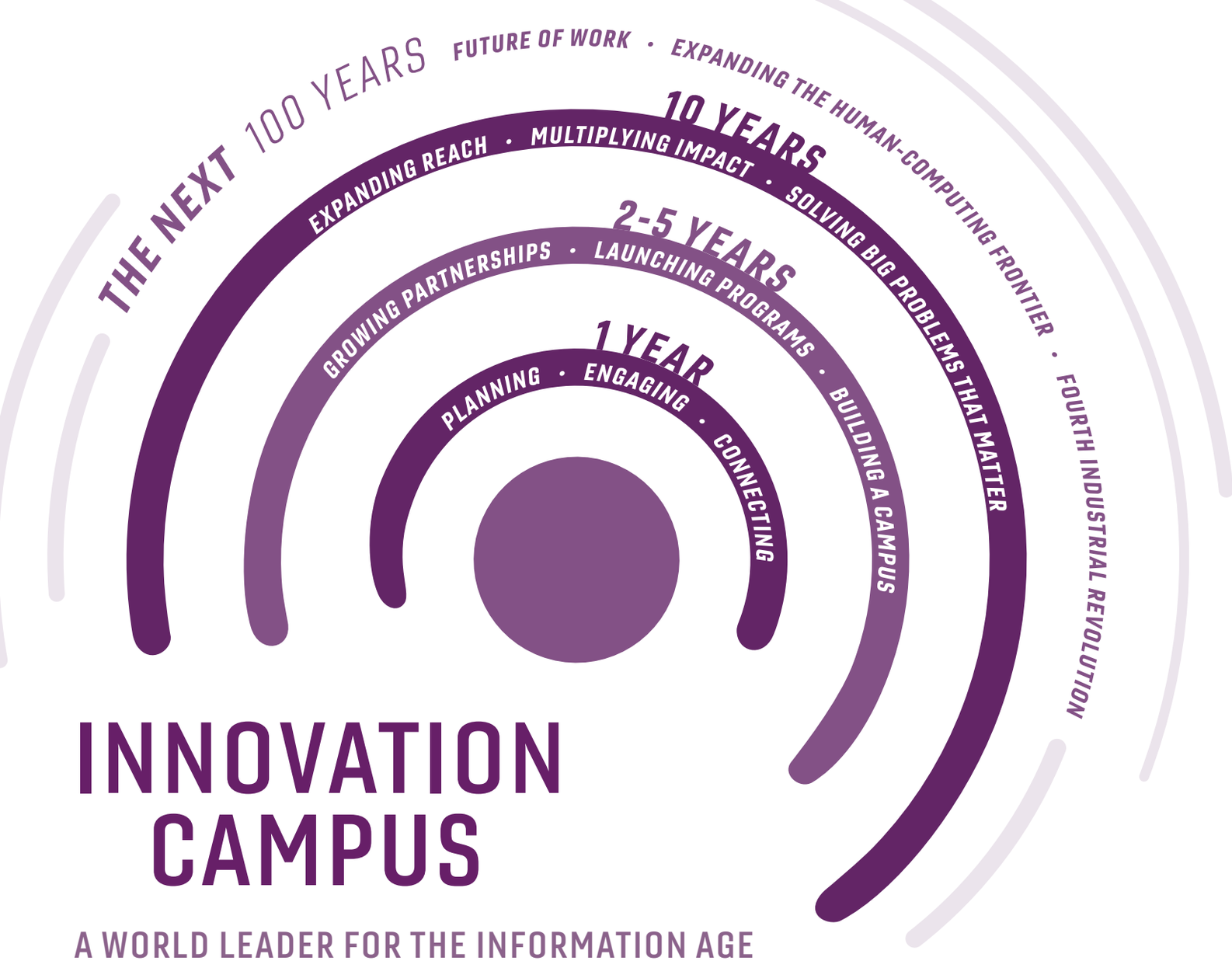

VIRGINIA TECH™



INNOVATION CAMPUS

A WORLD LEADER FOR THE INFORMATION AGE

When Amazon announced in 2017 that it was seeking a second headquarters location, hundreds of localities rolled out the red carpet in an attempt to lure the company. Virginia, however, had the foresight and courage to take a different approach, including leveraging the mission of its largest land-grant university as part of a comprehensive $1.1 billion tech-talent package.

"The state asked, 'How can we create an enabling environment that is an attractive place for companies like Amazon to operate?'" said Brandy Salmon, Virginia Tech's associate vice president for innovation and partnerships. "It was an opportunity to drive diversification and innovation in the commonwealth with a direct investment back into the state."

A key part of the answer, and the deal that ultimately landed Amazon in Arlington, was Virginia Tech's bold vision to develop the Innovation Campus to serve as a destination for high-tech talent. The planned 1 million-square-foot graduate campus in Alexandria will transform and sustain Northern Virginia — with room to grow, adapt, and evolve as the market changes.

"The rigorous programs we launch and the powerful research we generate will help drive the innovation economy," said Salmon, the campus's founding managing director. "Together with partners in industry, government, and education, we will cement Virginia as a world leader for the information age."

During the 14-month proposal process, which was quietly navigated by the Virginia Economic Development Partnership, both the company and state realized the benefits of tapping into Virginia Tech's core purpose of serving the citizens of the commonwealth.

"Virginia's biggest employment growth opportunity in the years ahead will be in tech — from artificial intelligence to cloud computing to cybersecurity, and everything in between," said Stephen Moret, president and CEO of the Virginia Economic Development Partnership. "Our success in growing the tech sector will be inextricably linked to our success in developing, attracting, and retaining world-class tech talent. [The] announcements by Amazon and Virginia Tech highlight just how important higher education is to that equation."

As a result, not only will the company's expected need for 25,000 employees provide opportunities in Virginia, but the project as a whole will attract other businesses and firms needing to fill their rosters.

In Virginia Tech, the state found a qualified partner who was willing to step forward and had a blueprint in place already to expand the university's work in the greater Washington, D.C., metro area.

"Amazon's challenge provided the catalyst to accelerate a plan that we already had in place," said Virginia Tech President Tim Sands, "by bringing together Virginia leaders who are committed to the vision to transform and sustain the commonwealth as a leading magnet for tech talent and innovation — with room to grow, adapt, and evolve."

The $1 billion campus will be built in the National Landing area of Alexandria, as part of a 65-acre mixed-use development near the future Potomac Yard Metrorail Station. The area will be developed by real estate investment trust JBG SMITH and Lionstone, a data-driven real estate investment firm that specializes in investing in U.S. locations with concentrations of highly productive jobs.

The Innovation Campus will triple Virginia Tech's footprint in Northern Virginia, where it currently maintains seven facilities throughout the region, with operations in Old Town Alexandria, Arlington, Fairfax, Falls Church, Leesburg, Manassas, and Middleburg.

It will bring together hundreds of new graduate students, dozens of new faculty members, and numerous industry partners. In Blacksburg, Virginia Tech will increase undergraduate enrollment in computer science, computer engineering, software engineering, and related disciplines by 2,000 over the next eight years.

The first class of Innovation Campus master's degree students will enroll in the fall of 2020 in existing space adjacent to where its

ONSITE: Virginia Tech President Tim Sands (center, at right) at the announcement of the Innovation Campus location.

new academic building will eventually be built. When complete in about 10 years, the campus will enroll 750 master's candidates and hundreds of doctoral students and postdoctoral fellows.

The Innovation Campus's degree programs and research opportunities will focus on computer sciences and software engineering, while offering specializations in high-demand areas, including data sciences; analytics and collective decisions; security and the internet of things; and technology and policy.

It also will offer a new master's of engineering degree in computer science and applications, pending approval from the State Council of Higher Education for Virginia. This program will focus on software development, with an emphasis on entrepreneurial, hands-on learning through a capstone course for which students will work in teams to complete a software project's life cycle.

"It is more focused on practical skills and topics that are necessary in industry," said Cal Ribbens, who heads the Department of Computer Science at Virginia Tech.

While Amazon was the catalyst for Virginia Tech to build its campus now, business leaders in the Washington, D.C., area have stressed that the impact of the Innovation Campus will go far beyond meeting the campus's goals to grow the tech-talent pipeline.

"What's happening in Northern Virginia is truly transformational, and Virginia Tech's Innovation Campus will be right at the heart of it," said Glenn Youngkin, co-CEO of The Carlyle Group and a member of its Board of Directors. "Think of the possibilities — new technologies, new businesses, new markets, extraordinary new talent — all being created right here in Northern Virginia. And now, the scope of this ambition can be fully matched by this great location, which will be the home of the next global technology hub."

Sanju Bansal, founder and CEO of Hunch Analytics and co-founder of MicroStrategy, said Virginia Tech's new Innovation Campus is the missing ingredient for the regional economy.

"Virginia Tech's new Innovation Campus will fill an important void in our regional economy," Bansal said. "Local companies will improve their competitiveness by tapping into the steady stream of

skilled graduates, and importantly, the campus will serve as the convener of researchers, practitioners, and policymakers. It will foster collaboration across academia, government, and industry that can result in the next Googles and Amazons taking root in our own backyard."

Virginia Tech's history is highlighted by transformational events aimed to meet the ever-evolving needs of our world. And while the Innovation Campus is definitely one of the most recent, it's guided by the same age-old principles on which the university was founded in 1872.

"While needs and challenges have changed greatly over the course of the university's nearly century-and-a-half history, our commitment to make an impact has not," said Dennis Treacy '78, Virginia Tech Board of Visitors rector. "Creating an Innovation Campus is right in line with Virginia Tech's character — our drive to serve."

For more information, please visit vt.edu/innovationcampus. ■

INNOVATION CAMPUS WILL INCLUDE:

- **300,000** square feet of academic space and research and development facilities.
- **250,000** square feet of partner space dedicated to startups and corporate facilities.
- **350,000** square feet of housing space for students and faculty.
- **100,000** square feet of retail and support spaces.

ABOUT VIRGINIA TECH

DEDICATED TO ITS MOTTO, *UT PROSIM* (That I May Serve), Virginia Tech pushes the boundaries of knowledge by taking a hands-on, transdisciplinary approach to preparing scholars to be leaders and problem-solvers.

Since its founding as a land-grant college in 1872, Virginia Tech has grown to an enrollment of 35,000 and is the state's leading research institution. In Northern Virginia, the university is developing a 1 million-square-foot Innovation Campus that will become a global center of talent production and technology excellence. In Roanoke, the Fralin Biomedical Research Institute at VTC and the Virginia Tech Carilion School of Medicine are a part of an emerging Academic Health Center. The main campus is in Blacksburg, Virginia, while the university's international presence is anchored by the Steger Center for International Scholarship in Riva San Vitale, Switzerland.

Virginia Tech conducts more than $530 million in research annually. The university boasts world-class research institutes and facilities — such as the Smart Road transportation research testbed and the Cube, a four-story theater and laboratory in the Moss Arts Center.

The university's College of Engineering ranks eighth in the nation for research expenditures and its undergraduate program ranks 13th in the nation, with an industrial engineering program that ranks fourth. Four graduate engineering programs are among the nation's top 10 in their specialty.

In other academic areas, the College of Architecture and Urban Studies ranks in the top five nationally for its undergraduate programs in architecture (No.6) and interior design (No.11), while natural resources and conservation programs in the College of Natural Resources and Environment consistently rank the best in the U.S. The master of information technology program ranks No. 2 nationally.

Virginia Tech is one of just two comprehensive research universities that has a Corps of Cadets within the larger civilian student body. The corps boasts the highest commissioning rate — 79 percent — of all the senior military and service academies in the nation.

Across Virginia, the university maintains a presence in every corner of the commonwealth, with 11 Agricultural Research and Extension Centers, Virginia Cooperative Extension offices, and the Tech Center Research Park in Newport News.

Guided by its Principles of Community, the university is dedicated to increasing access, inclusion, and diversity in order to create a community that nurtures learning and growth for all of its members.

The desire to serve is deeply ingrained in Virginia Tech's learning, discovery, and engagement. More than a motto, *Ut Prosim* is a value system that guides students' decisions and helps mold them into responsible citizens of the world. ■

THE FUTURE OF FARMING

IN LABS ACROSS VIRGINIA TECH, researchers are inventing the farm of tomorrow by building on a rich history of agriculture and engineering dating back to 1920, when the university became the first east of the Mississippi to provide an agricultural engineering curriculum.

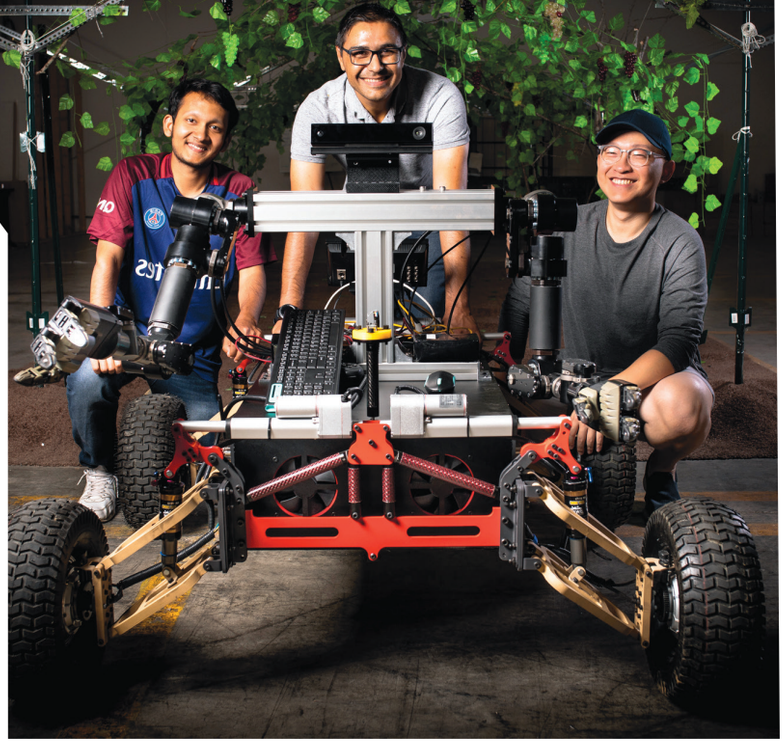
And that work is changing and enriching lives even as the average age of the American farmer continues to rise.

Mechanical engineering professor Alex Leonessa divides the work engineers do in agriculture into at least two major categories: precision technology and assistive technology.

Fifty-nine-year-old Ron Burleson, a landscape flower and beef farmer from Unionville, Virginia, benefitted from assistive technology after he suffered a stroke six years ago that severely limited his mobility. Both Burleson and his wife, Susie, are Virginia Tech College of Agriculture and Life Sciences alumni.

He's found ways around his limitations. His Trackchair, an all-terrain wheelchair, helps him navigate his field and greenhouse. He was even connected directly through a U.S. Department of agriculture program called AgrAbility to an engineer who custom-designed a lift that allows the 6'5" farmer to safely get in and out of his tractor.

In Virginia, a National Science Foundation (NSF) grant is funding Partnership for Innovation, a collaborative effort between the AgrAbility Virginia Program, local company TORC Robotics, and Virginia Tech faculty from agriculture and life sciences and engineering. The partnership has one main goal: to design assistive technology for a dozen volunteer farmers with disabilities throughout the state — and to do it across disciplinary lines.

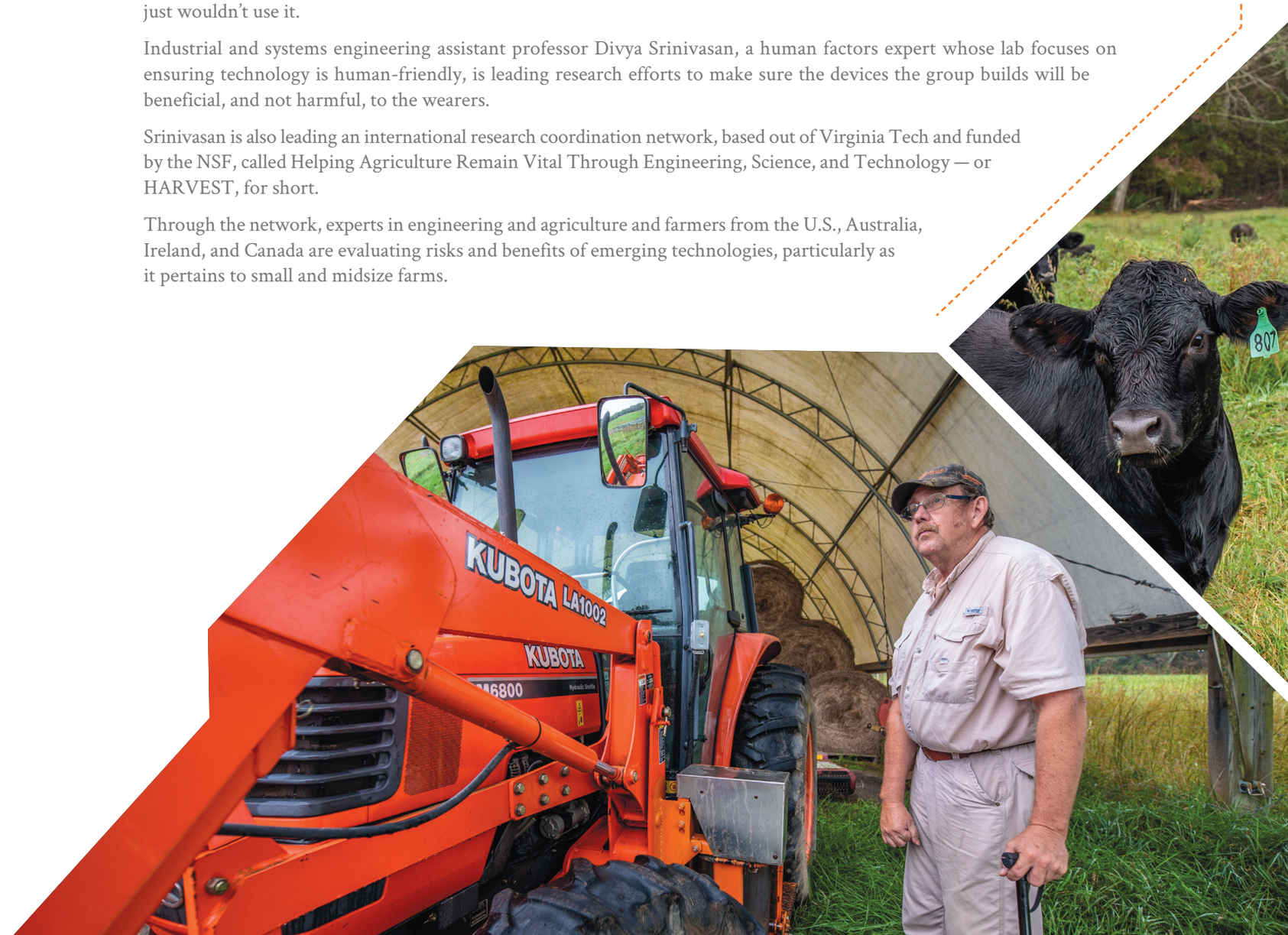


But assistive technology must work for the individual. Researchers from the College of Engineering are finding this to be true as they construct devices for farmers through the grant. When designing a wearable exoskeleton, for example, agriculture faculty and farmers discouraged the engineers from making complex devices with intricate parts. If the exoskeleton required specialized knowledge to maintain, characteristically independent farmers likely wouldn't bring it to someone else to fix. They just wouldn't use it.

Industrial and systems engineering assistant professor Divya Srinivasan, a human factors expert whose lab focuses on ensuring technology is human-friendly, is leading research efforts to make sure the devices the group builds will be beneficial, and not harmful, to the wearers.

Srinivasan is also leading an international research coordination network, based out of Virginia Tech and funded by the NSF, called Helping Agriculture Remain Vital Through Engineering, Science, and Technology — or HARVEST, for short.

Through the network, experts in engineering and agriculture and farmers from the U.S., Australia, Ireland, and Canada are evaluating risks and benefits of emerging technologies, particularly as it pertains to small and midsize farms.



Precision technology, Leonessa explained, is about robotic systems that autonomously tackle monotonous or physically demanding tasks, taking the farmer out of the loop. The end goal is that, at the push of a button, robots can do arduous agricultural tasks.

It's the concept behind robots built by agBOT, a student team Leonessa advises, that won first place in a national agricultural competition. Responding to the back-breaking task of watermelon harvesting, the agBOT team designed an autonomous harvester that rolls through a watermelon patch identifying melons, picking them up, slapping them to tell if they're ripe, then harvesting them.

The same concept extends to the work of Pratap Tokekar, an electrical and computer engineering assistant professor. Tokekar, an expert in the difficult realm of collaborative autonomous vehicles, is building a combination drone and ground vehicle system that can monitor and help control the height of vegetation — crucial for plant and soil health.

Mechanical engineering professor Kevin Kochersberger also uses drones, in his case to identify areas in fields that need extra care, whether due to drought or weeds. Then, a drone pilot can program a route to precisely spray fields with weed remover or pesticides as needed.

Then there's the tech that meets in the middle: both autonomous and assistive. Not taking the human out of the loop, but augmenting human capabilities. Mechanical engineering professor Tomonari Furukawa is building an autonomous grape-harvester that can pick delicate table grapes. Complicating this problem, the grapes' ripeness is difficult for the human eye to discern. Using cameras and computer vision algorithms, Furukawa's robot can spot when grapes are ripe, and human pickers can direct the robot to harvest.

To get to the real world, though, these forward-looking robots and devices built by university researchers must eventually be produced at scale. Only then will this technology be affordable, particularly for small and midsize farms.

"We are not designing robotic systems to do the job of the farmers," Leonessa explained. "What we are trying to do is make the job easier for the farmers." ■

LIVING IN THE FUTURE

HOW DID VIRGINIA TECH'S FutureHAUS rise from the ashes of a fire to climb to the pinnacle of design for the world's solar homes, taking first place in the 2018 Solar Decathlon Middle East?

The team succeeded by uniting students and faculty from various colleges and disciplines in building a net-zero energy home incorporating new methods of prefabrication, technology, and sustainability. The lone American entry, the Hokie-built 900-square-foot home, outranked 14 teams from a pool of 60 entrants.

"We have the most interdisciplinary team that we've ever had around any research project," said Joe Wheeler, architecture professor and lead faculty of FutureHAUS Dubai.

Moving FutureHAUS Dubai from concept to reality was a university-wide effort involving five Virginia Tech colleges, as well as the Myers-Lawson School of Construction and various centers and labs. Crossing traditional academic boundaries to solve complex problems, which is central to Virginia Tech's vision, drew in many of the team's key players.

The win was actually the culmination of nearly two decades of research, including two years of accelerated development after the previous model of the house was destroyed in a 2017 fire.

The FutureHAUS Dubai team had to create a home that serves the needs of an aging population, addresses growing environmental concerns, and integrates secure smart systems. The house was equipped with 67 devices, including touch screen control panels, automatic sliding doors, a smart mirror to help users find their clothes, and a moveable wall to adjust floor plans.

The team's victory in Dubai not only validated their vision for the home of the future, but also their vision for a new way to tackle the housing needs of an increasingly crowded world with finite resources. One important concept was to build FutureHAUS entirely in a lab as separate but compatible "cartridges" that are equipped with the walls, floors, ceiling, wiring, plumbing, and finishes. ■

A GLOBAL HUB FOR BIOMEDICAL RESEARCH

THE FOUNDING VISION TO CREATE

the Fralin Biomedical Research Institute at VTC, was bold: Amass a concentration of biomedical research talent and catalyze it with the resources of a major research university and an enterprising health care system, then give it the freedom to innovate.

It worked. Since opening nine years ago, the research institute has enabled interdisciplinary collaboration among creative, entrepreneurial scientists and provided access to state-of-the-art molecular biology, imaging, behavioral, and computational facilities. The institute makes transformative scientific advances that address the fundamental processes of human and animal health and disease while training the next generation of biomedical scientists and facilitating discovery-based medical education at the adjoining Virginia Tech Carilion School of Medicine.

And the institute and School of Medicine — emerging from the longstanding partnership between Virginia Tech and Carilion Clinic — have multiplied connections between Virginia Tech's Blacksburg and Roanoke campuses, creating a nexus of research and innovation that will extend across the state.

Under Executive Director Michael Friedlander's leadership, the institute has focused on a small number of strategic areas in biomedical and health sciences to differentiate the commonwealth as a national and global hub for research and innovation. Today, those strategic areas have evolved into cardiovascular science, neuroscience, cancer, immunology and infection, and regeneration and rehabilitation.

Meanwhile, the institute is working to increase development of intellectual property, to commercialize discoveries through startup businesses, and to grow an already strong portfolio of partnerships with industry to propel innovation from the laboratory to the clinic and community. Several recent discoveries have been patented and are centerpieces of spin-off companies, including a new brain cancer stem cell therapeutic and a new diagnostic screen for alcohol abuse risk, both of which have won highly competitive federal technology transfer business awards. ■

TRANSFORMING KNOWLEDGE INTO PRACTICE

THE RESEARCH INSTITUTES OF VIRGINIA TECH enhance the university's ability to address large-scale research opportunities by crossing traditional disciplinary and college lines, while providing clients access to world-class expertise across many disciplines and to the scientific and technical capability of specially equipped, advanced laboratories.

THE INSTITUTE FOR SOCIETY, CULTURE, AND ENVIRONMENT

fosters a creative, interactive, multidisciplinary structure for socially significant research and creative efforts in the social sciences, humanities, and art. Research extends from public policy to personal identity and includes explorations of race, ethnicity, class, and gender.

THE INSTITUTE FOR CREATIVITY, ARTS, AND TECHNOLOGY

is positioned at the intersection of science, engineering, art, and design, connecting transdisciplinary conventional and practice-led research, educational innovation, and scientific and commercial discovery.

THE INSTITUTE FOR CRITICAL TECHNOLOGY AND APPLIED SCIENCE

focuses on emerging technologies at the intersections of engineering, the humanities, and the physical, life, and social sciences. Focus areas include nanoscale science and engineering and sustainable energy and renewable materials.

THE FRALIN LIFE SCIENCES INSTITUTE

is an investment institute committed to supporting research, education, and outreach in Virginia Tech's life sciences community.

THE VIRGINIA TECH TRANSPORTATION INSTITUTE,

the largest transportation research institute in the United States by most metrics, develops and uses state-of-the-art tools, techniques, and technologies to solve transportation challenges. Institute research has impacted public policy on national and international levels.

THE HUME CENTER

leads Virginia Tech's research and experiential learning programs in national security, with a focus on cybersecurity, autonomy, and resilience.

FRALIN BIOMEDICAL RESEARCH INSTITUTE AT VTC

makes transformative scientific advances that address the fundamental processes of human and animal health and disease, training the next generation of leading biomedical scientists while also facilitating discovery-based medical education.

A CLEAN WATER SOLUTION

FOG HARVESTING – A DECADES-OLD METHOD

of catching microscopic droplets from the air that can help alleviate water shortages in a world where two-thirds of the population lives under conditions of severe water scarcity – has received a boost from an interdisciplinary research team at Virginia Tech.

Partially funded by the Virginia Tech Institute for Creativity, Arts, and Technology, the team's "fog harp" uses a vertical array of parallel wires that shed tiny water droplets three times faster and more efficiently than the traditional mesh netting used in fog nets today. The harp doesn't clog the way nets do.

Since the unveiling of the harp, researchers have heard from entrepreneurs, farmers, philanthropists, and citizen-scientists around the globe. The inventors are working on a full-scale prototype and industry partnerships to move the harp from the lab to the landscape. ■

STUDENT-BUILT SATELLITES DEPLOYED INTO ORBIT FROM THE INTERNATIONAL SPACE STATION

A small group of faculty, staff, and students gathered at Virginia Tech's Center for Space Science and Engineering Research earlier this year and watched as their Virginia Cube Sat Constellation satellites launched from the International Space Station.

The effort, which began in June 2016, was a collaboration between the Virginia Space Grant Consortium and four of its member universities: Virginia Tech, Old Dominion University, University of Virginia, and Hampton University.

Working together as a constellation, the three nano-satellites are each about four inches cubed and weigh approximately three pounds. They have been developed and instrumented to obtain measurements of atmospheric properties and quantify atmospheric density with respect to orbital decay.

Old Dominion University's satellite, which has a drag brake to intentionally cause orbital decay, is expected to remain in orbit for up to four months, while the satellites from Virginia Tech and University of Virginia should orbit for up to two years. ■

DESTINATION AREAS

AT VIRGINIA TECH, transdisciplinary communities work within the framework of nine Destination Areas to collaboratively address complex global problems. These Destination Areas build on the university's existing areas of expertise, including rural health, infectious disease, coastal mitigation, brain health and development, and security.

ADAPTIVE BRAIN AND BEHAVIOR

Advancing our understanding of brain plasticity as it pertains to decision-making, physical and psychological trauma, and development across the lifespan. Studies enhance knowledge of the impact of brain-behavior relationships on health and the human condition.

CREATIVITY + INNOVATION

Exploring innovative technologies and the design of creative experiences. The area will build and strengthen creative communities, support economic development, and enhance quality of life through self-sustaining and entrepreneurial activities.

DATA AND DECISIONS

Advancing the human condition and society with better decisions through data. The area strives to be a global destination for data analytics and decision sciences, integrating across all Destination Areas.

ECONOMICAL AND SUSTAINABLE MATERIALS

Understanding and addressing scientific materials challenges related to health, energy, environment, and resilient infrastructure. Efforts span the scope and sequence of materials use, from discovery and computational modeling to processing, manufacturing, and implementation.

EQUITY AND SOCIAL DISPARITY IN THE HUMAN CONDITION

Engaging with societal problems to advance equity in the human condition, maximizing wherever possible the equitable distribution and availability of physical safety and well-being, psychological well-being, and access to crucial material, social, and moral resources.

GLOBAL SYSTEMS SCIENCE

Understanding and finding solutions to critical problems associated with human activity and environmental change that, together, affect disease states, water quality, and food production.

INTEGRATED SECURITY

Focusing on themes related to cybersecurity, privacy and ethics, governance, and global security to understand and foster a world in which people, institutions, and nations are secured by technology and social systems that follow ethical principles and promote values.

INTELLIGENT INFRASTRUCTURE FOR HUMAN-CENTERED COMMUNITIES

Seeks to address problems that exist at, and along, the interdependencies between humans, communities, and infrastructures to ultimately improve quality of life.

+POLICY

Developing novel approaches to policymaking and analysis by focusing on the dynamics of complex decision making in multiple contexts and policy settings. The area works at the intersection of scientific evidence, governance, and analyses to translate scholarship to practice.

CLAIM YOUR ROLE

Virginia Tech is home for the curious, the bold, the insatiable.
A thirst for knowledge propels us, a call for service unites us.
Research. Discovery. Impact.

That's our role. Discover yours... vt.edu.

VIRGINIA TECH™