if left seat is actually flying the aircraft, and there's some functionality on that collective that you can't reach, then you've got the right seat pushing buttons," said Hale. "When you have two guys' hands on the controls, it's generally not a good situation."

The grip was developed by Essex in collaboration with Ace Aeronautics, which is currently working on upgrading the traditional Black Hawk platform with Garmin avionics and Avalex Technologies mission equipment.

"The controls that Essex is working to develop with this collective grip… we're planning to use the hands-on collective and stick controls to integrate the Avalex side and Garmin side," said Evan Brown, director of engineering at Ace Aeronautics. "So if you want to control a radio, whether it's an Avalex radio or Garmin radio, you can do that from the collective."

Hale said the Ergonomic Collective Grip is best suited for more complex, more powerful rotorcraft — primarily turbine-powered aircraft.

All the switches on the grip are qualified; all that remains is platform testing, which the company is hoping will take place later this year.

PRO FLIGHT GEAR
ZERO-G HELMET UPGRADE KIT

Given that helmets are required equipment for many helicopter operators, it is important that they are comfortable for pilots and crews to wear for several hours each day. Pro Flight Gear, known for the Alpha Eagle-Gentex helmets, came up with a solution to common problems that occur with helmet use, which it showcased at Heli-Expo 2019.

The Zero-G Helmet Upgrade Kit includes a helmet liner, ear seals, and ear cup pads that are designed to improve comfort and increase safety.

"Our Zero-G has now been accepted to the U.S. military and Canadian Forces," said Robert Munoz, Pro Flight Gear's managing director. "The military buys the equipment because it works; it's effective, it provides better crash attenuation, it provides better sound attenuation, and it's available to everyone."

Pro Flight Gear's liner is made of ballistic foam that repels impulse noise and can also mitigate concussions. The liner is stitched with silver thread, which has a thermal property — it keeps in heat or stays cold depending on operating temperature.

The material of the liner is also moisture-wicking and anti-microbial for odor control. "What's interesting is some women wear foundation makeup, but they go flying and the makeup will eat regular [helmet] liners," said Munoz. "That's not happening with our liner."

Munoz said the silver thread technology is exclusive to Pro Flight Gear. The ear seals that come with the Zero-G kit feature an inner diameter made of the same material as the liner. The inner diameter provides a sonic barrier that isolates noise in high frequencies and provides better sound clarity in noisy environments.

The kit has been tested (and is currently being used) by the U.S. Air Force.

"We're a company of six guys," said Munoz. "How do we keep up with it? We have good people, we trust each other, and we're focused on what we sell to the customer.

"Sometimes we send liners out and the customer says, 'We need a thicker one.' And I say, 'Where do I send it?' You have to take care of the customer."

ASTRONICS AES
FREQUENCY CONVERTER UNIT & WIRELESS CHARGING MODULE

At this year's Heli-Expo, Astronics introduced two new products from its Advanced Electronic Systems (AES) division. Firstly, the company has released the CorePower Frequency Converter Unit (FCU), which converts variable frequency power to constant 400-hertz power. Astronics said the FCU helps protect sensitive aircraft electronics from unregulated frequency and power surges.

"What we've done with our engineering group is we've tried to convert these products to more solid-state, which really helps the efficiency," said Christine Ellis, director of business development of airborne power and control at Astronics AES.

The CorePower FCU generates less heat with solid-state components and therefore does not need a cooling fan, which can be noisy. Kellsey Justus, vice president of airborne power and control at Astronics AES, said eliminating the fan also reduces maintenance of the FCU, as the fan is a mechanical component that could break.

The CorePower FCU is 30 percent lighter and 20 percent smaller than other units currently on the market.

Also introduced at the show was Astronics' new Wireless Charging Module for fixed- and rotary-wing platforms. Ellis said the charging module would be ideal for helicopters in the VIP sector and can be built into an armrest or tabletop. It requires a 20-volt power source and is Qi (pronounced "chee") certified. Smartphones that are Qi-enabled can simply be placed on the Wireless Charging Module surface to begin charging.

Astronics' Wireless Charging Module "embeds underneath/goes through a surface like wood veneer," said Justus. "At some point, all phones are going to be offering this [Qi technology]. So it's just keeping up with consumer trends."

The company is developing the charging module at its facility in Kirkland, Washington, and is "just getting into qualification for it," said Ellis.

Astronics brought a demo case to Heli-Expo that demonstrated how a compatible phone would charge when placed on the charging surface.

TURTLE-PAC
DRUM 25 LUGGAGE HELICOPTER FERRY TANK

Turtle-Pac had a new, collapsible helicopter ferry tank on display at Heli-Expo 2019 — a luggage compartment version of the Drum 25 Gallon and Drum 33 Gallon fuel tanks. The new tank, called Drum 25 Luggage, has the same diameter as the Drum 25 Gallon model, but is configured differently so the height of the tank becomes the length.

This new horizontal configuration allows the fuel tank to fit inside the luggage compartments of smaller helicopters like the Robinson R66, Airbus EC120, and Bell 206 JetRanger.

"The new [Drum 25 Luggage] tank was made based on client demand," said Laszlo Torok, Turtle-Pac founder. "It's specifically for the luggage compartment; our bigger [vertical] tanks can just be secured on a seat."

The fuel tank is filled via a two-inch hose, which is also used to then carry the fuel to the aircraft's fuel tank. With the fuel tank, pilots can maximize efficiency by flying more direct routes, as there is less of a need to deviate from a pre-determined route for refueling stops.

The fabric build of the tank also allows it to collapse and fold up for easy storage when it is not in use.

BHI² MODULAR BLACK HAWK FIREFIGHTING TANK

BHI² (BHI Squared) Helicopters is working towards certification of a modular slide-in firefighting tank suitable for Black Hawk helicopters that are configured with a normal cargo door.

The company brought its H-60X research and development aircraft, equipped with the new firefighting tank, to the static display at this year's HAI Heli-Expo 2019 in Atlanta, Georgia.

The 925-US gallon (3,500-liter) tank can be installed in Black Hawk helicopters without cutting or modifying the aircraft; the existing tie-down points on the Black Hawk are used to secure the tank in the aircraft.

"Most tanks use a hydraulic system that controls the door system," said Bart Brainerd, vice president at Brainerd Helicopters, one of two partner companies behind BHI². "This is an electric drive system, so it uses a 48-volt electric motor with a gearbox that drives the doors. It provides coverage levels [and] selectability; it provides partial tank drops, [and it] uses an electric snorkel."

The firefighting tank is set up to drop water from the left side of the aircraft.

BHI²'s tank will come with a software package that will allow pilots to perform different types of drops including split drops, half-tank drops, and third-of-a-tank drops.

The company expects to receive a supplemental type certificate for the tank system during the next couple of months. "We're excited to see this go into operation fighting fire, hopefully this summer," Brainerd said.

The tank has been successfully tested at the aircraft's never exceed speed of 193 knots. The company is estimating the tank will be flown at a speed of 160 knots once certified, but potentially as high as 175 knots.

While the floor limit in the Black Hawk is 8,400 lb. (3,810 kg), BHI² is estimating that the aircraft's operating weight with a full tank of water will be around 8,200 lb. (3,720 kg).

Brainerd said the tank could potentially be installed on any aircraft with a square opening, rectangular opening or sliding cargo door. "We definitely could look at it on a model-by-model basis to see if it's possible," he added.

The tank can hold 925 US gallons (3,500 liters), and can be installed without cutting or modifying the aircraft. **Rob Reyno Photo**

The tank is filled using a snorkel, and allows pilots to perform different types of drops. **Rob Reyno Photo**

BHI² Helicopters brought the tank to Heli-Expo in its H-60X research and development aircraft. **BHI² Helicopters Photo**

The addition of a fifth blade on the H145 and the creation of a new bearingless main rotor system will increase the type's useful load by 330 pounds (150 kilograms), said Airbus. **Eric Raz Photo**

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THE POWER OF FIVE

At Heli-Expo 2019, Airbus unveiled a five-bladed version of the H145. We found out how the eye-catching evolution came to be.

BY OLIVER JOHNSON

In many ways, Heli-Expo 2019 represented the most forward-looking edition of the event for years. Original equipment manufacturers and operators alike focused more than ever before on the revolutionary changes set to impact the world of vertical flight over the coming years — particularly with the huge swell in interest in electric vertical takeoff and landing (eVTOL) aircraft. But one of the most eye-catching aircraft on display was one that was very much part of the present. Airbus's unveiling of a five-bladed version of its hugely popular H145 light twin on the eve of the show resulted in a steady stream of traffic to the company's booth, with showgoers curious to see one of the more subtle, but no less impressive, evolutions the type has gone through.

The aesthetic changes are one thing, but most impressive of all are the benefits the extra blade will bring to operators, with Airbus promising an increase in useful load of 330 pounds (150 kilograms) over the existing version of the aircraft.

The upgraded version of the type — to be known simply as the "new H145" — has a new bearingless main rotor system featuring a fully composite flex-beam and main rotor blades. This represents a change to a main rotor system design that could trace its origins back to the BK117 and Bo.105. The new design also dispenses with the main rotor head entirely — and the accompanying oil and grease needed to lubricate it.

In addition to providing increased lift with the latest airfoil design and material technologies, the blades have a unique foldable design that provides storage and potential cost replacement benefits.

Airbus has achieved the aircraft's increase in useful load by reducing its empty weight by 110 lb. (50 kg), and increasing its maximum takeoff weight from 8,160 lb. to 8,380 lb. (3,700 kg to 3,800 kg). As Axel Humpert, head of the H145 program, told media during a pre-Heli-Expo briefing, the aircraft's useful load is now almost the same as its empty weight.

"This reflects the maturity [of the aircraft] that we have on the one side, and the performance of the new rotor on the other side," he said.

The new H145 (officially certified as the BK117 D3) will be offered both as a new aircraft off the production line, and in the form of an upgrade through a retrofit for existing H145s (previously known as the EC145 T2). Earlier versions of the type — essentially, those without a Fenestron — will not be eligible for the retrofit.

According to Humpert, new H145s off the production line will not cost any more than newly-produced four-bladed H145s.

"We wanted to keep the competitiveness of the aircraft, [so] we concluded that we shall not increase the price tag, but offer to the market a helicopter that [has] more performance, [and] offers more useful load than the other version, [to] bring its competitiveness to even a higher level," he said.

The retrofit will be available in an "an affordable package" he added, from any Level D certified service center.

Certification is expected from the European Aviation Safety Agency (EASA) in the first quarter of 2020, and Humpert said Airbus was in negotiations with launch customers for the type, with entry into service scheduled for mid-2020.

Both versions will be offered as deliveries begin of the newer type, "but we believe that the tendency will be created [for customers] to move to [the] five-bladed [aircraft]," said Humpert. A desire for fleet commonality is expected to account for those who still request the four-bladed aircraft.

To allow the manufacturer the flexibility to deliver aircraft in either configuration, it will have a batch of airframes that can be turned

into four- or five-bladed aircraft on the production line. The final four-bladed aircraft will be delivered in February 2021.

A DESIRE FOR MORE PAYLOAD

Market demand drove the development, said Humpert. "The capability and the performance of the machine are [so] high that [operators] want to take additional useful load on board," he said. "We had a rotor that allows [more useful load, so] we checked it in flight. Does it work? How does it feel? How does it pilot? And the results were so positive that we ran a business case, and it showed that we can achieve this goal with rather simple modifications inside an envelope that we can take while maintaining the competitiveness of the aircraft."

Airbus has kept the upgrade process relatively simple, allowing it to rapidly progress through the development program. Essentially, the changes involve removing the four-bladed rotor, rotor mast and swashplate; and replacing it with the five-bladed rotor, mast, and swashplate. Beyond that, the forward crosstube and horizontal stabilizer have been modified to avoid dynamic responses. "That's normal dynamic balancing that we do," said Humpert.

Finally, Airbus has removed light anti-vibration absorbers, and installed an electrohydraulic actuator to help the pilot check the freedom of control on the ground when the rotor or engine is off.

In terms of avionics, the upgrade includes the installation of Airbus's Wireless Airborne Communication System, which allows navigation and mission database information to be imported from a tablet, and has the capability for cockpit Wi-Fi. On the ground, it can automatically export flight data and generate flight reports.

The blades incorporate the latest airfoil design to produce more thrust than previous blades at the same power. While five blades have more drag than four blades in a rotor, Humpert said improvements to the aerodynamics of the rotor cuff of the blade had actually allowed the new H145's blades to provide more lift. "This is the aerodynamic evolution which is technically behind it," he said.

The new main rotor system has been simplified with no main rotor head — so the blades are attached directly to the rotor mast. This means fewer parts, resulting in the lower weight and simplified maintenance.

The blades have been designed for simplicity and thrust efficiency, said Humpert, and provide "some different characteristics" during flight. He said these included an increase in comfort level (with reduced vibration), while maintaining the same levels of noise and efficiency as the existing H145.

Why not six blades for the upgrade? "If I had a sixth blade, the useful load would not increase by 150 [kilograms]," said Humpert. "It would increase by less, but add more complexity [to] the mechanical and aerodynamic design. We achieved the target with five blades."

The new blades have affected the dimensions of the aircraft to a small extent — it is now almost four inches (10 centimeters) taller, and almost four inches shorter from the tip of the blade to the rear of the Fenestron. The diameter of the rotor disc has shortened slightly, from 36 feet, one inch (11 meters) to 35 feet, five inches (10.8 meters).

But with the foldability of the blades, which allows all five to be turned rearwards to run in the direction of the tail boom, the aircraft's potential footprint and storage requirements have been minimized.

Each blade is essentially made of two parts: a meter-long "control cuff" at the base of the blade that attaches to the mast, and the remainder of the blade, which attaches to the cuff through two bolts. To fold the blades, one of the bolts is removed and the blade rotated backwards.

According to Humpert, the cuff is the "high technology" part of the blade, containing the composite flex beam — and it's this that replaces all the bearings seen in a traditional main rotor hub. "It takes all the momentum, it takes all the need to change [the] pitch of the blade," he said.

In addition to allowing the blade to fold without the need for a complex mechanism, having the flex beam situated in a separate control cuff provides for potential cost savings if a blade is damaged. "The high-tech and expensive part is this control cuff," said Humpert. "[So] if the blade hits the wall of the hangar, for example, then you only need to replace this [outer] blade, which is much less expensive."

The blades have no life limit, with replacement determined on condition.

Airbus secured orders for 10 new H145s at Heli-Expo, and a further nine orders for retrofits of existing H145s. **Lloyd Horgan Photo**

The blades can be folded backwards with the removal of a single bolt on each one, simplifying storage. **Airbus Helicopters Image**

The new H145 was unveiled on the eve of Heli-Expo 2019 in Atlanta, Georgia, where it then made a very public debut. **Rob Reyno Photo**

Each blade is composed of two parts: a meter-long "control cuff" at the base of the blade that attaches to the mast, and the remainder of the blade, which is secured to the cuff by two bolts. **Rob Reyno Photo**

THE TEST PROGRAM CONTINUES

As of mid-February, the new H145's flight test program was about 40 percent complete, having officially begun following the signing of an agreement with Kawasaki (a longstanding partner on the BK117/EC145 program) in April 2018. The program had flown three campaigns by that point, including one in the Pyrenees Mountains, one in the south of Spain, and a cold campaign in Finland. Flight testing is due to be finalized in October this year.

Antoine Van-Gent, chief test pilot at Airbus Helicopters' facility in Donauwörth, Germany, said the difference in flying the two versions of the H145 "is almost negligible" — which was the aim of the development.

"There are some small parts where you see you can be a little bit more precise [with flight controls]," he said. "[But] we promised [the] program [team] that there will be no disadvantage to the aircraft for ride comfort, for controllability, [or] for handling characteristics. And up to now, even in the cold, we have seen [the] engineering does not surprise us in any negative way — and we get more or less the same aircraft."

The blades represent the first practical application for technology used in Airbus's Bluecopter program, which sought to advance various eco-friendly design and technology developments. But while the Bluecopter program used an H135 airframe, Humpert said Airbus has no plans to install the five-bladed setup on the smaller light twin in the future.

The manufacturer explored using Blue Edge blades (which feature swept-back tips, and are used on the upcoming H160 medium) on the new H145, but Humpert said the smaller rotor diameter and narrower blade chord on the type meant the full benefits of the technology wouldn't be realized.

Airbus has now delivered over 1,500 aircraft from the H145 family (which includes its predecessor, the BK117), with the collective worldwide fleet recording 5.5 million flight hours.

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The H145 was the owner of the largest Fenestron in the Airbus family of aircraft until the H160 was unveiled in 2015. **Rob Reyno Photo**

The new H145 has already completed flight testing in several different environments, including a cold-weather campaign in Finland. **Lloyd Horgan Photo**

The Sikorsky Autonomy Research Aircraft (SARA) is a modified S-76B. Sikorsky has used it to extensively test its autonomy technology. **Ted Carlson Photo**

Having spent more than five years honing its Matrix autonomous technology in its SARA S-76 demonstrator, Sikorsky recently invited three non-pilot journalists to see just how far the system has come — by climbing in and flying the aircraft themselves.

BY ERIC ADAMS

REMOTE CONTROL

In a recent flight aboard Sikorsky's autonomy testbed — an S-76 outfitted with a supercomputer, electrically actuated servos, and myriad sensors sprinkled around the fuselage exterior — the most eye-opening moments didn't necessarily come during the crisp lift-off, precision maneuvering, or brilliantly smooth landing. No doubt, each was hugely impressive, and that capability was the core reason I and just two other aviation journalists were invited to Sikorsky's Stratford, Connecticut, headquarters to become the first media to "fly" the self-flying helicopter.

Nor did my "aha" moment come while I effortlessly tapped my instructions into a tablet computer strapped to my knee, or even when I got my hands on a pair of inceptors aboard SARA (Sikorsky Autonomy Research Aircraft) that interpreted my intentions and automatically balanced the controls typically modulated by the collective, cyclic, pedals, and throttle, allowing me to bank easily through the sky or fine-tune my position above the airfield.

No, the most vivid part of the flight actually came during the in-between moments. That is, the periods when I jumped in to make a change, or when Sikorsky test pilot Mark Ward — my "copilot" on this mission and the only other human on board, given that the cabin is packed with test gear — executed a rare input of his own using the conventional controls. Usually he did this merely to demonstrate the handoff process between pilot-control and computer control, between hands-on and hands-off, and indeed between brain-on and brain-off. The transition requires no thought, just action. It's immediate and, most importantly, easy, allowing you to seamlessly refocus your attention between tasks. Though I'm not a certificated pilot, I have flight experience and readily grasped the workload-reduction potential this innovation offers.

The system, called Matrix Technology, is designed to be instantly interruptible simply by taking over the control inputs, and it re-engages once control is relinquished, either continuing with its programmed mission or maintaining your most recent heading and attitude. It can lurk in the background as an always-on virtual co-pilot or ever-vigilant emergency backup during manual flying, or be used to manage most or all of the flight while the crew communicates, strategizes, or simply monitors. Sikorsky debuted the system in 2013 and has been honing it aboard SARA ever since, to the point now where it's about to be deployed in military and commercial helicopters.

My 30-minute flight in the vicinity of Sikorsky's headquarters was revelatory on several levels, from the low level of training required to fly SARA to the indisputable sophistication lurking in plain sight. It began with about 45 minutes of instruction on how to use Matrix, via a simulator in a motor coach parked adjacent to the S-76. There I learned how to use the tablet, with its moving map — alas, no pinch/zoom capability, since that might be inadvertently activated in flight — central helicopter icon representing SARA, and control widget that operators summon to input instructions. You tap on that, set your speed, altitude, and direction, or just tell it to liftoff and establish a hover at a prescribed altitude. You can load preset flight plans, or simply tell it to fly to a point on the map, prompting the computer to calculate the best route and approach strategy. I also familiarized myself

This is the tablet I used to input my flight plan and execute it. It's hard-wired into the system's computer, which itself takes data from the helicopter's systems and then executes the flight via electrical servos attached to the controls. The stick to my right is the inceptor that controls left/right and forward/reverse movement — essentially, of course, heading in whatever direction you point. **Eric Adams Photo**

The SARA simulator, which is located in a motor coach. It's an exact duplicate of the system aboard SARA, and is in fact linked with it during test flights, so engineers on the ground can make adjustments, monitor, and even fly the helicopter remotely. **Eric Adams Photo**

with the two inceptors. A preflight briefing followed with Ward, lead autonomy engineer Igor Cherepinsky, and the key engineers and flight-test personnel working on the program.

When we finally boarded SARA, the tablet and inceptors were of course immediately familiar. Ward started up the helicopter's dual turbines and taxied us out to our liftoff point — ground operations are still fully manual — and handed control over to me. Communicating with Cherepinsky in the trailer to confirm everything was set properly, I tapped "execute" on the tablet. A few seconds later, we lifted off slowly from the ground and the system put us into a steady 60-foot hover. I then used the inceptors to maneuver us around the field for a few minutes, marveling at the ease with which I was able to do so, particularly given my previous helicopter flight experience that amounted to precisely zero hours. Each time I let go, the helicopter steadied itself precisely. I kept looking to make sure Ward wasn't secretly helping the system out, but he clearly wasn't. The only reason his hand was even on the stick was to activate the mic trigger when talking to Cherepinsky or myself. When we eventually headed out to our waypoint above the countryside, the helicopter managed every aspect of the flight, motoring us along with spooky precision.

While the system operates relatively simply from the pilot's perspective, it is packed with algorithms and powered by steroidal hardware able to manage huge volumes of data coming from multiple cameras, laser scanners, radar, and onboard sensors. As you watch the moving map, you see the lidar hard at work scanning the terrain and the air for obstacles and identifying suitable landing zones, calculating the approach to each on the fly in the event one is needed.

Eventually, the kind of computerized automation demonstrated with Matrix will permit such things as optionally-piloted flight and even fully autonomous air-taxi missions for civilian passengers, with no trained pilots aboard at all. That specific vision still sits well over the horizon, dependent as it is on a staggering gamut of successes in electric vertical-lift, regulatory approval, and financial management, among other things. But in the near term, crews flying with the features developed in this program will find themselves able to more readily attend to mission-specific tasks — communication, observation, strategizing — rather than managing the minutiae associated with helicopter piloting. Not only that, but as a baseline safety tool, Matrix could become your hyper-vigilant, never-distracted co-pilot that will help keep you out of trouble and bail you out of whatever jams you do find yourself in.

Ultimately, Ward said, the goal is not just for this to enhance safety, but to help redefine mission capabilities. "This allows operators to reduce crew requirements, yet still handle complex missions," he explained. "It creates flexibility and the potential for true single-pilot operations."

Cherepinsky added that this potential exists even in the face of the most challenging circumstances, such as poorly lit landing zones or otherwise degraded visual environments. Matrix technology can already handle landings on barges at sea, and it's been proven in simulation to be able to manage autorotations as well as approaches to ships and oil rigs at night and in severe weather. "In these cases, pilots will essentially monitor the situations and step in as needed," Cherepinsky said. "So for now it's absolutely designed for professional pilots. The next step is to make it usable by minimally trained crews, where it will have much more control over the missions and will handle much more of the communication and other responsibilities." That will involve further honing the user interface, which Cherepinsky said is designed for professional pilots, and it still needs to make

Sikorsky chief test pilot Mark Ward, monitoring the Matrix system in the air. His hand is on the stick mostly to activate the mic button, but the system takes care of everything else. If he wanted to jump in, he could simply take over control and his movements would override any system inputs, deactivating the autonomous flight mechanisms until he relinquished control back to the helicopter. **Eric Adams Photo**

While SARA has been used to mature the Matrix technology, it will see its first commercial application in a Sikorsky S-92. **Ted Carlson Photo**

> *Each time I let go, the helicopter steadied itself precisely. I kept looking to make sure Ward wasn't secretly helping the system out, but he clearly wasn't. The only reason his hand was even on the stick was to activate the mic trigger when talking to Cherepinsky or myself.*

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progress in terms of interpreting and executing casual verbal or keyed-in commands. "Nailing the interface is really hard," he added. "We can have all these great algorithms, but how do we enable the human operators to convey their intent for each flight? That's taking a lot of time to get right."

Then there's the fundamental challenge of convincing professional pilots that the system won't itself hinder them in some fashion. But Ward said those who've tried it, while occasionally resistant to the idea of computers taking control — given the instincts and training they've honed to execute complex, often highly nuanced missions — have been consistently won over, just as previous generations were quickly won over by simple autopilot. "People may automatically assume we're trying to kick them out of the cockpit," Ward said. "We're not. We're trying to make it so you can do more while in the cockpit, without worrying about the thousands of things you usually need to worry about at any given moment."

Features found in Matrix Technology will begin to appear first in the UH-60 Black Hawk helicopters the U.S. Army flies — in fact, a group from the Army tried it out at Fort Eustis, Virginia, late last year, with highly favorable reactions — and then its features will be available in Sikorsky's commercial helicopters, including the S-92 heavy-lift model. After that, well, the sky's the limit, including eventually being a potential key enabler of civilian aerial mobility. Even if that long-promised vision doesn't materialize, there will likely still be enormous benefits to pilots wishing to manage their missions as efficiently and safely as possible.

Eric Adams | Eric Adams is an aviation and automotive journalist, and former editor at *Popular Science* and *Air & Space/Smithsonian* magazines, among other titles. He's been an aviation enthusiast his entire life, and has no intention of changing that.

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The Thales TopMax is a monocular-style head-worn enhanced vision system. It is designed to reduce takeoff and landing minima, offering new functionalities based on its wearable design. **Thales Photo**

EASING THE LOAD

Across the industry, OEMs and suppliers are working to reshape helicopter cockpits to reduce the workload on pilots — and enhance aviation safety.

BY THIERRY DUBOIS

As engineers and researchers from across the industry continue their ongoing quest to refine and enhance the next generation of rotary-wing aircraft, one key theme has emerged from the changes planned for the cockpits of tomorrow: a reduction in pilot workload. Primarily driven by advancements in interfaces, arriving between 2025 and 2030, helicopter crews will be able to allocate more time than ever before to mission management. The same period will likely also see a growth in the number of types using fly-by-wire controls, but while artificial intelligence (AI) is being intensively studied by many companies, it has yet to work its way into a certifiable decision aid.

"The strongest design driver is user interface," Jim Gibson, an experimental test pilot with Bell, told *Vertical*. When the complexity of a flight increases, for example, a pilot may become overwhelmed and lose track — and this is when controlled flight into terrain happens. To help avoid this, "let's make it easier for the pilot to operate the aircraft," said Gibson.

With less time spent on the physical aspects of controlling the aircraft, the pilot is able to spend more time focusing on the operation at hand, he added. "In a medical evacuation, that would be coordinating with the nurse in the back, communications with air traffic control and the hospital, as well as coping with challenges such as night or weather," Gibson said.

Jon McMillen, in charge of business development for Sikorsky Mission Systems, is on the same page. He sees the pilot as a mission commander, monitoring the flight and making inputs when relevant. This is what drove the development of the in-service automated rig approach feature on the Sikorsky S-92, he said.

In the future, automation might see an aircraft take off and fly to a waypoint, avoiding obstacles, before hovering to pick up a patient and a physician. The pilot would therefore have mental resources available to better plan ahead. "You want the pilot fully engaged when he gets there," said McMillen. In an operation such as firefighting, crews often have to deal with unexpected situations, and automation of the more procedural aspects of the flight could allow them to increase their focus on the more challenging aspects.

Sikorsky has conducted extensive research in that direction with the Sikorsky Autonomy Research Aircraft (SARA) demonstrator, an S-76 fitted with special equipment to give it various degrees of automation *(see p.56 for our flight report).* "We demonstrated a helicopter can be flown with a tablet — without conventional gauges, horizon line etc. — using just a flight profile," said McMillen. "There is a paradigm shift on how raw data can be replaced with a mission or flight intent."

Full autonomous flight is far off, especially because of certification challenges. But the interface Sikorsky has created for SARA may find applications in conventional rotorcraft.

"The information is becoming more consolidated, easier to digest, with less raw data," said McMillen. An automated checklist may include tests running on their own, using oil pressure sensors for instance. "You can have the system run it through the startup

process, pointing to a system you need to look at and interrogate," said McMillen.

New ways of displaying information may help. The pilot in a conventional cockpit has to aggregate numbers from the variometer, altimeter, speedometer and fuel gauge, as well as engine parameters. "You can do that for him, a bubble — varying in size — around the helicopter's symbol [on a display] can represent the available power and its color may give a clue on the fuel level," said Christophe Bey, executive director of Akiani, a French company specializing in human factors and user experience.

Reducing the pilot's workload saves cognitive resources, and greater mental availability leaves room for preparing action plans, Bey told *Vertical*. "Sometimes a pilot receives so much information that he tries to understand things that are not worthwhile — this is a human bias — and forgets anticipation tasks."

In terms of hardware, transparent avionics screens may give better visibility when close to the ground. Opacifying panels may recreate the instruments, Bey suggests. Some of them would be switched off for takeoff and landing.

DEMOCRATIZING AUTOPILOTS

The use of autopilots may become widespread in the future. The use of such systems has already been democratized to an extent — the Airbus H135 light twin has been offered with a four-axis autopilot for a few years, while the Genesys HeliSAS is bringing complete two-axis autopilot functionality to a growing number of light aircraft types. Avionics giant Garmin is looking at bringing further automation to lighter helicopters, and hopes to cut its cost. Referring to stability augmentation systems and autopilots for visual flight rules (VFR) helicopters, Bill Stone, Garmin's senior manager, aviation business development, points out the amortization challenge. "You can design a low-cost solution but you have to amortize it on a small market," he said. "We try to find scalable solutions to use on multiple platforms; we manufacture in-house to tightly control costs."

Another means to reduce pilot workload may be through the use of voice command. "Technology has really come along in the last few years," said Stone. "For routine tasks, the pilot can simply talk to the avionics." In the terminal area of an airport, for example, a vocal order for a wind check is easier than manipulating the avionics, he suggested.

Voice command belongs to a trend for increased resilience of the system/human interface. The more intuitive the interaction, the smaller the risk of error, said Akiani's Bey. "Tapping on a touchscreen is better than typing coordinates," he said.

Fly-by-wire controls may help reduce workload, too. Over the last two decades, however, they have been a tantalizing goal for design engineers at helicopter OEMs, with the cost making a business case harder to prove than with their fixed-wing counterparts. Airbus Helicopters, for instance, pursued the technology for civil applications, considered it for the then-named X4 program, but eventually dropped it for the resulting H160.

Military rotorcraft such as the NH90 and the CH-53K do have fly-by-wire controls. But the first civil certified helicopter is set to be the Bell 525 Relentless super medium twin. "Fly-by-wire costs have come down over the last 20 years in the military," said Bell's Gibson. And he is certain that costs will continue to fall, allowing such a system to arrive in lower-cost helicopters. "The better we become at it, the cheaper it gets," he said. "At some point it will become compatible with a light twin."

Advanced avionics have arrived in light aircraft, too. Garmin introduced two G500H TXi displays for the Robinson R66 and R44 at Heli-Expo 2018. **Garmin Photo**

The Collins Aerospace HeliSure family of products aims to enhance pilots' situational awareness. It delivers sensor data in real time through an intuitive user interface that features 3D visualization. **Collins Aerospace Image**

Sikorsky's McMillen agrees. "Fly-by-wire technology has been maturing and cost is coming down," he said. "We will see it on larger [commercial] aircraft sooner rather than later."

Dan Toy, principal business development manager for avionics at Collins Aerospace, said that making fly-by-wire affordable is a challenge, largely because controls have to be triple redundant, and this extends to every single element. "You have to make the system work under any type of failure, so it increases complexity," he said.

All manufacturers agree fly-by-wire certification is very costly. But such controls have "tremendous benefits," said Toy. The capabilities of an autopilot are much greater if coupled with fly-by-wire controls, added Akiani's Bey.

On the Bell 525, pushing the cyclic stick forwards or backwards directly controls speed. The pilot does not have to mentally reckon on what the pitch angle should be, relative to the desired speed and the aircraft's weight. For takeoff and approach, the system enables repeatable maneuvers, whatever the weight.

In case of a double engine failure (which statistically might happen once in an aircraft's life), the pilot usually has to react within a handful of seconds. This is the responsiveness needed to keep the rotor turning in order to perform an autorotation. Fly-by-wire controls will give the pilot a head start, automatically applying the first of the required control inputs.

The use of fly-by-wire also offers new possibilities in the design of controls. Engineers may take a hard look at how the pilot interacts with the aircraft. Bell is thus testing a variety of physical configurations for flight controls in its future vertical takeoff and landing (VTOL) aircraft, including the Nexus. About 800 people — including both experienced pilots and non-flying consumers — have trialed Bell's three different configurations through virtual reality simulators, according to Gibson. "We are in survey mode," he said. Bell will start working on flight control laws next year.

INCREASING SITUATIONAL AWARENESS

Enhanced and combined vision systems are perhaps closer to maturity. Enhanced vision relies on optical sensors (such as infrared cameras) to enable a crew to see through fog or at night. Flight data, such as speed and an artificial horizon, is superimposed on the picture. Combined vision adds synthetic terrain.

While such systems have proved to improve situational awareness in the fixed-wing industry and in military rotorcraft, they have yet to find their way into civil helicopters. Civil fixed-wing aircraft mostly use head-up displays. Due to their lower speed, wider field of vision and varied operations, helicopters would likely be better suited to head-worn devices. These are fairly common in the military world, Toy noted. But making those devices affordable is a challenge, which Collins Aerospace is working on.

Thales is developing a monocular system. This will allow crewmembers to share their view of items of interest, such as an accident site during an air medical mission. One crewmember could be looking at the site on the ground, and their viewpoint could be shared on another crewmember's display. On such a system, the next waypoint may also be highlighted, Bey suggested.

AI may sound like a buzzword for cockpit improvement, but the kind of AI technology that has made spectacular progress in the

The cockpit of the Airbus H135. The European Aviation Safety Agency certified Airbus's Helionix avionics system in the type, featuring a four-axis autopilot, in 2016. **Airbus Photo**

consumer world is, to date, unsuited to cockpit electronics safety standards.

Based on neural networks, a Siri-like AI system learns from a large amount of data. It works in an empirical way, but it is capable of making an error. Moreover, the system cannot explain its choices, thus undermining the confidence a human operator may want to place into it.

In France, experts at Thales and aerospace research center Onera disagree on how long it will take to design a certifiable AI system — their respective predictions being a minimum three and 10 years. Collins Aerospace's Toy references "the late 2020s."

Ideally, AI could become "a competent assistant," as Bell's Gibson put it. "Pilots do not see the autopilot as a copilot for good reasons — it is deterministic and may lack a response to an unexpected situation," he said. But the probabilistic (as opposed to deterministic) nature of AI makes its certification virtually impossible with the current approach. Certification authorities will have to change the way they look at a new system, said Sikorsky's McMillen. An airframer will have to prove to the certification authority that the machine can be trusted. An application may be, in the case of a worrying alert in the cockpit, helping the pilot to find an alternative airfield.

Trust is already an issue with current automation. "When the situation gets worse, some pilots no longer have confidence in the system, such as an unexpectedly disconnecting autopilot," noted Akiani's Bey. The pilot distrusts the system for the rest of the mission, believing it has let him or her down. They should put the disconnection in context, which would make them realize the helicopter's attitude, for example, was outside the autopilot's operating envelope, said Bey.

An algorithmic (i.e. deterministic) form of AI exists, but "is 10 years behind" probabilistic AI, according to Bey. Some advanced automated systems incorporate algorithmic AI. "Our auto rig approach feature is a form of AI: it knows your goal, flight regime and brings you there safely," said Sikorsky's McMillen.

In addition to adapting the cockpit to human beings, what about better selecting the latter? Progress in neuroscience has enabled the creation of new tests. They can help select those persons whose behavior degrades less under stress. Or, the cognitive state of the pilot may be checked before flight, said Bey. A major challenge, however, would be how to manage the result if a pilot is found unable to complete the flight — has the operator got a replacement pilot ready to go?

While many fear that increasing automation may eventually make pilots obsolete, they shouldn't worry too much about the future of their profession, said Bey. It would be extremely expensive to replace them with the required redundancies, he said. Keeping humans in the cockpit will continue to make sense for the foreseeable future, with automation simply serving to help increase the safety of their work.

Thierry Dubois | A freelance writer specializing in aerospace technology, helicopters and business aviation, Thierry also moderates international conferences on aviation technology topics.

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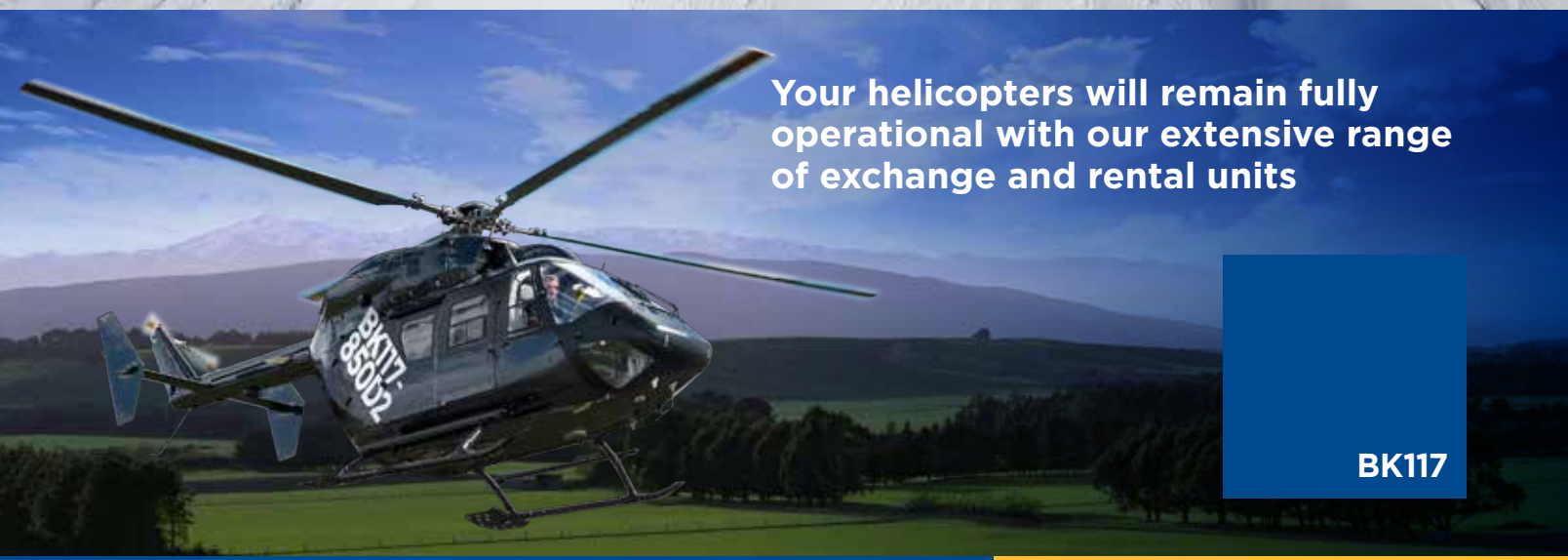

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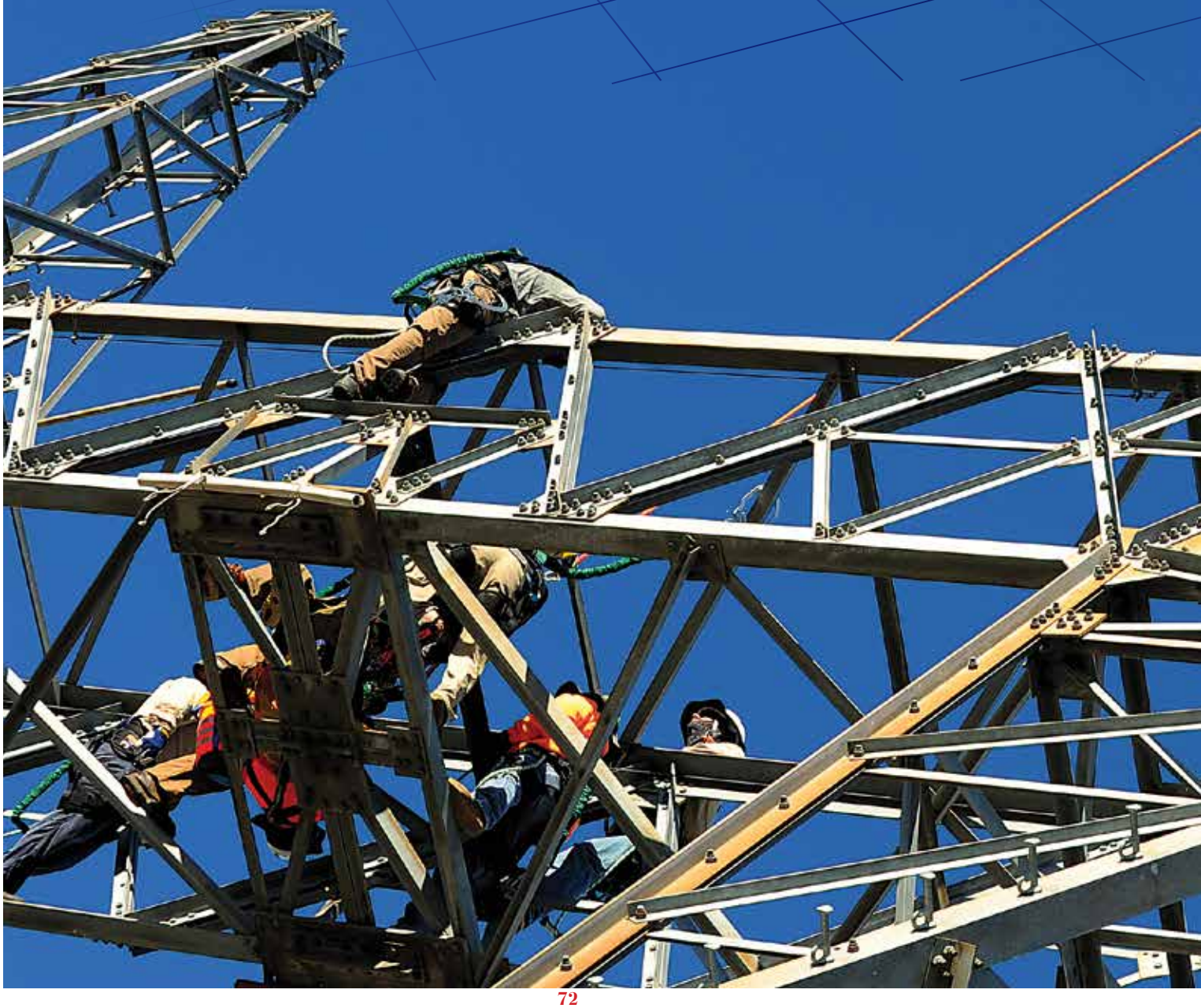
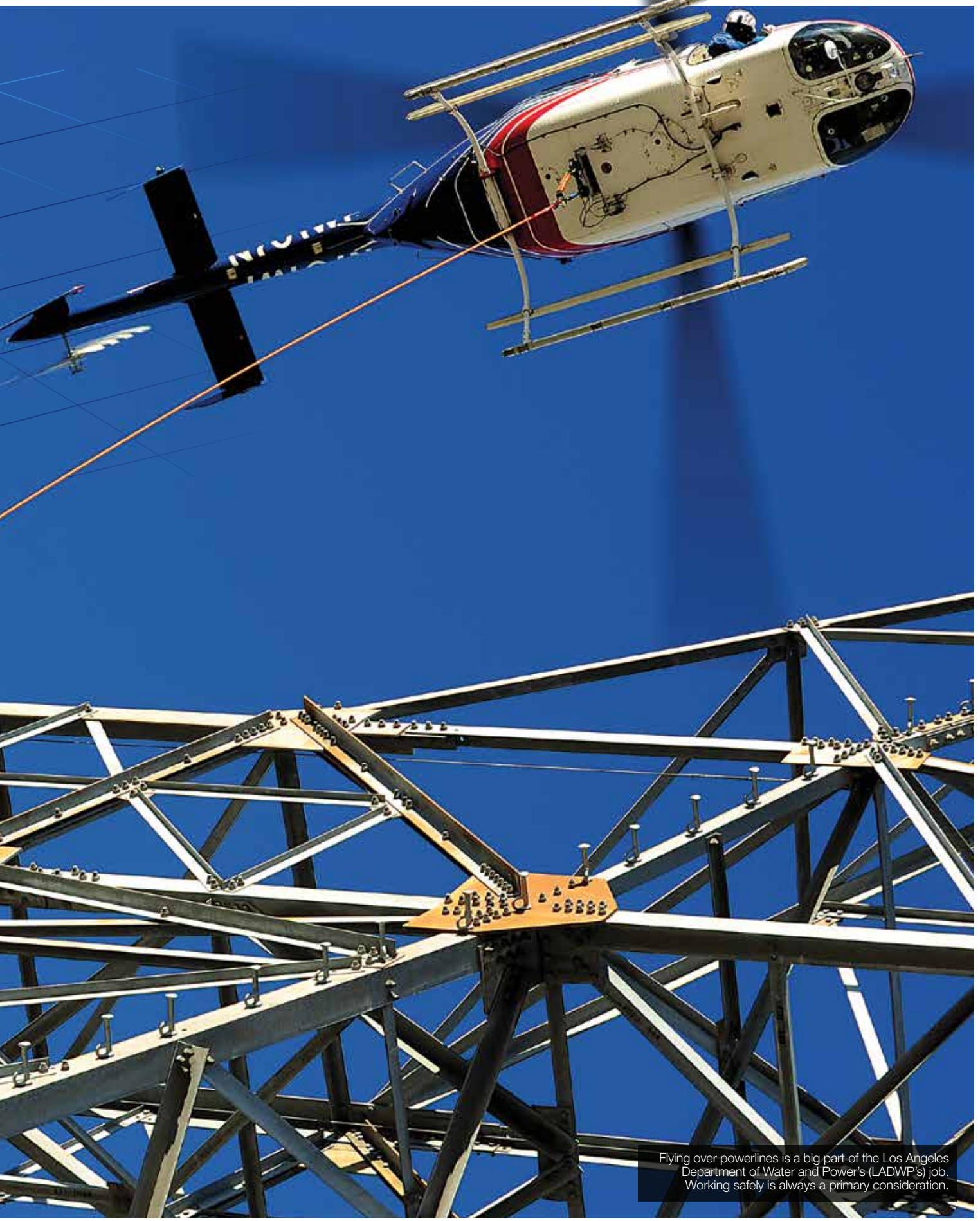
WORKING FOR THE PEOPLE

A fleet of four helicopters helps the Los Angeles Department of Water and Power keep supplies running to the second largest city in the United States.

STORY & PHOTOS BY SKIP ROBINSON





Flying over powerlines is a big part of the Los Angeles Department of Water and Power's (LADWP's) job. Working safely is always a primary consideration.

The Los Angeles City Department of Water and Power (LADWP), the largest municipal utility in the United States, carries a heavy burden. With a population of over four million people, natural semi-arid desert conditions, and an average of just 13 inches (33 centimeters) of rainfall a year, Los Angeles has a seemingly unquenchable thirst. About 20 percent of the city's water comes from the Sierra Nevada Mountain range, with the extensive Los Angeles Aqueduct system taking it through a series of canals, tunnels, pipelines and pumping stations to the second largest city in the United States. The LADWP is tasked with patrolling and maintaining this essential piece of infrastructure, along with all other facilities and infrastructure that make up its vast water system. And just as significantly, it powers Los Angeles, supplying more than 26 million megawatt-hours of electricity a year to its 1.5 million residential and business customers.

Formed in 1902 for water services, the LADWP expanded to electrical power services in 1916. Today, it has more than 10,000 employees, and has the responsibility of maintaining and repairing the 338 miles (545 kilometers) of the Los Angeles Aqueduct (including eight reservoirs), and more than 3,500 miles (5,630 kilometers) of overhead transmission tower lines. The lines extend from Los Angeles through the Owens Valley to Adel, Oregon, and through Boulder City, Nevada, to Delta, Utah.

Covering this vast area would take hundreds of trucks and ground crews, but a fleet of four helicopters — two Bell 407s and two Airbus H125s — allows the LADWP to be far more efficient with its resources.

The department began using helicopters to patrol, inspect and repair its infrastructure in the 1960s. It originally used Bell 47G3-B1s, then transitioned to Bell 206 JetRangers, and used two former military Bell UH-1B/Cs for heavier utility work. The LADWP quickly saw the benefits of using rotary-wing aircraft to perform its role. Instead of days, crews could reach potential problems in a few hours, saving thousands of hours each year in employee time, which in turn saved rate payer money.

LADWP Aviation Services transitioned to the Bell 206L-3 LongRanger in 1988, giving the unit much better performance in hot and high conditions, longer range, and the ability to lift heavier loads during utility work. Between 1988 and 1997, the unit also operated a Bell 412SP, using it for heavy utility work, such as the placement of poles. However, the aircraft was more than the LADWP needed, and it was transferred to the L.A. City Fire Department to be used as a firefighter until its retirement.

Water travels hundreds of miles across the Los Angeles Aqueduct system to reach the city. It is patrolled by helicopter on a regular basis.

The two new Airbus H125s are proving popular with crews. Here, one is performing a standard patrol of LADWP assets in the L.A. Basin.

After the terrorist attacks of Sept. 11, 2001, additional patrols of water and power systems were called for, as they were considered potential targets. Because of this, LADWP Aviation Services bought two Bell 407s to supplement the LongRangers.

Today, the long-serving LongRangers have been retired and two new Airbus H125s have replaced them. The H125s are proving popular due to their power, comfort, endurance, lift capability, and high altitude performance. The team appreciates the 407's speed, and it is the primary aircraft for the LADWP's new human external cargo (HEC) program, which pairs pilots with line workers to service the department's overhead transmission lines.

A VARIED MISSION PROFILE

LADWP Aviation Services flies daily security patrols around the Los Angeles Basin and surrounding areas, extending to the upper desert. Patrolled areas include waterways, reservoirs, pump stations and pipes. The team told *Vertical* there are close to 100 pieces of infrastructure they inspect on their flights, which are performed with one pilot and an aerial observer, both of whom know the route and what to look for. In very general terms, they're looking for anything out of the ordinary, such as damage to the waterways or pipes, or people near LADWP facilities who should not be there.

The unit also completes longer patrol flights north of the city from the Antelope Valley, above the Los Angeles Aqueduct, through the Owens Valley to Mono Lake, north of Bishop, California. This is normally about a five-hour flight, so the helicopter will refuel at Bishop or another airport (as needed), and then head back to Los Angeles. On these longer flights, the use of a helicopter is particularly efficient, with some of the water piping extremely difficult to access by any other means.

LADWP Aviation Services also schedules patrols and inspections of thousands of transmission towers and powerlines. The company feels that having a view from above gives a better angle from which to spot any damage and obstructions that may compromise the safety of the lines.

> *"The LADWP has an important role to play following a natural disaster, such as an earthquake, completing a full and complete inspection of waterways, reservoirs, and power-generating assets."*

Here, LADWP crews practice long line rescues. At this time, the Bell 407 is the primary rescue helicopter, as it is set up with the proper gear.

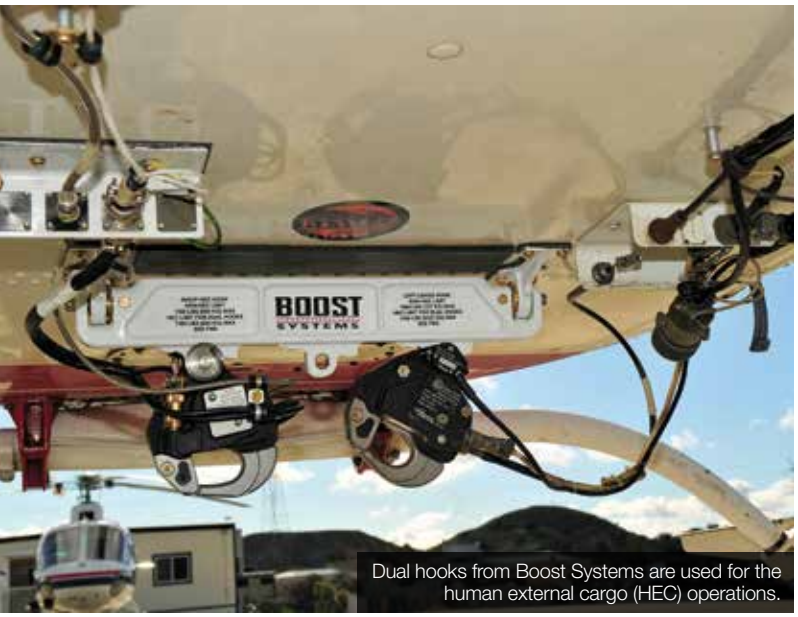
Both the Bell 407 and H125 have cargo hooks, and are used for construction and support.

The unit's long line operations are generally flown with a single pilot, using lines from 50 to 200 feet (15 to 60 meters) in length. These jobs include setting power poles, replacing transmission tower components, pulling sock line from tower to tower, and Scuba Grabber (a set of hydraulically operated claws used to remove debris from rivers and other bodies of water) operations.

Work on transmission lines normally requires de-energizing the entire circuit of a powerline. This often means rerouting power through other lines not owned by the LADWP, and doing so can result in hundreds of thousands of dollars in lost revenue. Using a helicopter to work on powerlines dramatically increases the efficiency of the maintenance operation, minimizing the length of time the power needs to be rerouted.

The LADWP's recently-launched HEC program allows lineworkers and pilots to partner together on transmission linework for the first time in the department's history. Helicopters will carry lineworkers from

All pilots with the LADWP are experienced and well-trained for the requirements of the job.



Dual hooks from Boost Systems are used for the human external cargo (HEC) operations.


Ground crews train with the helicopters on a regular basis.


Precision placement of personnel is part of the DWP HEC mission.

the ground onto a transmission structure or wire using an external line below the aircraft. This helps lineworkers access hard-to-reach areas and creates a safer work environment by reducing climbing, while increasing productivity.

Participants in the program completed their certification with help from external trainers from Ashland, Oregon-based Air Rescue Systems. From November 2018 through January 2019, employees from the different job classifications learned to collaborate together through classroom sessions and practical exercises on transmission towers. Training included helicopter safety and short haul procedures and work practices.

LADWP personnel were also trained to use HEC to rescue injured linemen from towers. For this operation, a line worker is equipped with a rescue harness from Air Rescue Systems called the Air Rescue Vest. Some of the towers are so remote that it can take hours to reach them on dirt roads, so the LADWP is also equipped with a rapidly deployable litter called the Air Rescue Extraction System, which allows it to repackage and transport an injured worker by HEC to a landing zone that is more quickly and easily accessible for first responders. The department chose to equip the Bell 407s with a Federal Aviation Administration (FAA)-certified HEC dual hook from Boost Systems.

Other operations performed by LADWP Aviation Services include new project survey flights — looking for new solar, wind-farm or other infrastructure locations.

And it has an important role to play following a natural disaster, such as an earthquake, completing a full and complete inspection of waterways, reservoirs, and power-generating assets. It also has an agreement to provide helicopter support for the city following such events, in which it would fly city officials and provide general emergency operations support.

Operational flights take place from sea level to 12,000 feet (3,660 meters), and involve mountain and desert operations in both cold and hot and high conditions. Making the flight conditions even more challenging is the wind that prevails in the mountains and through the Owens Valley during much of the year.

LADWP Aviation Service pilots may be called out to respond to emergency outages anywhere in the system, and this might take them out of town for several days. Survey flights and system maintenance support flights may also take a crew out of the city for an extended amount of time.

WATCH **VIDEO**

EXPERIENCED CREWS

LADWP Aviation Services has its own hangar and office facility, and the team consists of two chief pilots and six line pilots. The requirements for new hires are 3,000 flight hours as pilot in command, and 1,500 hours in turbines. Hot and high and longline experience is a benefit, and as the unit recently began HEC operations in support of linemen and for quick-response rescue operations, so is experience in these operations. The unit told *Vertical* they look for pilots with a breadth of experience, maturity, good judgment, and the ability to work with the other LADWP pilots and employees.

All pilots complete training at Airbus and Bell every two years, and take part in in-house recurrent training every six months, led by a LADWP chief pilot. Flight checks are flown in both the H125s and Bell 407s in specialized operations, such as sock rope pulling, flying with external loads, and operating the Scuba Grabber. As HEC operations become more common, pilots are required to practice HEC proficiency every two weeks.

As the Los Angeles Basin has very busy skies, including numerous photography and sightseeing flights, a thorough knowledge of the area's airspace is required. Equipment used by LADWP Aviation Services includes gyro-stabilized binoculars, high resolution digital still cameras, and handheld video cameras for patrol flights. The unit will also rent a helicopter camera mount when high quality videotaping is required.

All four LADWP helicopters are maintained by the City of Los Angeles Department of General Services. This department maintains helicopters from the LADWP, and the L.A. Police and L.A. Fire Departments from its hangar at Van Nuys Airport. This FAA part 145 certified repair station has the ability to complete almost all levels of maintenance on these aircraft, and can return them to service in a timely manner.

The team maintains its helicopters to a high standard, as reliability is critical given where the aircraft are flown, while the flight crews take pride in the aircraft and the mission they fly.

In the aircraft and personnel of LADWP Aviation Services, the citizens of Los Angeles have an extremely reliable asset that continues to keep their city connected to the most essential of supplies, while saving time and rate payer money.

Skip Robinson | Skip has covered helicopter operations through photography for 25 years and has worked with *Vertical* Magazine for over a decade. His main interests are rescue, para-public and military operations. Skip is based in Los Angeles, California.

The H125 has the performance needed for mountain operations. Here, an H125 flies in the northern reaches of the Sierra Nevada mountain range.

TWIN POWERED

Twin brothers David and Danny Brigham have distilled decades of aviation experience into the foundation of AeroBrigham, a fast-growing and well-respected modification, completion and maintenance company.

STORY BY OLIVER JOHNSON
PHOTOS BY SHELDON COHEN

Born just 36 minutes apart, the paths fraternal twins Danny and David Brigham have taken through life have never been far from each other. The two served in the U.S. Army together and were the first in their family to enter the aviation industry, albeit in slightly different forms. Upon leaving the Army, David entered the civilian world as a mechanic in the rotary-wing industry, while Danny became a mechanic for American Airlines. When David established his completion and modification company United Rotorcraft Solutions in 2005, Danny helped out on a part-time basis, but it was only after the pair decided to cash in their retirement savings and trade in semi-retirement that they've realized a long-held ambition to work together full-time.

AeroBrigham, the company they created and co-own, opened its doors in Decatur, Texas, in April 2015. Specializing in aircraft modifications, completions, refurbishment, maintenance and service, AeroBrigham has quickly grown to become one of the leading players in its sector.

David's background in the rotary-wing industry stretches back 36 years to his time as a maintenance crew chief on the Boeing CH-47 Chinook in the Army. After leaving the military, he joined Century Helicopters in Fort Collins, Colorado, and then Columbia Helicopters, working as a crew chief on the Columbia 234 Chinook. In his five years at Columbia, he travelled the world servicing the heavy-lift juggernauts.

But it was as general manager at Texas Aviation Services, a position he held for five years, that he was introduced to the world of modifications and completions.

"I always wanted to expand my knowledge base and learn more — be able to work on more aspects of the aircraft," said David. "So I started looking at avionics, component overhaul, and eventually paint, and then I really started getting into the completions aspect."

Danny Brigham works on a blade at AeroBrigham's facility in Decatur, Texas. He established the company with his twin brother David in 2015.

David (left) and Danny Brigham, the co-owners and president and vice-president, respectively, of AeroBrigham. The twins have each spent their careers in aviation, but the last four years represent the first time they have worked together full-time. **Mike Reyno Photo**

The transition to running his own company was something he describes as "almost one of those accidental things," resulting from a chance encounter with a small aviation business owner in Decatur. "I just happened to mention to him that one of these days I'd like to start my own company," said David. "But I had no real plans to start a company."

After that business owner sold his company, one thing led to another, and David was offered the opportunity to lease the business owner's old hangar, with the first six months offered for free. After making some phone calls to ask if he could bid on some work, David won a couple of contracts. He quit his job, and moved to Decatur to start United Rotorcraft.

"It was exciting, but scary at the time," he said. "I had, literally, about $300 extra in my checking account when I quit my job at Texas Aviation and came up here. But I had two contracts and had deposits in the bank, and that's how I started the company. I just built it from there, and strictly built it off the profits from jobs."

Those first two contracts were night vision goggle cockpit modifications, but the breadth of the work quickly grew thanks to David's well-established relationships in the completions world.

Within four years, David was fielding calls from various companies asking if he'd be interested in selling United Rotorcraft, and he ultimately agreed to do so to Air Methods in 2011. By that point, it had grown to 32 employees, and had about $13 million in gross annual revenue.

David remained with the company for another three years to help it transition into part of the Air Methods group, and then retired.

Except… he didn't.

Soon after his no-compete clause with Air Methods expired, he got back into the industry. "I really wanted something to do," he said. "And I didn't want to just go to work for anybody."

An AeroBrigham VIP completion inside an Airbus H125 AStar. The company can provide luxurious finishes tailored to a customer's exact requirements.

The company provides a wide variety of services, and has a fully-equipped avionics shop that allows it to test any piece of avionics for any aircraft — fixed- or rotary-wing. **Mike Reyno Photo**

The AeroBrigham team inside the company's 15,000-square-foot hangar in Decatur. The company has 18 staff, with a broad range of skillsets. **Mike Reyno Photo**

Danny, who had been working as an emergency room nurse following his own retirement from American Airlines, was also ready for a change of pace.

"I was getting kind of burned out," said Danny. "I said to Dave, 'Hey, why don't we start another company?' I felt if I was going to have my own business, he'd be the perfect partner. He'd been in business so long and had a lot of great contacts and a good reputation."

Pooling their retirement savings together, the Brigham brothers went into business together as partners, establishing AeroBrigham in the same 15,000-square-foot Decatur hangar in which United Rotorcraft had started 10 years earlier.

"We wanted to do the same thing we did with United Rotorcraft, but we just wanted to grow it a lot faster, and we wanted to be more diversified," said David. The diversification has taken the form of an increased amount of fixed-wing work, providing completions for aircraft such as Cessna Caravans or Beechcraft King Airs. However, AeroBrigham's primary focus is still the rotary-wing industry, with a specialty for aircraft produced by Airbus, Bell, MD Helicopters, Leonardo and Boeing.

PROJECTS LARGE AND SMALL

Today, AeroBrigham has 18 employees with a broad range of skillsets, allowing it to take on an enormous variety of work. This includes VIP, emergency medical services (EMS), search-and-rescue, utility, and law enforcement completions; aircraft refurbishments; systems integration; avionics installations; paint; and service and maintenance support.

"It's a really good mix of both small and large projects," said David. "Right now, we've got some VIP completions in here, we've got some large utility aircraft we're working on, we've got two law enforcement aircraft in here, we've got private individuals that bring the aircraft in, and we still do a lot of EMS aircraft completions and maintenance."

To help it provide this variety of service, AeroBrigham has a huge range of specialist tooling and machinery, including a CNC machine that allows it to manufacture parts and instrument panels; a huge roomful of test equipment that allows it to "test any avionics for any aircraft;" a very capable sheet metal shop; and a dedicated paint shop.

Among the company's more notable recent projects was the completion of a Bell 407 for Marion County Sheriff. AeroBrigham sourced the aircraft, which had been used for aerial tourism in New York, and fully customized it to meet the Sheriff's needs and requirements.

This included the creation of a custom-made carbon-fiber instrument panel, incorporating 12- and 15-inch monitors, a Garmin G500 EFIS system, and a tactical flight officer (TFO) station in the cabin. The TFO station included a 15-inch monitor with a Churchill Navigation augmented reality mapping system. The aircraft also had a FLIR Star Safire 380 HD system with a thermal imager and high definition color camera.

"We got them a really functional, great aircraft, with literally every bell and whistle they asked for, for way less than they would have spent if they'd bought a new helicopter," said Danny. "They're flying it a ton."

AeroBrigham's work arrives with the company from a variety of sources, but an increasing amount is driven by the airframe original equipment manufacturers (OEMs).

"Some of the OEMs are guiding people to us and just telling them that this is where you need to go for the VIP or whatever completion, or avionics in general," said David. "They're comfortable with us, they know our work quality, and they're already working with us."

VIP completions are becoming increasingly common, with David predicting at least another six aircraft coming in later this year for the polished executive finish AeroBrigham can provide.

VIP completion work is a growth area right now, with some of the airframe OEMs helping direct customers towards AeroBrigham for their completion.

The hangar was also the original home of David Brigham's previous company, United Rotorcraft Solutions.

A Bell 407 lands at AeroBrigham's facility to be transformed into an emergency medical services (EMS) aircraft for Survival Flight.


Following an extensive EMS completion, a Bell 407 is ready to be delivered to Survival Flight.


The selection of suppliers for its EMS completions depends entirely on customer preference.


Customers are increasingly moving to glass cockpits, said David Brigham, with ADS-B installation work growing as the FAA's 2020 mandate approaches.

The time it takes to perform such a completion varies according to the finish requested, but averages about 120 days, he said. The work begins with discussions with the client to discuss their options and desires for the project. AeroBrigham will provide a rendering of the proposed design, incorporate any requested changes, and then move forward with the proposed configuration in the aircraft itself.

For some items, like leather, AeroBrigham has a preferred vendor (Aero Comfort), while for others, such as medical equipment suppliers, the selection will depend entirely on the customer.

Another major component of AeroBrigham's business is its maintenance work. It can perform anything from small repairs to heavy maintenance and annual inspections. "We do a lot of component overhauls for dynamic components and engines, we'll do module changes and inspections, but the engines we send out," said David. "Same thing with hydraulic components — we send those out for overhaul."

The company's reach is broad. It can help domestic customers source aircraft overseas and complete the required inspections to get a U.S. aircraft registration for them. Conversely, it has international customers that request U.S.-registered aircraft, and AeroBrigham will help them source it, complete the export paperwork, and containerize and ship the aircraft. It will shortly be shipping another aircraft to a repeat customer in Perth, Australia.

In terms of general industry trends, David said he was seeing a lot of customers moving to newer glass cockpits, and there is also an increasing amount of ADS-B installation work to meet the Federal Aviation Administration's (FAA's) 2020 requirement for aircraft to be equipped with the technology.

"We're starting to get pretty backlogged with ADS-B work," said David. "If somebody wanted to bring an aircraft in for ADS-B right now, I wouldn't be able to fit it in for a couple of weeks."

A NIMBLE COMPANY

According to David, it's the company's breadth of experience that sets it apart from its competitors. "We're also a relatively small company, so we're every nimble," he said. "It's relatively easy for us to react to customers' needs."

Another major string to its bow is the relationship AeroBrigham — and David in particular — has developed with the FAA. "We can get field approvals done here that most of our competitors can't do around the country," he said. "That's not just because of our abilities, but our relationship with the FAA and our past experience with them. We've done some extremely complex field approvals that other businesses or FSDOs [Flight Standards District Offices] in the country aren't willing to do."

For Danny, the company's success is due in no small part to David's influence. "The level of expertise we have as a company is a huge strength, and that's chiefly through Dave," he said. "His knowledge is just off the chart and he's got an incredible memory."

But he said this capability is well reflected by a strong group of people at the core of the company, which means that AeroBrigham is able to keep any outsourcing to a minimum. "We outsource as little as possible," said Danny. "We buy things as we need them and we pay for them. If we need manuals for a job, that's when we get our manuals; if we need special tools, that's the time we get special tools — and then we have them for the next similar job."

Despite the success already recorded by AeroBrigham, the Brigham brothers are looking ahead to further growth for the company, both physically and in terms of the scope of work it completes.

The company's existing hangar is already at maximum capacity. Plans for a new, 50,000-square-foot hangar are in the works, with

The AeroBrigham hangar is happily busy right now, but the company needs to expand to meet the growing demand for its services.

According to company president David Brigham, AeroBrigham could triple in size once it moves to a new, larger, facility. **Mike Reyno Photo**

AeroBrigham in discussions with several municipalities as to where that might be. David hopes to break ground on the new facility later this year.

"Once we get that new facility up, or as we progress to getting that new facility up, I think we'll probably triple the size of the company," he said.

One of the drivers behind that growth will be an expansion into new areas, such as certification and product development. The company is already working on securing its first supplemental type certificates, which it hopes to be able to announce later this year.

Another potential development is an expansion into aircraft leasing. "We've got a couple different customers that we're working for to try to find the right aircraft," said David. "We want to get those purchased, complete, and out on lease."

While the success enjoyed by AeroBrigham in just four years might seem surprising for some, for Danny, it's a continuation of the pattern of success his brother established 10 years ago with his first company. "To me, it seems like we've done even better, and we will continue to grow and hire people with Dave as the driving force," he said.

David stressed that Danny manages much of the behind-the-scenes work. "We wouldn't be this far along without him," he said.

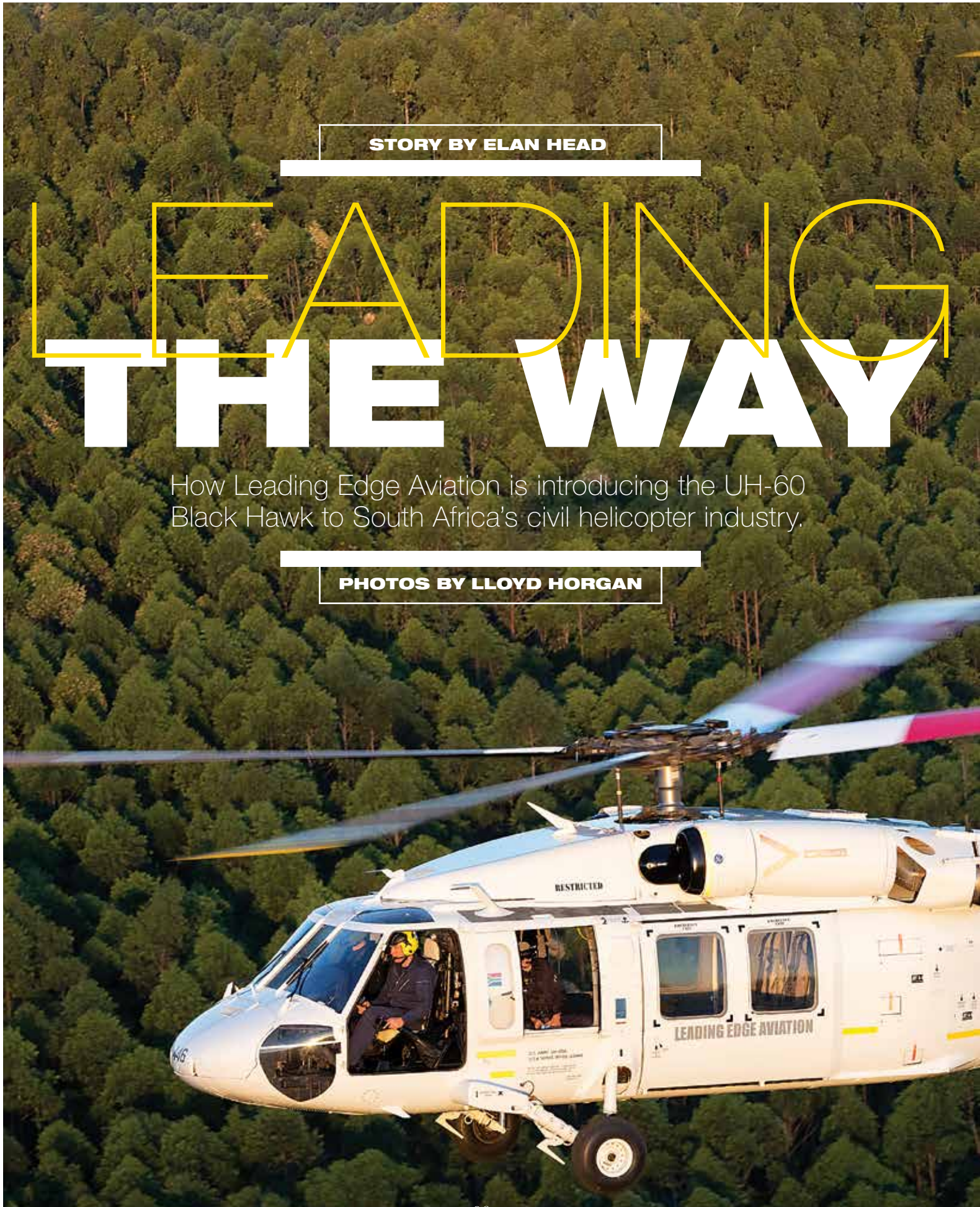
Danny said the experience of working with his twin brother has been worth the wait. "We grew up together, served in the Army together and then I went into heavies and he went into helicopters. And now we finally came full circle and we're back together again. It's pretty awesome."

STORY BY ELAN HEAD

LEADING THE WAY

How Leading Edge Aviation is introducing the UH-60 Black Hawk to South Africa's civil helicopter industry.

PHOTOS BY LLOYD HORGAN



Leading Edge Aviation's UH-60 Black Hawk and UH-1H Huey fly in formation near the Nelspruit Airport in South Africa.

DOWNLOAD THE WALLPAPER!

Over their four decades in operation, Sikorsky UH-60 Black Hawk helicopters have flown almost every mission you can think of — almost.

Last August, a Black Hawk chalked up what is believed to be a first for the model when it was used to relocate a white rhino in the province of Mpumalanga, South Africa.

Slinging rhinos by helicopter isn't unusual. And, as more surplus U.S. Army Black Hawk helicopters enter the civilian market, they're likely to be pressed into service on a greater variety of lift jobs.

For the rhino lift in Mpumalanga, however, the only helicopter up to the task also happened to be the first and only civil Black Hawk in South Africa: a UH-60A owned by Leading Edge Aviation out of Mbombela (formerly known as Nelspruit).

When Leading Edge founder and longtime firefighting pilot Mark Jackson made the decision to acquire a UH-60, he knew it wouldn't be easy. Not only had there never been a Black Hawk on South Africa's civil aircraft register, he faced some skepticism about the viability of the larger helicopter in that market.

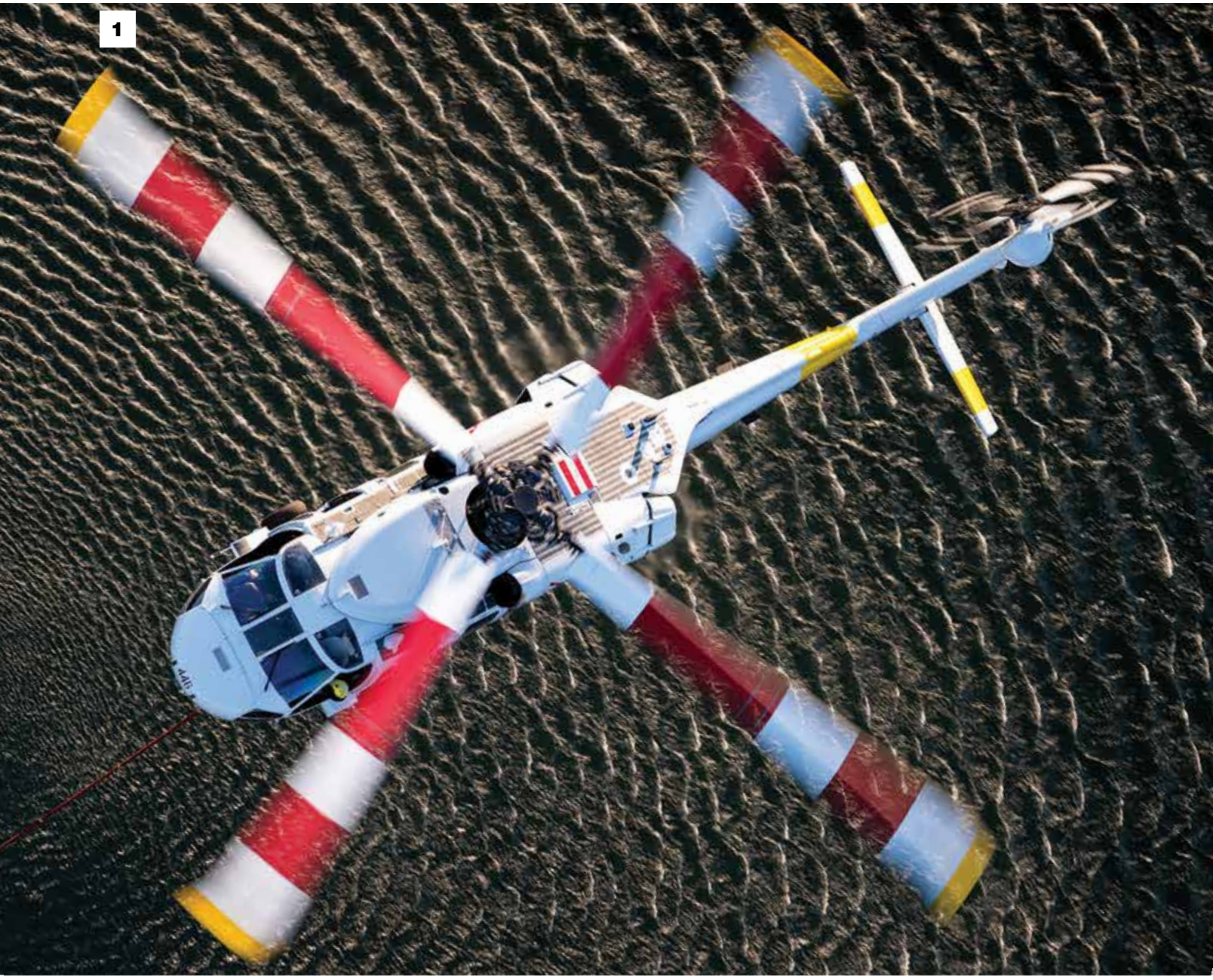
Now, a year-and-a-half after it first arrived in a South African port, the Black Hawk is starting to prove its worth for firefighting and disaster relief — and, of course, the occasional rhino lift.

"Initially there was a lot of resistance to the Hawk, but as we've gone farther down the road, it's become a great part of the kit at the fire bosses' disposal," said Jackson's son, Peter Jackson, who is one of the pilots and maintenance mechanics on the aircraft.

Describing it as a huge evolution in capability over the Bell UH-1 Hueys that have dominated the business for decades, he said, "I hope it will bring the South African firefighting market forward as a whole."

REPLACING AN AGING FLEET

Mark Jackson's first exposure to flying came through the Rhodesian Air Force, where he served as a maintenance engineer and crew chief. He trained as a civilian pilot in airplanes and helicopters, and as he progressed through his commercial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1 // The Black Hawk's fully articulated rotor system is particularly appreciated during operations in South Africa's Cape provinces, where winds routinely exceed 30 knots. **2 //** For civilian helicopter pilots, the Black Hawk's multi-crew cockpit can take some getting used to. "It's a mindset change, for anyone that's used to single-pilot operations," said Peter Jackson. **3 //** Leading Edge typically uses a 150-foot long line on the Black Hawk for better visibility from the wide cockpit.

> *"Initially there was a lot of resistance to the Hawk, but as we've gone farther down the road, it's become a great part of the kit at the fire bosses' disposal."*

flying career, "the fact that I could maintain my own aircraft was a massive advantage," he said.

Jackson and his wife started Leading Edge Aviation in 1996 as an aircraft maintenance facility, also keeping a rotating stable of light airplanes for leasing and other purposes. Meanwhile, Jackson was flying diverse jobs throughout South Africa and beyond.

Some of his most memorable flying was in support of humanitarian aid missions, he recalled. Flying an Aérospatiale Alouette III in support of Air Serv International, he responded to massive floods in Mozambique in 2000. He also flew a Bell 407 for Air Serv after the 2004 Boxing Day Tsunami in Southeast Asia, and supported Médecins Sans Frontières, flying an Airbus AS350 in Pakistan after the 2005 Kashmir earthquake.

Shortly afterwards, Gary Blain of Billings Flying Service in Montana was in the process of acquiring a U.S. Army surplus Bell UH-1H Huey for a friend of Jackson's when he suggested that Jackson buy one as well. Jackson sold three of his small planes to make the deposit on the Huey, then traveled to the States to seal the deal on the aircraft.

After extensive maintenance and restoration work, the aircraft started its first season of firefighting in late 2006. Beginning

in 2007, it was subcontracted to the government-funded fire management agency Working on Fire, with Jackson flying the helicopter under Working on Fire's operating certificate. He later acquired a second UH-1H.

Over the next decade, the Hueys would fly a combined 3,000 hours on fires, with Jackson flying around 2,200 of those himself. But he began to grow increasingly concerned about reliability and parts availability for the 1960s-era helicopters — and reluctant to see his two sons, both of whom fly, follow him into these legacy airframes. "The Hueys are phenomenal, but it is an aging fleet," he said.

When Blain suggested that he consider a surplus Sikorsky UH-60A Black Hawk from the U.S. Army's Black Hawk Exchange and Sales Team (BEST) Program, Jackson was receptive. Not only did the Black Hawk represent a tremendous leap in performance and capability over the Huey, it also featured a fully articulated main rotor, crashworthy build, and redundant systems.

"Your safety margin is hugely increased," he said. "The fact that I have two sons that have grown up in the industry [meant] the decision wasn't hard to make."

As an approved bidder in the BEST Program, Billings Flying Service acquired the aircraft from the Army and obtained a Federal Aviation Administration (FAA) restricted category type certificate for it. Then, Leading Edge began the process of acquiring the aircraft, a complex process that required U.S.

Cont'd on p.94

1 // Like his father, Peter Jackson is an aircraft maintenance engineer as well as a pilot. **2 //** Everyone at Leading Edge works hard to keep the Black Hawk looking and flying its best. **3 //** The Leading Edge team is small but passionate. It includes, from left, Peter Jackson, Tosh Ross, Mark Jackson, and Ryan Vermooten.


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RESPONDING **TO IDAI**

PHOTOS COURTESY OF LEADING EDGE AVIATION

In mid-March of this year, southeast Africa was hit by Cyclone Idai, an intense tropical cyclone that caused severe flooding in Mozambique, Zimbabwe, Malawi, and Madagascar. At press time, more than 1,000 people were reported to have died as a result of the storm, with thousands more missing and millions impacted by the resulting damage.

Leading Edge Aviation's Sikorsky UH-60A Black Hawk and Bell UH-1H Huey were on government firefighting contracts in Stellenbosch, South Africa, when the company was contacted by the Zimbabwean telecommunications company Econet Wireless. Econet had partnered with the Bill & Melinda Gates Foundation and Richard Branson, among others, on a humanitarian response to Idai, and was seeking helicopters to deliver much-needed aid to remote communities that had been isolated by mudslides and flooding.

Following intergovernmental negotiations, Leading Edge was released from its firefighting contracts 10 days early. The aircraft and their crews — consisting of three pilots, one mechanic, and one crew chief for the Black Hawk, and two pilots and one crew chief for the Huey — departed directly for Mutare, a city in Zimbabwe's eastern highlands, where a staging area had been set up for relief operations. There, they joined four other civilian helicopters (two Bell 407s, and two Airbus AS350s) as well as two Agusta Bell 412s and an Airbus Alouette III from the Air Force of Zimbabwe.

A central command post in Mutare was staffed with representatives from the Air Force and participating nongovernmental organizations, who allocated aircraft to specific missions. According to Leading Edge's Peter Jackson, the load-carrying abilities of the Black Hawk and Huey made them preferred for moving supplies, while the smaller helicopters were used to transport doctors and other aid workers.

Many of the affected mountain communities had no landing areas suitable for the Black Hawk, so it flew most of its cargo in one of three nets at the end of a 170-foot long line. Jackson said the crews quickly found an efficient rhythm: "We would take a full net out, and by the time we came back we would drop that first one off, pick up the next full load and then take off again. So we were able to really leapfrog on that and that kept our RPMs up all the time. One day we did nine hours in a day between the three [Black Hawk] pilots, with only one start and one shutdown."

The Black Hawk also performed one medevac mission involving two babies who had been critically injured in a building collapse. Along with their mothers and an attending doctor, they were flown to Mutare for transfer to a local hospital.

Jackson described the operations in Zimbabwe as "incredibly rewarding" and "what helicopters were made for." Pioneering helicopter designer Igor Sikorsky, who always emphasized the lifesaving potential of his machines, doubtlessly would have agreed.

Leading Edge's Black Hawk and Huey delivered 135 tons of aid over a six-day period in March.

Catastrophic flooding and mudslides in the wake of Idai left many thousands of people stranded. Helicopters were an efficient way to deliver food and medical supplies to isolated communities.

For Leading Edge founder Mark Jackson and his son, Peter, being able to help people — whether through disaster relief or firefighting — is the most rewarding aspect of their jobs.

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Cont'd from p.90

State Department approval. "The fact that we had been operating ex-U.S. military aircraft boded well for us," Jackson noted.

While that process was under way, Peter Jackson and another pilot, Tosh Ross, traveled to Billings Flying Service for flight training in the UH-60A, receiving FAA type ratings that were accepted by the South African Civil Aviation Authority (CAA). The maintenance team of Peter Jackson and Peter Fetting then completed initial maintenance training through Flightsafety International in West Palm Beach, followed by a second maintenance course presented in Mbombela by Billings Flying Service.

Once the aircraft was approved for export, it was inspected by a CAA delegation; shipped by sea to the port of Durban; then underwent another inspection by the Armaments Corporation of South Africa before being reassembled, painted, and granted a CAA restricted category type certificate.

"The fact that it would be the first of its type meant that it would be a massive challenge, especially in a remote place like South Africa," Mark Jackson said. Peter took the lead in coordinating all of the necessary approvals.

"I've been investing a lot of time in the paperwork side of things," Peter acknowledged when *Vertical* visited Leading Edge last October. Beyond the critical support from the CAA, he said, Billings Flying Service was instrumental in pushing the process to a successful conclusion.

"We've worked so closely with Billings," he said. "Without their continued input and support, it wouldn't have come together."

SELLING THE VALUE PROPOSITION

But getting the aircraft to South Africa was only half the battle. The other half was convincing local industry that it was needed. Observed Ross, "Everything is so tight. Everyone is trying to squeeze the best bang for the buck."

Ross is an experienced helicopter and fixed-wing pilot who spends much of his time flying Boeing 737 freighters; although he had largely exited the world of aerial firefighting, he was drawn back into it for the chance to fly the Black Hawk. "For me, this was a great opportunity to get involved in something really new," he said.

As Ross explained, there has been some sticker shock asso-

1 // According to the Jacksons, much like other parts of the world, South Africa is starting to see larger wildfires and more extreme fire behavior, reinforcing the need for capable firefighting aircraft to protect lives and property. **2 //** The Black Hawk's two-person cockpit provides an opportunity to mentor pilots who are new to firefighting. **3 //** Billings Flying Service has offered invaluable support to Leading Edge over the years — contributions honored with this Montana flag in the Leading Edge hangar. **4 //** Mark Jackson has logged over 2,000 flight hours in Hueys, mostly in firefighting operations. "The Hueys are phenomenal, but it is an aging fleet," he said.

4

ciated with this larger, more capable aircraft, particularly in the firefighting world. However, more people are starting to realize that while the Black Hawk may be twice as expensive as the Huey, it can carry three times as much water — making it a more effective asset in the long run.

"It's an expensive aircraft if you look at it from an hourly rate. But you have to look at what it can do in an hour," he said.

The first customer to take a chance on the Black Hawk was Sappi, a pulp and paper company that contracted the aircraft to be on standby for firefighting. Forestry is big business in Mpumalanga province, and Sappi is one of the largest private companies that have found it worthwhile to invest in these types of contracts as an insurance policy for their timber stands during the dry season.

"They really threw us a lifeline by offering us an initial two-month contract," said Mark Jackson. "Sappi gave us the opportunity to show the aircraft at work." Sappi was sufficiently impressed to offer Leading Edge additional work through the local fire protection agency for the upcoming fire season.

In February 2019, the Black Hawk was contracted by Working on Fire for the fire season in Western Cape province. A month later, it deployed to eastern Zimbabwe to assist in the response to Idai, an intense tropical cyclone that caused catastrophic flooding there and in Mozambique, Malawi, and Madagascar.

At press time, both the Black Hawk and Leading Edge's Huey had just returned from moving medicines and supplies to communities cut off by floods and mudslides. The two helicopters delivered 135 tons of lifesaving supplies in just six days — similar to the type of work that Mark Jackson did in Mozambique in 2000.

For Jackson, this type of work is exactly why he wanted to introduce the Black Hawk to Africa's civil helicopter industry.

Despite the Black Hawk's greater capabilities, the Jacksons still believe there's a future for Hueys in the industry, "as long as your maintenance is good and your parts are procurable," said Peter Jackson.

"I absolutely love helping people," he said. "I think one of the things you see, particularly with firefighting, you always see the best in people."

While South Africa can be a challenging place in which to run an aviation business, Jackson said that, given a choice, he would prefer to stay close to home than pursue more lucrative contracts far away. "We would rather earn less and stay in South Africa where we can help our people," he said.

LOOKING AHEAD

Leading Edge began flying the Black Hawk on the operating certificate of Henley Air, a well-known South African helicopter operator, based in Johannesburg, with whom the Jacksons have an established relationship. However, the company recently obtained its own operating certificate, aimed specifically at the firefighting and utility market.

Ultimately, Mark Jackson said he would like to replace his remaining Huey with another Black Hawk. "I'm wanting to usher in a new generation, a new chapter," he said.

Leading Edge flies its Black Hawk with two pilots and a crewmember in the back, a configuration that is proving helpful in ushering in that new generation. Flying with Ross, Peter Jackson has been able to learn the finer points of aerial firefighting from a more experienced pilot.

"It's a risky business, but you can mitigate that with the right selection and training," said Ross. With the Hawk, "we've got a great opportunity to train people like Pete, where they can learn things through hands-on experience."

"The other thing that's good from a dad's point of view [is] that you have two sets of eyes watching out for dangers," added Mark Jackson, remarking on the wire hazards that are particularly prevalent in the Cape region. "What I'm enjoying is that this is a new generation airframe, with the younger generation flying it."

Leading Edge still has its work cut out for it in learning the finer points of the Black Hawk, and in maintaining it half a world away from the rest of the global fleet. There's also still work to be done in persuading customers of its value proposition. But everyone involved with the aircraft is optimistic.

"It's a small team," said Ross, "but when everyone's pulling in the same direction and has the energy, there's nothing you can't achieve."

Elan Head | An award-winning journalist, Elan is also an FAA Gold Seal flight instructor with helicopter and instrument helicopter ratings, and has held commercial helicopter licenses in Canada and Australia as well as the U.S. She is on Twitter @elanhead and can be reached at elan@mhmpub.com.

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When it comes to moving the instruments of industry into high terrain, Airgreen proves that the helicopter is in a league of its own.

STORY BY JON DUKE // PHOTOS BY LLOYD HORGAN

A Leonardo AW139 from Airgreen's Turin EMS base at Turin Aeritalia Airport takes part in a training flight.

WATCH **VIDEO**

An Airbus AS350 B3 returns to the Aosta Valley base following a day spent lifting sections of pylon.

Buttressed against some of the most severe peaks that the Alps have to offer, Piedmont (literally meaning "at the foot of the mountains") in northwestern Italy is home to flourishing agriculture, commerce, and tourism industries. Whether through ski-lifts or hydroelectrics, treating the mountains as an opportunity and not a barrier has been the key to the region's success.

Among the earliest to foresee the opportunities for aviation here were Giuseppe and Mauro Airaudi, the owners of a forestry business whose crop extended across the alpine foothills. Recognizing the potential for aircraft to prevent losses incurred to wildfires, the brothers began to research aerial firefighting in 1986. Realizing that helicopters were well-suited to their particular environment and mission, they began exploring the additional utility of their newly-purchased Aérospatiale Alouette II.

"In the beginning, my father and my uncle used the helicopters in the mountains to move loads, or for hydroseeding fire-damaged areas," Ivo Airaudi, Mauro's son, told *Vertical*. "We started with the Alouette II, but even as a child I remember thinking that the [Aérospatiale AS315B] Lama was much more powerful. When we eventually bought our first Lama, we really started to increase our activity, not just for ourselves, but for other clients."

Soon, other local companies were expressing an interest in contracted lifting work, and after the purchase of another Lama, the brothers established a separate entity to service the burgeoning requirement. Airgreen was born, and before long, the company was signing contracts to support domestic onshore oil-and-gas exploration.

"We are still operating in the onshore oil-and-gas sector," said Ivo Airaudi, who serves as Airgreen's crew training post-holder and chief pilot. "Only now it is overseas in places like the Balkans."

In 1995, after nearly 10 years of operation, the leadership felt confident enough to take advantage of circumstance and opportunity, buying part of another organization that had been providing rescue services in the neighboring region of Valle d'Aosta.

BRANCHING OUT

With the purchase came more aircraft (Alouette IIIs, Lamas and Agusta-Bell AB412s) and the responsibility to fulfil the rescue services contract in Italy's most mountainous region, home to Mont Blanc — the highest peak in Europe — and the infamously lethal Matterhorn. Both stand among other nearby peaks at over 14,500 feet (4,400 meters), and the area is popular with hikers and climbers in the summer, and skiers in winter.

With its helicopter emergency medical services (HEMS) and rescue credentials established, Airgreen was awarded contracts in Piedmont and the island of Sardinia in the Mediterranean.

"Flying rescue operations in the alpine environment is very challenging," Airaudi said. "In our company, we try to keep in mind all the experience that we gained flying aircraft like the Lama, and use that experience to really enhance the capability of the more modern aircraft that we operate now."

The more modern aircraft arrived in the shape of the Leonardo AW139 in 2006, just in time to support the Winter Olympic Games in Turin. Since then, Airgreen has acquired a further five AW139s (including a long-nose variant), alongside an AW169 and two H145s, all for the rescue and HEMS role.

Task specialist Edoardo Barberis attaches a long line for an underslung load.


The view out of the cockpit of an Aérospatiale SA-315B Lama approaching the Graian Alps.

The Lama performs an aerial lifting job in the Graian Alps.

"We have a big problem in this company," Airaudi said. "We are driven by passion. So, we would really like to have all the best helicopters on the market so that we can enjoy flying them!" There is a serious note though, as he explained: "While that costs more in training and spares, it enables us to cope with all [the] types of rescue that we perform here in Italy, which usually involve several casualties. . . . So we need helicopters that can carry all these people, at high altitude and in difficult weather conditions."

Both the AW139 and AW169 are fitted with medical interiors by Aerolite, with the H145 interior provided by Macær Aviation Group (MAG). The aircraft are also all equipped with a single hoist, a backup unit being superfluous and likely not worth the additional weight for onshore rescue scenarios, particularly in the mountains where performance is at a premium.

Airaudi is obviously proud of the capability that the variety of aircraft bring to the company's diverse operational environments.

"We are now using all the best aircraft available on the market for rescue operations across seven different bases," he said. "And we have a new contract that started this year in Sardinia where we use an AW139 and two H145s."

All of these aircraft are fully instrument flight rules (IFR) capable, with advanced levels of automation already integrated into their avionics. But, as with many technological advances in aviation, systems designed to improve safety can usually also provide plenty of opportunities for trouble — especially when combined with high terrain and inclement weather.

For this reason, Airgreen has also fitted helicopter terrain avoidance and warning systems (HTAWS) to all its IFR-capable machines, as well as various combinations of synthetic vision, Leonardo Helicopters' obstacle proximity LIDAR system (OPLS), and enhanced vision systems. These systems increase the crews' situational awareness, particularly in the tricky conditions that exist on the boundary between visual and instrument meteorological conditions. Such conditions abound in the mountains, where a helicopter is capable of creating its own microclimate as it whips the snow up.

Even during transit flying, it is not possible to simply fall back on traditional IFR techniques, as the pilots are severely constrained by high terrain. Alpine transit routes typically rely on either very high-level IFR or very low-level visual flight rules (VFR) operation, with nothing available in between. The Alps force high-level routes, which make descents into hospital landing sites problematic. When your only options are separated by around 9,000 feet (2,740 meters), pilots are often forced to make an early decision between the two that they then find themselves stuck with.

"We are building our capability to work in bad weather," Airaudi said. "Before, our only option was to maintain visual contact with the surface, which places you at high risk. We are hoping soon to validate 12 IFR low-level routes linking all the local hospitals, with LPV point-in-space approaches. This will allow us to fly at higher speed at lower altitudes."

This operation will mirror techniques used by crews in Norway, and is only possible due to the various redundant systems that equip modern helicopters like the AW139, AW169, and H145. It would be unthinkably dangerous in an older type with legacy avionics.

The mixed nature of its fleet no doubt adds to costs, but it also allows Airgreen to provide specific capabilities to suit the variety of environments it operates across. It also provides some mitigation against the risk of fleet-wide groundings.

BACK TO ITS ROOTS

Airgreen's expansion into rescue and HEMS missions has been so successful that these operations now account for up to 70 percent of its work. However, the length of these contracts carries increased exposure to the volatility of the variable costs of meeting them.

"With very long contracts there are a lot of things that can affect the cost of delivery after the price has been agreed," Airaudi explained. "So, you have to be careful how you manage it, because in the end you have to provide a quality service."

This is perhaps one reason that Airgreen has been determined to maintain and expand its utility role. The shorter-term nature of these tasks provides some ability for the company to absorb cost variations elsewhere, but shrewd decision-making is still essential. One such decision was the acquisition of Airbus Helicopters AS350 B3 AStars. While a more modern design than the Lama, careful decisions still have to be taken about which aircraft suits which task.

New pilots are usually expected to cut their teeth utility flying before progressing to rescue and HEMS, with 1,000 hours the typical minimum experience, starting on firefighting duties that demand less precision than sling-loading in the mountains. The training system is fluid but progressive, said Airaudi.

"Pilots usually will be experienced in sling-loads in less complex aircraft before they move on [to other types]," he said. "Doing this, they spend long periods of time flying in specific mountain areas, learning the weather systems in an aircraft that is close to its maximum all-up mass. They learn all the secrets of the mountains, and when they move on to rescue flying, they will go back to the same places, so they know what to expect."

There are always exceptions, though, and Enrico Salvadori is one. Having been inspired to pursue a career in aviation watching Airgreen's helicopters, he trained in Canada before returning to Italy with some utility experience. His passion no doubt helped him secure a job with Airgreen on his return.

> *"Since flying the more complex aircraft, I have really fallen in love with IFR flying, because the technology reduces the workload so much. However, the hardest part of being a rescue pilot is being able to say 'No' when the risks are just too great."*

An AStar helps rebuild some pylons after they were damaged by a storm in the area.

Airgreen helps keep refuge huts in the Italian Alps supplied to endure the winter.

"I grew up watching the Lamas and B3s in the valley, and I dreamed about maybe one day flying that helicopter," he told *Vertical*. "I would go skiing and see the helicopters come and get injured people out, and that was what I wanted to do. I know I'm really lucky to do this."

Offered a co-pilot position on the AW139 from the outset, he was enthusiastic about the opportunity to fulfil his ambition to fly in that role.

"I always thought that flying HEMS would be something for the other end of my career," he said. "I'm really thankful to be able to do it now, and I'm flying with pilots with a lot of experience, so I have a long time still to learn and to become as good at it as I can."

THE HEART OF THE COMPANY

Even before the arrival of more modern aircraft, the variety of types and the hard-working nature of Airgreen's tasks made it sensible to conduct maintenance in-house. Providing a sustainable and engaged engineering workforce is critical to the ongoing success of the company, as Airaudi is keen to point out.

"Maintenance is a core priority, because better planning of maintenance will result in better aircraft availability," he said. "So, we have invested in certification so that we can take young people who aspire to be aviation engineers and train them from the very basic skills."

Airgreen's European Aviation Safety Agency (EASA) part 147 certification enables it to provide training right from the basic principles. Once qualified, the engineering team integrates into the delivery of operations. A core part of their professional development involves working with pilots and aircraft on-task, particularly during sling-load operations in confined areas where they perform the "task specialist" role.

A crew performs a pinnacle landing during a training exercise with the medical team.

As a pilot who has taken up a HEMS role early in his career, Enrico Salvadori is enthusiastic about other possibilities.by a recent storm in the area.

While comfortable operating with night vision goggles, Airgreen is not yet conducting unsurveyed NVIS field landings.

New pilots are usually expected to cut their teeth flying utility operations before progressing to rescue and HEMS.

"This teaches all the necessary skills to provide safety-critical information to pilots, and familiarizes them with the requirements of the pilot when maneuvering the aircraft in tight confines," said Airaudi. The ultimate end-point of this training is qualification as a HEMS technical crewmember and hoist operator.

This provides a clear and well-defined career arc for those joining the company with aspirations to work with the aircraft on-task, as well as those wishing to take on the responsibility of keeping the fleet airworthy.

The head of Airgreen's maintenance department is Massimo Marchino. Alongside supervising the regular maintenance schedule for the company's diverse array of aircraft, Marchino has recently been coordinating with night vision imaging system (NVIS) specialists ASU Inc of Boise, Idaho, as it carried out the modification of two AW139s to NVIS compatibility. This adds greater capability to already well-equipped aircraft, but expanding their envelope into NVIS operation is something about which the company is rightfully cautious. While comfortable operating with night vision goggles, they are not yet conducting unsurveyed NVIS field landings.

Marchino's domain is Airgreen's maintenance hangar, built in 2017 to satisfy the increasing demand for maintenance services from third parties, including the Carabinieri (Italy's militarized police force) and the Vigili del Fuoco (the national firefighting service). With several AB412s occupying hangar space, Marchino explained that the they are often leased to customers overseas as the AStar is preferred for domestic firefighting.

"The 412s that we leased for firefighting duties in Spain are now back," he said. "So we need to understand how the aircraft have been used, and there will also be a package of maintenance to prepare them for storage."

The 412s are fitted with health and usage monitoring systems (HUMS), greatly reducing the man-hours required to conduct work-intensive activities.

"When we have to correct the main rotor track and balance, HUMS measures certain parameters in flight, and collects the data, which is downloaded the flight," said Marchino, "and the computer gives the necessary correction to balance the drive system. I estimate that HUMS provides a time saving of at least 60- to 70-percent compared to doing it manually."


Both the AW139 and AW169 are fitted with medical interiors by Aerolite.

The man-hours saved are even more meaningful considering the additional roles that the maintenance personnel carry out as task specialists.

THE SECRETS OF THE MOUNTAINS

While the mountains guarantee demand for Airgreen's expertise well into the future, this competitive marketplace will not reward complacency or overreach — and the company is particularly cautious about long, fixed-price agreements.

"We aim always to provide a high quality of service," said Airaudi. "If you grow too quickly it becomes difficult to maintain the correct culture, so we desire to grow more slowly."

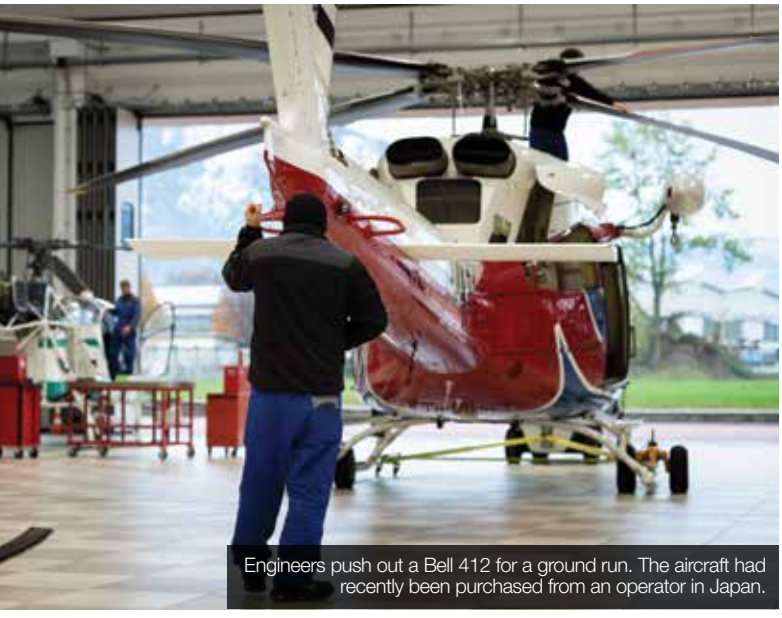
Instilling the company ethos in new team members isn't always easy. Airgreen's approach of providing meaningful career opportunities will no doubt help to retain its skill-base, and the variety of work obviously appeals to both the technical staff and the aircrews. As a pilot who has taken up a HEMS role early in his career, Enrico Salvadori is enthusiastic about other possibilities.

"I would like to experience sling-load operations and firefighting," he said. "With Airgreen, you can move around between jobs and become a more complete pilot, with a greater variety of skill and experience."

The variety of the work is matched by its demands, whether sling-loading among the mountain peaks in the austere Lama, or using the latest avionics to find safe passage through foggy valleys with a casualty; a challenge about which Airaudi is enthusiastic but clear-headed.


NVIS specialists ASU recently carried out the modification of two AW139s to NVIS compatibility.

The company's maintenance hangar, which was built in 2017 to satisfy the increasing demand for maintenance services from third parties.



Engineers push out a Bell 412 for a ground run. The aircraft had recently been purchased from an operator in Japan.

A Leonardo AW139 in Airgreen's maintenance facility at their main base in Cafasse.

A hoist-equipped Bell 412EP completes maintenance checks in the hangar.

"Since flying the more complex aircraft, I have really fallen in love with IFR flying, because the technology reduces the workload so much," he said. "However, the hardest part of being a rescue pilot is being able to say 'No' when the risks are just too great."

Northwestern Italy is a cultural, commercial and agricultural powerhouse, and helicopters have been instrumental in allowing these industries to exploit the mountains that might otherwise have constrained them. Among the first to see the potential of aviation to safeguard their business, Airgreen has laid down firm roots to grow beyond regional and national boundaries. It is hard to imagine a company that has been more central to providing the mountain access that is so vital to the success of the region.

Jon Duke & Lloyd Horgan | Vortex Aeromedia provides specialist media services for the aviation, defense, and aerospace sector. Formed in 2015 by photographer Lloyd Horgan and helicopter pilot Jonathan Duke, Vortex Aeromedia draws on their unique blend of military aviation and media experience to deliver high-impact film, photography, and writing specifically to the defense and aerospace industry. They have flown with, photographed, and filmed for a variety of international military and civilian clients. For more information visit www.VortexAeromedia.com.

The views afforded to those lucky enough to fly around the Aosta Valley and Piedmont region never fail to amaze.

A task specialist checks that the tail is clear during a landing in a field.

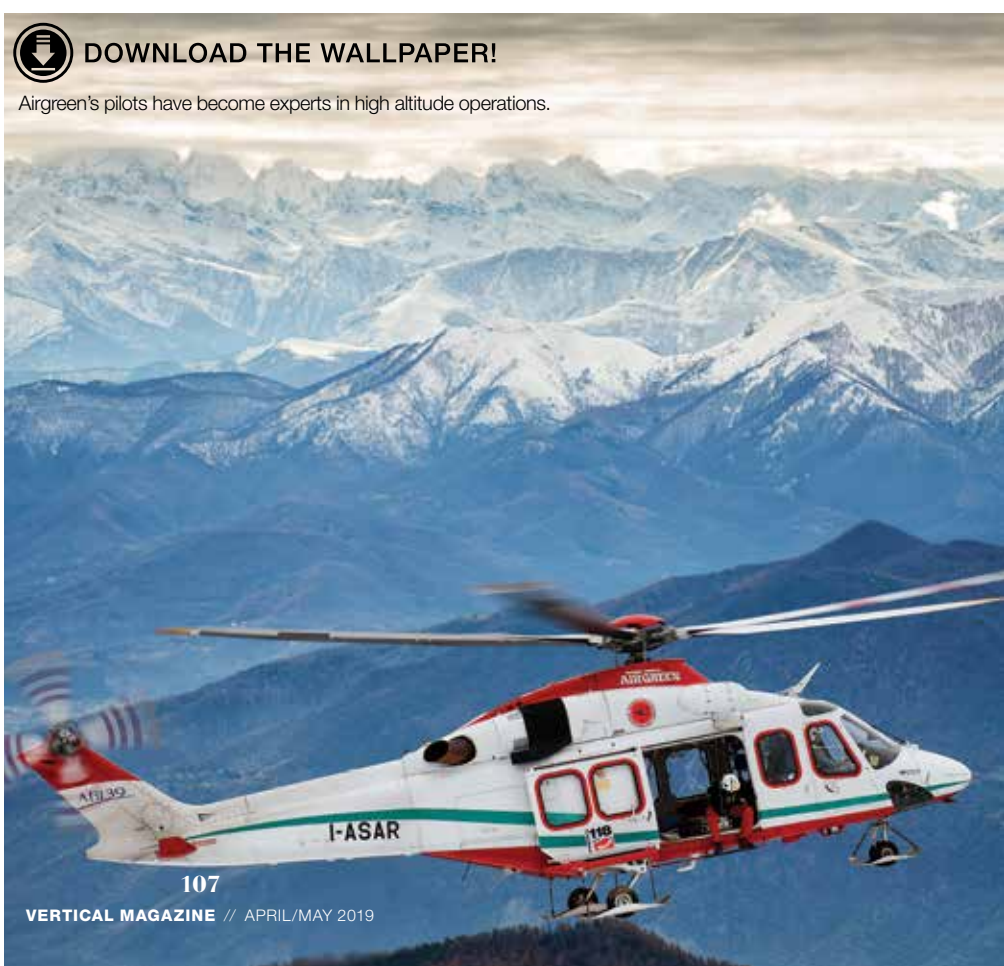
Even with its success within EMS/HEMS, Airgreen is still determined to maintain and expand its utility role.

The sun bursts through the cockpit window of the AS350 B3 from Airgreen's Aosta Valley base.

A task specialist prepares to attach the line for an underslung load of metal girders during a lifting job in the Graian Alps.

DOWNLOAD THE WALLPAPER!

Airgreen's pilots have become experts in high altitude operations.



WHAT DOES A DAR DO?

A Design Approval Representative tells us about his work.

BY MICHAEL PETSCHE

A Bell 412 operated by Wisk Air Helicopters demonstrates a water drop with its 375-US gallon (1,420-liter) Simplex Belly Tank. Like any helicopter customized for a specific mission, it carries a host of modifications that each require a supplemental type certificate (STC). **Mike Reyno Photo**

A Design Approval Representative can help bridge the communication gap that may sometimes appear between an operator and the regulator. **Mike Reyno Photo**

The execution of a project can take many forms, and is dependent on a huge number of factors, including the DAR, the project scope, the resources available, and the end user.

Helicopters are pretty awesome devices. Even when you understand the physics of how they work, it's still a wonder that the combination of whirling bits and pieces can result in flight. These magnificent machines put out fires, string powerlines, erect towers, pluck people in distress from mountains, and save countless lives. But here's the thing: a brand new, factory-spec helicopter right off the production line can't do any of those things. Flip through the pages of any issue of *Vertical*, and in almost every photo, the aircraft has been fitted with some type of special equipment.

A firefighting machine will have a cargo hook for the bucket, a bubble window, an external torque gauge, pulse lights and a mirror. A search-and-rescue aircraft will have a hoist. Air ambulances are filled with lifesaving equipment. And very little of that stuff comes directly from the airframe original equipment manufacturers (OEMs). Instead, this equipment is in place thanks to supplemental type certificates (STCs). As the name implies, an STC is required for an installation that supplements the original aircraft type certificate. It needs to meet all of the same requirements as the aircraft that it's installed upon. Therefore, it must undergo the same kind of testing, analysis, and scrutiny that the aircraft does.

How do regulatory authorities ensure that supplementary equipment meets the same standards as the aircraft they're designed to augment? Through people like me.

I am a Transport Canada Design Approval Representative (DAR), also known as a delegate. A DAR does not actually work for Transport Canada, but is delegated to act on its behalf to make findings of compliance in a particular field of specialty — such as structures, avionics, or as a flight test pilot.

To secure an STC, not only must a modification meet the same standards as the original aircraft, but it has to be shown not to degrade the safety of the aircraft. Let's take the firefighting helicopter as an example. The bubble window needs to be strong enough to withstand the aerodynamic loads in flight. In order to verify this, a structural test can be done on a test rig. However, the bubble window protrudes from the aircraft, resulting in extra drag. It could adversely affect how the aircraft behaves, or reduce climb performance, or have an effect on the pitot-static system. These are the sorts of issues that flight testing is meant to uncover.

Similarly, if someone wants to upgrade an old GPS system to the latest and greatest model, testing must be done to ensure that there is no electrical interference between the new unit and any other existing systems on the aircraft.

A big part of the STC process is determining just how you can prove that a modification meets the regulations. Does it need to be tested or is a stress analysis enough? Or is it a combination of the two — or another method entirely? And on top of that, which regulations are applicable? And furthermore, which version of the regulations needs to be applied? The rules for the Airbus H125, for example, are not the same as for the Bell 429. It's the role of the DAR (with concurrence from the regulator, in my case Transport Canada) to make these kinds of determinations.

While the STC process is technically uniform, the scope can vary widely from one project to another. Changing a seat cushion or changing an engine type can both be STCs. The execution of a project can take many forms, and is dependent on a huge number of factors, including the DAR, the project scope, the resources available, and the end user.

In my current role, I work largely on my own. The process typically begins with me submitting an application to open the project with Transport Canada. I prepare the documents and drawings, and witness and document any required testing. Then I compile it all and submit it to Transport Canada. Through all this, I will rely

It can be a long process to become a DAR, but they are a crucial link the chain to helping modifications go from the drawing board to operation in the field. **Heath Moffatt Photo**

heavily on the end user to provide their insight and expertise — and their facilities. After all, it's their aircraft, and they are the ones who will ultimately be installing, using, and maintaining the STC kit — so it has to make sense to them. Whenever possible, I will have documents and drawings reviewed by the maintenance team to make sure that theory and reality align.

BECOMING A DELEGATE

How does someone become a delegate? In Canada, it begins with an educational requirement. You must have an engineering degree, or have, in the opinion of Transport Canada, equivalent experience. In other words, if someone has many years of applicable experience, they can be eligible to be a delegate, even if they do not have an engineering degree.

A prospective delegate must also successfully complete the Aircraft Certification Specialty Course. This is a two-week intensive course that covers the ins and outs of aircraft certification: type certification, STCs, Change Product Rule and so on. And yes, there are exams!

Next is a one-year working relationship with Transport Canada. The process for becoming a delegate is not uniform, with the one-year timeline more of a guideline than a rule. In my case, it took less than 12 months. Prior to beginning my process, I had the good fortune of working for a talented delegate for many years. He taught me how it "should be done." I was given the opportunity to fly at 170 knots indicated airspeed in AStars pointed at the ground during flight tests; I snapped bolts while piling steel plates onto structures during structural tests; and I wrote numerous supporting reports for many kinds of STCs for many different aircraft types. My mentor is a (sometimes maddeningly) meticulous guy. Everything we did was thorough and correct. So, by the time I was presenting my own work to Transport Canada, it was evident that I already had a pretty firm grasp on the process. As a result, my delegation was granted before a full year.

During the period while I was building my relationship with Transport Canada, my friends would ask if I had to accomplish certain specified milestones or achieve specific "levels." The short answer is: not really. In fact, it's about building trust. It's almost counter-intuitive that in an industry with such strict regulations, granting delegation to someone is, to a large degree, based on a "warm, fuzzy feeling."

Ultimately, Transport Canada must have confidence in the delegate. Let's face it, we are in a business with tight schedules and high price tags. There can be a lot of pressure, financial or otherwise, to meet deadlines — and things can go wrong. Parts can fail under ultimate loading during a structural test. That cursed Velcro can fail the flammability test. And when these things happen, it can be the delegate that incurs the wrath of the angry operator who *really* needs to get his aircraft flying. Transport Canada must have the confidence that not only does the delegate have the technical knowledge and ability, but that they have the intestinal fortitude to stand firm under what can sometimes be difficult circumstances.

There's the somewhat cynical axiom that the only way for an aircraft to be 100 percent safe is to never let it fly. I have heard many tales of woe and misery about people's dealings with Transport Canada and how the regulator was being "unreasonable" about X, Y, or Z. I'm of the opinion that these instances often stem from poor communication — on both sides. This is another area where the DAR can help.

The DAR often acts as a liaison (or translator) between the operator and Transport Canada. Operators don't necessarily

A large part of the STC process is simply determining how you can prove a modification meets the regulations. It's a DAR's job to make this decision. **Heath Moffatt Photo**

A look under the cowling of an Eagle 407HP, which replaces the Bell 407's Rolls-Royce 250-C47B engine with a Honeywell HTS900-2. **Heath Moffatt Photo**

spend that much time studying design regulations. And similarly, Transport Canada engineers may not be fully familiar with the day-to-day challenges and obligations of aircraft operations. As a DAR, I speak the same language as Transport Canada. But I also spend a great deal of time in hangars, so I am also fluent in "aircraft operator." This level of bilingualism can alleviate misunderstandings. And with a little strategic communication, everyone involved can be satisfied a lot sooner.

Not surprisingly, communication and open dialogue between the DAR and the regulator is just as crucial. It has been my experience that Transport Canada *wants* to help get projects completed. They are aviation geeks, just like the rest of us, and they want to "Git 'er done." Because I have developed a solid relationship with Transport Canada, if ever I find myself struggling with something, I can call them and ask for guidance. Obviously it's not their job to fix the issue for me, but they are there to help. Whether they point me at an Advisory Circular that I wasn't aware of, or they draw from their own experience, 99 times out of 100, talking it through with them yields a solution very quickly.

We all want to keep aircraft flying — safely. And we all have our different roles to play. As a DAR, I enjoy being the go-between for the regulatory world and the operational world. The challenge of getting them to work and play nicely together can be pretty fun — and a big part of accomplishing that goal requires earned trust and open communication.

Michael Petsche | Michael Petsche is Transport Canada Delegate, DAR #372. He has been working with aftermarket rotorcraft kits since June 2007, and is now an independent consultant.

Interior Improvement

Aerotex has been looking after helicopter and fixed-wing interiors for the last 25 years, helping make aircraft more comfortable and safer to fly.

STORY BY DAYNA FEDY
PHOTOS COURTESY OF AEROTEX

Jing Xu (top), Carson Chanthyvong (middle), and Nathan Le at Aerotex's facility in Calgary, Alberta. The company has stayed within the family for the last 25 years, founded by Carson's father, Suki, after he immigrated to Canada from Laos.

There are countless hours of work that are poured into the maintenance and completions of the components that make up the insides of an aircraft. Operators rely on the caretakers of these components to enable the smooth and safe operation of their fleets. To help make helicopters and fixed-wing aircraft more comfortable and safer to fly, Suki Chanthyvong started Aerotex in 1994, after immigrating to Canada from Laos.

Starting out with just three employees at a facility in Calgary, Alberta, Aerotex focused initially on crafting and repairing aircraft upholstery; it has now grown into an approved maintenance organization (AMO) with 22 employees and has added both avionics and cargo net divisions.

"We cover all aircraft interiors top to bottom — you name it, we can do it," said Nathan Le, general manager at Aerotex. "And on the cargo net side of the company, we provide seatbelt repairs, any type of refurbishment on seats, [and] custom fittings for special projects."

While the company has grown, it has remained within the family. Suki's son Carson Chanthyvong now serves as Aerotex's president, and general manager Le is Carson's cousin. "We're very family oriented," said Le, "and we care about our customers. We believe that they're also our family . . . and we want to make sure that everything is to their exact needs."

The company is approved to provide services for helicopters across the spectrum of original equipment manufacturers (OEMs) including Bell, Airbus, Sikorsky, Leonardo, MD Helicopters, and Robinson Helicopter Company. Some of the more common aircraft that are brought to Aerotex's facility include the Bell 212, 412, and 206; Airbus AS350 AStars, EC130s and EC120s; and Robinson R22s and R44s, to name a few.

These helicopters, and other fixed-wing aircraft, come to the Calgary AMO from well-known North American operators like Eagle Copters, Alpine Aviation, Longview Aviation, and Viking Air Limited. Le said the company has also branched out globally to companies like Abu Dhabi Aviation and Falcon Aviation, and is looking to become a vendor for a company in the U.K.

Aerotex is AS9100-compliant (an international quality management system standard for the aviation, space and defense industries) and "we are working to make sure that we maintain that status," Le said. It is also one of only a few a companies certified by Transport Canada to provide cargo net, shoulder harness, and seatbelt repairs by performing webbing replacement with special equipment.

Here, Yanling Cai (Ling) sews a seam for the edge of a seat cover.

Thomas (left) and Jason Chanthyvong (Carson's brother) cut fabric out from the company's CNC fabric cutting machine.

Aerotex has worked with the Calgary Police Service Air Support Unit several times to provide various services, like aircraft covers, for its Airbus EC120s — known as Helicopter Air Watch for Community Safety (HAWCS) aircraft.

DOING WHAT IT TAKES

Over the last 25 years, Aerotex has seen over 1,000 helicopters in need of custom interior products or refurbishments go through its facility. But this number doesn't represent every helicopter the company has worked on throughout more than two decades, since the staff will often travel to aircraft owners and operators who are in need of products or repairs.

"Recently, myself and a team member here flew out to Newfoundland, last minute, to go meet with a customer," Le said. "There were some tears in their seat covers, so we flew all the way out there to repair them. That's how much we love our customers."

He said the team will also travel to aircraft owners for custom fitting projects to ensure products fit properly in aircraft and meet customers' specifications, "instead of us just sending [products] out to them." Le added that there's no limitation to the distance the Aerotex team would travel to assist a customer.

Some work is kept in-house, including orders to build certain interior components like seats, for example.

Many of the customized orders that Aerotex receives are to improve safety within and while operating aircraft, Le told *Vertical*.

"I talk with a lot of chief pilots, and they always ask me, 'Will you be able to make this?' And my answer is always, 'Of course I can,'" he said. "So we work closely with pilots, line maintenance [personnel], as well as avionics personnel in helping them find the optimal solution for their aerospace needs."

Aerotex has worked with the Calgary Police Service Air Support Unit several times to provide various services, like aircraft covers and seats, for its Airbus EC120s — known as Helicopter Air Watch for Community Safety (HAWCS) aircraft.

THE WAY FORWARD

"One of our big projects that we're pushing forward right now is getting our avionics department out there," Le said.

On the avionics side, Aerotex focuses mainly on the custom assembly of wire harnesses; the company holds a supplemental type certificate (STC) for a harness kit, and is growing to acquire additional STCs in its avionics division. Le told *Vertical* the company is also working on creating a repair shop at its Calgary facility that caters specifically to avionics.

Within its upholstery division, Aerotex designs and manufactures helicopter covers for all types — something the company has done since its inception. "We make covers for [rotor] blades, engines — everything you can think of to cover a helicopter," Le said.

Being situated in Calgary, Aerotex is familiar with harsh winter

weather, and the company knows many North American operators experience a wide variety of weather conditions, too. It recently started producing covers with winter modifications that feature layered materials — from 3M Advanced Materials — to protect aircraft on the coldest of days.

The well-received cover side of the business is in the process of becoming more efficient as the company is working "vigorously" to digitize the cover patterns in its library to exact measurements with its CNC technology.

"When a customer orders a cover it gets cut on our plotting cable in no time," Le said. "The fastest time I've seen something get cut on there was about 30 seconds, and then it was sewn right away. So with our CNC capability for fabrics as well as metals, woods, etc., we've been able to significantly reduce our lead times."

Le added that Aerotex is now working towards ensuring its patterns are correct as they get inputted into the company's CNC database to speed up the production process as much as possible.

Reduction of lead times is something Le said Aerotex is striving towards as the company is making various improvements. The current average lead time at Aerotex is about three weeks, but the company is hoping to reduce that to two weeks or less. This time is extended for custom orders, however, as this type of work require prototypes to be built first for customer approval.

"Customers will say, 'This is the seat we want, can you make it?' " Le explained. "We're going to make [a prototype] first, and then as soon as they're happy we will proceed with the process."

Aerotex has also recently implemented in-house quality management to ensure every product is inspected before leaving the facility and meets both the company's and the aircraft owners' standards. Le added: "We don't ever want to send anything out that has not met specification."

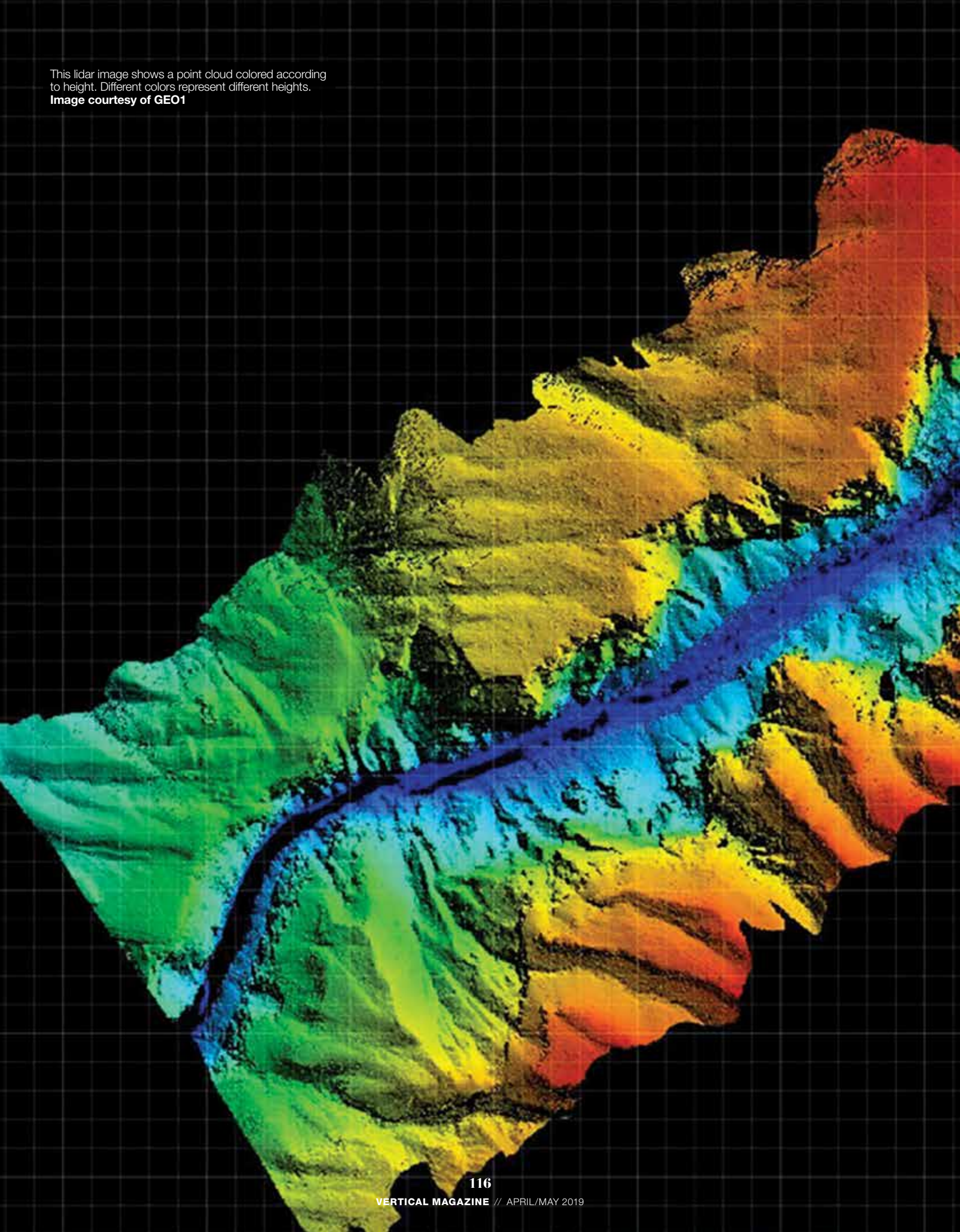
Le said these combined efforts will contribute to the company's ongoing goal of keeping customers happy and aircraft in top form.

"I'm very grateful to the Aerotex team for their unwavering dedication and support as we go through changes within the company moving forward," he said. "I'm also very grateful for our loyal customers; we provide not only superior quality products, but superior relationships as well. We're looking forward to continuing our tradition and growing the company."

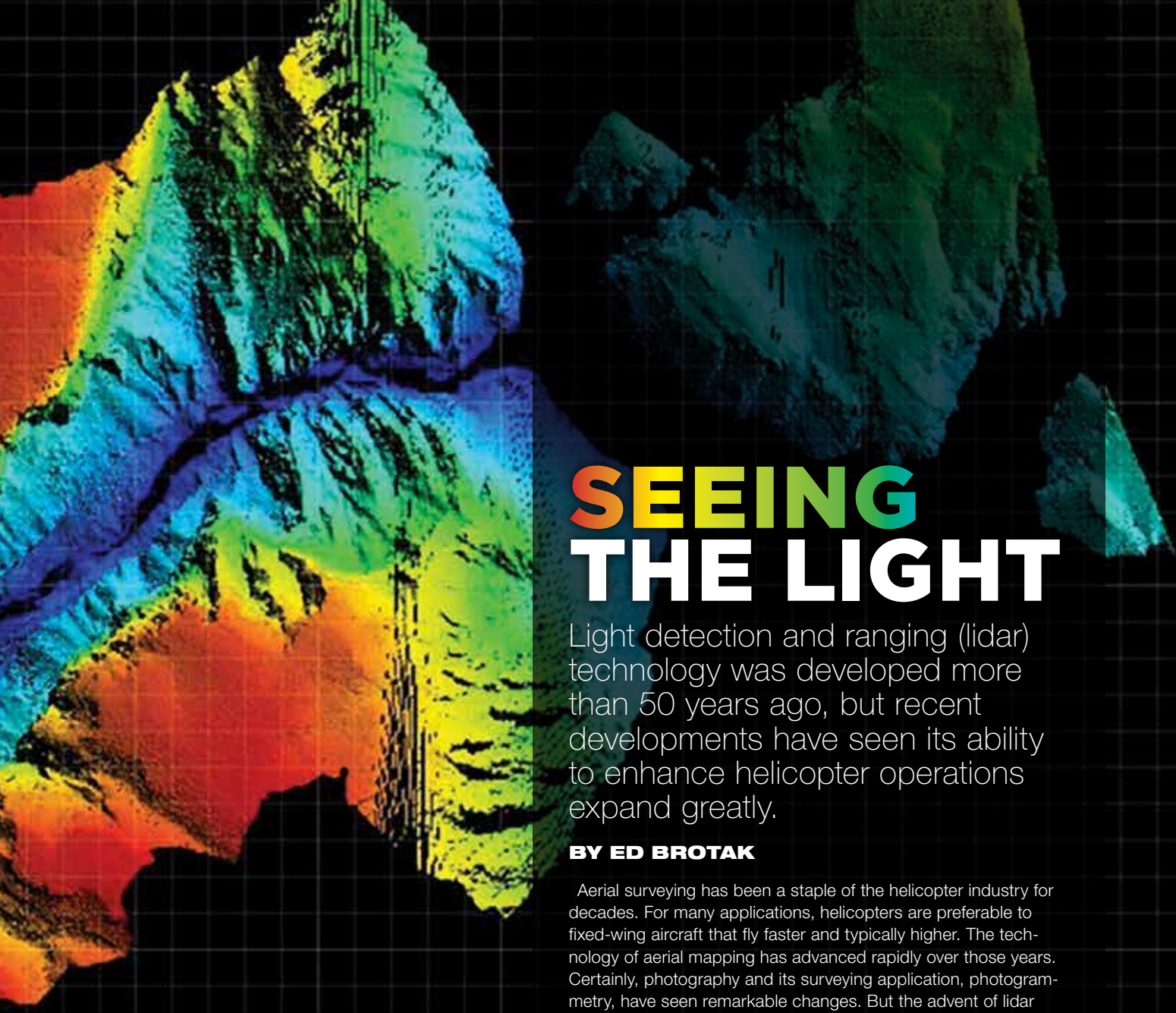
The company has grown into an approved maintenance organization with upholstery, avionics and cargo net divisions.

Xiu Bi Xu (Kelly) sews together a helicopter troop seat cover.

Dayna Fedy | Dayna is junior editor of *Vertical* magazine. She completed her undergraduate degree in communication studies in June 2017, joining MHM Publishing later in the year to pursue a career as a writer and editor.



This lidar image shows a point cloud colored according to height. Different colors represent different heights.
Image courtesy of GEO1



SEEING THE LIGHT

Light detection and ranging (lidar) technology was developed more than 50 years ago, but recent developments have seen its ability to enhance helicopter operations expand greatly.

BY ED BROTAK

Aerial surveying has been a staple of the helicopter industry for decades. For many applications, helicopters are preferable to fixed-wing aircraft that fly faster and typically higher. The technology of aerial mapping has advanced rapidly over those years. Certainly, photography and its surveying application, photogrammetry, have seen remarkable changes. But the advent of lidar (an acronym for light detection and ranging) opened a whole new realm of surveying opportunities, and today, we are seeing that this technology can even make helicopter flights safer.

Lidar was developed in the 1960s. It works on the same principle as conventional radar, in that energy is sent out by a transmitter and some comes back from a target to be captured by a receiver. But by using light, which has a much shorter wavelength than radar microwaves, lidar is much more precise and gives a more detailed, 3D image of the object in question. Concentrated pulses of light from a laser are most effective, with optical sensors detecting the backscattered light. For aerial applications, the amount of time it takes for the light to come back to the receiver can be converted into a distance from the aircraft to the ground or object.

GPS technology, which became more widely available in the 1980s, gave the ability to identify precise locations of the returned light. This yields a data point that includes highly accurate measurements of latitude, longitude, and height from a location on the Earth's surface. Putting all of the surveying information together yields a "point cloud" — a highly detailed image utilizing a very dense grid of elevation points.

Lidar surveying has a large number of applications.

"I've [used] lidar for electrical, gas, landslides, property surveys, coastal erosion, U.S. border and VFX [visual effects]," said Garner Shepard, the lead lidar pilot for Corporate Helicopters of San Diego, California. The company's main lidar customers are utility companies.

Shepard has now been doing lidar surveying for nine years. "The biggest change [over that time] is the size of the equipment," he said. "The older systems were big. Now they can fit on smaller aircraft and even drones. They also put out real time data now so operators can see coverage as they are surveying."

Mike Tully, president and CEO of Aerial Services Inc. of Cedar Falls, Iowa, has been flying lidar survey operations for eight years. He told *Vertical* his lidar jobs include "corridor-type projects," such as road corridor surveys, electrical transmission surveys, oil/gas pipeline corridor surveys, archaeological mapping, and railway surveys.

"Block-type projects — flood plain mapping, environmental mapping, [and] agriculture are 'typically' fixed-wing projects — but helicopters can be used for any of these projects depending on the size and scope of each project," he said.

While Tully said there have been no "major" changes to the technology in the time he's been using it, he said there have been constant incremental improvements. "Sensors are becoming faster, more powerful, [and offer] more features," he said.

Some of the latest lidar scanners can operate from as high as 5,000 feet (1,525 meters) above ground level without reduced quality. "Today, we are beginning to see the first multimodal sensors that combine a camera and lidar sensors into a single sensor and process the data . . . together as one data source," he said. "Many very interesting capabilities are possible with this incremental change."

Among the most recent innovations is the Geiger-mode. "You can think of these as sensors that capture 3D images, where every pixel in the image has an elevation — and X/Y coordinate position — associated with it," said Tully.

ENHANCED CAPABILITIES

Gary Grigsby, president and lidar manager at Western Research & Development

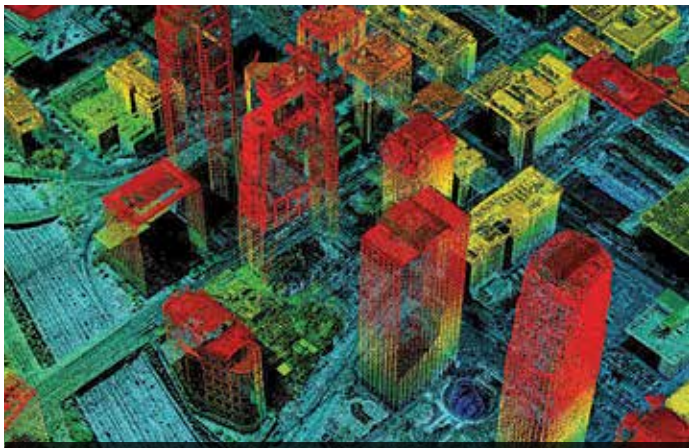
Ltd. of Cheyenne, Wyoming, has been performing lidar surveying for 11 years. His company has used the technology for corridor mapping of railroads, highways, pipelines, and power transmission lines, as well as monitoring of open-pit mines, landfill sites, and irrigation channels. He has also mapped floodplains, refinery and chemical plant sites, and construction sites.

"The [lidar] technology manufacturers are just making it work faster," said Grigsby. But he questions the advantages of more data. "They think more points are better, however, you can only work with so many," he said. "We usually thin the point cloud 60 to 80 percent."

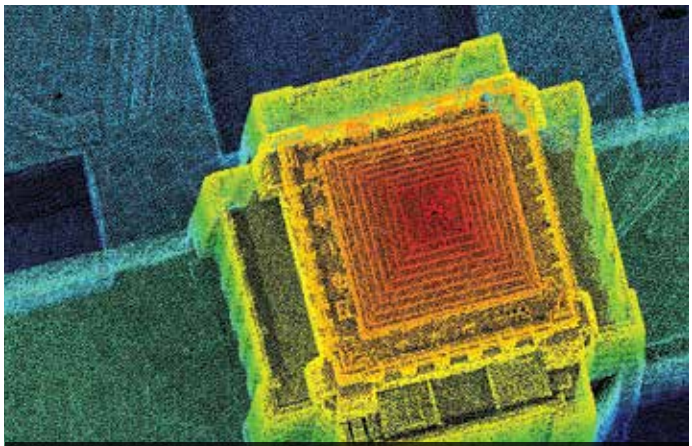
Tully's company does lidar surveying with both manned helicopters and unmanned aircraft systems (UAS). He said a number of factors help determine which application is best. The first is economics of the project — which platform will deliver superior cost performance? Then there are accuracy specifications — which platform is capable of meeting required accuracy specifications and at least cost, factoring in the requirements of ground control? Next, there may be other regulatory factors that might limit either platform, such as flight over people, beyond visual line of sight (BVLOS), or flying at night. Tully said other project specifications might also impact the choice. For example, a UAS may be more appropriate for a project that requires frequent recaptures, a higher point density, or a need for increased accuracy.

Will UAS replace helicopters for lidar applications? "Until we are able to fly BVLOS, there will be plenty of opportunities for [manned] helicopter lidar," said Shepard. "[And] there are some big hurdles that must be overcome for drones to be financially viable. . . . Payloads for lidar, video, and still photography are limited and, most importantly, the battery cells are still limited to a short amount of time in the air."

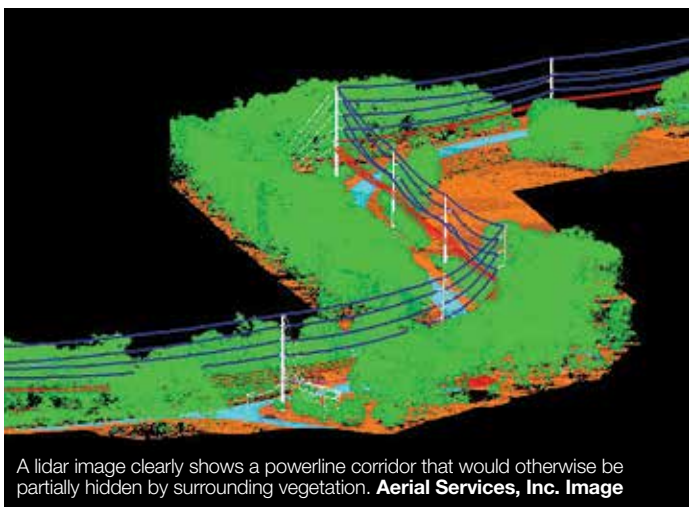
Shepard said his team often travels hundreds of miles on a line, and can do usually 40 miles of survey in an hour with a helicopter — much more efficient than a drone. "Terrain and altitude are



Here, lidar gives a spectacularly detailed 3D representation of a cityscape. **Image courtesy of GEO1**



Lidar can be used to map all kinds of things, from highways, to pipelines, to construction sites. **Image courtesy of GEO1**



A lidar image clearly shows a powerline corridor that would otherwise be partially hidden by surrounding vegetation. **Aerial Services, Inc. Image**

The size of lidar technology means manned aircraft still often represent the most appropriate choice for utilizing it. **Aerial Services Inc. Photo**

also a big factor, [as] drones are very limited at high altitude, with strong winds and areas with no roads," he added. "They are good for small jobs where the initial set up for a heli would be more expensive."

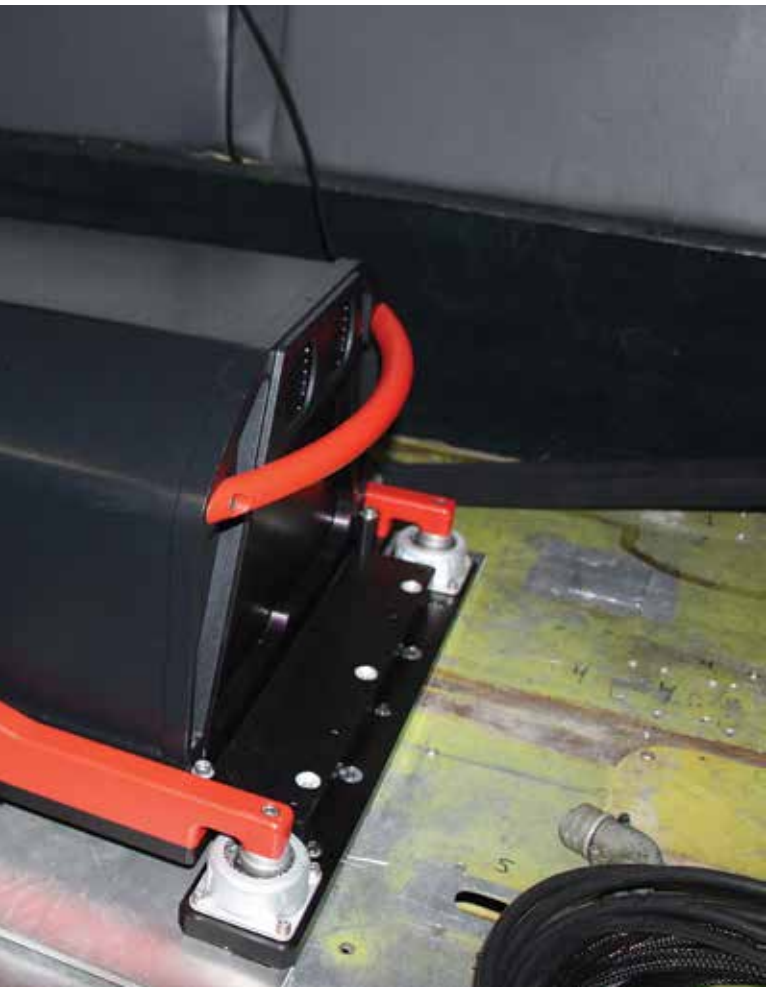
Grigsby agreed, saying dones will need to be able to fly for a longer time between recharging before they can compete against a helicopter in all operations. "Right now, they can do about 30 minutes max," he said. "Large areas will still need to be done by real aircraft. It will probably take several more years before batteries are capable of longer durations, [and] they will also need to get lighter. The more weight, the shorter time off ground. The bigger the batteries, the bigger the drone — [and] the bigger the drone, the more problems they will have with the FAA [Federal Aviation Administration] allowing them in the air."

IMPROVING SAFETY

Lidar technology has also been used to improve helicopter safety. For example, Leonardo's Obstacle Proximity Lidar System was created to warn pilots of potential main or tail rotor strikes when they are moving or hovering in confined areas. In the system, multiple lidar sensors give a 360-degree representation of obstacles up to 80 feet (25 meters) away, such as wires, posts, or walls. A representation of these hazards is then projected on a display. This capability is extremely useful when sight is limited, and is particularly well suited for search-and-rescue and emergency medical services operations.

One problem that can affect all aircraft, regardless of configuration, is turbulence — and lidar may also be able to help warn us of this.

The most insidious kind of turbulence, clear air turbulence or CAT, can often strike without warning. The most publicized incidents involve large passenger jets typically flying at or above 30,000 feet (9,150 meters), but this doesn't mean CAT is restricted to high flight levels. Turbulence can occur throughout the atmosphere — basically anywhere the wind is blowing.



Lidar, which uses the extremely short wavelengths of light waves, should, in theory, be able to detect the minute particles in the air that would be moving with cloudless turbulence. The Doppler effect — the change in frequency of a wave as an observer moves toward or away from an object — is the basis for Doppler radar, but it also works for light. The wavelength of returned energy will change if the encountered target is moving. Doppler lidar is already being used at various airports to detect and warn of wake vortex turbulence. Therefore, Doppler lidar should be able to detect CAT while aloft.

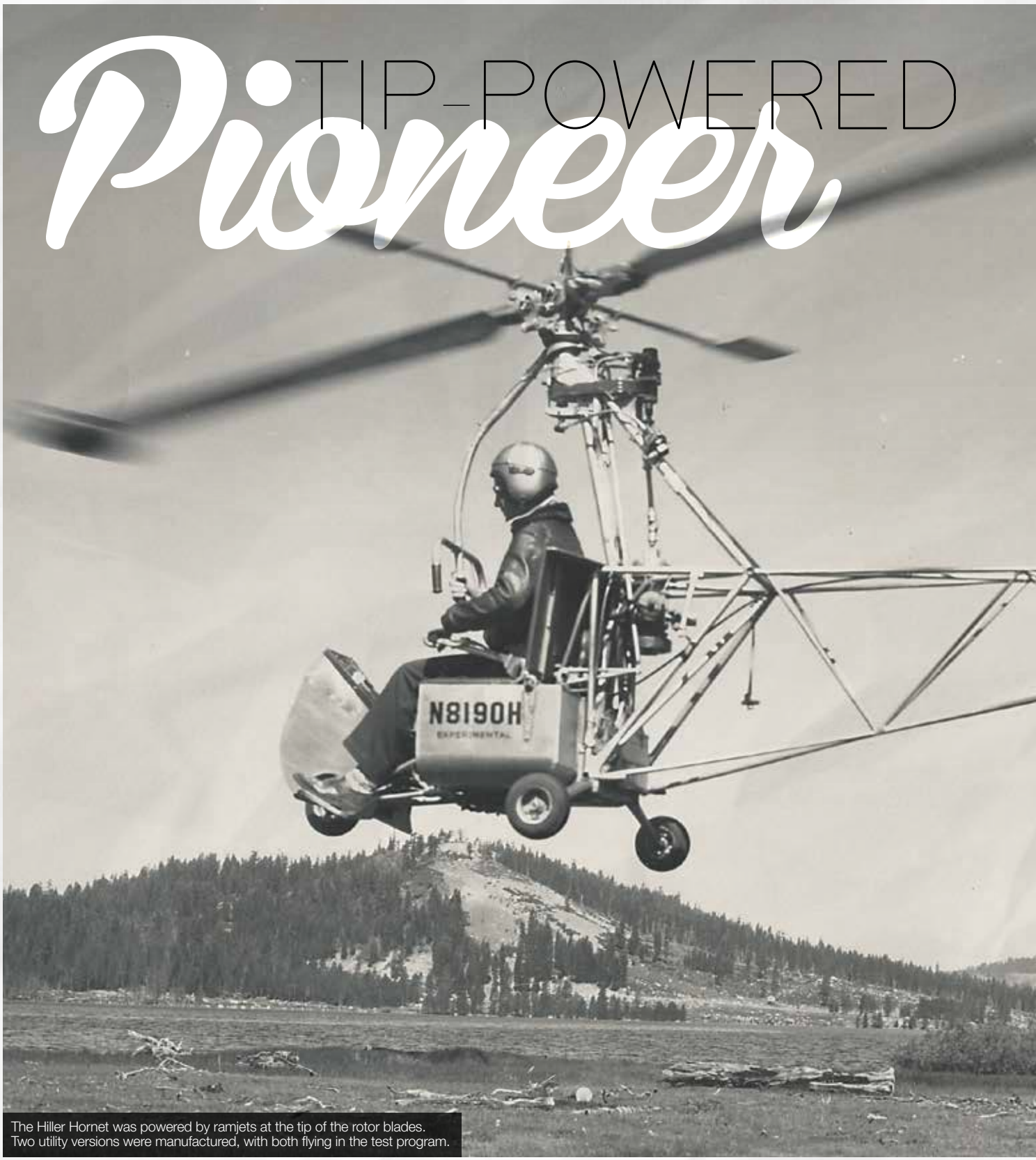
For years, engineers have tried to develop a lidar system capable of detecting CAT for aircraft, both fixed-wing and helicopters. One drawback has been getting the system small enough and light enough to be practical. Last year, Boeing and the Japan Aerospace Exploration Agency (JAXA) began flight testing a 185-pound (84-kilogram) lidar-based instrument that can detect CAT about 10 miles (16 kilometers) away on board Boeing's eco-Demonstrator — a 777 freighter. If this technology proves successful, a version of the system could potentially be developed for helicopter usage.

Ed Brotak | Ed Brotak, Ph.D., is a retired professor of atmospheric sciences at the University of North Carolina, Asheville. His specialties include weather effects on aviation, marine operations, and ground transportation.

The Hiller Hornet

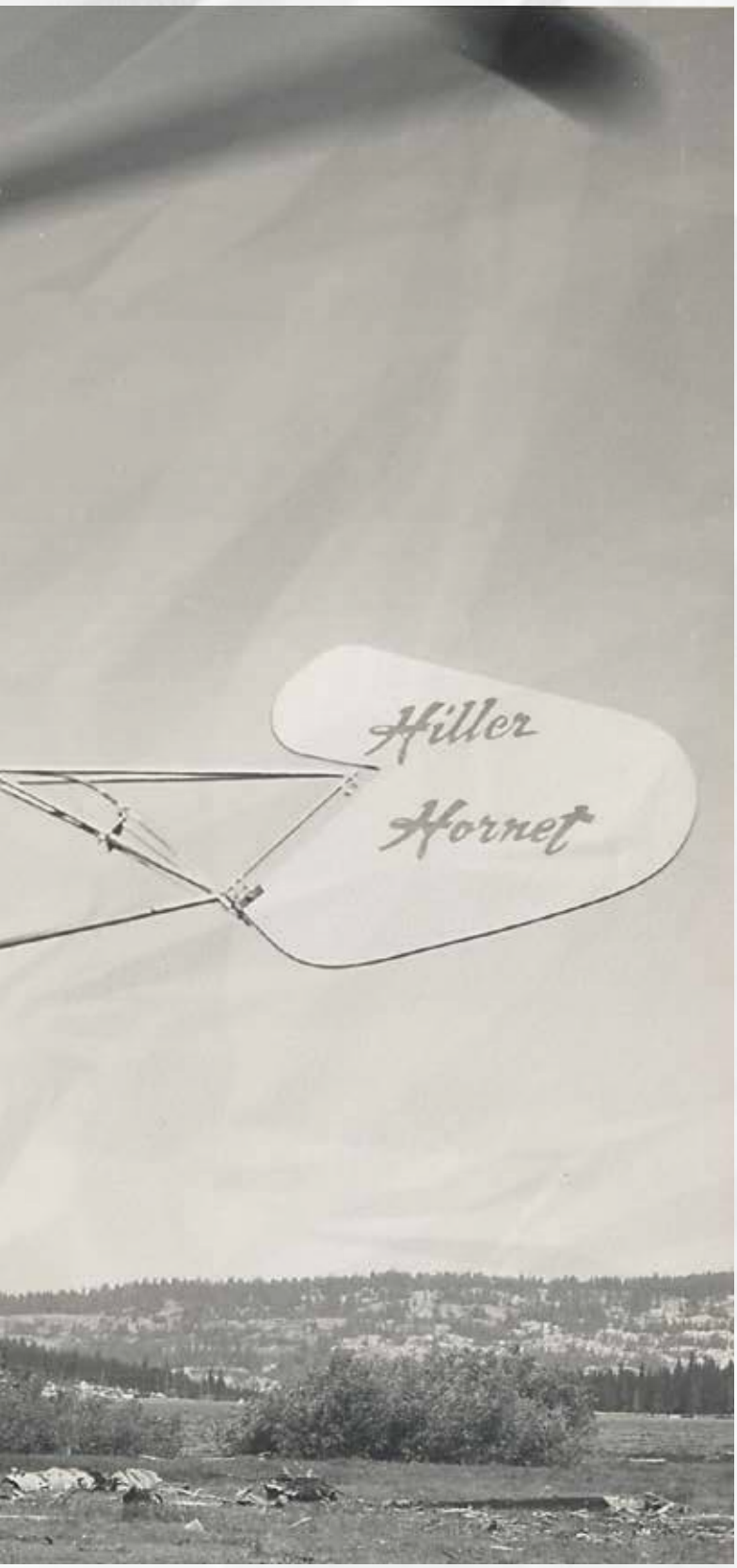
written by Bob Petite // photos courtesy of the Jeff Evans Collection

TIP-POWERED Pioneer



The Hiller Hornet was powered by ramjets at the tip of the rotor blades. Two utility versions were manufactured, with both flying in the test program.

The story behind the Hiller Hornet — the first production tip-jet helicopter.



The young, innovative, and talented engineer Stanley Hiller was one of the leading helicopter pioneers in the industry's earliest days. Among his many achievements was the development and creation of the ramjet-powered Hiller HJ-1/YH-32 Hornet. The aircraft, publicly unveiled at the Hiller Helicopters factory in Palo Alto, California, in February 1951, took an innovative approach to the anti-torque problem. The two ramjets that powered the helicopter were mounted on the tips of the aircraft's two main rotor blades. With no torque to counter due to the lack of a traditional engine and transmission system that would normally generate it, there was no need for a tail rotor.

While Hiller was not the first to explore the idea of using jet-tip engines to power a helicopter, the Hornet was the first such aircraft designed as a practical, rather than experimental, model.

Eight years earlier, in the midst of the Second World War, Austrian engineer Friedrich von Doblhoff built and flew his WNF 342, which sent compressed air and fuel inside the rotor blades to combustion chambers on the blade tips for propulsion.

Later in the 1940s, McDonnell Aircraft designed and flew a lightweight experimental helicopter called the XH-20 "Little Henry" that had ramjet engines on the tips of the rotor blades; and the Marquardt Company flew a helicopter called the M-14 "Whirlajet," which had two pulsejet engines on the end of the rotor blades.

Tip-jet contemporaries of the Hornet included Hughes Aircraft Company with its XH-17 (first flight 1952), American Helicopter Company with its XH-26 (1952), and Sud-Ouest in France with the S.O.1221 Djinn (1953).

Hiller had long been fascinated by the idea of finding new ways to perform vertical flight that eliminated the need for a tail rotor. He built and flew the first coaxial helicopter (the XH-44) in the U.S. in 1944, when he was just 19. Two years later, his company had developed and flown the first jet torque-compensating helicopter, the J-5. This used a fan blower, placed underneath the engine, which could be directed to counter torque.

After the civil certification of Hiller's successful Model 360 three-place helicopter in 1948, Hiller challenged his engineers to come up with a design for a jet-powered helicopter for the civilian market. He wanted a two-seater that was simple, low-cost, ultralight, and easy to fly and maintain.

PICKING THE RAMJET

First came a secret engine development program. Over two years, the team explored 17 different designs of jet engines, with more than 5,000 modifications incorporated to arrive at the final design. Hiller's engineers evaluated turbojet, pulsejet, and ramjet engines, and tested them extensively on a whirl stand and a static test stand. The Hiller tip-mounted 11-pound (five-kilogram) ramjet engine showed the most promise and was selected for the aircraft. Ramjet powerplants have no moving parts, and the engines for the Hornet could be changed in only a few minutes with the simplest of tools. Each unit developed 31 lb. (14 kg) of thrust, which was the equivalent of 34 horsepower. It cost about $150, but was only expected to last for about 500 hours of use.

Hiller's engineering team next looked at designing a proof of concept helicopter in order to flight test the new powerplant. The first of three experimental test ships were built at the company's Palo Alto plant, with the first flight of the experimental XHJ-1 Hiller Hornet taking place during August 1950. That flight was piloted by Hiller chief test pilot Frank Peterson, but test pilot Bruce Jones did most of the experimental flight testing on the aircraft. Hiller was also checked out on his new helicopter.

The company soon had three prototypes flying: the original streamlined fiberglass-enclosed two-seater, and two stripped-down utility versions. A fourth Hiller Hornet was manufactured, but it never flew.

Hiller foresaw many applications for the Hornet, primarily as a flight school trainer, a commuter aircraft, and for pleasure flying. Potential military uses included as an air ambulance, artillery spotting, reconnaissance, and observation. Other potential industry uses were for aerial photography, publicity, courier service, and for executive transportation.

The simplicity of the new Hiller-Hornet was described in a 1951 special edition of the *Hiller Copter-News*. "Powered with two tip-mounted ramjet power plants developed by Hiller — engines which do not have a single moving part — the Hiller Hornet has only two hand controls and fewer instruments on the panel than the average automobile," the magazine stated. "Contrary to most jet aircraft, the Hiller Hornet's sound range compares favorably with that of the conventional-powered helicopter."

Located on the aircraft's small instrument panel were the tachometer, fuel flow indicator, air speed indicator, and the altimeter. Just below the altimeter was a starter button for igniting the ramjet engines. Hand controls included an overhead cyclic control stick, and a collective pitch and throttle just left of the pilot's seat. This mechanism was also attached to the rudder installed at the tail of the helicopter. Its movement horizontally to the left or right controlled the direction of the flight. A collective pitch stick for vertical ascent and descent was so designed and located as to control the helicopter directionally through movement in a horizontal plane.

The helicopter was reportedly very stable due to the proven Hiller Rotor-Matic paddles and the aircraft's high-inertia rotor.

A HELICOPTER FOR THE MASSES

The small, utility two-place helicopter weighed 356 lb. (160 kg) empty, with a gross weight of about 900 lb. (410 kg), and length of about 12 feet, nine inches (3.9 meters). It was designed to sell for only $5,000, and was small enough to be parked in the average home's garage. Hiller's idea was that the Hornet would be a commercial helicopter for the masses, and he hoped that the price would drop even further when engineering and research expenses were written off over time.

The aircraft's rotor diameter was 23 feet (seven meters), and the height to the top of the rotor was 7 feet, 10 inches (2.4 meters). Its normal cruising speed was 70 m.p.h. (110 km/h) with a top speed of 80 m.p.h. (130 km/h). Its range with two passengers was close to 50 miles (80 kilometers). The ceiling at full gross load was 12,000 feet (3,650 meters). The rate of climb was 1,100 feet (335 meters) per minute.

The helicopter had a tubular main structure, made from a combination of aluminum and steel. The two-bladed all-metal rotor system attached to a teetering type rotor hub. The auxiliary starter was located behind the pilot's seat and could be hand cranked by using an electric power unit, or by a small gasoline engine. A 25-lb. (11-kg) luggage compartment was behind the seat. The fiberglass cabin enclosure could be dismantled in a few minutes, and underneath was a tricycle three-wheel undercarriage.

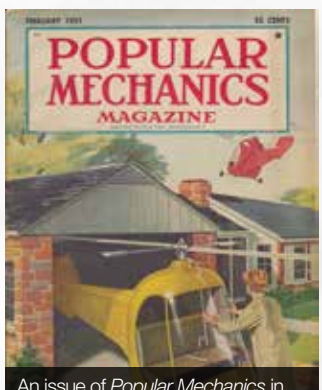
The aircraft's fuel tank held 37 US gallons (140 liters), and the Hornet was a bit of fuel guzzler, burning through about 50 US gallons (190 liters) per hour. The panel in the cabin featured a low-fuel warning gauge.

Autorotation on a Hornet kept the experienced pilot honest. The ramjets retarded main rotor windmilling, resulting in the helicopter

The small Hiller Hornet (right) sits next to a Hiller Model 360 helicopter.

Pilot Bruce Jones starts up the utility Hiller Hornet with Ed Bennet carefully watching. Note the flames coming out of the Ramjet engines.

Three Hiller Hornets take flight at the Hiller Plant in California.



An issue of *Popular Mechanics* in 1951 shows the Hiller Hornet being used as a commuter aircraft.

A U.S. Navy Hiller Hornet at the Classic Rotors Museum in Ramona, California.

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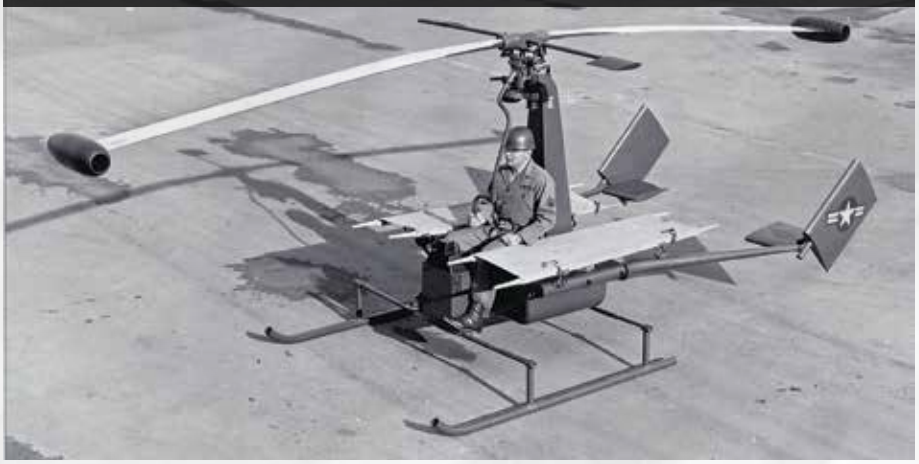
A Hiller YH-32A called "Sally Rand" on the tarmac at the Hiller Plant. Note the two litters on the helicopter. Three of these helicopters were manufactured.



descending at a staggering 3,000 feet (915 meters) per minute towards the ground. However, with careful flaring, one could still have a soft landing.

Getting going in the Hornet was quite simple. Start the auxiliary engine, depress the clutch, and once the speed of the main rotors had reached about 150 rpm, you pressed the starter button to ignite the fuel in the ramjets. When the rotor blades reached just over 500 rpm, the Hornet was ready for liftoff. No warmup was required.

Civil Aeronautics Authority (CAA) commercial certification was underway by early 1951, with commercial marketing of the Hornet planned for the spring of 1951. However, due to the war in Korea, and because of expanded military orders for Hiller's Model 360 helicopters, this had to be adjusted. All production of Hiller's helicopters was focused on the military.

With commercial certification on hold, Hiller gauged the military's interest in the Hornet. The U.S. Army and U.S. Navy ordered an evaluation quantity of the two-place upgraded Hornet in June 1952. The improved updated HJ-1 Hornet was designated the H-32 for the Army, and HOE-1 for the Navy.

The H-32 became the Army's first operational ramjet helicopter, and the HOE-1 was the Navy's first tip-powered jet helicopter. Five HJ-1 Hornets were manufactured: two for the Army, and three for the Navy.

Hiller engineer's felt that the improved Hornet would be a good proving ground for the principles of tip-powered ramjet helicopters. Evaluations by the U.S. military would also prove the claims of lower cost and maintenance for this type of helicopter.

A MILITARY DESIGN

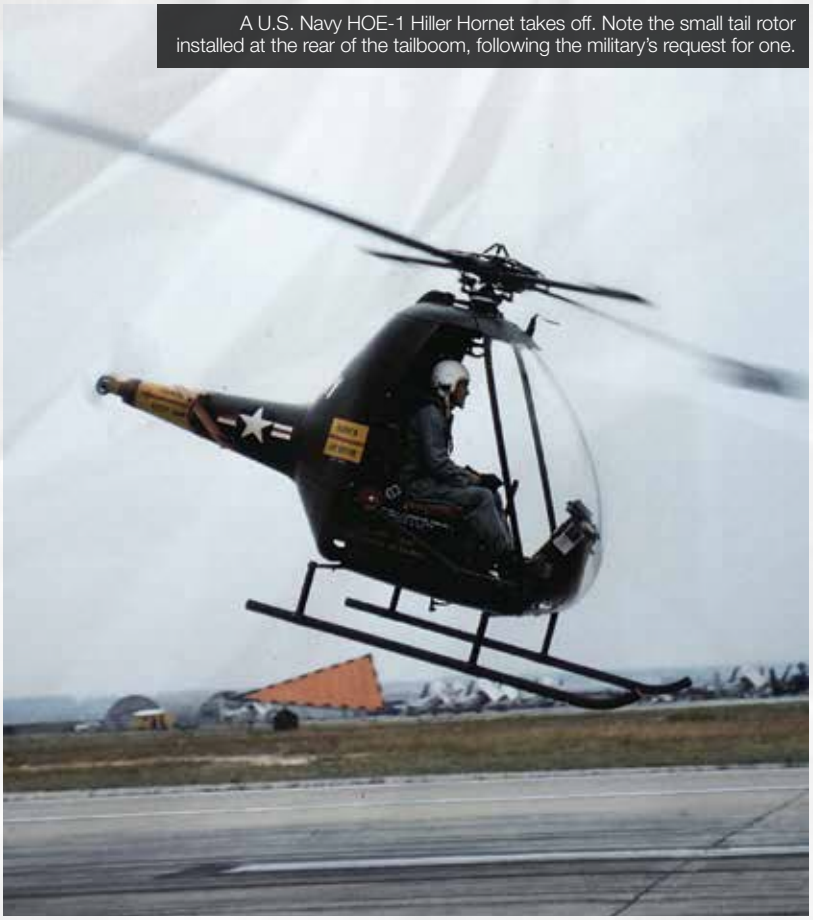
The new Hiller H-32 differed in many ways to the original tip-powered HJ-1 rotorcraft manufactured in 1951. The new improved version was on skids instead of wheels. The cockpit cabin was slightly larger, with a new fiberglass tailboom, plus a small one-piece tail rotor in the back. Inside were standard cyclic sticks and pedals to control the small tail rotor. The military had requested the changes to make the aircraft's controls common with other helicopters in its fleet. The small tail rotor helped to improve yaw control in the performance of the H-32.

The empty weight of the H-32 increased to 530 lb. (240 kg), with the gross weight now 1,080 lb. (490 kg). The service ceiling was reduced to 6,900 feet (2,110 meters). The range dropped to only 28 miles (45 kilometers), while the endurance was reduced to about 30 minutes. Hiller was not impressed with the reduced performance caused by the military's changes.

The ramjet engine was also updated with a larger diameter, and new weight of 12.7 lb. (5.7 kg). Called the 8RJ2B, the ramjet engine produced 45 horsepower. The CAA approved the new engine in October 1954 for commercial production and sale.

Hiller delivered the first Hornets to the U.S. military in late 1954, when service tests and evaluations began. The Army followed up with another order for 12 H-32s, for a total of 14. Hiller's production run of the military tip-powered Hornets was the first of its kind in North America.

In 1955, Hiller received a contract for an armed helicopter called the YH-32A ULV (ultra-light vehicle). Three YH-32A



A U.S. Navy HOE-1 Hiller Hornet takes off. Note the small tail rotor installed at the rear of the tailboom, following the military's request for one.

helicopters were manufactured and evaluated at the Fort Rucker Army facility in Alabama during 1957. The helicopter used the Hiller Hornet rotor and systems with a twin tail at the back. Tests were carried out using missiles, rockets, and a recoilless cannon. The helicopter armed concept program was successful, but the military placed no further orders.

Over time, the military decided that the aircraft's short range, high fuel consumption, its potential for fuel starvation, and concerns with its autorotation capabilities would not meet the acceptance standards for both the Army and Navy. Within a year, the military withdrew the H-32/HOE-1 helicopters from service. Hiller decided to give up on marketing the Hornet commercially after the CAA did not approve civil certification.

All told, Hiller manufactured 25 Hornets, and about half have survived, on display in museums across the U.S. and in private collections.

Even with the end of the Hornet program, Hiller had not given up on the promise of tip-jet propulsion. He was already thinking of using the technology on a larger scale, dreaming of a future when large heavy-lift flying cranes, and passenger carrying sky buses would fly using tip-powered jets.

Bob Petite | Bob is a member of the Twirly Birds, The Vertical Flight Society, the Canadian Aviation Historical Society, the American Aviation Historical Society and the Bell 47 Helicopter Association, Inc. He is the author of The Bell 47 Helicopter Story.



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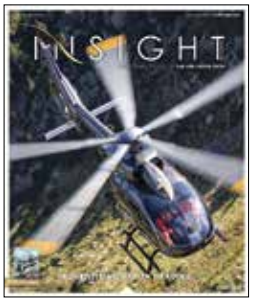

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COLUMN

TO PANIC, OR NOT TO PANIC?

THERE I WAS... // **DORCEY WINGO**

So I married a beautiful young lady from south of the border and took her with me everywhere I went, driving to new job sites and helicoptering for a month or so. Then would come a big move, which meant flying the helicopter many miles to the next job site.

Turning our rigs over to our trusty drivers and mechanics to get our trailers there, it was a ton of fun — if you like working in deep snow and ice. There was a bonus: you could take your snuggle-bunny along with you for a little companionship, after putting your Lama to bed at night.

When we met the helicopter at Lava Hot Springs, Idaho, our vintage Airstream was parked all alone in a deserted, muddy RV campground. Ice cold water was squirting 10 feet into the air from a tiny leak in the outdoor faucet's pressure-regulator. This mud hole would be our home for two weeks while we finished up a scintillating snowbound seismic survey.

My wife Lourdes ("Lulú") was not a licensed driver at this time in our relationship. She was all alone in the trailer while I was out having a ball, flying low-level, sling-loading seismic gear all over the sunny, snow-covered hills of southeastern Idaho. She told me she was happy making a home for us in her comfy camper, while scanning one or two fuzzy channels on our small TV.

When it came time to move the operation 200 miles south to our Provo base, logistics required Lourdes be my passenger in the Lama. It was to be her first flight in a helicopter.

I remember taking her photo as she sat strapped into the four-way harness in the left front seat, all lit up with dazzling Idaho sunlight. She was smiling for the camera, but her hands framed the face of a woman scared to death. The rotors were motionless. I hadn't even started the engine.

Rest assured that I talk a good talk when it comes to passenger briefings and how much fun the flight is going to be, heading down the west side of the majestic Rocky Mountains and past the Great Salt Lake. Lourdes drank it all in and agreed to go with me, but she was clearly nervous.

Lulú had two airliner flights to her credit before this, and she was muy nervioso both times, she told me. I assured her that I was a competent pilot and I wouldn't intentionally try to scare her. If there were any problems, I could handle them. I probably shouldn't have mentioned problems.

Lifting off with Lulú a few minutes later, I headed south on a course that paralleled the interstate to Salt Lake City. By the time I levelled off at about 1,000 feet, Lulú was well into what I later learned was a panic attack. She was not the same calm person I gave my passenger briefing to only moments before. Lourdes looked very uncomfortable and pleaded with me in Spanish to stop everything and get her back on the ground.

But we were expected in Provo within two hours with the company's helicopter, so I was in ferry mode and figured optimistically that she would eventually calm down. I looked to my left. The spectacle of the glorious snowcapped Rocky Mountains was lost on Lulú. She wanted out.

I made sure she wasn't trying to unbuckle (she was too scared to do that) and encouraged her to check out the Great Salt Lake passing slowly by on our right, where tourists were bobbing around like corks. Lourdes couldn't swim, but she wanted out — making me feel terrible for ignoring her pleas.

But you know what? She made it to Provo like so much abused baggage, a little worse for the trip, but a team player for sure. She'd be easier to work with on the next ferry flight, I figured.

Months later, we were halfway through a fine summer helicopter contract based on the North Rim of the Grand Canyon. Lourdes was with baby by this time (I have no idea how this happened) and her best friend Dora had flown up from Mexico to visit us in our North Rim campground.

Lourdes was all excited having Dora there with her. The two of them soon hatched a plan whereby she and Dora would fly home to Sinaloa, Mexico, for a big deal baby shower, then fly her back to me three weeks later. I was delighted to see Lourdes so happy about travelling again.

The nearest commercial airport was on the South Rim of the Canyon. All that was left to do was fly Dora and Lourdes across the awesome abyss in the Lama, a flight OK'd by the customer.

I knew Lourdes would take the bit when it came time to cowboy up and climb back into that French flying machine. Dora was up for her first ride and looking forward to it, I could tell.

But as much as I would like to write that I was right… I was not. Lourdes and Dora opted not to panic. For them, it was to be a 260-mile bumpy-road drive through Lee's Ferry to the airport, thank you just the same. The customer drove them there in a roomy four-wheel-drive truck. The girls left on time for Mexico. Lourdes would be picked up at the airport three weeks later, and driven back to the North Rim, the long way around again.

Lourdes eventually grew to accept helicopters. In the years that followed, she would fly along with me and our three kids. On airliners she was fine. But in helicopters, she was still nervous.

Chris Rohrmoser Illustration

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