Thinking outside the furrows...

Ag Startups are Changing the WORLD
Entrepreneurial agricultural and biological engineering are not new, but in this issue of Resource we present some of the new movers and shakers in these areas. They are reaching for new heights with new ideas, and they’re taking new risks. Based on their examples, we hope you see opportunities in your own area. Perhaps a new idea will lead to future cooperation or a new business plan. One of our Society goals is to be your preferred source for professional information and new technologies, and this issue delivers.

For many of you, my face might be new, so let me introduce myself. My name is Maury Salz, and I’m your 2018-2019 ASABE President. I follow Steve Searcy, who did a great job and provided many steps forward for the Society, particularly in identifying the current values that members receive from ASABE. See the summary of the McKinley Advisors study for more details (www.asabe.org/ETV). Steve’s focus set the stage for future initiatives, which we will be pursuing.

I’m lucky to have grown up in northwest Iowa on a traditional corn-soybean-oat-dairy-beef-hog-chicken farm. We didn’t have many acres, but we certainly had unending chores. We had few modern conveniences and very few communication devices. Our leading tech was a TV that received four channels (total boredom because we always watched Dad’s shows) and a party-line telephone. I had a lot of time to learn about farm equipment, mostly by fixing what was broken.

Working with farm equipment led me to know, at a very young age, that I wanted to be an ag engineer. I started to prepare in high school. After graduation, I attended Iowa State University and received a BS degree under the ag eng department’s Carl Bern. (Thanks again, Carl!) Since then, I’ve worked in the development of farm tractors and grain harvesting products for Deere, Case-IH, and now CLAAS. I’ve had the great fortune to work alongside many talented engineers, developing new products that do more with less.

So, where is our Society heading? During my watch, I’ll be pursuing more growth and sponsorship opportunities, which are among our Society’s top goals (www.asabe.org/Goals-Metrics). We recently held a major sponsorship activity: the Global Water Security Conference in Hyderabad, India, on October 3-6, which Resource will cover in an upcoming issue. Next, with President-Elect Sue Nokes and our Board of Trustees, we will develop growth initiatives based on the recommendation of the McKinley Advisors study. We’ll also work to grow our digitalization strategy, to get you information that matters to you more quickly and easily.

The opportunities for agricultural and biological engineers are almost endless, and the coming year is going to be an exciting time for all involved. Thank you for giving me this opportunity. I’m looking forward to our accomplishments together. If you have thoughts or opinions, I’d appreciate hearing from you.

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Feb. 11-13 2019 Agricultural Equipment Technology Conference. Louisville, Ky., USA.

July 7-10 ASABE Annual International Meeting. Boston, Mass., USA.
This is my second opportunity to be a guest editor for a special issue of Resource, and both times I’ve been amazed at the willingness of our industry to contribute interesting and relevant information that benefits the ASABE membership. This issue features stories by risk-taking entrepreneurs in ag tech. Our contributors have applied the training and skills they acquired in the academic world to real-world problems and opportunities. They’re passionate about their ideas, their products, and their contribution to feeding the world.

Our contributors have gone far beyond the furrows. I’m astonished by the breadth and depth of topics they discuss and the variety of businesses they’ve started. Because of my own professional background, I was expecting more machine-based technologies. Traditional ag tech is still important, but it’s not the whole story. We’ve seen unprecedented breakthroughs in many non-traditional areas—data collection, analytics, inputs, renewable fuels, production practices, instrumentation, decision support, animal welfare, consumer preference support, and more. After reading through this issue, you may be inspired to found a startup business. You’re not alone! Do so armed with the advice of those who’ve been there.

My good friend, colleague, and fellow First Word contributor on the facing page briefly describes his experience in trying to market an idea that was based on his research in the academic world. The timing was not ideal, and the whole situation occurred after he’d made a career move. My point? There are no cookie-cutter answers to the questions about how to start and build a business. I can vouch for that based on my own experience.

In addition to their wide variety of products and ideas, there are some common themes among our contributors:

**Mentors:** Faculty, business, and technology gurus are out there, so you don’t need to go it alone. Winners love to be associated with winners.

**Money:** Funding sources come and go, and vary widely. How much equity you’re willing to give up helps focus your funding strategy. A “market pull” is easier to sell to investors than a “technology push.”

**Mind-boggling triumphs and challenges:** The highs and lows keep entrepreneurs up at night, alternately celebrating and worrying.

**More work to do:** Success means different things to different people, but it’s easy to see that none of these entrepreneurs is resting on laurels.

All of our contributors are driven by a passion to improve agriculture, and they did it in ways that no one thought of before. Something sparked these entrepreneurs to use their knowledge, skills, and energy to develop exciting, original ideas, and then market those ideas for the benefit of people all over the world. They’ve taken risks—leaving steady jobs, investing their savings—and they’ve succeeded. If they had to do it all over again, knowing what they know now, it’s a safe bet they would say yes. And they would do it even better!

These bright, resourceful, and motivated folks all got bit by the entrepreneur bug, and they have great stories to tell about it. Congratulations to all our contributors! We look forward to learning about other new companies that are thinking outside the furrows, and we’ll report on them in future issues of Resource!
In the early 1990s, I worked for a company that developed simulation software for wastewater treatment plants. I was hired to validate the underlying IAWPRC model with measurements. After months of wracking my brain, and en passé realizing that I had zero talent, and zero interest, in biochemistry, I told my superiors that there was no way the model could be validated based on their limited measurements. Their reply was: “Well, then we don’t need you anymore, do we?”

So, no, I don’t have a great track record in corporate culture, or in entrepreneurship in general.

I’m not much of a risk-taker. I’ve always preferred the safe, comfortable academic world. However, after doing this academic gig for a few decades, little of my creative output ever made it to an application, and that made me wonder what impact I was really having, other than in education and mentoring. What value do my ideas have if no one wants to buy them?

Among rookie entrepreneurs, a common misconception is to think their brainchild is worth its weight in gold, even when no one else does. Steve Jobs used to say, “The customer does not know what it wants,” and that appeased me a little. On the other hand, after I showed my arrangement for measuring the electrical impedance of biomass under compression to a captain-of-industry friend, he looked at me and said, “I bet there are fifty applications for this. You just don’t know about them.”

So there I was. Clowns to the left of me, jokers to the right, and I was stuck in the middle with my semi-creative thoughts. How could I get out of that rut?

Around the same time as that professional mid-life crisis, my longtime partner in crime, Martin Bohn, mentioned that there was interest in some machine vision trickery that I had developed. He and I decided to start a consulting business. At first, I found it very exciting, not because we made any serious money (we didn’t), but because I liked that the outside world cared about what we were doing. Our work didn’t re-present the pinnacle of my scientific prowess, but that didn’t bother me. I also found out that there were boring things to do, such as keeping records and filing taxes. Luckily, my better half happens to be a CPA.

The biggest challenge was finding funding for daily operation, let alone expansion. I naively assumed that investors would just show up at the door with suitcases full of cash. I could have followed the advice of the startup gurus who claim that friends and family are high on the list of potential funders, but that sounded too much like selling a used car to my brother-in-law. I could have tried the GoFundMe route, but that seemed more like a startup casino than a bona fide financial arrangement. As a result, after a few years, our company ran out of steam, but overall it was a great learning experience.

So take some advice from the peanut gallery, and start that company you’ve been pondering! It’s incredibly easy to do that in the U.S., in contrast to pretty much the rest of the world. For inspiration, watch “The Founder,” a biopic about McDonalds founder Ray Kroc. Listen to YouTube experts rant about business plans, angel investors (a poorly chosen moniker), and the valley of death. And remember that passion and creativity triumph over all the small stuff. Most important, learn from the mistakes of others (see above).

Find partners you trust, who have ample motivation, intelligence, and passion for your shared ideas. Protect yourself (LLC that thing). Pay your taxes. Avoid conflicts of interest, which are about as enforceable as Prohibition, but do what you can, and be a mensch. Contribute something to society, not just to your own bottom line (the world doesn’t need another Pet Rock). And don’t dwell on intellectual property, which seems like crack cocaine for young entrepreneurs.

Is all this going to make your startup a huge success? Maybe. Entrepreneurship is riddled with risk—just like life in general. Good luck, and after you get rich, remember to donate a building to your alma mater!
Bar Biologics (www.3barbiologics.com) is an early-stage startup spinout of The Ohio State University that’s dedicated to improving farm yield, profitability, and sustainability using beneficial microbial products that increase crop yields while reducing dependence on chemical fertilizers and pesticides. 3Bar’s patented microbial delivery system is activated on-farm to deliver the freshest, most viable biological products on the market. On-site growth of the microbes shorts the conventional supply chain, resulting in less waste, lower production costs, and fresher, more viable microbes delivered to the field. 3Bar’s breakthrough technology allows practical application of many microbes proven in research but never before available in a commercially viable form.

Going from a large organization to a startup was a huge change for me, and it presented some risk, but the opportunity to develop a new technology in an emerging industry, build a company from the ground up, and create new jobs is exciting. Every day in a startup is different, and we all wear many different hats, which makes each day interesting. From the beginning, we’ve followed a “lean” startup model, which means that we focus on the customers first in the form of interviews and early discovery, and then get a minimally viable product into the farmers’ hands right away. For the last four years, we’ve been field testing our first product, Bio-YIELD, in Ohio. The initial reception from corn and soybean farmers has been strong, and university trials have shown that our microbial delivery system is capable of increasing yields. This early success and the willingness of farmers to try something different are what drive us.

Some of the challenges of working in a startup? We often don’t have the resources we need to complete all of the desired research and marketing. In particular, field trials are expensive, so we have to be selective about what we take into the field to test. In addition, as a small company, distribution is challenging. We currently work with several distributors in Ohio and surrounding states. However, as we look to grow beyond Ohio, working with larger distributors will be difficult, given the increasing industry consolidation and tight profit margins in input markets.

As a small company, it’s exciting to watch how much our company can grow and change in just a few months. We currently have six full-time employees, so maintaining our company culture, built on our mission of helping farmers become more profitable and productive, is very important. One of the biggest rewards is getting farmers excited about the emerging area of biologicals. At first, some farmers are skeptical about these “bugs in a jug.” However, each time they see the yield improvement in their fields, we are building confidence that microbial products really work.

As a company focused on bioformulation and delivery, we plan to grow by filling a niche in the agricultural biologicals industry—delivering the most beneficial microbes to the field. We’ve had some success in partnerships with universities and other companies doing microbe discovery research. Using our novel delivery system, we hope to get more microbial products to market and into the hands of farmers. While our first product, Bio-YIELD, is marketed as a biofertilizer for row crops, we see huge opportunities for living microbial products as both biostimulants and biopesticides for other crops.

Jane Fife joined 3Bar Biologics as Chief Science Officer in 2016, where she leads R&D to improve bioformulation and delivery of beneficial microbes for more effective plant growth and biological disease control. Prior to 3Bar Biologics, Jane spent 12 years at Battelle Memorial Institute working in biodefense research. Later she managed technology development in agribusiness, focusing on bioformulation and precision agriculture applications. Jane has BSc and PhD degrees in agricultural engineering from The Ohio State University and an MSc from the University of Kentucky in biosystems and agricultural engineering, with research interests in applying innovative technologies for more targeted delivery of agricultural inputs and smarter, more sustainable agricultural production.
As a serial entrepreneur, I thoroughly enjoy working with startups. Based on my previous experience with data and analytics, I was intrigued by AGERpoint’s LiDAR-based technology. AGERpoint (www.agerpoint.com) brings “frontier tech” solutions to global challenges—specifically by providing growers with extremely precise data, analytics, and actionable insights for their crops.

As with any startup, there are challenges as we work to develop our offerings and establish our niche in the market. Some specific challenges have led us to fine-tune our strategy. For example, we have limited time to capture data during a growing season. Other tech startups can run experiments at any time. They’re not limited to collecting data only when the test subjects (trees, in our case) are growing. This time constraint has taught us to act fast to take advantage of when our subjects are available.

We’ve also done a significant amount of experimentation with different crops and growing techniques. LiDAR-based data capture and analytics is not a “one size fits all” solution. Although it has shown great promise for a multitude of crops, each crop has its own nuances that must be accounted for in the data collection and algorithm development. Through our experimentation, we’ve learned which crops are best suited for this technology, and we’ve focused on specific crops—particularly tree crops such as almonds, hazelnuts, pecans, and citrus.

In addition, because LiDAR data capture and analytics is a new concept for the agricultural community, we need to gather more than the usual amount of case studies to provide proof-of-concept to the industry. As a result, we’re working closely with early adopters of groundbreaking new technology.

Historically, techniques for collecting orchard data, such as tree inventory, height, canopy diameter, canopy volume, canopy density, and trunk diameter, have been labor-intensive, inaccurate, and costly. AGERpoint is a precise data platform for agriculture decisions and actions. We collect unique data and present it in a way that allows meaningful insights. So far, we’ve scanned more than 30,000 acres and 3 million plants, producing over 1.4 trillion data points. We’ve also received two patents, and we’ll continue to innovate and build our patent portfolio.

A major reward has been discovering new insights based on our data. As part of our experimentation, we’ve honed our ability to spot almost anything, from irrigation leakage to orchard floor debris, to mitigate or prevent crop risk. Identifying these opportunities for growers at a holistic level, not just in a small sample, creates a huge opportunity for more efficient and successful crop management. It’s extremely rewarding to deliver value for our clients.

We plan to grow AGERpoint by focusing on what we do best—delivering precise analytics with actionable data for our target crops. With ongoing experimentation, we’ll continue to fine-tune our data and analytics offerings to provide insights for growers that offer significant value by saving time, money, or both.

Andrew Nash, CEO, joined AGERpoint after more than 30 years of experience in the technology industry, including e-commerce, digital marketing, and analytics. AGERpoint, a company that has a unique vision for bringing big data and data science to agriculture, is his first foray in the ag tech world.
Agrible (www.agrible.com) is an incredible company. We build amazing agricultural predictive analytics products faster and more efficiently than anyone. To do this, we have a diverse set of disciplines on staff: physicists, agronomists, computer scientists, atmospheric scientists, agricultural engineers, data systems engineers, industrial designers, user experience designers, and many others. It takes a community to build something as rich as Agrible, and I’m proud of our team.

Once I discovered my love of agricultural engineering, I blasted through my MS and PhD programs. I worked as a post-doctoral researcher in the BSE program in Madison, Wisconsin. I’d always dreamed of becoming an academic, working on research projects and teaching, but I didn’t take that path. Instead, I moved into agricultural consulting, focusing on research and development for companies like Syngenta, where I discovered the power of building a team to complete complex projects faster than I could alone.

While working in Urbana-Champaign, I was introduced to the world of startups through Serra Ventures and the vibrant entrepreneurial community that is part of the University of Illinois and Champaign-Urbana, in general. I thought, “I could do that!” I worked my way through venture capital, business plans, series funding—and received a crash course in business from the school of hard knocks.

Working at a science-based startup has allowed me to do everything I wanted to do. My first goal was to develop new technologies to help growers achieve better profits, stewardship, and sustainability during times of uncertainty in the weather and in grain prices. My second goal was to build a great business to achieve the first goal, which is a critical thing that academics don’t get to do. My third goal was to do all this as quickly as possible. Realizable, achievable business goals drive a startup.

The most difficult thing I had to understand about business is that focusing on revenue, business development, and product development in service of the business is a key goal, and this focus must serve the business plan. If there’s no business plan, then there’s no business. I learned not to build a business for my own intellectual satisfaction. The business has to have value for others, and that value is expressed as revenue. Losing this focus is the ultimate pitfall in a venture-based business.

Agrible focuses on delivering real-time sustainability analytics to supply chain partners and food companies. New opportunities for growers to add value to their products are generated by participation in our sustainability campaigns. Agriculture is a fundamental human activity, but the benefits of next-generation technology have not yet made their way into this activity. In response to this challenge, Agrible is launching a new community product that combines our predictive agronomic analytics with a new model of automated sustainability as part of the Agrible platform. The ability for food companies, retailers, growers, and others in the supply chain to work together with the ability to realize the benefits of real-time sustainability and stewardship is transformational for everyone. Both of these science-driven products will help build the future for agriculture and drive revenue for Agrible and Nutrien Ag Solutions.

As an engineer, to be able to proudly say “We built that” is why I get up in the morning. In addition, our users want us to succeed, and serving them drives our success. Last summer, our Pocket Rain Gauge achieved more than 3 million uses across the U.S. It’s a useful product, and it introduces more people to Agrible and the power of predictive analytics in agriculture simply by estimating rainfall without a gauge.

Paul Miller, Chief Science Officer and founder of Agrible, Inc., received degrees from the University of Illinois and Purdue University and has spent his entire career in agricultural engineering. “Always a nerd, loving computers and programming, my computational background has served me well as a domain scientist. At eight years old, I received my first dose of project management when I discovered that I could not type well. I roped my poor mother, who could type really fast, into helping me program games on my TI-99/4A, which were saved to a cassette tape. I loved that project, the TI-99/4A, and my mother!”
Two years ago, I found myself sitting in an office at the University of Illinois Urbana-Champaign with a group of colleagues who all had international experience working on water projects. Our common link was a course we had taken on creating context in engineering design that brought together student perspectives from across the campus. Armed with a critical perspective from that course, we recognized the shortcomings of development work, and we wanted to create a non-profit that challenged the status quo of international water projects. How could we help ensure that these projects would meet people’s needs in a technical, sustainable, and socially conscious way? Fast forward to the present, and our organization, Akelos (www.akeloswater.org), is working in partnership on projects in Honduras, Senegal, and Guatemala with a diverse group of over 25 volunteer members.

There is no shortage of organizations that pursue development initiatives in countries outside the U.S. However, the field is plagued with stories of failure, a disheartening reminder that not all good intentions lead to success. This comes as no surprise—it is inherently difficult to work on international development projects. These projects force us outside of our familiar cultural and political contexts, and they require us to navigate the often conflicting objectives of the stakeholders. The critical point, where failure inevitably occurs, is at this gap in communication. For example, the technical achievements of an outside group of engineers are often disconnected from the local reality of the problem, or the funding requirements are completely mismatched with the priorities of the community.

Focusing our efforts on connection, communication, and collaboration became the primary mission of our organization. We work as consultants for our partners—other non-profit organizations that have existing water projects—by applying our experience and insight where our partners most need the assistance, whether in technical designs that incorporate community feedback or in social considerations of the project implementation.

Among our three current projects—in Senegal, Honduras, and Guatemala—there are vast differences that require unique approaches. In Senegal, we’ve emphasized the management strategy for the pending infrastructure that will bring four geographically and politically separate communities together to run a water distribution system. While we also assist our partners with the technical design, our focus has been on the importance of management and facilitating discussion among the stakeholders.

Similarly, the redesign of a water filtration system in Honduras is focused on the appropriateness and ease of maintenance of the new infrastructure, something that was neglected in the previous design. While we have the benefit of experience on our side, every project is difficult, and every project is unique. It would be extremely difficult—and counter-productive—to standardize an approach for partners whose environments are vastly different, so we don’t. That’s what makes our work so useful.

Water scarcity will be an increasing source of distress for the global population, and it will disproportionately affect the rural communities we work for. These communities already struggle to maintain reliable and accessible water supplies. Their local economies rely mostly on agriculture, so they will need increased access to irrigation as rainfall patterns shift due to climate change. However, any efforts to increase access to water must be done carefully, with respect for the people, the environment, and the science. Akelos is having a positive impact on the way non-profits manage their projects and their resources by helping to facilitate conversations, provide technical assistance when necessary, and emphasize the importance of working together with the communities we serve.

Kelsey Schreiber, Graduate Student, Department of Agricultural and Biological Engineering, University of Illinois Urbana-Champaign, has a background in systems engineering. As an undergraduate, she had dreams of using her engineering degree to bring change to communities around the world. Now, as a graduate student and the president of Akelos, she has a unique opportunity to research the effectiveness of international engineering projects and put the findings to use for non-profit organizations.
My background in product, operations, and business development in the Internet and mobile fields, as well as my life-long entrepreneurial spirit, prepared me well for my role as CEO and co-founder of Atomation, an Internet of Things (IoT) company. Atomation (www.atomation.net) connects legacy objects to the cloud, making objects smart and able to communicate valuable diagnostic data. The benefits that Atomation provides companies are many, including making their operations more efficient and effective.

As anyone who’s ever founded a business can tell you, it’s never really a good time to take the leap. For me especially, the timing was risky. I had a wife and two kids, and I was making significantly more money than I would during the early days of Atomation. But I’d reached the point where I felt like I understood the ecosystem, and I had confidence that I could make it work.

In starting a business, everything is difficult. The pace is maddening—to be successful, there’s no stopping, and there’s no slowing down. One of the first challenges I encountered was building a team of talented, dedicated people who are willing to accept a low salary (at least at first) and are comfortable with the risk of working for a startup. Along with Atomation’s co-founder and CTO Eran Keshet, I had to convince people to join the Atomation family based purely on my motivation and vision.

Another common pitfall is raising money. It can be difficult to convince early investors that a startup is headed for success. For Atomation, hiring prominent business leaders in St. Louis, our U.S. headquarters as of late 2017, was key. Richard Wolkowitz, Atomation’s chief of global strategy and legal, helped our St. Louis investors trust my vision for the future. Filling out Atomation’s U.S. team with knowledgeable experts also helped me deal with the cultural differences I encountered when I moved from Tel Aviv.

A third common pitfall is getting distracted. It’s tempting to jump at opportunities, such as a lucrative offer from a big company, but not every opportunity is a good one. Instead, I take the time to analyze whether such an offer will take our company to the next level, whether it fits with our goals, and whether it’s in a market we should be entering. For instance, IoT can be applied to every industry out there; however, for Atomation to keep growing, we must remain focused on our key industries, including industrial manufacturing. Even though we may get offers from other industries, we’re choosing to focus where we see the most growth.

As a tech company, we’ve run into challenges turning an idea for a product into a reality. To solve this, we pour resources into research and development, and we keep a flexible mindset. For example, if we were trying to develop a specific computing solution and it wasn’t working as expected, we’d find an acceptable compromise, with the understanding that we could improve the next version.

Although there are many pitfalls in growing a business, they are outnumbered by the rewards. I’m immensely proud that Atomation, which was just a small startup in Israel a few years ago, is now working with major companies like Ameren, Syngenta, Andritz, and DynaQuip Controls. Knowing that I’ve helped build an IoT platform that gets rave reviews from technical experts is also extremely gratifying. But the biggest reward is that many of the people who came to work for Atomation at its start are still here because they believe in us. Our company feels like a family because we trust each other, even in difficult times.

I’m excited for the road ahead. Over the next three years, we are planning to pursue three main growth strategies. One is scaling the business by obtaining more customers, more use cases, and greater integration of our platform. Second, we’re looking for strategic investors whose interest in Atomation extend beyond the financial—we want true partners who will help us get to the next level. Our third strategy for growth is to work on building our management team and filling key positions with talented people.
My background is somewhat diverse. My college education led me toward law school. After researching what an attorney actually does, I discovered it was anything but the legal dramas I saw on TV. So I went into finance instead. After three years of sitting behind a desk, I needed more of a challenge. So I went back to school and got a second degree in ag and biosystems engineering from North Dakota State University. I’ve always had a passion for mathematics and the option to be creative in the workplace. Engineering was my path!

I’ve always liked working outside and the challenges that go along with it. In the spring of 2012, I decided to get back to the family farm where my dad grew up. He left the farm to pursue his passion for medicine, and I realized that I wanted to come home. I was able to work outside and spend the last few years of my grandparents’ lives with them.

Along with the other farm chores, I planted aronia bushes, starting with 10 acres and 7,500 plants.

Aronia berries are a promising new crop because of their antioxidant content. After five years of growing aronia berries, I knew I needed to get this product into the mainstream because of its fabulous health benefits. We launched ax water (https://drinkaxwater.com) to bring this new superfood to the U.S.

The challenges of starting a new business? Many! First, aronia is a new crop, and there wasn’t anyone to call to figure out how to get started. Using a petroleum-based fabric for weed suppression, I was told, made us ineligible for organic certification. Later that changed, but in the meantime weed suppression without chemicals was a lot of work. It left me with two options: mechanical means, or just let nature play survival of the fittest.

An even bigger challenge was educating people about aronia and about what antioxidants can do for their health. The FDA does not allow claims about disease prevention for food ingredients or products, even though studies have demonstrated aronia’s health benefits, including reductions in blood pressure and cholesterol, and aronia is a natural anti-inflammatory. Because I couldn’t provide this information, I had a great product with a great story, but I couldn’t tell anyone. So I decided to educate people about the berries’ secondary benefits. Aronia is three to four times higher in antioxidants than blueberries, pomegranates, acai, and other berries. I also emphasized that our product contains only 30 calories per 16 oz. bottle, with just 4 grams of sugar, no preservatives, no artificial coloring, and no artificial flavoring.

Our product has already won awards. We were invited to Barcelona for the International Water Congress, where we were nominated as a finalist for three awards and were voted the new entrepreneur most likely to succeed. That recognition helped affirm that we were on the right path. We’ve also received testimonials from customers who have experienced genuine health benefits from our product. I’m not a medical expert, but that positive feedback shows that we’re improving people’s lives, and that’s enough for me.

We’re planning to grow our business by pursuing a more national distribution strategy. We’ve also changed our packaging from the original black label, which we thought would help us stand out on store shelves. It certainly did that, but it also confused consumers. They thought it was an energy drink, which it isn’t. The redesign of our packaging helps educate people about aronia. We also have plans to extend our product line into different sectors of the health and wellness market.

We started the business in 2017, and we were profitable within the first four months. We reinvested the profits in marketing to continue to grow ax water into a household name. With the help of our great team, and the Lord’s blessing, we hope to continue helping people stay hydrated by the best means possible. My life goal is to help people, but I wouldn’t have predicted that this business is the way it would happen.

Blake Johnson is CEO and President of ax water. Raised on a small farm in North Dakota, he combined his ag experience and his entrepreneurial skill to start a business that specializes in health and wellness products made from aronia berries. Blake got the idea for the business while growing aronia on the family farm.
Growing up, I was fixated on the interplay between agriculture and technology—how something as natural as a farm could be so aptly complemented with something as complex as advanced machinery. Farmers have optimized the farming process with tractors and other mechanical systems, but now that we live in the digital era, automation and artificial intelligence (AI) are transforming agriculture in ways we never thought possible. Our company, Blue River Technology (www.bluerivertechnology.com), was founded on the premise that the ag industry will soon experience a technological revolution that will transform how farmers manage their crops.

Early in life, I developed a passion for agriculture and technology. That passion deepened when I studied electrical engineering at Stanford University, where I obtained an executive MBA. Machine learning was an emerging field when I met Lee Redden, who was studying for a PhD in robotics and computer vision. Lee and I bonded over a mutual interest in agriculture. During his childhood in Nebraska, he also developed a passion for agricultural technology. Together, we determined that we could use computer vision and smart machines to differentiate between weeds and crop plants to target weeds precisely.

We knew there would be a great demand for the technology we were developing. At the time, farmers in the Midwest were using genetically modified seeds that resist herbicides, but herbicide-resistant weeds were spreading like wildfire. Herbicide companies had developed new products to address this issue, but none were as effective as the original formulations. Knowing that the old practice of treating every plant the same was not good enough, we developed See & Spray to apply herbicide directly to weeds, thereby avoiding application to the crop, and to use herbicide alternatives to control weeds that would otherwise be resistant. This prevents herbicide-resistant weeds from developing and avoids spraying crops with herbicides, giving farmers the ability to manage their field around the needs of each individual plant.

Funding was the first major hurdle that we had to overcome. At that time, most investors were looking for the next big mobile app or social media platform, so we had to convince them that investing in agriculture made good business sense. We also had to convince them that technology and agriculture go hand in hand and communicate our vision for how our technology could play a key role in feeding, sheltering, and clothing the world.

Another challenge (and opportunity) that we’ve focused on is leveraging AI to reshape the ag industry. Because of AI’s potential to change the world, there’s huge competition in the tech industry to unlock that potential. As a result, tech giants are quickly acquiring small, promising companies with AI capabilities and aggressively recruiting the best and brightest AI talent to get ahead of the competition.

John Deere has been on the forefront of agricultural technology since the early 1800s. Deere’s vision for how farms can operate more efficiently matched our own vision, so there was no other company that we wanted to be a part of. Deere acquired us in September 2017. Since then, Blue River Technology has grown, attracting engineers who are looking for a startup environment that also has the stability of a well-established company. Our employees are attracted to our mission of helping farmers feed the world as well as the environment. Not many engineers in Silicon Valley get the fun of working with cutting-edge technology on really big machines while solving meaningful problems.

Working with farmers is the most rewarding part of our job. We give them the ability to manage their crops in whatever way they like, based on the needs of each individual plant. Many farmers didn’t believe this technology was possible. Now they’re saving money, which they can invest elsewhere, because of the reduction in herbicide use. We see a world where we can reduce herbicide use by 2.5 billion pounds. Together, Blue River and John Deere are giving farmers the tools they need to work more efficiently and meet the world’s increasing demand for food, fuel, and fiber.

ASABE member Jorge Heraud, co-founder and CEO of Blue River Technology, intends to revolutionize weed control and dramatically reduce chemical use. Prior to founding Blue River, Jorge worked at Trimble Navigation as Business Unit Director for Precision Agriculture and as Director of Engineering, designing and delivering high-technology products including automatic steering, GPS receivers, displays, and variable rate controllers.
BlueInGreen (www.blueingreen.com) was founded in 2004 by ASABE member Marty Matlock and me, along with Virtual Incubation Company in Fayetteville, Arkansas. BlueInGreen is a water solutions company that provides a method for delivering dissolved oxygen, carbon dioxide, and ozone into water. Our main market is water and wastewater treatment for aeration, pH adjustment, oxidation/disinfection, and odor control. BlueInGreen won the Water Environment Federation (WEF) Innovative Technology Award in 2010 as well as the Global Cleantech Cluster Association (GCCA) Grand Prize in 2015. We currently have more than 35 installations operating in the U.S. and Canada, treating a combined 800 million gallons of water each day. BlueInGreen employs 16 people, holds six U.S. and six international patents, and has had an economic impact exceeding $20 million to date.

Marty and I started BlueInGreen because we’re both interested in making a difference in the world. We saw our invention as an immediate solution to real environmental problems, and we believed that commercialization was the fastest way to get this solution to those who needed it. Commercializing the technology helped us find funding to develop full-scale prototypes and prove the technology to the marketplace. As engineers, we enjoyed the design and development work. As university professors, immersing ourselves in the private sector allowed us to stay current on engineering practice and bring this experience back to the classroom, to teach our students about the ultimate goals of research.

We encountered many difficulties along the way, mainly in raising money for commercialization, which is very different from raising money for research. We were able to acquire SBIR and STTR funding from the National Science Foundation and the National Institutes of Health, and those programs led to private investor funding. We needed to figure out the world of private investors because private money is required for commercialization. Just because a technology works (which is the endgame for engineers) doesn’t mean that it can make money. Taking a technology to market is much harder than inventing it! Private investment also meant diluting our equity in the company, and this required a good business plan.

By starting this business, we were breaking new ground at our university, and we often encountered vague, outdated, or non-existent guidelines for balancing a public sector research program with appropriate private sector commercialization. The traditional faculty reward system doesn’t support this type of work, and this led to difficulties in justifying our work internally. In addition, the public and private sector work cultures are very different regarding disruption and productive failure (a hallmark of startup companies and the antithesis of a government agency like a public university). We often wondered if pursuing commercialization at a public university was even possible. We also encountered difficulties between the university and BlueInGreen regarding consulting and ownership of the intellectual property.

Our reward was in transferring a useful technology to industry, where it can solve problems that could not be solved before. We also trained dozens of graduate and undergraduate students in real-world engineering practice, giving them better experience than traditional academic work. And we improved our own engineering skills and learned many business skills, such as managing growth, staying focused on critical activities, and building customer relations, all of which take time and discipline. BlueInGreen has added more than $20 million to our state’s economy and is providing high-paying jobs for our graduates and other professionals. Marty and I have also realized a (so far) modest income from royalties on our invention, which we hope will increase dramatically in the near future.

Initially, Marty served as BlueInGreen’s Chief Sciences Officer, and I served as Chief Technology Officer. I also took a one-year paid leave from the university to serve as President and manage prototype development, project coordination, and fundraising. We both served on the Board of Directors. We have since stepped down from those roles because BlueInGreen has brought in outside leadership from investors. In 2018, Marty began a separate company, G17 Solutions (www.g17solutions.com), to integrate technologies like BlueInGreen’s water treatment systems into comprehensive community sustainability designs, focusing on Southeast Asia.

We are now fully engaged in our roles at the university, and we have no operational responsibilities with BlueInGreen, but we still provide research support on potential new products and markets. We greatly enjoyed developing our ideas and sending them out into the world, and we look forward to seeing them continue to grow and thrive.

ASABE member Scott Osborn, Associate Professor, Department of Biological and Agricultural Engineering, University of Arkansas, Fayetteville, holds BS and MS degrees in agricultural engineering and a PhD in biological and agricultural engineering. He has worked as an engineer for Grain Systems Inc. and Kellogg Company. His expertise is in equipment design, heat and mass transfer, and sediment oxygen demand. Scott’s partner, ASABE member Marty Matlock, is Executive Director of the University of Arkansas Resilience Center and Professor of Ecological Engineering, Department of Biological and Agricultural Engineering. Marty explores technologies and processes to increase the resilience of ecosystem services in human-dominated ecosystems with a focus on the interface of food, water, and community systems.
Breaking News: In 2018, for the second year in a row, Clear Labs was named one of the 25 Most Innovative Agtech Startups by Forbes magazine. This food safety company was launched in 2014 to help brands build dramatically stronger food safety and quality programs with comprehensive genomics-based testing and data science.

Although my background is in business, I’ve always been inspired by the potential of science to change the world. It’s driven me to build companies based on scientific breakthroughs and to harness the power of science to improve entire industries as well as our day-to-day lives.

For most of my career, I’ve been focused on the intersection of big data and genomics, fascinated by how these emerging technologies can be applied to industries like food, agriculture, and health. I’ve been fortunate to work with PhDs in genomics, computer science, biology, and engineering. It became obvious that these people, and others I met down the line, hold the key to world-changing research. Yet these friends of mine were often frustrated—they were working with incredible science, but they had no way to bring it to market. Their potential impact was huge, but they had no clear path to changing the world.

With my background in business, I saw an opportunity to leverage the startup model to translate scientific advances into real-world applications. Clear Labs (www.clearlabs.com) is an excellent case study for this process. My co-founder and Clear Labs’ CEO Sasan Amini and I recognized that genomic sequencing was at a juncture. Costs were dropping faster than Moore’s Law. We had entered the era of the $1,000 human genome. We saw an opportunity to develop applications for this technology outside of the clinical market.

Why food? The genome of a tomato is considerably less complex than the genome of a human, so we were confident in our ability to drive down the turnaround time and reduce the cost of next-generation sequencing (NGS) even further. At the same time, the food industry, which is responsible for the economic and human costs of 48 million cases of foodborne illness and 3,000 fatalities in the U.S. every year, was hungry for safer ways to do things.

The timing was right. Today, we have a proprietary NGS platform that is strengthening the safety of our global food supply chain. The advances in DNA sequencing, bioinformatics, and automation have driven down costs and opened up a new era of food safety. We’re helping the food industry embrace these advances.

We’ve also had our own pitfalls along the way. The biggest challenge of using a startup to bring science to the market was making sure that we were working in lockstep with industry. Throughout the life of the company, we’ve learned that helping people understand how science can be applied efficiently and effectively requires a lot of time, education, and collaboration. Now, as a member of leading industry organizations, I speak the same language as the global experts who are addressing food safety, security, and authenticity issues across the supply chain.

Another challenge we’ve faced is taking science that works well in a controlled environment and throwing it into the wild environment of industrial use. Most startups face the challenge of doing something that’s never been done before, but the science is only as good as the form it takes for the industry it’s serving. We’ve had to build custom solutions from scratch to meet the precise needs of the food safety industry.

The rewards are well worth the challenges. How we handle our food, from farm to table, impacts billions of lives every day. Making that food safer improves the supply chain, and it saves lives. That’s a powerful feeling.

Mahni Ghorsay, co-founder and Chief Commercial Officer for Clear Labs, leads business development, sales, and marketing. Clear Labs was founded with the mission to make the global food supply safer with a next-generation sequencing (NGS) platform purpose-built for food safety testing. Before Clear Labs, Mahni worked at Bina Technologies (acquired by Roche), which provided secondary and tertiary genomic analysis for researchers and clinicians.
Edenworks (https://edenworks.com) is a ten-person startup based in Brooklyn, New York. We develop and operate ecosystems that grow fresh leafy greens and seafood using industrial-scale recirculating aquaponics. My background is in modeling and engineering mechanical and biological systems, including robotics, collective motion, fermentation ecology, and now plant production. Motivated toward both understanding and creating, I try to abstract the principles that underlie how systems work, apply those principles to engineered systems, and ultimately deliver products that wouldn’t be possible without a high degree of technical innovation.

I joined Edenworks to explore two questions. How does the exponential growth of a healthy startup force its employees to grow as practitioners, through mechanisms that may not be present in other settings? And how can startups translate research into marketable solutions, while simultaneously making fundamental advances in knowledge?

After getting a degree in agricultural and biological engineering from the University of Illinois, I knew that I wanted to pursue use-inspired basic research in a commercial setting, whether at a startup or a mature company. Not all startups require basic R&D, so indoor farming was the perfect testing ground for the questions I wanted to explore. Plant and fish production in a controlled environment is complicated, so it presents some interesting fundamental problems, such as how to deliver an optimal microclimate. Fortunately, the problems aren’t so hard that it’s impossible to grow the company while we try to solve them.

One of the practical benefits of a startup is that the momentum starts out low, so it’s possible to make adjustments. We’ve course-corrected on multiple occasions, such as refining our crop selection, our target markets, and our use of sunlight. These improvements were the result of relentless efforts to identify the unknown unknowns, and treating both technical and market deriskment as a primary objective. As a result, many of the rewards of our work are in the process itself.

The opportunity to have a positive impact on the world—alongside talented, driven colleagues—has been a phenomenal motivator and learning experience. One of the most surprising joys has been building a network of vendors and technical advisors that we rely on for essential products and services. Site visits, trade shows, and an abundance of fact-finding technical conversations have been critical. In addition to developing our own innovations, we also try to leapfrog the development process by integrating existing solutions in new ways that are specific to our application.

Whether it’s bringing together different types of automation, making design choices that allow us to buy off-the-shelf components, or bringing together partners who wouldn’t otherwise have a chance to collaborate, we’ve had success in being open to solutions that originate both inside and outside our own company. Nothing compares with the satisfaction of doing blank-page work in-house, which is something that our team engages with on a weekly basis. But it’s the larger network of know-how that provides our in-house R&D with focus, insight, and leverage. This openness allows us to understand our own systems, choose the right problems, and learn from others’ mistakes.

A startup, like any business, has to deliver a product. For the past four years, we’ve continuously grown, packed, and shipped produce to a variety of customers on a weekly basis. As an R&D manager, the product that I deliver (with help from our many cross-functional teams and partners) is the farm itself, as used both by our farm operators and by our plants and fish. Our experience in maintaining and improving our farms will help build the farms of the future.

To grow the company and ensure our success, our focus will continue to be on quality and cost. I’m particularly interested in generating value at the interface between agriculture and manufacturing. On the one hand, this means bringing state-of-the-art practices from industry, such as scheduling and quality control, into our production systems. On the other hand, it means understanding the biology of our production systems at a deep level, and using that knowledge to improve how we operate. I look forward to using this knowledge to scale the company in Brooklyn and beyond.

Nico Hawley-Weld, Edenworks R&D manager, works at the interface between agriculture (growing things) and manufacturing (making things) overseeing R&D efforts in process automation and plant science.
I grew up around entrepreneurs, which I think is an uncommon experience. My mother is a small-business owner, and my father is a successful businessman who launched multiple high-growth businesses. Surrounded by people who were passionate about going to work on the weekends, I learned that true happiness lies in being your own boss and finding purpose in your occupation.

When I launched PureSpinach (www.purespinach.com), I had a problem that I was passionate to solve: when I went to the grocery store, I couldn’t find vegetables, especially greens, that were as fresh and flavorful as I wanted them to be. I find solace in cooking, and good cooking only happens with good ingredients, which is another way of saying “you are what you eat.” I wanted better fresh food options, so I decided to explore how to make that happen for myself and for others who feel the same.

One of the biggest pitfalls I’ve encountered in starting this business is the difficulty of proving that a proposed solution is scalable. At PureSpinach, even though we grow agricultural products that are better than market standards using a unique and efficient process, it’s not easy to convince investors and customers that our business is sheltered from competition, and that profitable scaling is only a matter of execution.

A more common pitfall has to do with the highly publicized success of startups that are backed by venture capital. It’s too easy to believe that a successful ag tech startup (or any tech startup) inevitably requires VC funding. In reality, the development of useful technology shouldn’t be hard to finance, once the efficiency and market strategy have been proven. If we knew early on what we know now, we would have been a lot less worried about pitching how we were out to conquer the world, and we would have spent more time making sure we were building a healthy cash flow.

For entrepreneurs in the millennial generation, like me, finding purpose in an occupation is a primary goal. Purpose is even more important than monetary return and positive feedback. Owning or being part of something that resonates with your soul is priceless. In my case, I produce food that I’m proud of and that my loved ones consume. That feeling is so rewarding that, when things are hard and hope is dim, I remind myself about how devastating it would be if we stopped what we’re doing, if we lost our great product and our opportunity to share it with the world.

Another major reward of a startup is the blessing of owning something that grows and learns with you. If businesses are like people, then startups are like children—they need extra care and attention, but their creators look on them with love.

To grow our company, we’re making ambitious plans to scale up our production, invest further in our technology, and keep listening to our customers to understand how we can serve them better by providing foods that are healthier, tastier, and safer than what’s generally available. We’re currently working on a next-greenhouse facility and a complete line of products. When we reach our next milestone, we’ll be providing daily fresh leafy greens to New York, New Jersey, and Philadelphia through a large network of retailers from an extremely sustainable production facility with close to zero carbon footprint. We’re very excited about that.

Serdar Mizrakci is an industrial engineer and entrepreneur specializing in manufacturing and automation. Born and raised in Turkey, his career began in the family business, a sizable solid fuels importing business, where he completed rotations in production/operations, business development, and finance/IT. Serdar started his first venture as a spinoff of that business, working on design and manufacturing of industrial packaging robots. After completing an MBA at Cornell University, he became interested in controlled-environment agriculture and the business opportunities in that field.
ExpresSeed (www.expresseedgenetics.com) offers affordable point-of-use devices that quickly detect and quantify specific genetic markers and single nucleotide polymorphisms (SNPs) in plant seeds and tissues. Unlike the widely used enzyme-based PCR methods, ExpresSeed’s method quantifies genetic markers using self-assembling nanostructures. By avoiding enzymatic methods for genotyping, our method dramatically improves portability, reduces assay time and sample preparation, and significantly reduces costs due to simplification of the assay reagents. Novel features of the ExpresSeed method include:

- Fast detection, less than 10 minutes.
- Affordability, less than $100 for 100+ genes.
- Reduced complexity, just crush the plant material and insert it into device.
- No dependence on protein markers, which enables detection of non-protein-based traits.
- Multiplex operation, which can detect dozens to hundreds of genes per sample.
- Battery-operated portability.
- Automated tracking of sample sites and the potential for predictive data modeling using cloud computing.

The ExpresSeed method works by assembling microscopic nanoparticles at two sites in unamplified genomic DNA. The nanoparticles are coated with DNA sequences that match the genetic marker of interest. If the target genetic marker is present in the sample, the nanoparticles self-assemble into an ordered structure that is detectable by the scattering of laser light passing through the sample. A second detection method provides higher sensitivity by quantitating individual nanoparticle assemblies using automated microscopy along with a machine-learning algorithm.

The nanotech innovation that powers ExpresSeed provides a new way to perform genetic detection. Seeing how the technology could solve real-world problems, we launched our first application as an independent startup rather than the traditional academic route of publishing papers. This accelerated the rollout in industry-specific use cases. Launching the product by addressing specific uses brings a combination of scientific, validation, and funding challenges.

Simpson College founded the Emerge Foundation, its entrepreneurial development program, to help students and faculty members commercialize their ideas. The program’s business development resources helped us launch our startup, obtain the initial funding, and find the initial customers. Lowering those barriers to entry has been key to the development of ExpresSeed.

We’re excited to launch a product that has potential to improve food security, increase protein production, and improve producer profitability. Working on a product rather than an academic paper has focused our research efforts on solving specific problems. That focus has rapidly advanced the technology’s capabilities beyond what we could have achieved with lab-based research alone, and it helped us identify likely funding sources.

ExpresSeed has several potential markets in agriculture and other industries. Our current strategy is to find partners for commercial applications in forestry, aquaculture, and livestock production. Outside of agriculture, ExpresSeed has attracted the interest of biotech companies looking for lower-cost lab methods. Some of these prospects will likely evolve into startups incubated at the Emerge Foundation and funded by venture capital, by licensing arrangements, or as collaborative R&D projects with industry partners.

Derek Lyons is an Associate Professor of Chemistry and Physics, Aaron Santos is an Assistant Professor of Physics, and Todd Kielkopf is the Program Coordinator for the Emerge Foundation at Simpson College, Indianola, Iowa.
At Farmobile (www.farmobile.com), we specialize in collecting agronomic and machine data and organizing it into a portable standard for viewing, downloading, and permission-based sharing.

Most of this data is locked up in machines (tractors, combines, sprayers, etc.), so farmers don’t have access to it. It’s no secret that the race to gather farm data is at full speed, but farmers are often an afterthought in this process. We believe that farmers should own their data, so we founded Farmobile to provide farmers with real-time access to this valuable information.

The influence of Big Ag is one of the biggest challenges we face. Manufacturers want to keep the machine data for themselves. They understand the value of this information, and many current policies prevent farmers from accessing information that’s gathered in their own fields. To empower farmers, we created an entirely new system for gathering farm data, and a platform that could standardize, visualize, and share the data.

The challenges have been numerous. In confronting industry policy that favors Big Ag over farmers and working against entrenched traditions, we’ve had to navigate many potential pitfalls. The biggest technical challenge facing us, and the industry, was gathering raw data from multiple equipment makes and models, and then converting it into a standardized format that allows farmers to use the data to benefit their operations.

We created a unique format to share data among different systems, which has provided an improved environment for data processing, including standardizing digital assets into electronic field records. Our dynamic platform includes a robust, secure application programming interface (API) that can handle a wide range of field-collected agronomic and machine data and other data sets. It also provides consistent, near real-time delivery of results.

Likewise, our market requires buyers who can use this data, while also providing incentives for farmers to make their data available. It’s the classic chicken-and-egg scenario, but our partnerships with major co-ops, insurances companies, and agronomists, as well as our growing base of subscribers, continue to expand the value of Farmobile for both farmers and retailers.

Other companies have focused on developing proprietary platforms that create incongruent data sets. We’re focused on making sure all ag data is portable and creating shared value across the industry. That starts with standardization. As a result, our data is the highest quality in the industry, and that allows farmers and their trusted advisors to glean more insights. There’s also huge value for our channel partners and for applications that use our API.

We’re currently focused on scaling up our platform by adding more subscribers (and more farm data) and more partnerships. This is an exciting time for Farmobile and for the entire ag industry. We’re all from farms ourselves, so we know how to build something from the ground up. We all have a love of agriculture and a desire to make a difference in the world.

In particular, we are creating a technology that will drive the future of agriculture. That future requires better data quality and the ability to turn raw data into revenue. We’ve spent the past five years fighting for farmers’ rights to own their data while helping industry realize the value of this data. Our long-term mission is to make sure farmers own their data outright, so they can negotiate from a position of strength and provide better stewardship of their land for generations to come. Farmobile provides a world-class platform to support that mission.

Jason Tatge, CEO of Farmobile, is passionate about farmers’ data rights. Jason earned a degree in financial economics from Gustavus Adolphus College in St. Peter, Minnesota, and an MBA from the Fogelman School at the University of Memphis. He is actively involved in the entrepreneurial community.
I’ve been fascinated with robotics for as long as I can remember, going back to my days growing up on my grandfather’s farm. Since then, I’ve been fortunate to work at companies like Willow Garage, which developed the foundation for modern robotics software, and Google X.

In 2012, I met a robotics PhD named Jon Binney, who shared my vision for using robotics to solve real problems, not just novelty applications. We saw the big improvements in robotics—cheaper sensors, cloud computing, and robust machine learning algorithms—and looked for industries that could benefit from those developments. Agriculture stood out, thanks to my farming background, and because we both love the idea of helping to feed people.

Jon and I road-tripped across California for several months, talking to dozens of farmers and their employees. We heard the same things over and over: farm labor is scarce, and high-quality produce needs constant care. Crops were rotting in the field because there weren’t enough workers to harvest them, which contributed to yield plateaus and lower productivity.

Those conversations made us realize that we could use robotics to grow premium produce with the care necessary to maximize yield. The efficiency would allow lower costs, and hyper-local growing would mean that fresh produce didn’t need to travel hundreds of miles to reach the customer. With those insights, Iron Ox (ironox.com) was born.

Like most startups, we faced challenges. Leaping into the unknown is scary, especially from a steady job. In the early days, we talked with farmers and produce buyers to understand the supply chain and to determine where automation was most needed. We were bootstrapping the company at the same time, and it was tough to avoid the temptation to just build something, rather than diving deep into industry needs. In hindsight, that exploratory process was the best approach because it invalidated some early assumptions, and we still use the insights that we gained.

Of course, the roadblocks and pitfalls didn’t come without major rewards. One big milestone was tasting the first batch of lettuce grown in our automated greenhouse. Seeing our robot in action was another huge accomplishment—it represented years of work and ideas brought to life. Watching the robot handle the lettuce so carefully and so precisely was a gratifying moment. The most rewarding experience thus far has been hearing the need for this solution echoed back to us from people who are trying to eat healthier but face common barriers to fresh food, like food deserts and prohibitive prices.

As we’ve grown and struck up new conversations with industry experts, their enthusiasm for Iron Ox has been overwhelming. At an indoor ag event, the attendees were visibly excited about what we were doing. I was surprised and humbled, given how new we were at that point. We even spoke with a farmer who offered us money for a robot—before we even had one developed! That enthusiasm led to financing, growth, and strategic relationships that continue to propel us forward. Few things are more rewarding than widespread belief in your mission.

By 2050, the global population is expected to surpass the rate of food production necessary to feed the world’s people.

Automation can help solve the farm labor shortage, and technologies like hydroponics, computer vision, and machine learning can create more efficient production, with higher yields and fewer resources. Automated production can change the future of food.

What does the future look like for Iron Ox? We aren’t just engineers building robots. To tackle something as complex as food production, we continue to expand our expertise in plant science, machine learning, and the business of growing, harvesting, and distributing fresh produce. We’re building our team, and we’re focused on perfecting our processes to yield the most nutritious, best tasting, and most beautiful produce possible, and make it available to everyone.

Brandon Alexander, CEO and co-founder of Iron Ox, developed the mission control software for Project Wing, the Google X drone delivery program. Before that, he worked at Willow Garage, a robotics think tank, as a web robotics engineer, designing tools that teleoperators use to manage robots at multiple facilities, and he contributed core robotics code that’s still used today.
MagGrow (www.maggrow.com) is a patented and proprietary spraying technology that helps farmers grow more by using less. The system, which has been three years in development, gives better coverage than conventional spraying systems. The two core benefits are 70% drift reduction and 20% to 40% increased coverage. In addition, our customers are seeing many other benefits including:

- Reduced water usage by up to 50%.
- Extended spray windows.
- Environmental and legislative compliance.
- Increased efficacy and disease control due to smaller droplets, without the associated drift issues.

MagGrow was co-founded with David Moore, a long-term friend and work colleague in Nova UCD (University College Dublin) nearly six years ago.

The problem: 70% of pesticide spray does not reach the target crop. The MagGrow system reduces drift by 70% and increases coverage by 20% to 40%.

Farmers have new technology pushed at them all the time. We quickly understood that it is extremely difficult to get new technology, especially hardware, onto farms. You need to work with growers, gain their trust, and provide them with independently verified data. You also need to take into account the seasonal nature of farming, so you must get your trial timing right; otherwise, it could be very time-consuming and expensive. As a result, ag tech entrepreneurs need time and money to establish their company and their technology, and that typically means a longer exit strategy for investors.

Fortunately, there are many rewards. It’s fantastic to be involved in a technology that’s truly sustainable, using fewer scarce resources, such as land and water, to grow more. We are doing our bit to help solve the greatest food and water challenges this planet will ever face: the need to grow the same amount of food over the next 40 years or so as we have in the last 10,000 years combined. And our efforts have been recognized. Since bringing our innovative products to the market, MagGrow has received a variety of industry awards (www.maggrow.com/awards).

On a personal level, I love the challenge of launching a brand new technology and going global with it. We help protect the environment by reducing pesticide waste and contamination, and it’s not hard to see why our team is so passionate about what we do.

We have a clear strategy for working with distributors as channel partners in our existing markets (the U.S., Canada, and Europe). After identifying early adopters in the distributor’s customer list, we conduct installations and tests to demonstrate the benefits of MagGrow. The final stage involves holding demonstration days to showcase our technology with the assistance of the early adopters (also using their field data) and then scaling via a hard launch with our channel partners.

In parallel, we’ve started discussions with potential strategic partners and plan to conduct joint work programs throughout 2018 and 2019. These two strategies will help MagGrow grow much more quickly than if we were to try to build it out by ourselves.

Gary Wickham, co-founder and CEO of MagGrow, began his career at Henkel Loctite Ireland, where he held several senior management positions that included building Loctite’s first-ever clean-room facility for the company’s biomedical and microelectronic products. Following his MBA, Gary joined Reheis Pharma Ireland as Managing Director. In 2003, he co-founded Stay City apartment hotels, a highly successful international business.
APS (www.mobileagpower.com) is a startup that was created from the student-led Purdue Utility Project (PUP). As an undergrad in ag engineering at Purdue, I worked on the Purdue Utility Project developing a simple, rugged utility vehicle for smallholder farmers, and I traveled twice to Cameroon with the project team. Later, in my graduate program, I worked on an NSF-funded project on fluid power. I became interested in launching MAPS as a startup when I saw that our utility vehicle was actually being used. What was a research project for students was also a source of income for those who depended on it for transportation and farm power. Seeing the vehicle in use, transporting essential inputs for local farmers in developing countries, helped me understand the difference between a research project and a business. A research project and a business share some similarities, but they are also very different. R&D is an integral part of all businesses, but when your bottom line depends on satisfying a customer, your priorities can change. Suddenly, the goals of the company will align with the goals of the customer. With that in mind, MAPS strives to provide a product that meets our customers’ needs.

Our main product, the AgRover, is a multi-purpose utility vehicle designed primarily for the smallholder agricultural market. It replaces animal carts, bicycles, and even foot travel. With the AgRover, our customers can move more of what they need water, seed, and fertilizer in less time, giving them more time for other productive tasks. [Editor’s note: see the July/August 2017 issue of Resource for an article on the AgRover.]

The AgRover can haul 2,000 lbs in its bed, on or off the road, with road speeds up to 20 mph. The vehicle can also perform fieldwork, pulling implements like planters, cultivators, and small plows. Its engine can be used for purposes other than transportation, such as water pumps, threshers, and generators. The simple, rugged design sets the AgRover apart from its competition. No other product can perform the variety of tasks that the AgRover can at a similar price.

MAPS and PUP have produced the AgRover in six countries to date. Currently, our primary manufacturing facility is in Lagos, Nigeria. Our approach to production is based on local manufacturing with locally sourced parts and materials. Building the AgRover locally provides skilled jobs, and it ensures that the vehicle can be easily serviced, repaired, and upgraded.

Many difficulties cropped up during the transition from a student service-learning project to a startup business. One of the biggest challenges, especially early on, was developing a supply chain halfway around the world in sub-Saharan Africa. Increasing production to gain an economy of scale also introduced challenges that needed to be overcome.

Until the launch of MAPS, the goal was to build one successful prototype in one summer, on location with the student-led Purdue Utility Project. Seemingly overnight, our vision went from prototype development to delivering a commercial product. The challenge of moving from prototype to production was especially difficult due to our strategy of establishing local manufacturing. Developing a successful quality control process helped increase the supply of appropriate parts and materials in the customer areas, and that also sets the AgRover apart from the competition.

Taking part in a startup has been gratifying. My colleagues and I always get excited when we see a local farmer using our product. It fulfills our mission of providing high-quality equipment to smallholder farmers at an affordable price. In addition, manufacturing the product locally instills a sense of pride in our customer communities. Building and maintaining the AgRover gives these communities improved productivity, and the assurance that MAPS will be there to provide after-market customer support.

Jordan Garrity is a graduate of Purdue University (BS 2014, MS 2016) and co-founder of Mobile Agricultural Power Solutions (MAPS) International.
I work as a research and development engineer at Modular Farms, a company I discovered while developing my own vertical structures for urban farming. To my surprise, in my current job I can finally apply my eclectic mix of skills. I’ve done a thesis on the electric separation of earthworms, and I have a mix of plant, soil science, and engineering in my background, as well as postdocs in greenhouse gas emissions, biofilters, anaerobic digestion, and biomass storage. I worked in government and industry jobs and was always drawn to technology for urban organic farming. I even helped organize ASABE sessions on the subject. After a while, I started wondering if that mix of experiences made me an undecided nomad who never managed to specialize in a particular field!

After I developed my own vertical farming structures, I went through the slow process of commercialization and looked for my next job as well. I met my current employer at the Toronto Food Policy Council, of which I am a member, and we seemed to have similar ideas on the next generation of devices for vertical farming. We both valued simplified, lean designs that can be manufactured at low cost and flat-packed. About a year later, once the company had started to expand, the CEO of Modular Farms contacted me with a job offer.

Meanwhile, I had joined the Impact Centre, a University of Toronto business incubator. There I set up a suspended garden and modular vermicasting system—a demonstration of how to close the nutrient cycle and turn food waste into fertilizer and back into edible plants again, all within small indoor spaces. I was accepted at this incubator after participating in exhibits, such as Carrot City, that focused on technology for urban farming.

My R&D work at Modular Farms is similar to working in a lab, because of how independent and creative the work is, but with the goal of creating a final product—automated hardware, in our case. I also have the opportunity to work with entrepreneurial colleagues in a startup that’s willing to take risks on new ideas. Our work qualified us to join the residence program at the Autodesk Technology Centre in Toronto, where Autodesk facilitates the prototyping work of several startups. It’s a great exposure to Autodesk expertise and tools.

What is refreshing about my job is that my mix of skills—a mix that makes most agricultural engineers “jacks of all trades”—is a perfect fit for R&D work. In just a few months, I’ve had a chance to create 3D models, develop electric control circuits and programming flowcharts, design and build hardware, write technical documents, and always be on a learning curve. I’ve rarely had this ability to use many of my skills in a single project. The moment of truth, of course, will be when the company implements the innovations that we’re developing.

Another advantage of my results-oriented job is the freedom to manage my time and keep up with other things that I value, such as motherhood and developing my own products.

My employer is a vertical farming company that is rethinking the current technology. Consider that today’s vertical hydroponic designs are essentially the same as the system originally designed back in the 1940s to produce food on location for the U.S. Army. That design has undergone many incremental innovations since, but the core principle—sustaining plants by recirculating water mixed with synthetic fertilizer—hasn’t changed.

My job is to apply modern, ecologically sound design constraints to a hydroponic system and create a structure with novel watering and fertilizing mechanisms. The future we envision includes vertical farms that fit seamlessly into human habitats, are not major energy sinks, help close the nutrient cycle, are modular, and are much more affordable than the current options. It’s rewarding work, and I hope to present it at ASABE’s Annual International Meeting once it’s completed.

ASABE member Hala Chaoui, Research and Development Engineer, Modular Farms; and Principal, Urban Farms Organic (UFO), Inc., Toronto, Ontario, Canada.

Editor’s note: As this issue goes to press, Modular Farms is in the process of registering a new company name. It will soon be known as NHXT.
I’m a plant breeder with an interest in the genetic diversity of our agricultural systems and the intellectual property rights and norms that govern the exchange of plant genetics. Improving our agricultural crops through plant breeding depends on the exchange of plant genetics to improve yield, agronomic performance, nutrition, and flavor.

For millennia, farmers saved the seed of their best plants to gradually improve their future crops. Plant breeding as a scientific discipline evolved in the early 1900s, as part of the Land Grant University system. As a result, over the course of the 20th century, the perceived value of seed changed. Originally viewed as a public good that could be exchanged freely, seed is increasingly considered a product of human invention, something proprietary that must be protected. This trend has affected the exchange of plant germplasm among plant breeders at universities, in private institutions, and independent plant breeders. Intellectual property rights are now the norm, in both the private and public sectors, and these legal barriers can impede plant breeders’ freedom to operate, make gains from genetic selection, and improve crops.

This trend has also led scientists and breeders to call for a change to the system and to suggest some kind of open source alternative, as has been developed and widely adopted in the software industry. In 2010, a group of plant breeders, seed companies, non-profit organizations, and social scientists met to discuss what an open source system for plant varieties might look like. Their discussions launched the idea of the Open Source Seed Initiative (OSSI), which became a 501(c)(3) non-profit in 2015.

Over the next few years, we worked to develop how the organization would operate. Initially basing the idea on the software industry, we developed a legally defensible “copy left” license. However, there are some fundamental differences between software and seeds. Our seed company partners looked at the license—which was eight pages long and indecipherable to anyone but a lawyer—and suggested that it was completely impractical for use on seed packets. Additionally, because a license is considered a type of contract law, it would have to follow every seed of every variety in order to be enforceable. Anyone who has worked with seed knows that it’s very easy to exchange seed without an eight-page license attached, rendering the open source aspect legally indefensible.

We decided to distill the license into an Open Source Pledge, which reads: “You have the freedom to use these Open Source Seed Initiative-Pledged seeds in any way you choose. In return, you pledge not to restrict others’ use of these seeds or their derivatives by patents or other means, and to include this Pledge with any transfer of these seeds or their derivatives.” With the goal of no further restrictions on seed varieties or derivatives, the Pledge is intended to ensure the four seed freedoms:

1. The freedom to save or grow seed for replanting or for any other purpose.
2. The freedom to share, trade, or sell seed to others.
3. The freedom to test and study seed and to share or publish information about it.
4. The freedom to select or adapt the seed, breed crosses with it, or use it to breed new lines and varieties.

This system, which is based on a moral/sharing economy and a system of collaboration, has grown substantially as a release mechanism for new plant varieties. We’ve built a network of 38 plant breeders who have released over 400 new, open source, crop varieties that are being sold by 62 seed companies in the U.S., Canada, the U.K., and Australia. Most of our partners are freelance plant breeders working outside of formal institutions. We maintain a database and registration system for new seed varieties on our website (https://osseeds.org). OSSI doesn’t distribute seeds but instead works with our seed company and plant breeder partners who sell open source varieties and label them with the Pledge.

While OSSI is still a small organization, it has made a difference in supporting the work of independent plant breeders and has helped foster the growth of decentralized plant breeding and seed enterprises that serve the needs of a just and agro-ecological food system through the development and release of open source plant varieties. We are continuing to strengthen and support the community of plant breeders, seed companies, farmers, gardeners, communicators, and concerned citizens who are committed to the development and use of OSSI-Pledged open source seeds.

Claire Luby, Faculty Associate, Department of Horticulture, University of Wisconsin-Madison, teaches introduction to horticulture and works on seed sovereignty with a variety of different communities. Her dissertation focused on assessing genetic variation and freedom to operate in a large collection of U.S. carrot cultivars. She is co-founder, previous executive director, and a member of the Board of Directors of OSSI.
SpectroClick (www.spectroclick.com) is developing handheld spectrometers for analyzing water, soil, raw materials, products, and effluents in agriculture and industry. The technology represents the culmination of my career in teaching, research, service, and economic development the missions of the University of Illinois at Urbana-Champaign.

My first exposure to research was watching J. D. Ingle Jr. derive signal-to-noise expressions for spectrometry. Thirty-eight years later, in Hanoi, Vietnam, in an instrumental analysis class that I taught using perspectives I’d gained from that early experience, a student who was learning about spectrometry invented an arrangement of diffraction gratings. That was the start of SpectroClick. Serendipity triumphed!

In contrast to that brilliant student in Vietnam, I’ve seen many college freshmen who have no interest in the subject but need to get through the class. In effect, they say: “Just tell me what to do. I’ll do it, hand in the answer, and go home.” Too many people don’t want to understand science, but they want to enjoy the benefits of science. In teaching freshmen classes, we force the students to adapt. In business, we must adapt ourselves to the needs of our customers. Thus, as much as “know-nothingism” irritates the professor in me, I also see it as a business opportunity.

Founding a startup appeared to be the only way to develop our technology (U.S. Patent No. 8,885,161) into a product rather than merely an intellectual curiosity. My ignorance of business was breathtaking. To my surprise, more than 90% of the people who asked about SpectroClick simply assumed that the technology worked or could be made to work. They were more curious about our customers, cash flow, team members, and markets. I started the company assuming that developing the technology would be our greatest challenge. Once we got it working, I assumed that markets would open automatically, and investors would appear, providing the funds we needed to build a business. In reality, we were developing a solution in search of a problem. That’s a common mistake, and it’s a much harder way of attracting investors than the opposite approach!

The potential stakeholders in an enterprise tend to believe that the hardest part of building the enterprise is the part that they understand most thoroughly. Techies think that getting the technology to work is hard, while selling is easy. No sales person would agree! Lawyers worry about intellectual property and freedom to operate. Those topics never come up in freshman science classes.

With the benefit of hindsight, I’d advise would-be entrepreneurs to assemble a professional staff, including technical, finance, legal, and marketing teams, before trying to develop the technology. My greatest frustration at SpectroClick has been the lack of a permanent technical team. The funding for such a team is now part of our “Use of the Investment Proceeds” table in our business plan.

Without a well-rounded staff, the technical development will perpetually lag due to lack of critical input, numerous interruptions to learn business skills that are independent of technical skills, and difficulty in getting market traction. Would you buy a highly technical product from a company in which only one person understands the technology? Neither would I, but SpectroClick is still inching toward availability of a minimally viable product (MVP) with no “second in command” who knows the code, the chemistry, and the complications. Other people in our company are similarly hamstrung by this lack of redundancy in their knowledge and skills.

At some point, we’ll look back and attribute the eventual success of SpectroClick in large part to someone who decided to fund the development of a permanent technical team, so that hardware testing, analytical method development, and software debugging could occur at a brisk pace to serve the markets that our customer discovery and marketing teams have found.

Until then, imagine walking through a field, finding a bare spot, and wondering, “Is it bare because it has a nutrient deficit? An excess of nutrients? A toxic contaminant? Let’s find out!” Out comes an instrument and a smart phone with the instructions. Point and click, and the instructions start playing. You don’t even have to think. Just follow the instructions, and a few minutes later, you discover that the bare spot is a sink for phosphate and nitrate. That’s why the plants have overgrown and died. Add fertilizer? Heavens no—there’s already an excess! And you didn’t need to bring in an agronomist or send out a sample to find out. Wouldn’t you love to have a device that empowers you that way? Soon you will.

Alexander Scheeline, co-founder and President of SpectroClick, is Professor Emeritus of Chemistry at the University of Illinois, Urbana-Champaign. His research interests are optical spectrometry, nonlinear dynamics, oscillating reactions, and oxidative stress.
every day, pig producers are faced with a myriad of decisions, some of which are made with limited information and by under-skilled staff. The result? Inefficiencies, high animal mortalities, and production losses. It’s not that producers don’t have access to data. The amount of data currently being generated is astounding. In the swine industry, environmental controllers, feeding systems, and production management and financial software all generate vast amounts of data on the millions of animals produced annually in the U.S. The problem is that producers often don’t have the time or the skills necessary to translate all that data into useful information that can improve their management decisions.

Additionally, in current production systems, data-driven decisions are generally reactive, based on an event that’s already occurred. And even with limited information, a decision still must be made. There is tremendous opportunity to proactively manage animal environments to avoid detrimental events that can lead to production interruptions, mortalities, and inefficiency.

As breed-to-wean pig farms have increased in size, new management challenges have resulted in mortality rates of 15% for sows and piglets. In contrast, the smaller farms of the past reported mortality rates as low as 5%. The swine industry has recognized this challenge and has started to develop initiatives focused on understanding the causes and implementing solutions. At TellTail (www.telltail.ag), we believe that data science has the potential to drive significant improvements in sow and piglet care.

TellTail focuses on adaptive decision support for early identification and response to critical events. We combine historical data, current status, and future predictions into analyses that offer science-based input for the care of gestating sows and piglets. My team is at the front end of this ag tech startup, applying Internet of Things (IoT) and data analytics to assist with decision support for the management of pig farms.

We recently completed an iCorps program through the National Science Foundation, and we’re embarking on the proof-of-concept phase for our first product. In the iCorps program, we interviewed more than 100 different players involved in pig production to help us understand the ecosystem and where our technology could provide the most value. One of the biggest lessons learned so far is that we needed to dig deep into understanding the day-to-day operations on the farm to ensure that our product would not create an additional burden on the workers.

So, as a university professor, what’s my interest in a tech startup? My early career aspirations focused on industry, but I never found a good industry fit for my desire to apply engineering skills to animal housing and management challenges. Instead, I’ve been fortunate to work in academic research, where I’ve focused on solving problems in the lab and understanding how animals interact with their environment. However, as technology has continued to progress, I’ve noticed that the gap has widened between what can be done (as shown by science) and what actually happens (as practiced on farms).

After receiving tenure, I pondered the next phase of my career. My consistent answer was that I wanted to use my skills in a real-world application, to see science translated into practice, and to improve the sustainability of pig production across three areas of concern: economic, social, and environmental. A few nudges from respected mentors and some personal conversations with peers resulted in the idea of founding a startup that could apply my research in the swine industry.

I love my academic career, and I don’t intend to leave it behind, but commercialization is the only way that certain technologies can be sustainable in production agriculture. Data analytics is a powerful tool, but it’s been underused in animal production. A tool that applies data analytics to decision support has potential to improve production efficiency and animal welfare, so TellTail is focused on translating science into practice to improve the management of pig farms.
Breaking News: In 2018, for the second year in a row, TerViva was named one of the 25 Most Innovative Agtech Startups by Forbes magazine. TerViva cultivates the pongamia tree, which produces an oilseed with ten times more yield than soybeans and has the potential to create a biofuel alternative.

TerViva (www.terviva.com) is a young agricultural company that’s developing the pongamia tree to revitalize underproductive agricultural land. People have long identified many uses for pongamia trees, including shade, vegetable oil and meal (from the seeds), herbal remedies and medicines (from various plant parts), and honey. TerViva is particularly focused on the oil derived from the seeds and the nitrogen-rich leftover seed meal.

Our business has two separate phases: identifying cultivars with superior genetics to enhance commercial production and harvesting of the seed pods, and developing products that can be derived from the oil and meal. We have projects in Florida, where citrus production has been challenged by citrus greening disease (also known as HLB), and in Hawaii, where new agricultural crops are being sought to offset the declining production of sugarcane and pineapple.

I work on the tree-growing side of our business. Specifically, I seek out and evaluate promising pongamia cultivars, examine pod yields, and determine how various traits relate to yield and tree health. In our R&D plantings, I keep tabs on the various cultivars and help recommend an optimum subset of cultivars to plant at larger scales. I enjoy the intellectual challenge of learning about new species, and I’ve worked with lots of them. My career has focused on the intersection of R&D, applied breeding, and pragmatic field constraints.

During my BS and MS training in forest biology, I became interested in genetics and applied breeding. Subsequently, I earned a PhD in genetics at UC Berkeley, where my faculty advisor held joint appointments in forestry and genetics. While many of my fellow grad students studied the development of corn, yeast, or fruit flies, I studied a commercial conifer species for which very little genetic information was available—the incense cedar. My studies involved using genetic markers (isozymes) to describe genetic variations among populations. I also grew seedling progenies in a nursery to evaluate genetic variations related to seedling growth and water stress.

My isozyme studies laid the foundation for my current work with DNA markers, while my nursery experiments gave me experience with the methods of quantitative genetics commonly used by breeders. Later, post-doctoral positions exposed me to molecular biology and DNA methods.

While TerViva is my first experience in horticulture, I haven’t seen that as a problem. For one thing, pongamia has been only partially domesticated. The bulk of my career has been with undomesticated trees—that’s what forest geneticists do—so working with a relatively undomesticated species such as pongamia is not new for me. Most horticultural crops, including tree crops, have a long history of domestication, commercial cultivars have been previously identified, and field evaluations are done using tried-and-true methods. For pongamia, very little such information is available, so we’re writing the rules from scratch. Yes, this is challenging, but it’s quite doable.

Pongamia seeds are not true-breeding, which means that seedling offspring are variable among themselves and rarely behave like their parents. However, vegetatively propagated plants are genetically similar and behave like their vegetative parent. Consequently, growth and yield are considerably more uniform, and the plants are more easily managed. Given the large reservoir of genetic variability that we know resides in pongamia, we don’t anticipate the kinds of breeding problems that are associated with some other, less variable, tree crops.

TerViva offers a market-driven response to the need for better use of land. We’re planting our trees in parts of the U.S. that have permanently abandoned agriculture land, where we can revitalize agriculture and make money by selling sustainable food and non-food products. We can replicate this approach in others parts of the world where there is poor-quality agriculture land, where similar alternative crops like soy and palm won’t grow, and where there are markets for sustainable, organic protein and vegetable oil.

I feel fortunate, at this stage of my career, to have a position that fits so well with my scientific training and interests, while also providing socially and economically desirable outcomes that benefit people.

David Harry, Vice President for Germplasm Development at TerViva, is a former faculty member at the University of Illinois and Oregon State University, where he taught tree breeding and genetics. David earned an MS in forestry at UC Berkeley and then completed a PhD in genetics. His breadth of experience encompasses both plants and animals and includes stints as a federal research scientist, university faculty/researcher, industry scientist, private consultant, and USDA research advisor/manager.
The ASABE Constitution establishes that “a Fellow shall be a member of unusual professional distinction, with outstanding and extraordinary qualifications and experience in, or related to, the field of agricultural, food, or biological engineering. A Fellow shall have had 20 years of active practice in, or related to, the profession of engineering; the teaching of engineering; or the teaching of an engineering-related curriculum. The designation Fellow shall have honorary status, to which members of distinction may be elected, but for which they may not apply.”

Recognition by peers is a superlative honor. At the 2018 Annual International Meeting in Detroit, thirteen new fellows received one of the highest distinctions an ASABE member can achieve. Here and in the next three issues of Resource, we shine the spotlight on some of ASABE’s best and brightest, beginning with the honorees below. Congratulations to these newly elected Fellows!

**David Bohnhoff, P.E.,** Professor, Department of Biological Systems Engineering, University of Wisconsin, is honored for his outstanding leadership and contributions to research, teaching, outreach activities, and standards development involving the design, analysis, and construction of post-frame buildings.

Bohnhoff’s extensive research has led to establishing and managing a comprehensive post-frame building research program, resulting in the development of new component and system analysis techniques, innovative component designs, unique construction techniques, computer-based design aids, and several industry standards and design guidelines. This research program has several notable areas of focus: mechanically laminated assemblies, metal-clad wood frame diagrams, shallow post and pier foundations, wood post-to-concrete connections, wood I-posts, diaphragm trusses, precast concrete posts, notched purlins, framing tolerances, cladding and trim tolerances, fall protection, thermal envelopes, component and building failures, and foundation installation tools. Bohnhoff is the principal author on more than 100 technical publications.

**Paul Ayers, P.E.,** Professor, Departments of Biosystems Engineering and Soil Science, Institute of Agriculture, University of Tennessee, Knoxville, is recognized for applying engineering principles to solve natural resource problems, including off-road vehicle impacts, aquatic habitat mapping, and rollover protection structure (ROPS) designs.

Ayers has developed a viable research program to improve ROPS for tractors and other machines that spans more than 30 years. The scope of his research has been wide, from providing means to judge the suitability of retrofitting older non-ROPS tractors with ROPS, to accurately predicting the plastic deformation present during ROPS testing, to the development of ROPS for non-tractor applications such as zero-turn lawn mowers. Ayers’ work on assistive devices for raising and lowering foldable ROPS has improved operator ergonomics and safety and, when successfully translated into practice, results in fewer deaths and injuries from overturns. Ayers has also made outstanding contributions to soil dynamics research, focused on the multidisciplinary aspects of soil-machine-plant interrelations.

**Devendra Man Amatya, P.E.,** Research Hydrologist, USDA Forest Service, Cordesville, South Carolina, is honored for his contributions to understanding the hydrology of wetland forests and the impacts of management alternatives.

Amatya has developed an extensive research portfolio that has made significant contributions to the hydrology of forests, particularly runoff and evapotranspiration, on low-gradient coastal landscapes and their interactions with land use and changing climate. He has also conducted extensive research on quantifying the long-term hydrology and water quality effects of silvicultural and water management practices on managed forests using monitoring and modeling approaches, the results of which include a novel strategy of planting switchgrass as a cellulosic biofuel crop within pine forests to help manage water quantity and quality on poorly drained, pine-forested watersheds throughout North Carolina.

**Meet the Fellows**

**Devendra and family with grandson Kevin.**

**Paul performing underwater video mapping.**

**David and wife Rhonda celebrating 36 years together.**
Travis B. (Rusty) Unterzuber

As engineers and scientists affiliated with ASABE, we often use the word “sustainability.” We use it to describe the longevity and long-term impact of a process. As an individual, how do you ensure the sustainability of your final wishes? That’s done through a process called estate planning.

My perspective is as a user of estate planning. I’m not an attorney or financial advisor. Rather, I’m someone who, with my spouse, realized that we needed a better plan for what happens to our assets after both of us are gone. Hopefully, this article will encourage you to start thinking about your own situation. Everyone needs an estate plan, regardless of age. And yes, it is a very personal and potentially overwhelming process.

By default, you already have an estate plan. No matter where you live, there are laws, regulations, and customs that dictate how your liabilities (what you owe) are settled and how your assets (what you own) are distributed. The problem is that this process might not match your preferences, nor have the long-term impact you desire.

The most unsettling part of the estate planning process is the beginning, because it involves acknowledging that your life will end. You also recognize that those you love have the same vulnerability. After you start the process, each step becomes easier, with one exception. There is a point at which you must decide the disposition of your assets, or “who gets what.” For my wife and me, those decisions were not as difficult as we expected. In fact, the result was very satisfying.

Many factors will influence your own decisions. For a significant portion of your life, your desire to take care of your family will drive your decisions. Your estate plan will also need to change over time as a result of major life events, such as career moves, marriage, children, and retirement. Your plan will also need to change as you accumulate more assets.

Consider the needs of someone who is just a few years out of college. Even if that young person has a spouse or children, a simple plan is probably sufficient. Properly executed wills that leave all assets to the surviving partner, along with primary and secondary beneficiaries on life insurance policies and investment accounts, could be enough.

In our case, as I prepared for retirement, it became embarrassingly obvious that our wills from 30+ years ago were no longer adequate. Not only were there more assets, the assets were in many different forms—including various investment accounts and hard assets, such as real estate and physical property. In addition, some assets were jointly held, and some were in our individual names. Because of the complexity, we hired an attorney to handle the legal aspects of our estate plan.

We also realized that the disposition of assets that we designated in our previous wills no longer reflected our preferences. Our revised estate plan established a two-step sequence. The first and obvious step is that the surviving spouse receives and retains control of all the assets. The second step addresses the inevitable: what happens when the remaining spouse passes away?

That decision was also much easier than we expected. We concluded that we wanted to make sure our assets had a sustainable impact. We made personal bequests to family and friends, but those are a small portion of the estate. Our most satisfying decision was to give the bulk of our estate to well-established foundations that serve our community, my under-grad alma mater, and the ASABE Foundation.

There are many advantages to designating a foundation in your estate plan:

- The operating principles and oversight ensure that the funds are appropriately distributed to achieve your desired long-term impact.
- The longevity of a foundation minimizes the problems caused when individual not-for-profit groups change their focus, merge, or cease to exist.
- The assets will transfer tax-free.
- The assets will be invested to provide perpetual funding.

The ASABE Foundation was already part of our giving plan, so it was easy to justify it as part of our estate plan. My long-term relationship with ASABE has been a constant positive influence during my career of 45+ years. Supporting the ASABE Foundation will help ensure that ASABE remains a strong professional society, and that it has a positive influence on future careers. For that reason, consider including the ASABE Foundation in your estate plan as well.

Our revised estate plan has given us a great sense of satisfaction. We know that each of us will be able to live comfortably and enjoy peace of mind. After we’re gone, we know that our final wishes will have a sustainable, positive impact on the causes that we care about most.

Please contact Mark Crossley, ASABE’s Director of Advancement (crossley@asabe.org or 269-932-7002), to discuss including the ASABE Foundation in your estate plan.

ASABE member Travis B. (Rusty) Unterzuber, retired, Davenport, Iowa; unterzuber@mchsi.com.

This is one in a series of articles from the Foundation Development Committee.

ASABE Fellow Sylvia Schonauer, P.E., Foundation Trustee and Development Committee Chair, Principal Engineer (retired), W.K. Kellogg Institute, Bellaire, Mich., USA; sylvias@valkyrie.net.
From 1/4 Scale to Standards

When I was an undergraduate, participating in the International 1/4 Scale Tractor Student Design Competition was the best part of my ASABE membership. Every team tries to build the best-performing machine, and each team’s design evolves from year to year. The 1/4 Scale competition has also evolved, but one element remains the same—cooperation. When the worst-case scenario inevitably occurs, every team lends a helping hand. From contributing spare parts to providing insight from their own experience, everyone works together in the spirit of cooperative competition.

Competition with cooperation doesn’t end at graduation—it’s just beginning. The spirit of the 1/4 Scale competition is found throughout industry. Companies take the place of schools, employees take the place of students, and standards replace rules. Each company competes to deliver the best product to the customer and cooperates in developing industry standards. Just like our 1/4 Scale tractors, industry standards are constantly evolving to achieve increased safety, compatibility, and operability.

It takes experience to write standards, but involvement only requires time. As an observing member of an ASABE Standards committee, you can become part of the development process. The ASABE Standards committees are divided into technical concentrations, and subcommittees work on individual standards. Many meetings are held virtually, at the Annual International Meeting (AIM), and at AETC.

For more information on the ASABE Standards committees and how you can extend your involvement with ASABE, check out the links below, or contact ASABE Standards Administrator Jean Walsh at walsh@asabe.org:

• ASABE Standards Development:
  www.asabe.org/standards/committee-list.aspx
• ASABE Annual International Meeting:
  www.asabemeetings.org

ASABE member Austin Roepke, Electrical Systems Engineer, John Deere, austinroepke@gmail.com.

YPC News editors: ASABE member Amélie Sirois-Leclerc, YPC Executive Committee member at large, asiroisleclerc@gmail.com, and ASABE member Shane Williams, YPC Executive Committee chair, shane.williams14@gmail.com.
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