MICHIGAN STATE UNIVERSITY ANNUAL REPORT

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Dear friends of the MSU Innovation Center,

As we reflect upon 2021 in our Annual Report, I am compelled to say, it's been a year like no other, and it has raised my appreciation of MSU as an organization built on dedication and perseverance.

I am proud of the MSU Innovation Center, and it's been a privilege to work with a team of individuals who are committed to staying Spartan strong, aligning with MSU's core values of Collaboration, Equity, Excellence, Integrity and Respect. As we move into 2022, I am optimistic we will carry great momentum into the "new normal" and deliver value to Michigan and the world.

MSU President Samuel L. Stanley Jr., M.D. recently released the university's strategic plan:

<u>"MSU 2030: Empowering Excellence, Advancing</u> <u>Equity and Expanding Impact"</u> – a plan that puts people first, prioritizing the success of students, staff and faculty.

A piece of that report — "Discovery, Creativity and Innovation for Excellence and Global Impact" – speaks directly to the mission of the Innovation Center. Quoting the strategic plan:

"MSU scientists, scholars and artists pursue excellence in service to the common good as they generate new knowledge and apply it in practical ways to address complex societal problems. They look for answers to fundamental questions that lay the groundwork for solutions to problems decades in the future. They also study our histories and cultures to assure new knowledge is informed by our collective and unique experiences as part of the larger society."

It is from this engine of creativity that the Innovation Center derives the substrate for partnerships, innovations and economic opportunities.

We align ourselves to the objective to "Invest in research to advance partnerships that increase economic development and opportunity in our region and beyond and that helps understand, shape and improve the future of work and the workforce." We look forward to working with our partners to achieve this goal.

Developing corporate partnerships is one of the three core activities of the Innovation center. In the past year, we helped forge a new partnership with Toyota that facilitated mentoring relationships between women students of engineering and Toyota engineers.



You can read more about that story here, as well as another longstanding auto-industry relationship – the MSU Ford Alliance Partnership, which has led to more than 100 successful projects to date.

The strengths of our other organizational pillars — startups and entrepreneurship, and tech transfer and commercialization — are highlighted here through several stories including the collaborative launch of Great Lakes Crystal Technologies, as well as the release of Plunder Panic, MSU's first video game to hit the marketplace. And I can't forget to mention our rising students.

You can learn more about the scholarships we've awarded to support entrepreneurial success, including one to Brendan Wang, who has been busy working to put an end to the vaping epidemic.

2021 was also a big year for MSU partnerships in health care, and the Innovation Center partnered with our medical colleges to help move it all forward.

Noted examples include BAMF Health in the new Doug Meijer Medical Innovation Building in Grand Rapids, opening in late 2021, and a master research relationship with Perrigo, with new international headquarters now under construction on the Grand Rapids research campus.

Across the state in Detroit, MSU announced a new 30-year partnership with Henry Ford Health System, creating a locus of collaborative research and innovation aimed at improving health outcomes.

Thank you for taking time to view the 2021 MSU IC Annual Report. I hope you enjoy reading the stories as much as we love sharing them.

Stay well, and please stay in touch.

Charles A. Hasemann, Ph.D. Assistant Vice President for Innovation and Economic Development

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Collaborative support fuels diamond growth MSU's entrepreneurial ecosystem amplifies tech transfer potential for startups

Validation is a great motivator.

External confirmation that your work has potential can offer a valuable confidence boost.

And when it comes in the form of grant funding and operational support for a nascent technology, it fuels momentum in meaningful scientific research.

The diamond technology research and development being done at Great Lakes Crystal Technologies started in August 2019 as a spin out of the world-class diamond materials and device collaboration between Michigan State University and the Fraunhofer USA Center for Coatings and Diamond Technologies, located on the MSU campus.

GLCT's founders are Dr. Timothy Grotjohn, a professor in MSU's College of Engineering, and Dr. Keith Evans, a veteran of the post-silicon semiconductor industry who has deep experience in bringing new semiconductor materials to market.

Grotjohn, MSU Innovation Center's 2021 Technology Transfer Achievement award winner, holds nine patents related to diamond synthesis and processing.

Diamond potential

Diamond is grown in MSU labs for use in semiconductors and other advanced electronic applications sought after by entities such as the U.S. Department of Energy.

That work is crucial because diamond material has an incredibly high thermal conductivity – much higher than copper – making it ideal for use in semiconductors.

"When you use a diamond in a photon or proton beam, it holds up. Most other materials would be destroyed," Grotjohn said.

"We've worked on diamond for 30 years or more at MSU. It feels good to have all that work produce papers and conference talks, but to move it into the commercial sector means it will have impact in the world."

Before GLCT was started, MSU helped Grotjohn and his colleagues explore whether or not the idea for a company focused on diamond technology was even viable. Through MSU's and Spartan Innovations Entrepreneur-In-Residence program, Evans was matched with Grotjohn to serve as the CEO of the startup company.

Collaborative support fuels diamond growth MSU's entrepreneurial ecosystem amplifies tech transfer potential for startups *continued*

In his EIR role, Evans worked with the MSU Foundation, Spartan Innovations, MSU Technologies and Red Cedar Ventures to commercialize advanced technologies developed at MSU.

Or, more simply: "I focused on the tech side and Keith did the paperwork and budgets," Grotjohn said.

But while the diamond technology research had been going on for decades and was proving to have significant market potential, that didn't mean evolving into a company was a given. With funding support from Spartan Innovations, GLCT was motivated to reach essential business milestones to continue to grow.

Investing toward success

Thanks to that support from Spartan Innovations and Red Cedar Ventures, Evans could focus on preparing pitches to investors and seeking grant support from external funders.

Red Cedar Ventures is the investment arm of the MSU Foundation, focused on growing startup companies created by MSU faculty, staff and students. It sets milestones to help accelerate the commercialization of startups, creating opportunities for MSU technologies, ecosystem partners and the state of Michigan.

"Red Cedar Ventures motivated us to seek out SBIR and STTR grants," Evans said.

While small Business Innovation Research (SBIR) and Small Business Technology Transfer (SBTT) grants from the federal government are highly competitive, they encourage domestic small businesses to engage in research and development with the potential for commercialization.

"Great Lakes Crystal Technologies has won more SBIRs than any company that's gone through the Innovation Center ecosystem," Evans said. "And we met more milestones with Red Cedar Ventures than we could cash in on. I'm a very independent guy, but I learned that when good advisers advise you, you better listen." Those advisers came from both Spartan Innovations and the MSU Foundation, working in concert to create turnkey solutions for entrepreneurial faculty with startup ideas.

Brad Fingland, director of venture creation, physical sciences, for the MSU Innovation Center, calls GLCT the poster child of using every resource available to them.

"They've been able to leverage all the resources we have at the university," Fingland said. "We funded a postdoc who acted as the principal investigator for the SBIR and STTR grants, we sponsored their CEO, Keith Evans, and they're also a tenant in one of our lab incubators. They've taken a lot of the programs we offer and used them to the fullest degree."

To date, GLCT has won more than \$1 million in SBIR and STTR funding, and it's now partnering with a multi-billion-dollar company to commercialize high-tech diamond technologies. Grotjohn and Evans are diligently working toward taking decades worth of research from MSU into the marketplace.

Evans, who has worked with startups that spun out of research at other universities, said he's impressed by MSU's web of support.

"I've never seen it done better," he said. "I've never felt the well-aligned set of players and a startup ecosystem the way I have at MSU. My experience was the opposite – everybody was fighting to get resources. MSU does a fabulous job. I feel so fortunate to have been connected to the Entrepreneur-In-Residence program."

Rich Chylla, Executive Director of MSU Technologies agreed.

"This is another great example of MEDC university programs accelerating commercial success in technology transfer," Chylla said. "The diamond technologies at MSU benefited from both an ADVANCE proof-of-concept grant to move the technology forward while Keith Evans work as an Entrepreneur-in-Residence was partially supported by the Tech Transfer Talent Network (T3N) program."

Collaborative support fuels diamond growth MSU's entrepreneurial ecosystem amplifies tech transfer potential for startups *continued*



Moving to market

Ray DeVito is a technology manager with MSU Technologies, the intellectual property and tech licensing arm of the MSU Innovation Center. His work focuses on providing a means to advance university research and development into a commercially viable space in the market.

"With diamond material, there is a pretty broad sweep of technologies involved," DeVito said. "It's an interesting collaboration."

Part of that collaboration is with Fraunhofer, a German research institute with U.S. locations, including one on the East Lansing campus.

The Michigan State University Fraunhofer USA Center for Coatings and Diamond Technologies provides innovative research and development services based on its expertise in coating and diamond technology. Grotjohn is a senior scientist in the center, working on the modeling, design, diagnostics and applications of plasma-assisted materials processes and processing machines. "It takes a good depth of expertise to do this level of work in this field and make it viable," DeVito said. "If it was easy, everyone would grow diamonds in their basement."

John Albrecht is the executive director of MSU's Fraunhofer Center. He said MSU's work in diamond technology is unique.

"I deal with a lot of universities around the country, and most have some form of research and development support," Albrecht said. "But MSU is very faculty-friendly when it comes to encouraging these commercialization opportunities and setting up companies. These startups can have an employee who stays on the Spartan Innovation payroll until they get their first SBIR grants, they set up space for their headquarters, they set them up with a leadership team, a CEO.

"They give them the opportunity to succeed."

The diamond technology project is about halfway to its next milestone of an additional \$1 million in financing, and the team hopes to demonstrate minimum viable products this year.

"The MSU Foundation and the variety of supports we give this work helps move basic research into a more directed development program for commercially viable application," DeVito said. "To go from the theoretical to the actual, you start in the lab with a team of Ph.D.s, but you need a company with technical expertise to scale it up for effective mass production.

"This work has so much potential."





Ian Gray Scholarship recipients find entrepreneurial success

For the past several years, the MSU Innovation Center has awarded the Ian Gray Scholarship to MSU students who demonstrate hard work, determination, and a passion for entrepreneurial success.

Gray, for whom the scholarship is named, spearheaded the creation of the MSU Innovation Center and served as vice president for Research and Graduate Studies at MSU until his retirement in 2012. The scholarship is awarded to an MSU student each year who exhibits the qualities of an entrepreneur.

In 2021, that student was Ethan Hopp, an MSU senior from Detroit majoring in electrical engineering.

Bitcoin, Ether and Ravencoin. As cryptocurrency sweeps the nation, Hopp wanted to create something that makes the process a little easier to navigate. And with the help of the lan Gray Scholarship, Hopp's creation is picking up pace.

Hopp is creating a Bitcoin rig that allows users to go to class, game and surf the web, all while the software is earning cryptocurrency. Hopp was inspired after he wanted a better case to hold more equipment and realized the prices were too high. "All of the other options I saw were either cheap and tossed together or cases that were \$3,000," Hopp explained. "Instead, I got together with some of my buddies who are mechanical engineers, and we designed this computer case that can hold multiple graphic cards and power supplies."

Cryptocurrency is a digital currency secured by cryptography, which makes it nearly impossible to counterfeit or double spend. Some popular cryptocurrencies include Dogecoin, Bitcoin and Tether. Combined, those three hold an estimated \$947.6 billion in market value.

Mining for cryptocurrency is similar to mining for gold. Complex computers must compete with other users to solve a puzzle to validate their transactions and earn cryptocurrency.

There were some options out there for Hopp to use, but none of them fit his direct needs. He decided to tackle the problem head on and create his own solution.

To Hopp, the meaning of being an entrepreneur is clear: someone who takes risks.

Ian Gray Scholarship recipients find entrepreneurial success continued

"I've been thinking about building a CNC router so we can actually use and create these cases ourselves," Hopp said. "So instead of paying someone to do it for \$1,000, we can actually just buy the material and do it ourselves."

The abundance of resources offered by the MSU Innovation Center and MSU's Burgess Institute for Entrepreneurship and Innovation has led to mentorship relationships, new skills learned in courses and now scholarship funding.

The next step for Hopp is to finish a second prototype. Once he is happy with the final product, he would like to tie into some big tech conferences.

Hopp and his team also utilized resources from different facets of the university as well. He partnered with the web and logo designers offered through the Burgess Institute for Entrepreneurship and Innovation.

The Gray Scholarship recipient receives \$2,000 per semester to help cover tuition or student expenses. With some of his school expenses now covered by the scholarship, Hopp decided to use that flexibility to help his process become more independent and further his creation.

"The fact that we can get money through the university is really great," Hopp said. "It costs \$1,000 just to become incorporated and another \$1,000 to get a prototype done. We would not have been able to do that without support from this scholarship."

2020 recipient takes on vaping epidemic

MSU student Brendan Wang set his entrepreneurial path with one goal in mind: to help people live healthier and happier lives. Wang, a senior in MSU's Eli Broad College of Business, has created a solution to help put an end to the nation's vaping epidemic.

Wang created a device that mimics a traditional vape pen, minus the smoke, nicotine and other harmful chemicals. After nearly two years of hard work and determination, CAPNOS Zeroâ is off to a promising start. Through resources at the MSU Innovation Center, along with the Burgess Institute for Entrepreneurship and Innovation, CAPNOS Zero is now being sold to users across the country both online and in stores. "We conducted so much research and development along with our manufacturer, engineering mentors and our team to then bring together what we have today," Wang said.

CAPNOS launched to the public in mid-September. Users can go online to order the CAPNOS Zero. Within three days of announcing the official product launch date, CAPNOS received over 40 additional pre-orders with \$1,050 in revenue. On the day of their first in-person launch at East Lansing party store, Jonna's 2 Go, CAPNOS sold half of its stock in-store and delivered over 320 CAPNOS starter packs.

Going into their product launch, CAPNOS prioritized three major fields: customer experience, operational excellence and relationships with their partners to continue growing as a company.

"We want to make sure we are providing the best service that we can to ensure the best possible customer experience," Wang said. "We are making sure we can fulfill and deliver on time to not only our consumers, but also our retail partners and other partners alike."

Wang was inspired by his own personal experience as a former vape user. He wanted to create a product that could help people beat their nicotine addictions and lead healthier lives.

Wang said being recognized as the 2020 recipient of the Ian Gray Scholarship helped advance his idea, and his hard work is definitely paying off.

"When I first found out I received the scholarship, I felt gratitude and disbelief. I'm just grateful for everyone, and I've been so inspired by the entrepreneurs around me," Wang said. "I've looked up to my peers pursuing their academic careers as well, and I just thought, 'wow, out of so many extraordinary people, I am so grateful to receive this award."

The scholarship provided Wang with \$2,000 per semester to help with tuition or student expenses, freeing up funds to invest in development of the CAPNOS device.

Ian Gray Scholarship recipients find entrepreneurial success continued

"As soon as I met Brendan – I knew that our team had picked the right person to receive this scholarship," said Charles Hasemann, MSU's assistant vice president for Innovation and Economic Development. "Brendan not only has the passion and drive to bring a product to market that will really make a difference in the world, but he has the winning attitude and exceptional people skills that will serve him well as he ventures into his professional career after college."

Wang plans to expand his product line with hopes that CAPNOS will continue to grow around the world.

"The primary vision that I have for CAPNOS is to see that we can become a global company," Wang said. "Seeing CAPNOS in obscure places in Europe or Asia, building more products, building our service line to combine tech with the physical aspect are all the major initiatives that I would like to see for CAPNOS over the next five years."







New partnership empowers MSU women in engineering

In a move to strengthen the journey among female engineering students, Toyota has partnered with Michigan State University on a mentorship program that builds upon its already strong ties to MSU's Society of Women Engineers.

Toyota has a long history of supporting K-12 mentorship and STEM programs, but this is the first of its kind at the university level. As technologies advance every day through autonomous, electric, connected and mobility vehicles and systems, the timing is spot on.

"Toyota believes we can support the students' knowledge of these technical areas as well as our personal experiences in the real world," said Randy Stephens, a group vice president of Product Performance Engineering. "We hope to see students empowered by their collaboration with us."

Not only is the partnership beneficial for students, but for Toyota's future as they gain information and prepare for a new generation of engineers. It's also an opportunity for all involved to launch a program with endless possibilities for expansion. Given that it is the first year for the program, leaders wanted to start small, with 15 junior and senior engineering students participating. Each mentor was uniquely assigned to a mentee by using information provided based on personalities and interests.

Toyota mentors meet virtually with students at least once a month to discuss career options, challenges and skillsets while providing advice on how to present ideas to grow in the industry.

MSU's engineering students learned about the program through their advisor, Judith Cordes.

Cordes was motivated by the idea of this program for two reasons. One, she and other advisors are always searching for ways to build on student involvement. "We know from our mentoring program, as well as many studies, that mentoring is a key component for continued success," Cordes said.

Secondly, they were excited to start a program with corporate partners. Unlike other projects, this one has the ability to impact both MSU students and Toyota engineers.

New partnership empowers MSU women in engineering continued

That partnership was solidified by Brice Nelson of the MSU Innovation Center. As director of corporate partnerships, this kind of work is at the heart of Nelson's role with Business Connect, a unit of the Innovation Center focused on corporate engagement.

"This is a great example of a corporate partner working with MSU to create a mutually beneficial program," Nelson said. "The structured mentorship of this critical talent pipeline could very well position Spartan women to have a significant impact on the mobility industry for years to come."



Jenny Lam and Isabel Woelke, both seniors at MSU, are notable examples of the type of students this program was designed to assist. Having taken on several leadership roles in their academic careers, they were motivated to find yet another way to progress as female engineers.

Both Lam and Woelke are involved with MSU's chapter of the Society of Women Engineers, a non-profit educational service organization composed of science and engineering students and graduate engineers who work to recruit, support and retain women in the engineering profession.

"I am always looking for ways to improve myself professionally and as a student, so I thought this was a good way to get out of my comfort zone and seek some extra help," Lam said.

Woelke agreed, and said she finds value in connecting with a mentor to discuss career options, professional development opportunities and day-to-day functions of being an engineer.



"We all have so much to learn from one another," she said. "I'm just really grateful to be in a program like this."

Lam has learned to take her mentor's experiences and mold them into a way where she can apply them to her own life. "My goals for this mentorship are to really work on being a better leader and communicator, and that encompasses building my confidence as well," she said.

Her mentor, Emily Khouphongsy, an MSU College of Engineering 2008 alumna, served as president of the Society of Women Engineers while a student at MSU. For the past decade, she has been a professional advisor to the group, and is proud to give back to the university by sharing her passion for mentoring.

"I believe we all face challenges as we learn and grow in all areas of life," Khouphongsy said.

"Part of the personal value of life's challenges is then the opportunity we have to help others as they navigate the same things."



Video game developed at MSU paves way for future gamers

Playing a video game typically involves a clear path to success.

But for the people creating the game, the path to getting it to market can be much more ambiguous.

The creation of <u>Plunder Panic</u> — the first game to hit the market from Michigan State's Game Design and Development Program — gained traction in part by the infrastructure and guidance through ties between the <u>College of</u> <u>Communication Arts and Sciences</u>, the <u>MSU</u> <u>Innovation Center</u> and the <u>MSU Foundation</u>.

Plunder Panic, an arcade game for up to 12 players that features battling pirate crews, is available on <u>Steam</u> and will be released on all major consoles in early 2022. The development of the game is a treasure map of sorts that could guide future MSU students to internship and employment opportunities while bolstering the already sterling reputation of <u>MSU's GameDev</u> program.

GameDev at MSU ranks <u>first in the nation</u> for game design and development programs within public universities, according to The Princeton Review. Worldwide, MSU's game design and development program also ranks seventh among undergraduate programs and 12th among graduate programs.

How the MSU Innovation Center helped build a gaming studio

Brian Copple, a technology manager with the Innovation Center, said the groundwork for Plunder Panic came about when he met with Brian Winn, director of <u>MSU's Games for</u> <u>Entertainment and Learning Lab (GEL)</u> in 2018.

They identified that while the GEL Lab and the College of Communication Arts and Sciences provided teaching on a nationally recognized level, a next step for moving promising games to market was missing. Copple then invited Frank Urban, a venture creation director with Spartan Innovations — the startups arm of the Innovation Center — to collaborate in the path forward.

"One of the deficiencies we identified was that there was no clear path to commercializing gaming concepts coming out of the university," Copple said. "We wanted to explore the potential to spinout a startup company from MSU that could commercially develop gaming concepts originating from MSU while also giving our students opportunities for internships and potentially their first job after graduation before trying to garner employment with one of the large game development companies."

The commercialization project started by hiring a gaming consultant to dig into the gaming industry and look at how the top gaming institutions in the country were commercializing games that were under development.

Video game developed at MSU paves way for future gamers continued

A commercialization plan was finalized after a number of pivots based upon market research and available support, and <u>Will Winn Games Inc.</u>, now an East Lansing-based video game studio, was born.

Matt Rudd, an Entrepreneur in Residence (EIR) with Spartan Innovations, was assigned to the company because of his years of entrepreneurial startup experience in the Michigan ecosystem. The company launched with a \$20,000 investment from Red Cedar Ventures, a wholly owned subsidiary of the MSU Foundation, in November of 2020, and then another follow on investment of \$20,000 was awarded in the spring of 2021.

The company continued down its path to commercialization developing its product, e stablishing its team and expanding its Board of Directors. Jeff Wesley, executive director of Spartan Innovations and Red Cedar Ventures, now serves on the Board.

With the continued positive traction, Will Winn Games raised \$262,000, which included another \$25,000 follow on investment from Red Cedar, bringing the total investment to \$65,000. Urban and Brad Fingland from the Spartan Innovations team met monthly with the Will Winn team, helping to successfully commercialize this new startup.

"The Spartan Innovations and Red Cedar Ventures teams saw this company progress and continue to achieve milestones on its path to commercialization," Wesley said. "It is a great team of leaders to partner with... We have not only supported them in best practices, but experienced great leadership from the Entrepreneur-in-Residence and now CEO Matt Rudd. Early support also came to this company from the Business Accelerator Fund, supported by the Michigan Economic Development Corporation and the Lansing Area Economic Partnership."

During the game development stage of Plunder Panic, Copple helped Winn's team secure \$5,000 from the MSU Copyright Development Fund (CDF) to attend the 2018 PAX EAST SHOWCASE, which allowed real players to review and critique the game. Player feedback was overwhelmingly positive as Plunder Panic was featured in the PAX EAST INDIE MEGA BOOTH.



Following the conference, Copple was able to secure an additional \$25,000 tranche from the CDF to cover the software development costs required to implement the new features identified at PAX EAST.

"The College of Communication Arts and Sciences has also made a significant investment in the development of Plunder Panic," Copple said. "The creation of the gaming kiosk on the main floor of the Communication Arts & Sciences building, highlighting Plunder Panic and other games from the MSU Game Development Program, was a significant investment."

Collaboration 'is critical'

The MSU Innovation Center, Spartan Innovations, Red Cedar Venturesthe MSU Foundation, the College of Communication Arts and Sciences, and the GEL lab, all worked together to lay the foundation for Will Winn Games.

Rudd, now CEO for Will Winn Games, said that while in the planning phase for licensing and commercializing Plunder Panic, the studio pivoted to serve as an incubator for GameDev graduates on a smaller scale during the COVID-19 pandemic.

Rudd credited the full collaboration of all the teams involved for finalizing the business model and objectives for Will Winn Games. The plan went beyond bottom-line revenue and conceptualized how the company could positively impact gaming commercialization for MSU, enhance student learning experiences and craft the next generation of game developers.

Video game developed at MSU paves way for future gamers continued

"Collaboration is critical to finding products and technology coming out of MSU that is commercially viable," he said.

Copple said it took three and a half years to get Plunder Panic from concept to license and commercialization. The fact that the game was developed, and a new company was created in-house with MSU's host of resources, was an impressive accomplishment considering that the process takes about 18 to 24 months for an established gaming company, Copple added.

Releasing Plunder Panic to the world

Plunder Panic's playing style evokes after-school multi-player gaming sessions with a group of friends. The game started out with a local multiplayer concept but has shifted toward online play.

"Many of us have fond memories of these times, spending too many hours gaming, laughing and having fun together in-person," said Will Jeffrey, co-lead designer and executive producer, who puts the 'Will' in Will Winn Games. "Plunder Panic embodies those feelings and is a ton of fun to enjoy together."

Jeffery partnered with Winn back in 2017, while Winn served as the director of the GEL Lab. Jeffery has since left MSU to pursue a career at Disney Imagineering and Full Sail University in Florida. Within Will Winn Games, Winn took on the role of studio director and president while Jeffrey now serves executive producer and project manager.

Jeffery partnered with Winn back in 2017, while Winn served as the director of the GEL Lab. Jeffery has since left MSU to pursue a career at Disney Imagineering and Full Sail University in Florida. Within Will Winn Games, Winn took on the role of studio director and president while Jeffrey now serves executive producer and project manager.

"The launch of Will Winn Games has given us an opportunity to reunite and work together to see our Plunder Panic baby grow to adulthood and be released out in the world," Winn said.

What's next?

As Plunder Panic prepares to make a splash in the gaming world, it does so as a trailblazer for aspiring MSU students who now have the advantage of having a gaming studio close to home.

"I definitely believe that new games will be on the horizon now that MSU has a transparent, clear pathway to commercialization," Copple said.

And that could be sooner rather than later with the startup's recent move into the MSU Foundation's <u>VanCamp Incubator</u> space in East Lansing. Winn said the growing team is excited to begin working on the next set of games.

"Success for me would be growing Will Winn Games into a stable, vibrant studio that develops a strong track record of quality game titles that are successful in the marketplace, all while building a dynamic team of game developers, fostering a best-in-class corporate culture, enhancing MSU's top-ranked GameDev program, and helping to expand the Michigan video game industry."



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Power generation you can see through

This article has been reposted from MSUToday.

Building greener vehicles with help from plants

Spartan engineers and Ford Motor Co. are creating new polymers and composites for the automotive industry using sustainable materials from nature

As a building material, bamboo is pretty amazing. Even though it's technically a grass, bamboo's reeds can be tougher than timber. It also grows fast, helping make it more sustainable than lumber.

None of this is a secret to environmentally conscious consumers who have welcomed bamboo into their homes as desks, flooring and cutting boards, to name just a few applications. Still, as ubiquitous as bamboo is, people might be surprised to find it in their cars, which could be a reality in the not-too-distant future.

That's the future that researchers at Michigan State University and collaborators in the automotive industry — especially at Ford Motor Co. — are working to create. Not just with bamboo, but an array of other plant materials to help cut costs and carbon emissions while making cars and trucks.

And where else would you see this charge but in Michigan? With its legendary automotive history and forward-looking auto shows, the state provides fertile grounds for this story. It's a story rooted in the past, in innovators who have always valued teamwork and resourcefulness. But it's also about the future, about ongoing partnerships and the next generation of Spartans, for whom "Go Green!" is more than a cheer. It's a way of life.

The grass is always greener

Lawrence Drzal, a University Distinguished Professor in the <u>College of Engineering's</u> <u>Chemical Engineering and Materials Science</u> <u>Department</u>, has been working to reduce the cost of composites used in cars for decades. Of course, he didn't want to trade off on their performance either, meaning he needed materials that were both strong, tough and abundant.

"What was kind of ignored and was an area that had potential was plant fibers," Drzal says. Wood was an obvious first choice for its strength, but trees take years to grow and harvest. And, after all, time is money, so he shifted his attention to grasses, including bamboo.

"Grasses can grow to maturity in about three to four months, they're perennial, and their stems have very good properties," Drzal says. "Plus they're biodegradable and can be recycled. There are a whole lot of benefits."

As it turned out, though, Drzal, like many innovators, was ahead of his time.

"We did a lot of work in our group with these fibers in the early 2000s, but the one thing that was lacking was a technological pull," he says. "We would investigate these materials, show they had good properties, but typically didn't offer any savings. They were a nice curiosity, but they weren't used very much."

To understand what Drzal means about savings and technological pull, it's important to understand the existing composites his new materials were competing against.

Power generation you can see through continued

Drzal and his team were particularly interested in making what's called sheet molding compound. "It's got the consistency of cookie dough," Drzal says. "You pop it into a mold and then cure it, then you get a car hood or whatever you were making."

The compound is a composite, or mixture. One component of the composite is a polymer that can easily be shaped or molded before it's hardened or cured. Mixed in with that resin are fibers, the other component of the composite. The fibers boost the strength and stiffness of the moldable resin, resulting in a cured composite much tougher than the cured resin alone.

For sheet molding compound, carbon fibers have the best properties. They also come with a steep price tag. Glass fibers, meanwhile, provide good strength at a more economical cost. As a result, glass fibers have established themselves as the most widely used material and, thus, the benchmark against which Drzal would compare his new composites using plant fibers.

That comparison always favored the incumbent glass materials at first, but the criteria used to compare materials have evolved since then.

"You don't want to be shipping fibers from all around the world. You want to utilize plants grown in your backyard."- Lawrence Drzal, University Distinguished Professor at MSU

The upfront cost of the materials remains a major factor, as does a composite's performance. But companies are becoming increasingly interested in utilizing sustainable materials. For example, if a new material is lighter than the glass composite, that can translate to better fuel efficiency for a vehicle. That's not only better for the planet, but it's also a major factor for folks buying cars.

The manufacturing of glass fibers is energy intensive. Glass fibers need to be processed at high temperatures, and they're abrasive on machining equipment. Plant fibers can be processed under gentler conditions, reducing the money spent on energy and maintaining equipment.

Furthermore, the grasses that automakers can use could provide an additional source of income for farmers. About 10 years ago, Drzal worked with an analyst to show that if grass-based composites performed well enough to entice auto makers to pay a modest price for the plants, it'd be a boon for agriculture. This analysis examined a perennial grass called miscanthus or silvergrass.

"It's a grass that grows wild in Michigan," he says. "You typically see it along the side of the road in Michigan. It grows six feet high, and it doesn't need fertilizer or insecticide."

"If farmers have land where they can't grow food crops, they could plant this grass. If they could sell it for five cents a pound, we showed it could compete with wheat in terms of income."

In terms of grasses that are attractive for automakers, Drzal and his team have focused on a half dozen — the fantastic six, Drzal calls them — that grow around the world. "You don't want to be shipping fibers from all around the world," Drzal says. "You want to utilize plants grown in your backyard." There are plenty of vehicle parts that could be made from biofiber reinforced composites like sheet molding compound, he adds, mostly in the interior of vehicles.

Put all this together and, in theory, you get car companies making more attractive products, while reducing their costs and carbon footprint while supporting farmers in their communities. And theory is becoming practice.

There's still a ways to go, Drzal says, but plant-based materials are making inroads — and that's saying something.

Back to the future

Back in the mid-20th century, Henry Ford himself was a proponent of plant-based materials. He wore suits with soybean fibers, ran a soybean laboratory in Dearborn, Michigan, and even created what he called a "plastic car made from soybeans" in the 1940s.

Attitudes have changed since then, though, due in no small part to fossil fuels becoming a more accessible and affordable feedstock for cars' polymer parts. By the early 2000s, when gas was about a third of the price that it is today, going green wasn't a huge priority for auto companies. In fact, Ford's Debbie Mielewski remembers getting kicked out of meetings when she'd pitch eco-conscious ideas to make cars more sustainably.

Power generation you can see through continued

But Mielewski trusted the company's roots and her convictions for the future. She kept making those pitches and developing materials to shrink the industry's environmental impact.

"I was doing it because I knew it was the right thing to do," says Mielewski, who's now a technical fellow of sustainability at Ford's Research and Innovation Center in Dearborn. Mielewski, who is a University of Michigan graduate, says that Michigan State has been a steadfast partner while the world caught up to her — and Henry Ford's — sustainable thinking.

"Even though I'm a Wolverine, I can say that MSU has been a leader in the state in understanding these materials and developing them for the automotive industry," she says. "Without MSU and other university participation, we would not be where we are today."

And where they are is at the front of the pack, showing how the industry can bring the benefits of plant-based materials to their automobiles.

"We want to prove people wrong and show that just because something is biobased, it doesn't mean it's substandard," Mielewski says. "And if we can do this in the automotive industry — where we have such strict r equirements for safety and performance — we can do it anywhere."

Ford's plant-based materials portfolio includes a composite used to craft storage bins for the Ford Flex. The bins contain fibers from wheat straw, which is so abundant in Ontario, Canada, that farmers have been known to burn their excess to get rid of it. Now, they can sell it to Ford.

"Without MSU and other university participation, we would not be where we are today."

- Debbie Mielewski, Technical fellow of sustainability at Ford Motor Co.

The company has also introduced headlight covers for the Lincoln Continental made from a composite that integrates coffee bean husks, or chaff. The chaff, which is sourced from McDonald's coffee suppliers, would ordinarily be tossed out as waste. Now, it's helping make car parts that weigh less and handle the heat of headlights better than their predecessors. Ford's drive to incorporate more sustainable materials also goes beyond composites. Since 2008, Ford has made nearly 20 million vehicles in North America that have seats stuffed with foam derived from soybeans rather than petroleum, preventing millions of tons of carbon dioxide from entering the atmosphere.

Here, the approach is slightly different than with composites, but the motivation is similar. Instead of adding tough plant fibers to a polymer resin to strengthen a composite, researchers are investigating more sustainable sources for the atoms that make up a foam's cushy polymer. In particular, the atom of interest is carbon.

"It's still carbon-centric, we're not trying to change that," says MSU's <u>Ramani Narayan</u>, a University Distinguished Professor in the College of Engineering. "What we're doing is replacing the carbon from petroleum fossil fuels with biobased carbon."

Narayan is perhaps best known for his work developing polymers for more ecofriendly packaging, but he also investigates some materials for the automotive industry. Case in point: He, Mielewski and their Ford colleague, Alper Kiziltas, published a scientific article in March examining <u>polyurethane foams</u> in which the carbon comes from soybeans. Why soybeans?

"Because it's Michigan," Narayan says. Grown on more than 10,000 farms in the state, soybeans contribute over \$1 billion to Michigan's economy.

"MSU and Ford have had a strong relationship for many years, and that shows through the success of projects like this," says Brice Nelson, director of corporate partnerships for the <u>MSU Innovation Center</u>. The MSU-Ford Alliance Partnership began in 2014 and has resulted in more than 100 projects, says Nelson, who helped forge the alliance.

"This is a great example of how our research makes it into the commercial market."

To be clear, Ford is commercializing these materials made with help from plants and bringing them into the world as automotive parts. But the company is exploring new frontiers in materials through partnerships with universities that make the most of everyone's research assets. And, at MSU, Spartan students are invaluable assets.

Power generation you can see through continued

The next generation

Spartans often intern at Ford, which is actually part of the bedrock of the partnership. Mielewski says she collaborates only with universities that are willing to send students as interns.

And it's a two-way street. Mielewski and other mentors at Ford can introduce students to MSU faculty advisers with shared research interests when the students return to school. This helps both the company and the university work with talented students who care deeply about sustainability and are driven to change the world for the better.

In return, students gain experiences and education to help launch their careers, even if those careers are outside of automotive. "Part of the experience is learning that work can be fun if you find the right passion for you," Mielewski says. "Having a career doesn't have to be a scary thing."

Madeline Robison, a rising senior majoring in <u>environmental engineering</u>, can attest to all of those points. She first joined Ford as a summer intern out of high school and worked with Mielewski, who told her about Narayan's work at MSU.

"I was really lucky in the fact that I was with Dr. Mielewski's group that first summer," Robison says. "I was very interested in sustainability and she connected me with Dr. Narayan."

Robison joined Narayan's lab her first year at MSU as an undergraduate research assistant, which is a role she kept into her junior year. During that time, she also returned to Ford for a second summer internship as a Spartan.

"That second summer, I was given more responsibility," she says. "I was able to take more control of the work."

For example, in one her projects, Robison imbued foams with a variety of additives, including coffee chaff and nanocellulose. The latter is a form of cellulose, the world's most abundant natural polymer made by plants, algae and other organisms. Robison then measured and compared various properties of these foams, such as how firm and compressible they were, to help Ford evaluate their potential for use in cars. But she also had a hand in many other projects. "I'm really glad that I got to do that and have all those experiences," Robison says. "That would be my advice to other students: Take advantage of all the experiences, all the internships, that you can."

Heading into her senior year, she spent her summer confronting sustainability challenges from a different angle, working in infrastructure design and building, as an intern for the company Arup.

But her time working in materials at Ford and MSU has helped her develop invaluable and highly transferrable skills, including networking and project management. The experiences have also helped her better understand the opportunities that are out there where she can pursue her desire to lessen humanity's impact on the planet.

"I went into this summer thinking it's something I could potentially be doing for the rest of my life. It's amazing to have a diversity of experiences earlier on to help narrow down what you like and learn what you don't like," Robison says. "That opened my eyes to certain paths I could take, and now I'm going down a new one."



Spin e-scooters generate heavy use in 2021, make way for research potential

Michigan State University launched a new exclusive partnership earlier this spring bringing hundreds of e-scooters to campus with <u>Spin</u>, a San Francisco-based micromobility unit of Ford Motor Co. The partnership is a continuation of the university's effort to use the <u>campus as a</u> <u>testbed</u> to drive the future of <u>human-centric</u> <u>mobility solutions</u>.

More than 600 scooters are now on campus, and that number will likely continue to grow. By early November, Spin had already tracked more than 170,000 rides.

"I am not at all surprised at Spin hitting this milestone so quickly on the MSU campus," said Brice Nelson, senior director of corporate partnerships at Business Connect, the corporate engagement arm of the MSU Innovation Center.

"Spin has a great team that has become part of our ecosystem by working collaboratively to understand and address operational issues while investing in future mobility by working with student teams and faculty research programs." Scooters can be found at various locations throughout campus as well as on East Grand River and Albert avenues. To unlock the scooters, riders must download the Spin app onto their Apple or Android device. The scooters cost \$1 to unlock and 20 cents per minute to ride.

In the Spin app, riders can view a map of the Slow Zones (reduced speed zones) and the locations of the scooters. The scooters have a top speed of 15 mph on campus and are operational from 6 a.m. to 10 p.m.

With COVID-19 precautions, all scooters are sanitized several times each week by Spin representatives. Riders are encouraged to sanitize their hands before and after riding to prevent the spread of germs.

"We look forward to giving students, staff and faculty a safe, sustainable and socially-distanced form of transportation to navigate MSU's expansive campus," said John Lankford, head of campus partnerships at Spin.

Spin e-scooters generate heavy use in 2021, make way for research potential *continued*

"As the micromobility unit of Ford Motor Company, we're excited to serve the MSU community in Ford's home state of Michigan while driving research that will inform the future of the micromobility industry."

Anonymized data from the scooters will be available to MSU mobility researchers to further understand how people use scooters and interact with other methods of transportation to get from point A to point B. This area of research is expected to expand as the popularity of micromobility options grows on campus.

"MSU is on the cutting edge of providing safe and efficient micromobility options," Nelson added. "We have the base to continue our process of implementing and inventing technology that leverages our campus infrastructure to enable the coexistence of pedestrians, bicyclists, e-scooters, cars and buses."

Any e-scooters other than Spin, including those privately owned, must obtain a permit to park from the MSUPD. Individuals must be 18 years old or older to ride Spin's e-scooters and should obey local traffic laws. MSU and Spin encourage users to wear a helmet while riding.

"Spin has demonstrated itself to be an innovative leader in the micromobility space and we are excited to provide our campus with improved mobility while continuing to evolve MSU into a best-in-class first-mile last-mile research destination," Nelson said.

Ben Pietrowski, a regional manager for Spin and 2003 College of Engineering alumnus, said the partnership between Spin and MSU is making a difference.

"I've enjoyed working closely with MSU to ensure that we're delivering on safety and parking adherence in order to maintain a sustainable program," Pietrowski said. "Seeing this many students choose Spin for daily transportation has me wishing scooters were an option when I was at MSU trying to get to those 8 a.m. classes from Brody. Go Green!"



MICHIGAN STATE UNIVERSITY INNOVATION CENTER 2021 Innovation Celebration

Technology Transfer Achievement: Timothy Grotjohn

Diamonds are grown at Michigan State University.

But these gems aren't destined for jewelry; they're materials created for use in semiconductors and other advanced electronic applications.

And Timothy Grotjohn, a professor in MSU's College of Engineering, has been researching and working on the technology for decades.

"Over the past 30 years, I've been involved in not just the equipment but the processes and applications for lab-grown diamonds," Grotjohn said. "People are surprised we grow diamonds at Michigan State."

Diamond has a broad range of applications, Grotjohn said, thanks to its extreme properties.

"What's held it back is it's hard to grow," he said. "You can't take a mined diamond and use it for these applications. There are too many impurities and imperfections. It might look fine on a ring, but that's not what works for electronics."

Two universities are doing the majority of the diamond research in the country – MSU and Arizona State. Grotjohn, MSU Innovation Center's 2021 Technology Transfer Achievement award winner, holds nine patents related to diamond synthesis and processing.

"MSU is getting to be known for its diamond work," he said. "We can supply those key semiconductor pieces others can't."

That work is crucial for entities such as the U.S. Department of Energy because diamond material has an incredibly high thermal conductivity – much higher than copper – making it ideal for use in semiconductors. "When you use a diamond in a photon or proton beam, it holds up," Grotjohn said. "Most other materials would be destroyed."

Grotjohn's work also intersects with the Fraunhofer USA Center for Coatings and Diamond Technologies, located on MSU's campus. Fraunhofer provides innovative research and development services based on its expertise in coating and diamond technology. Grotjohn is a senior scientist in the center, working on the modeling, design, diagnostics and applications of plasma-assisted materials processes and processing machines.

In 2019, Grotjohn co-founded Great Lakes Crystal Technologies, created as a spin-off from MSU's work with Fraunhofer, focused on creating a cost-effective source of high-performance diamond materials for advanced, non-gemstone applications.

"It's good that MSU is interested in moving this technology out into useful applications that will help society and the country and the world," Grotjohn said. "Diamond has lots of good uses. For me, it's good to see the work you've done over the years not only has produced the papers and journals, but it's now becoming products and moving into companies."



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Innovator of the Year: Muhammad Rabnawaz

Muhammad Rabnawaz's mind is brimming with ideas.

The assistant professor in Michigan State's School of Packaging and adjunct professor in the Department of Chemistry is constantly looking for ways to blend fundamental science with large-scale impact.

"I grew up in Pakistan and did my Ph.D. in Canada," Rabnawaz said. "Coming to the U.S. was a game changer for me. I never imagined one could do so many things in this country. It's so robust, and the people are hard-working, passionate, motivated. They're big dreamers."

"I thought, 'Oh, this is a country I should be in.""

Rabnawaz, the MSU Innovation Center's 2021 Innovator of the Year award winner, has published more than 50 research articles in the field of polymer and materials sciences that cover a broad range of topics including polymer synthesis from renewable feedstocks, design and preparation of smart materials and polymer composites. He's also filed and/or been granted more than 30 patents, eight of which are licensed or optioned.

"The credit for our innovations primarily goes to my research team who put the ideas to work and the collegiality and supportive leadership at the School of Packaging and College of Agriculture and Natural Resources," he said.

One of his current projects is aimed at improving the biodegradability of paper packaging and disposable cups and plates.

Rabnawaz and his team created a new coating for the packaging that's both economical and ecofriendly. They worked with the MSU Innovation Center to obtain a grant that helped speed up the commercialization of their work.

"The MSU Innovation Center is such a unique platform," Rabnawaz said. "You don't find such a robust resource at other universities. They showcase your technologies on all the relevant platforms, giving our work significant and much-needed exposure."

Without the Innovation Center, he said, their technologies probably wouldn't be as successful.



New and innovative packaging coating materials have a wide range of functions. From allowing coated paper products to both repel oil and water as well as dissolve into harmless molecules to creating a surface coating to allow you to get every drop out of your ketchup bottle, Rabnawaz's work has plenty of real-world applications.

"We developed a technology to prevent the buildup of dirt on the surfaces of things such as solar panels," he said. "If you live in a part of the country where there is a lot of dirt and wind, that can stick to the panels, decreasing their efficiency. But when the panels are coated with this substance, they repel the dirt."

Without the support from the MSU Innovation Center, Rabnawaz said his research would not have moved ahead as quickly as it has.

"That's important to get the advantage," he said. "If I don't have the support that connects this data to the industry, my research wouldn't make it to market. I need to focus on my research and mentoring students. With the facilitation and encouragement from the Innovation Center, my work can thrive.

"It motivates me, honestly. I don't know where I'll stop now."

Corporate Connector of the Year: Jennifer Rumler

As managing director of Michigan State's sales leadership minor, Jennifer Rumler is keenly aware of the value of corporate connections.

MSU's unique program isn't funded by the university – it's supported almost exclusively by corporate partnerships.

"So, I have a sales job too," she said. "I have to sell companies on the notion that investing in this program helps them develop their sales hiring pipelines."

When recent graduates choose a sales job as default career rather than a destination, they might not be the best fit in that role.

"A good personality doesn't automatically make you a good salesperson," said Rumler, MSU Innovation Center's 2021 Corporate Connector of the Year award winner. And when those employees aren't successful in the job, that costs companies money through attrition.

"We ask businesses, 'If we can provide you with students who self-selected to go into sales as a career and trained them with a required minimum of 500 hours of experiential learning, would you be willing to invest in that?' " Rumler said.

Currently, 16 companies have said yes.



Thanks to those corporate partnerships, MSU is developing a pipeline of creative problem-solvers ready to take on the role of professional salesperson. The program's curriculum requires a sales internship to graduate, so corporate connections are essential.

"These robust internship programs very often lead to full-time positions for the students," Rumler said. "We have a 100% job placement rate for the program for 10 of our 11 years. That's not 100% six months after graduation – it's before they graduate."

Another key component of MSU's program that appeals to corporate partners is an intentional focus on diversity, equity and inclusion.

"Companies are looking to build DEI into their programs. I've been working to make students aware of the lack of diversity in sales for the past seven years – we knew it existed, but we didn't know why," she said. "We worked to expose students to the research behind the lack of diversity in the field and examined the meaning behind corporate social responsibility.

"What we're doing at MSU is very much in line with what our corporate partners want."

While the pandemic has made one-on-one networking opportunities a bit more challenging, new connections have emerged for the program and the students.

"We're able to connect with people who are scattered across the country and around the world," Rumler said. "Alumni in Boston and Texas can participate live in our sales competition. A woman in India arranged her schedule to be a judge in one of our virtual competition rooms. That wasn't happening prior to the pandemic."

Top executives at Fortune 500 companies who couldn't leave their office to catch a flight and participate in an event on campus can easily hop on a Zoom call to be a buyer or judge in a student competition.

"They get to see where their corporate funding is going," Rumler said. "It's really opened things up for us and our partners.

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Innovation of the Year: Kathy Steece-Collier



Listening to Kathy Steece-Collier talk about her research on the development of improved therapeutics for people with Parkinson's disease, it's easy to get caught up in her enthusiasm.

She describes sitting by the pool with her children on spring break about a dozen years ago, reading a manuscript about a particular calcium channel in the brain.

"I thought, 'This could be a game changer!"

Steece-Collier, MSU Innovation Center's 2021 Innovation of the Year award winner, was doing a little light poolside reading about a newly discovered mechanism – specifically, a calcium channel – that was shown to be involved in changing the structure of brain cells in a region of the brain affected by Parkinson's disease.

She wondered whether the specific structural changes mediated by this calcium channel could prohibit the side effects that come with levodopa, a common drug to treat Parkinson's disease.

Levodopa, a drug prescribed to alleviate tremors, stiffness and other motor symptoms characteristic of Parkinson's, often causes dyskinesia, a drug-induced side effect that results in the involuntary and uncontrolled movement of hands, head and other body parts. The behaviors can be so debilitating, they significantly impact the quality of life for patients.

"The effects were partial and very transient," she explained. "But it showed us the target we were looking at was promising." She then worked with a colleague in her department, Dr. Fredric Manfredsoon, to develop a gene therapy approach that would provide more potent targeting of these calcium channels and, thus, a more lasting and potent therapeutic effect.

In 2019, Steece-Collier and her team received a \$2.8 million five-year federal grant to continue studying the capacity and limitations of this gene therapy that can reduce and eliminate those side effects by addressing structural changes of medium spiny neurons in the brain associated with movement.

"I've been studying ways of dampening dyskinesia for approximately 20 years, and I've never seen anything this effective," said Steece-Collier, who is a professor in the Department of Translational Neuroscience in the College of Human Medicine.

While there is still much work to be done, she said if their second phase of studies continues to show similar strong promise, this work is on track to go to human clinical trials, meaning the possibility for better quality of life for Parkinson's patients.

"My grandfather had Parkinson's. I have a picture of him in my office, and as I was writing grants or thinking about the research, I'd turn to the picture for inspiration," she said.

The effort to move her research forward toward clinical utility has also been supported by the MSU Innovation Center. "They worked with us to get a provisional patent on the gene therapy, and they continue to work on the intellectual property aspects of it."

A year ago, she was contacted by two companies interested in clinical trials.

"That's really rare," she said. "When you have an idea, it's hard to find even one company that's interested. To have two approach us is really remarkable. MSU's intellectual property managers and lawyers worked with us to help us choose the best partner. We have a talented and dedicated team that is working toward a promising new therapy for people with Parkinson's disease."

AgBio Challenge supports entrepreneurial research

From automated apple harvesting to pesticide management in Michigan vineyards, the MTRAC AgBio Innovation Challenge has completed a successful second year in awarding grants to research projects meant to solve specific industry challenges.

Seven grants totaling \$30,000 will support researchers in vetting their early-stage AgBio technology concepts. The awards are funded through the MTRAC AgBio Innovation Hub from the Michigan Strategic Fund and administered by the Michigan Economic Development Corporation.

"The MTRAC AgBio Innovation Hub plays a significant role in advancing the commercialization of agriculture biology projects from some of our state's most innovative researchers," said Denise Graves, university relations director for the MEDC's Entrepreneurship & Innovation initiative. "Michigan's agriculture industry makes up a substantial portion of the state's workforce and economy, and MEDC programs like MTRAC play a critical role in ensuring entrepreneurial success on both a statewide and national level."

To compete, researchers submit concept papers identifying how their research could help solve industry challenges. The papers are reviewed confidentially and scored according to criteria that include both commercial potential and risk assessment value. Prizes ranging from \$1,000 to \$10,000 are made based on these scores.

The awards are meant to encourage further exploration and development of technologies with relevance to AgBio industries. By advancing their work to the prototype stage, researchers may then qualify for translational funding under MTRAC or other programs.

The awarded research projects for the 2021 Innovation Challenge were varied and impressive, said Joe Affholter, program director of the Innovation Hub.

"This 2021 AgBio Innovation Challenge brought in both early-stage and some fairly advanced technology ideas ranging from the bioproduction of industrial chemicals to animal pathobiology to pesticide management, improved vineyard sustainability, carbon capture and environmental improvement," Affholter said. "This is a truly impressive group of concept papers."



2021 award recipients include:

Innovation Award (\$7,500)

- Karen Chou, Ph.D. (Animal Science, MSU): "Pesticide Management Program Application, a Sustainable Tool for Michigan Vineyards."
- Matti Kiupel, Ph.D. (Pathobiology and Diagnostic Investigation, MSU): "Early detection of Canine Malignant Lymphoma in Blood Samples Using Proteomics."

Exploration Award (\$5,000)

- Karen Draths, Ph.D. (Chemistry, MSU): "Synthesis of 3-Hydroxypropionic Acid from Methane and Carbon Dioxide."
- Kevin Walker, Ph.D. (Chemistry, MSU): "Increasing Enzymatic Specificity to Assemble Acyloins."
- Woongkul Lee, Ph.D. (Electrical and Computer Engineering, MSU): "Retrofitting Solar Microinverter to Irrigation Pump for Improving Water and Energy Use Efficiency."

Activation Award (\$2,500)

- Kyle Lammers and Zhaojian Li, Ph.D. (Mechanical Engineering, MSU): "Improving Automated Apple Harvesting with Laser Based Scanning."
- Keliang Wang, Ph.D. (Division of Coatings and Diamond Technologies, Fraunhofer USA Midwest Center, MSU): "Plasma Destruction Targeting all PFAS Species in Landfill Leachate."

AgBio Challenge supports entrepreneurial research continued

The inaugural Innovation Challenge in 2020 attracted researchers from around the state to submit proposals that apply emerging technologies to address problems in the food, feed, fuels, fiber and biomaterials markets, and the technological and ecological systems that support them.

"The pilot edition of the Innovation Challenge encompassed areas such as farm-level mental health, clean-burning wood energy systems, nanoparticle-based agricultural drone sensors and clean-burning wood energy systems," said Affholter. "It was truly a remarkable crop of ideas."

The Innovation Challenge saw diverse submissions from universities across Michigan despite the looming pandemic. There is no specific mold that awardees must fit. For example, one top-scoring paper came from MSU's Department of Communications while another came from Plant and Microbial Sciences.

"In addition to Michigan State, we also saw strong, award-winning papers submitted from Western Michigan and Central Michigan universities," Affholter added. "We are delighted to connect with so many skilled innovators around the state. We look forward to many of these researchers turning their early-stage ideas into commercially viable technologies."

2020 award recipients include:

Innovation Award (\$7,500)

- Eric Patterson, Ph.D. (Plant Soil and Microbial Sciences, MSU): "Foliar applied RNA to break Herbicide Resistance."
- Amanda Holmstrom, Ph.D. (Department of Communications, MSU): "Addressing Farm Stress via a Highly Tailored Mobile Application."

Exploration Award (\$5,000)

- Johnson Asumadu, PE (Electrical and Computer Engineering Department, Western Michigan University): "Magnetic Nanoparticle-based Gyroscope Sensor in Agricultural Drones."
- Cheryl Swenson, Ph.D. (Department of Pathobiology and Diagnostic Investigation, MSU): "Detection of Disease Using Machine Learning."

Activation Award (\$2,500)

- Yousef Haseli, Ph.D. (School of Engineering and Technology, Central Michigan University): "A Clean Wood Heating System"
- Qi Hua Fan, Ph.D. (Department of Electrical and Computer Engineering, MSU): "Active Trapping of Nitrogen Oxide Using Biochar"

Inspiration Award (\$1,000)

- Bahar Aliakbarian, Ph.D. (Department of Supply Chain Management, MSU): "Smart Recycling Platform to Tackle Plastic Bottle Waste Management Issue"
- Ping Wang, MD, Ph.D. (Department of Radiology, MSU): "Artificial Intelligence Analysis of Magnetic Particle Imaging for Tracking Transplanted Stem Cell Therapy for Diabetes in Animal Models."
- Dong Younsuk, Ph.D. (Biosystems and Agricultural Engineering, MSU): "Implementation of a Low-Cost Sensor Monitoring System to Improve Irrigation Water Use Efficiency and Disease Management.



Revolutionizing the livestock industry

Tech helps farmers predict productivity, health and profitability of animals while improving safety, efficiency

In the 1980s, Madonna Benjamin worked as a pig farmer in Canada, analyzing the relationship between livestock and human interaction.

After earning her Doctor of Veterinary Medicine from the University of Guelph in Ontario, Benjamin worked for Elanco Animal Health – a company that delivers products and therapeutic solutions that treat pain and prevent disease, enhance and extend quality of life and improve animal care.

Benjamin researched pigs experiencing an overload of lactate — too much lactic acid in the body — and the potential causes.

"Our research showed the use of an electric prod — in addition to the abuse of the prod — initiated stress and subsequent lactic acidosis," Benjamin said. "This research shifted the ways livestock are now handled and this need for low-stress handling."

Third-party groups now audit how pigs are handled, measure the use of the prod and how it's used, and observe the auditory reactions of the pigs.

Becoming part of the solution

After 10 years of working in the industry, Benjamin returned to veterinary practice and noticed a change in the rate of sow loss. Female pigs were either dying or being removed from the herd at increasing rates.

"I tell my sons, students and anyone willing to listen: You can criticize an industry, or you can become part of the solution," Benjamin said. "The former is less work, but the latter is more rewarding."

Benjamin — now an assistant professor and swine extension veterinarian in MSU's College of Veterinary Medicine — is working with her research team to develop efficient, targeted ways to track sow health and well-being.

The work is done with SIMKits, which allow for more in-depth tracking of livestock using a computer, sensory camera and monitoring system.

SIM is the concept of using computer vision to improve wellness in livestock. Initially, it stood for Sows in Motion. SIMKit is the system to capture information.

Revolutionizing the livestock industry continued

SIMKits use inexpensive, commercially available depth-sensor cameras that leverage infrared illumination to create dense, 3D scans of animals. When used with computer vision, the cameras can detect animal lameness or unusual shape in livestock.

"The SIMKit technology makes it possible to analyze posture/locomotion and whole-body surface changes and allows for comparison data to be built to help determine if mobility or lameness factors may be of concern," Benjamin explained.

By analyzing these posture predictions with sow reproductive performance, this crucial, real-time quantitative information allows producers to make informed production decisions that affect animal welfare, herd management and the profitability of individual animals.

"Our intelligence sensors act as eyes for the stockperson and producer," she said. "With such tools, there is prosperity for all – the sows, the producers and the stockpersons."

Hands-on work

After receiving an initial \$25,000 from the Michigan Pork Producers Association and funding from Michigan Alliance for Animal Agriculture, Benjamin and Michael Lavagnino, an academic specialist in MSU's College of Engineering, interviewed Michigan farmers to gain a better understanding of what types of technology they preferred and how they would like it to work.

MSU graduate student Steven Yik introduced Benjamin to Daniel Morris, associate professor in the College of Electrical and Computer Engineering, who was a co-advisor for Yik's master's program.

"Steven and I spent many mornings traveling to farms, leaving East Lansing at 2 a.m. to arrive by 5:30 a.m.," Benjamin recalled. "It was the weekly site visits that gave Steven the assessment tools to develop an incredibly robust capture system and software. He improved the prototype and programming for the SIMKits with each visit."

Morris, Yik and Lavagnino collaborated on the creation of the SIM program system and the SIMKit methodology to capture that information.

"For an engineer, it has been a new experience learning about animal husbandry and figuring out ways technology can play a part," Morris said.

Moving the tech to market

To leverage her research, Benjamin turned to MTRAC.

The Michigan Translational Research and Commercialization AgBio Innovation Hub works with university faculty across the state to accelerate the translation of laboratory research into market-ready technologies.

Benjamin partnered with Joseph Affholter, commercialization program director for the Hub, which operates under the MSU Innovation Center.

"The technology developed by Dr. Benjamin and her team demonstrates the spirit and intent of the MTRAC program," Affholter said. "It is the fruit of a talented and collaborative multidisciplinary team that has worked together to create a technology with industry-altering potential."

After applying for the MTRAC Full Grant, Benjamin and her team had to either license the product or launch their startup. Benjamin initially didn't want to release something until it was perfect.



Revolutionizing the livestock industry continued

MTRAC supported Benjamin and her team through this hesitancy, encouraging them to take the next step.

Brad Fingland, director of Venture Creation for Spartan Innovations — a wholly owned subsidiary of the MSU Foundation — also helped with the launch.

Spartan Innovations has been actively working with Benjamin since 2019 when her technology was the basis for a Venture Fellows team and an MTRAC project.

Working with MTRAC and Spartan Innovations allowed the team to gain confidence, Benjamin said.

"Without their support team, help with the budget, critical analysis of our ROI and connections with MSU Technologies and Spartan Innovations, we wouldn't have gotten the exposure we needed," she said.

Her technology was fully vetted as a potential business by a team of two Ph.D. students and one MBA student who were mentored by John McIntyre, a Spartan Innovations Entrepreneur-in-Residence.

The company was formed with initial capital raised from Red Cedar Ventures, a subsidiary of the MSU Foundation. The search for additional capital has been initiated.

In late 2020, MTRAC helped launch Motion Grazer Al.

"I acted as a consultant to further evaluate the spinout potential of the project into a company, and the outcome was positive," said McIntyre, who is now CEO of the company.

"You reach a point where it's time to introduce your knowledge and your work to a community," Benjamin said. "If you believe it's going to improve lives, then launch it."

Fingland said the Motion Grazer AI technology has the potential to completely revolutionize the livestock industry.

"Farmers will be able to predict the productivity, health and profitability of livestock while simultaneously improving a farmer's safety and efficiency," he said.



Fingland said Benjamin is an asset to MSU's entrepreneurial community.

"I value her perspective, technical knowledge and enthusiasm to undertake exciting new ventures – like starting a company!" he exclaimed.

Motion Grazer Al's initial market will be swine – worldwide sow market opportunity is \$1 billion a year – but plans include growing the portfolio to livestock including cows, sheep and poultry.

Brian Copple, technology manager with the MSU Innovation Center, also assisted Benjamin in bringing this project to fruition, guiding her through the intellectual property process and filing a patent, which is still pending.

"You can tell that's why she's an expert in the field because she is so passionate about swine health and maintenance," Copple added. "You can't miss it with her. She's very motivated."

Benjamin's transformational work is one of more than 50 projects funded under the MTRAC AgBio Innovation Hub over the past seven years. Technologies funded under these projects have resulted in the formation of five startups and the issuance of over a dozen commercial licenses to third parties. The program is jointly supported by MSU and the Michigan Economic Development Corporation, with funds provided by the Michigan Strategic Fund.



Ag startup fosters partnerships

PhenoLogic, Inc., a Michigan-based agriculture technology startup, has announced a partnership with Sente Foundry – a Chicago-based startup investment platform and global venture firm Hatcher+ to fund PhenoLogic's continued technology and development as well as expand its piloting program across North America.

Founded in 2019 by MSU alumni Traverse Jurcisin and Josh Murray, PhenoLogic designs smart hardware and software for commercial agriculture and horticulture producers. Their trademark product, Poseidon, is an automated in-line fertigation unit designed to prepare and deliver user-defined fertilizer recipes across multiple feeding zones.

In April of 2020, PhenoLogic was awarded \$15,000 from the MSU Burgess New Venture Challenge – a highly competitive event with 15 student teams competing for \$42,000 in total awards.

In addition to support from the Burgess Institute for Entrepreneurship and Innovation, PhenoLogic garnered investment and grant funding from Red Cedar Ventures, a wholly owned subsidy of the MSU Foundation.

PhenoLogic was also a part of the 2020 MSU Conquer Accelerator cohort where they participated in a 10-week program, focused on completing tailored, goal-driven benchmarks as well as one-on-one mentorship in a creative working space with resources to grow their company. "PhenoLogic has been a great addition to the Conquer Accelerator portfolio. The founders, Traverse and Josh, really understand their market and the value they bring to it," said Tom Stewart, program manager with Conquer Accelerator. "Smart fertigation systems will not only be integral to the growing cannabis industry, but it also has significant implications to the entire indoor and vertical farming industries."

Stewart's expertise in organizational design, program design and operational strategy has provided significant support to PhenoLogic entrepreneurs as they've worked on establishing their startup.

"Traverse and Josh are a great team to work with. I've watched their expertise grow, and we're so proud of how far they've come with PhenoLogic," Stewart said.

Now, almost a year later, PhenoLogic continues to grow as this partnership is part of their advancement into phase two of Sente Foundry's Indoor AgTech Program. Within this program, selected companies will join an ecosystem of indoor agriculture technology companies, AgTech investors and multi-state producers equipped to direct their innovations.

"The extensive industry experience and network that Sente Foundry and Hatcher+ bring makes them ideal partners as we pursue our expansion strategy," said Mateo Marchan, sales and marketing consultant at PhenoLogic. "We're excited to continue cultivating relationships."

BY THE NUMBERS 2021

120 New Inventions Disclosed



\$20.9M Corporate Support for Research Projects



\$4M Royalties from Licenses

New Startup Companies

