



READY FOR TAKE OFF

BUILDING AN ELECTRIC AIRPLANE IN BTV—UVM STUDENTS BRING
CLASSROOM LEARNING TO THE FUTURE OF FLIGHT

Story by Jeff Wakefield • Photography by Bailey Beltramo
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▲ Most of her internship is spent doing hands-on work in the workshop at Beta Technologies. Today Bella Rieley '23 returns from laser scanning the wing of an aircraft to see if a light she has 3D-modeled will integrate into the physical design of the vehicle.



When the coronavirus outbreak brought Bella Rieley home to Williston, Vt., in 2020, after two years at a major university in Boston, she thought her education was “derailed.” Then, influenced by a family friend who worked at the company and raved about it, she took a year off to intern at Burlington-based Beta Technologies, a super nova in the emerging field of electric aviation.

The experience “was so groundbreaking in my education that I couldn’t let it go,” she says. “So I transferred to UVM.”

Now a senior mechanical engineering major, Rieley, who continued her internship after enrolling, couldn’t be happier in her new educational setting. “What you learn at UVM is conceptual, but everything is applicable to what I do at Beta. It’s super satisfying.”

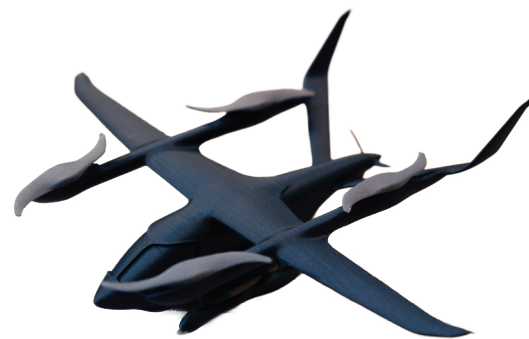
Rieley isn’t the only UVM student experiencing an educational and career-building high at Beta. The company is virtually an adjunct campus of the university, hosting nearly 40 UVM interns over the past two years.

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—Bella Rieley '23

It’s easy to see what attracts them. Beta’s paradigm-shattering eVTOL (for electric vertical take-off and landing aircraft) prototypes—AVA in 2019 and the more advanced ALIA in 2020—have taken the industry by storm. Venture capitalists and other funders have raised over \$800 million to support the company, a staggering sum for a Vermont-based startup that incorporated only in 2017.

And the New York Times, Washington Post, Wired, Bloomberg, CNBC, and a dozen other top media have all given the company marquee coverage for its success in addressing a challenge that is both daunting—electric aircraft must be so efficiently designed that they overcome the weight of batteries and can log long flight times—and urgent. Global aviation accounts for about 1 billion tons of CO₂ per year, more than the emissions of most countries, including Germany.



Not your father’s internship

Internships at Beta bear no resemblance to the mind-numbing, clerical variety of earlier eras.

For starters, the unpaid internship is an unlamented artifact of the past; today’s student interns, at Beta and elsewhere, are paid for their time. And fittingly for paid employees, they are given significant responsibility.

Imbedded in Beta’s workplace philosophy is the idea that students should interact with the company’s seasoned engineers as near equals. Mixing their “unbridled creativity,” says Beta CEO Kyle Clark, with the “experience and battle scars of older engineers” is the only way forward in a field that is inventing itself as it goes along.

“The mentality is: if you’re willing to take on responsibility and show that you can do it, the company is your oyster,” says Vincent Moeyskens, a computer science major and math minor who interned at Beta for four years, graduated from UVM last spring, and now works for the company.

Moeyskens was quickly a key member of his team, helping program the company’s simulator, used both to virtually introduce and test new systems in its aircraft and to train pilots on flying AVA and ALIA. Both eVTOLs, true to their name, take off and land like a helicopter but fly straight ahead like an airplane.

Rieley found herself in the thick of things from day one.

“My mentor was pivotal in forcing me to figure out how to use my hands, how to use my brain and how to problem solve,” she says. Early on she was asked to operate a CNC machine, an enormous tool for fabricating parts with a fast-spinning rotor that “could have killed me,” she says.

“Working with big machinery is super empowering, and my confidence just built and built. It was like, holy cow, I can operate that,” she says.

Later in her tenure at Beta, Rieley led the design and build of a second, updated version of a “sub-scale” remote-controlled flying model of ALIA, an indispensable tool engineers use to safely test new avionics systems.

“It was probably the defining moment for me at Beta,” she says. “It really allowed me to take a project of my own and test my skill sets and run with something.”



▲ Bella Rieley '23, Shannon Murphy '22, and Vincent Moeykens '21 (left to right) have contributed to the design of ALIA, Beta Technologies eVTOL (for electric vertical take-off and landing aircraft) during their internships, and now for Murphy and Moeykens, in their full-time jobs.



SEE IT IN ACTION.

Use the camera on your phone or tablet and this QR code, or visit go.uvm.edu/bella to watch a video about Bella's Beta internship.

Better prospects, better learning

Why does it matter, exactly, that Beta (and other Burlington tech firms: see sidebar) offer so many high-grade internships to UVM students?

UVM's commitment to expanding quality internship opportunities—across all its colleges and schools—is part of the university's pledge to ensure students have rewarding careers after they graduate. In 2020, nearly 70% of interns were offered full-time jobs by the companies they interned for, according to the National Association of Colleges and Employers. Beta has hired 11 UVM interns into full-time jobs.

But internships improve more than the career prospects of students, says Linda Schadler, dean of the College of Engineering and Mathematical Sciences. They also add immeasurably to their learning.

"What you find, after a student has done an internship, is that their attitude

about the classroom changes because they have a context for understanding why they're learning what we're teaching them," she says.

When Rieley was stumped by a challenge she was facing at Beta—how to measure the strength of a connecting rod she was fabricating for ALIA's flight control system—she remembered back to a mechanical engineering class she'd taken.

For a refresher, she contacted her professor, Dylan Burns, and had a productive talk that helped solve her problem.

As Schadler predicts, the experience will make Rieley a more engaged classroom learner in the future.

"You know that there's a real-world application for what you're learning, as opposed to a flat 2-D picture on a textbook page," says Rieley. "You think, I could actually work with that at some point in my career."

Vermont Values

The challenge of the work, and the company's skyrocketing success, are part of what attract UVM interns in droves to Beta.

But its ambitious mission to address a looming environmental crisis is just as important.

"Beta is trying to transform the face of transportation, to help save the environment," says Rieley, who hopes to work at the company after graduation. "Being located in such an incredible environment, Vermont, speaks to its mission. Beta is homegrown. We're local. We're doing this not just for ourselves; we're designing this aircraft so that everyone can experience what we have in Vermont."

"I want to teach people how the airplane works, why we're doing it."

—Shannon Murphy '22

For Shannon Murphy, a just-graduated mechanical engineering major who worked in the company's 3-D printing lab prototyping parts, Beta's environmental focus meshes with her own belief system and goals.

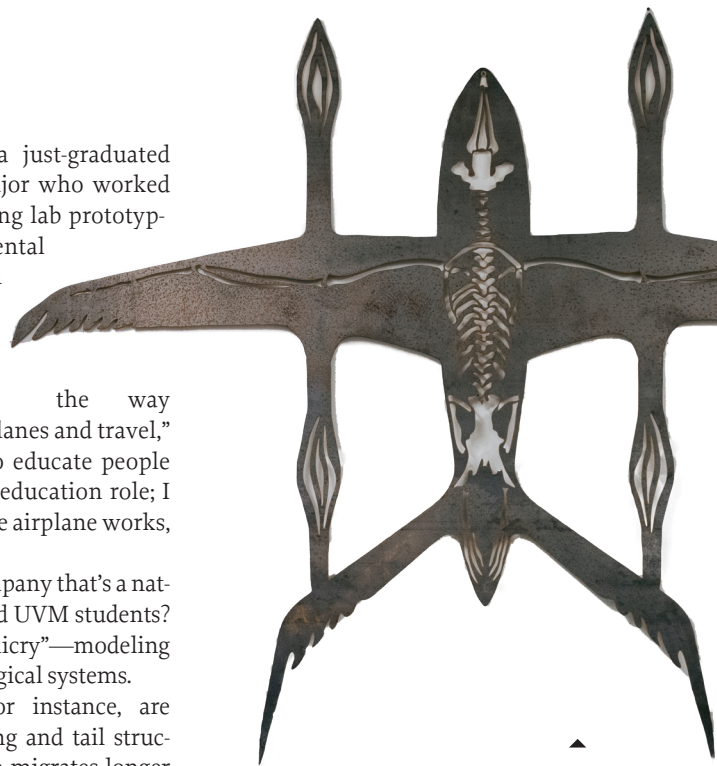
"Beta wants to do better for the environment and create and reinvent the way that people think about airplanes and travel," she says. "And they want to educate people about that. I fit in with the education role; I want to teach people how the airplane works, why we're doing it."

Another aspect of the company that's a natural draw for ecology-minded UVM students? Its emphasis on "bio-mimicry"—modeling engineering on natural biological systems.

ALIA's aerodynamics, for instance, are inspired by the efficient wing and tail structure of the arctic tern, which migrates longer distances than any other bird on earth.

Rieley and Moeykens, both trained pilots (Rieley earned her wings by taking advantage of a Beta perk, free flight lessons for employees), are attracted to Beta for yet another reason: the beauty of the company's aircraft in flight.

"ALIA looks really natural," Moeykens says, "like it belongs in the air."



ALIA takes inspiration from the Arctic tern, a small bird known for migrating further than any other bird. As a side project during her internship, Bella created this metal-cut silhouette of ALIA overlaid with the skeletal structure of an Arctic turn. Two of which are on display in the halls of Beta.



Green Mountain Ties

Beta CEO Kyle Clark graduated from Harvard with a degree in materials science, but Clark and Beta have strong Vermont—and UVM—ties.

For more than 25 years his father, Tobey, ran the university's Instrumentation and Modeling Facility, which creates custom equipment that UVM science, medical, and engineering faculty use in their research experiments. IMF fabricated parts used in Beta's early prototypes.

UVM engineering faculty also contributed significantly to the control system design of Beta's aircraft, Clark says. And the company's first hire was a UVM student, drawn from a hands-on engineering class Clark was involved with.

"The mentality is: if you're willing to take on responsibility and show that you can do it, the company is your oyster."

—Vincent Moeykens, '21

Beta's business strategy is as innovative as its engineering. Almost all companies developing eVTOLs conceive of the crafts as "air taxis" providing short hops to passengers in major cities, which could present challenges for Federal Aviation Agency approval. Beta, by contrast, is targeting the e-commerce-driven cargo market, greening up the fossil-fuel-drenched transport of packages by companies like Amazon and UPS. UPS has ordered 10 of Beta's aircraft with an option for 140 more, and Amazon has invested heavily in the company through its Climate Pledge Fund. Beta is targeting 2024 for FAA approval.

Why is Beta in Vermont and not in San Francisco or Boston? Clark is often asked that question, especially by funders.

"First of all, I was born here at the UVM Medical Center; I love it here," he says. "I also think Vermont is a state of firsts. If you look back, we have a long history of being open-minded—about (the immorality of) slavery, about gay marriage

and a range of social issues, and about technological things. The largest island microgrid the U.S. Department of Energy has seen is in Rutland."

Ultimately, though, the proof is in the pudding, Clark says. "We've come up with the highest-performing electric aircraft in the industry—right here in Vermont."



UVM students are certainly happy with Clark's geographic preference.

"I just can't believe that I work here and that this is my job and that's my office," Murphy said of her internship. "It doesn't seem like Beta would be here in Vermont. And then all of a sudden you walk in, and there's just all these amazing things happening—right down the street from where I go to school." **UVM**

▲
Vince Moeykens '21 (left), Shannon Murphy '22 (center), and Bella Rieley '23 (right) stand in front of ALIA, Beta Technology's cutting edge electric aircraft.

STARTUP CITY

Beta may be the crown jewel in Burlington's emerging new tech ecosystem, but it's not the only gem.

In the last five years, since a New York Times story heralded Burlington's emergence as a tech mecca (A 'Smart' Green Tech Hub in Vermont Reimagines the Status Quo), the area's "innovation activity is five to 10 times greater," says David Bradbury (Business, '88), president of the Vermont Center for Emerging Technologies (VCET), the tech incubator and co-working space featured in the Times story.

"There are so many Vermont tech companies now that offer internships for our students, it's amazing," says Holly Fosher, career readiness program coordinator in the College of Engineering and Mathematical Sciences.

To help students make sense of Burlington's increasingly rich tech tapestry, Fosher encourages them to join VCET, which waives membership fees for students, and to explore Hula Lakeside, a spectacular new tech incubator and co-working space that opened on the shores of Lake Champlain in 2020.

Thanks to VCET, Hula, innovations at UVM, and the influence of Vermont's legendary entrepreneurial culture (think Ben & Jerry's, Burton Snowboards, Seventh Generation), many tech firms in greater Burlington are startups.

The area doesn't lack for large, established companies that offer internships to UVM students, from chip manufacturer Global Foundries to software powerhouse Dealer.com to biotech giant Agilent Technologies.

But students who want to fast-track their learning and career opportunities often choose to intern, and work, at small companies just establishing themselves, where they can perform a variety of functions, have a major impact, and create strong resume entries.

2022 UVM graduate Skylar Bagdon, vice president of business development for startup Verde Technologies, is a case in point.

Verde has boggling potential. The company makes pliable, inexpensive, lightweight solar panels based on the groundbreaking "thin film" research of UVM Physics Chair Randy Headrick, which could accommodate many more homes and businesses than conventional rigid solar panels, enabling the company to tap a \$66 billion market.

To help the company reach that vast potential, Bagdon, a self-designed sustainable technology commercialization major at UVM, wears every hat on the hat rack, meeting with lawyers, real estate developers, financial planners, grant writers, federal research labs working on solar, and manufacturers over the course of a typical few weeks.

"It's awesome; I can't imagine doing anything else," says Bagdon, who has an office in the Hula complex.

When he was at UVM, the entrepreneurial Bagdon was the driving force behind the new Academic Research Commercialization, or ARC, program, which is generating even more opportunities for UVM student to intern at emerging tech companies. ARC exploits an obvious, but overlooked, source: UVM faculty innovators like Headrick, who often have brilliant research ideas that could be commercialized but lack the expertise and time to bring them to market.

Working with Corine Farewell, director of UVM Innovations, who selects the most promising faculty projects, and Erik Monsen, Steven Grossman Endowed Chair in Entrepreneurship in the Grossman School of Business, who advises the students, Bagdon and his student colleagues have attracted 17 students to ARC's paid internship program. Students have worked with three promising faculty projects to date—Verde began as an ARC client—with three more on tap this year.

Verde hopes to follow in the footsteps of another UVM-spawned startup and Hula tenant—Benchmark Space Systems, which makes propulsion systems for satellites. Founded by UVM alumnus Ryan McDevitt (Mechanical Engineering M.S. 2011, Ph.D., 2014) in 2017, the company is growing rapidly and now employs 80, including five UVM alums who began at the company as interns.



Co-working space in VCET's Burlington offices.

Photo: Ian Thomas Jansen-Lonnquist