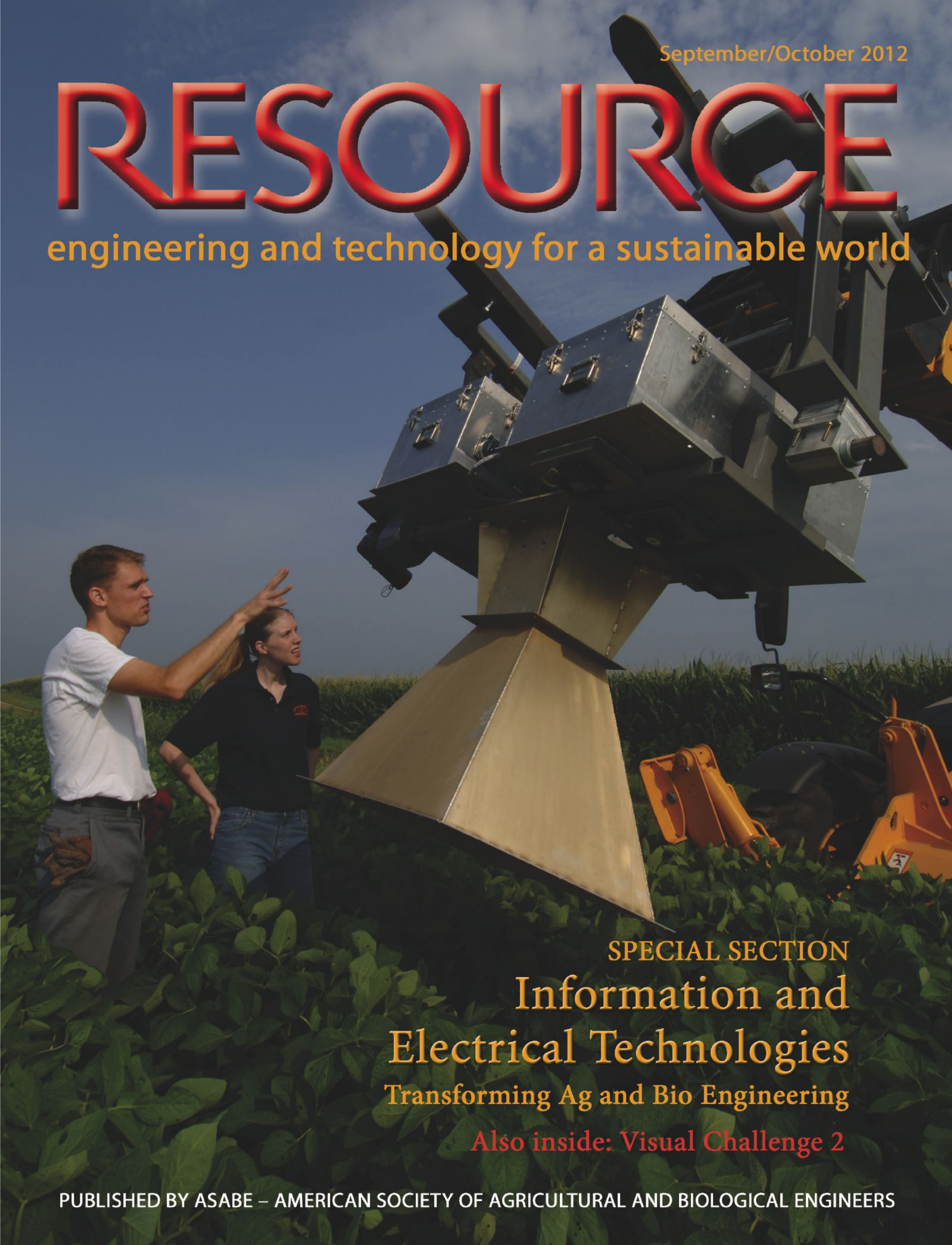
September/October 2012

RESOURCE

engineering and technology for a sustainable world



SPECIAL SECTION

Information and Electrical Technologies

Transforming Ag and Bio Engineering

Also inside: Visual Challenge 2

PUBLISHED BY ASABE – AMERICAN SOCIETY OF AGRICULTURAL AND BIOLOGICAL ENGINEERS

E-I-O, the Next Verse

I am honored to be the president of ASABE. My first item of business is to thank Sonia Maassel Jacobsen for her leadership over the last year. She has taken every opportunity to promote the expertise of ASABE members, to strengthen the image of the Society, and to engage in outreach that increases the value of the profession. The ***E-I-O*** that she established as the focus of her presidency is of such clear value that I intend to retain it as a platform for my work in the coming year.

It is clear that agricultural and biological engineers have the ***E***xpertise to face the challenges of the world's growing population. We are a diverse group, but basically we all work to provide food, water, fiber, and energy for the world. It is also clear that our ***I***mage is improving. A recent article in *Forbes* recommended our discipline as one of the top majors for college students to consider in the coming years. Why? Because no other profession grasps all the elements of the productivity problem, and because our profession is uniquely qualified to meet the needs of a changing world.

In recent years, we have established a public initiative—an ***O***utreach—to carry our expertise to policymakers in Washington, D.C. We recently completed a marketing study to better reach professionals affiliated with our academic programs. Last year, a future-thinking committee was established to evaluate our organizational structure and ensure that we are meeting the needs of our members and potential members.

As ASABE president, I intend to promote outreach, and I encourage each of you to do the same. For a start, you can work with the schools in your community to promote science and engineering. You might also provide projects for senior design courses at a university, or mentor an ASABE preprofessional member. The rewards for engagement in these activities can be profound.

There are millions of people on this planet whose quality of life has been improved because of the innovative work of agricultural and biological engineers. But the need for our expertise grows greater every day. Together, working through ASABE, we will continue to build a better world and make a difference in people's lives.

Tony Kajewski
KajewskiAnthonyH@JohnDeere.com

events calendar

ASABE CONFERENCES AND INTERNATIONAL MEETINGS

To receive more information about ASABE conferences and meetings, call ASABE at (800) 371-2723 or e-mail mtgs@asabe.org.

2013

Jan. 28-31 — **2013 Agricultural Equipment Technology Conference.** Kansas City, Missouri, USA.

July 21-24 — **ASABE Annual International Meeting.** Kansas City, Missouri, USA.

2014

July 13-16 — **ASABE Annual International Meeting.** Montreal, Quebec, Canada.

ASABE ENDORSED EVENTS

2012

Nov. 2-6 — **2012 Irrigation Show & Education Conference.** Orange County Convention Center, Orlando, Florida, USA.

Nov. 25-28 — **7th CIGR Section VI International Symposium on "Innovating the Food Value Chain."** Stellenbosch University, South Africa.

Nov. 26-29 — **Agricultural and Food Engineering for Life (CAFEi2012).** University Putra Malaysia, Putrajava, Malaysia.

2013

Feb. 24-26 — **International Conference on Agricultural Engineering: "New Technologies for Sustainable Agricultural Production and Food Security."** Sultan Qaboos University (SQU), Sultanate of Oman.

July 7-11 — **9th European Conference on Precision Agriculture.** Lleida, Catalonia, Spain.

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ON THE COVER

ASABE member Amy Kaleita and Brian Hornbuckle discuss the validation of remotely sensed estimates of the water cycle under a microwave radiometer positioned over a cornfield in Ames, Iowa. *Photo courtesy of Bob Elbert.*

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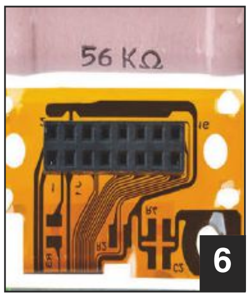
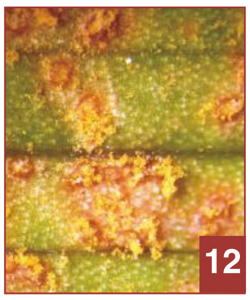
FEATURES





DEPARTMENTS

ERRATUM In "Energy Security: Let's Get it Right" by Gale A. Buchanan and James R. Fischer (*Resource*, March/April 2012, pp. 14-15), the GDP and energy consumption figures were incorrect. The U.S. GDP is about $48,000 per capita, with about 300 million BTUs of energy consumed per person. China's GDP is about $8,000 per capita, with over 64 million BTUs of energy consumed of per person. Our thanks to ASABE Fellow Howard P. Johnson for suggesting these up-to-date corrections. We regret the errors.

to the editor

Dear Editor,

Regarding the article by Jeong-Yeol Yoon in the May/June 2012 issue of *Resource* ("Who We Are and What We Can Do"), much of what he writes is right on the mark. ASABE has a very strong history of dealing with biological systems. As agricultural engineers, we have been educated to view the entire system of inputs and outputs, mostly biological in nature, but not always. We had courses in machinery, but those courses were different from the machinery courses taken by mechanical engineering students; they included mechanical properties of plants and animals. We had courses on soil and water topics, but these were different from the water courses taken by civil engineering students; they included water needs of plants growing in soils. We took courses in structures and environment, but these courses were different from the structures and environmental courses taken by mechanical engineers or civil engineers; they included environmental interactions between plants, animals, and physical conditions.

There is need for a society—some society—to represent the field of engineering related to biological systems at all levels. The best positioned society to fill this need is ASABE. We have people who are experts in plant modeling, animal modeling, and insect modeling, all related to environmental conditions of the real world. There is no other society that has as large a concentration of expertise in engineering of the complete system of biology as ASABE.

There are three other primary societies with the words "biology" and "engineering" in their names (not counting AIMBE, which is a secondary society). The first is the Institute of Biological Engineering (IBE). IBE was formed as a community of ASAE (as was its name at the time), but differences arose between the ASAE Board of Directors and the IBE Council, so IBE split from ASAE. Some hope that IBE could one day reconcile with ASABE, but that is not going to be possible. Despite having foundational statements that it serves biological engineering in the broadest possible sense, the strength of IBE papers and publications is in biological engineering at the cellular and tissue level, areas that do not significantly overlap those of ASABE, and certainly not the engineering of biological systems of interest in ASABE.

The society with interests closest to IBE, and the second society with the words "biological engineering" in its name, is the Society for Biological Engineering (SBE), a society formed by chemical engineers with interests in biomolecular, cellular, and tissue engineering. It is federated with the American Institute of Chemical Engineers (AIChE) as a technical community. Despite the name of SBE, its interests do not include the engineering of biological systems at all hierarchical biological levels, as they do in ASABE.

The third society is the Engineering in Medicine and Biology Society (EMBS), part of the Institute of Electrical and Electronic Engineers (IEEE). EMBS is federated very closely with IEEE and is almost exclusively concerned with engineering related to human medicine. EMBS does not represent the broad perspectives that are found within ASABE.

Of all the societies with engineering related to biology, the only one representing a broad, all-encompassing perspective of engineering related to biological systems at multiple biological levels is ASABE. That is our strength, and that is what we should promote.

At one time, engineering in agriculture was the keystone of our society, and we did it well. Times have changed, however, and agricultural research has metamorphosed into biological systems research. Funding sources reflect this change. At the same time, ASABE has changed, our students have changed, and the word "agriculture" is no longer attractive. It certainly is not as attractive as "biology" or "medicine." If we are honest about it, it wasn't even as attractive as a field of employment to us. The late Fred Wheaton, our former department chair, who grew up on a dairy farm on Michigan's Upper Peninsula, used to tell me, "I've had good days as department chair, and I've had bad days, but I've never had a day so bad that I wanted to put up hay."

Our problem in ASABE is letting go of "traditional interests" and positioning ourselves for a future that attracts the new breed of student, that feeds on the strengths that we have built over the years, and that positions us as the go-to society for understanding the interconnectedness of biological systems, the environment, and human activities. We have promised our students that they will learn about engineering, learn about biology, and be able to deal with interesting challenges when the two are put together. They don't want to be labeled as agricultural engineers, and they see little reason to associate with agricultural engineers. If ASABE is to have a strong future, which it most certainly can have, it needs to begin to seriously attract graduates of the new academic programs and give them what they need. There is no reason to abandon the traditional interests of ASABE, but they need to be de-emphasized and made subordinate to the more inclusive term of "biological engineering."

As to whether we should permanently banish biomedical engineering from the interests of ASABE, the response needs to be nuanced. Let the engineering of diagnosis, prognosis, and treatment of human medical needs be recognized as the purview of EMBS and BMES. But we cannot abandon human interests entirely. Let us embrace human safety, preventive health measures, and human interests in environmental preservation. The human being was, is, and always will be the motivation for much of what we do. Besides, looking at biology as a whole means that we cannot ignore the human as an important source of biological research information. It is appropriate that we recognize the human element in engineering related to biological systems.

This country and the world need a professional group with expertise concentrated at the overall, global, systems level. Someone needs to understand how everything fits together. This is an exciting prospect for ASABE; it could be exciting for its present and future members, for funding agencies, and for society as a whole. We have this strength, and it is time. As Dr. Yoon said, "What are we waiting for?"

Arthur Johnson, Professor Emeritus
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Editor's note: Sarah Luther, a member of the University of Florida team, reflects on the 2012 International 1/4-Scale Tractor Student Design Competition, held in Peoria, Ill., May 31 to June 3. Although the University of Kentucky took top honors at the 15th annual competition —nearly sweeping the judging categories and collecting sixteen trophies for their efforts, Luther—as a good Florida Gator—proves that winning isn't every thing.

Through involvement in the competition, students gain practical experience in the design of drive train systems, tractor performance, and manufacturing processes. In addition, they develop skills in communication, leadership, teamwork, and fundraising.

The competition is unique among student engineering-design contests in that it provides a realistic 360-degree workplace experience. Teams of students are given a 16 hp Briggs & Stratton engine and a set of Titan tires. The design of their tractor is up to them. A panel of industry experts judges each design for innovation, manufacturability, serviceability, maneuverability, safety, sound level, and ergonomics. Teams also submit a written design report in advance of the competition, and they must sell their design in a formal, face-to-face presentation to the experts, who play the role of a corporate management team. Finally, the machines are put to the test in a performance demonstration comprised of four tractor pulls.

Dear Editor,

As a first year team, we had no clue what we were getting into when we arrived in Peoria. We had scoured every bit of information given to us and prepared as best we could, but we couldn't have foreseen the challenges that awaited us. For example, we met the Saskatchewan team in the parking lot, and as competition veterans, they enlightened us about the tech inspection process and warned us about the cone that's used to check exhaust safety. Good and much appreciated advice. It seemed we were in for a number of surprises that weekend.

Luther, center, and her UFL team members pose with their tractor, the culmination of many months of hard work.

Right before we left for Illinois, Florida had endured tropical storm Beryl, and we had been stuck inside the shop trying to paint with a leaky roof and rain blowing in sideways through the doors. We spent most of the night of our arrival (Wednesday) painting and fixing some of our wiring—things that should have been done prior to arriving.

Thursday brought rain and freezing temperatures—at least it felt like freezing to us Floridians. The technical inspections required us to fix a few more things, in addition to faulty wiring and inadequate brakes. Luckily, Saskatchewan's electrical genius was there to help us. I spent the whole day fussing with our tractor. It seemed that about half the teams sailed through the tech inspections with flying colors. At least we know what to expect next year!

Thursday evening we met the Université Laval team and were bewildered that they had to cut so much off of their tractor to meet the weight requirement. They were all very nice, and we had a long chat about their team and their trip to the competition. We were quite impressed by the efforts that some of the teams make just to get to the competition. Our measly 18-hour drive was nothing compared to the 42-hour drive by Cal Poly or the flights Laval had to take.

Friday morning, we again spent hours fixing the tractor and were almost late to design judging. Our brakes couldn't hold up to the rigorous test at the competition, so we had to J. B. Weld new automotive pads onto the old Cub Cadet plates. Some of the Kansas guys had been walking around that morning checking out the other tractors, and they were kind enough to help us put the wheels back on our tractor and push it over to the design judging barn, as our brakes were still unhooked. Design judging made us realize how far behind we were compared to the veteran teams. I never thought about making an owner's manual for our tractor, and we were so impressed with how polished some of the other teams' designs were.

Later that day, the teams competed in the maneuverability competition, but we completely missed out because of our brakes. Thankfully, though, by the end of the day we had passed all of our tech inspections and had received our dinosaur sticker. We got a sticker for each tech inspection test we passed, and the dinosaur signified final weigh in. I have never been so excited about receiving stickers in my whole life!

On Saturday, my team finally got to relax a little. We gave our design presentation in the morning at a Caterpillar facility and got to play around a bit with all of the interactive exhibits on display. Later that afternoon, we faced our first performance test: the tractor pulls. Our clutch slipped in the first practice pull, but with the help of Saskatchewan, we put some more pressure on the spring and completed both of the lightweight pulls.

Sunday, during the practice pull and first heavyweight pull, we busted both the original differential gear carrier and the only spare we brought with us. The University of Tennessee-Martin helped us change out our carrier and even tore apart their spare transaxle to let us borrow a bearing cup. Satisfied with our first-year performance, we packed up our things and headed to lunch while the other teams finished their last pull.

The competition was a huge learning experience and quite stressful at times, but we had an absolute blast. I was amazed to see how helpful everyone was, and I remain incredibly impressed with how sophisticated all of the teams' tractors looked. We definitely learned that we need a lot more money and teammates to be competitive, as there are a lot of components to the competition. It is extremely challenging, but in a very good way. You can easily see how much heart and soul the competition planning committee puts into coordinating all of the competition events. I don't know how we would have been able to compete without the help of so many teams, who eventually just told us to "go into our trailer and get whatever you need." We can't thank them enough, and we are so glad to have been able to meet so many outstanding teams. We are looking forward to next year's competition and hope to move up in the ranks a bit, now that we know more about what's expected!

Sarah Luther, sarahlou91@yahoo.com

Information and Electrical Technologies

Transforming ag and bio engineering

According to the Computing Research Association, "Information technology has amplified our intellectual and physical abilities more than anything since the development of the written word ... We are hard-pressed to think of change of comparable magnitude in human history." While you may argue that other historical advances, such as the development and mechanization of agriculture, rival the advances currently seen in information and electrical technology (IET), you cannot deny the effects that these ongoing technological developments are having on our lives today.

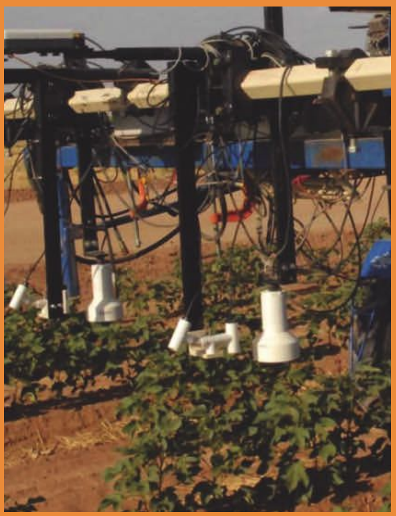
Brian Steward, special section guest editor, is a professor at Iowa State University, Department of Agricultural and Biosystems Engineering, Ames, USA; bsteward@iastate.edu.

Coincident with these advances in IET are the challenges that we face in sustainably providing the food, water, fiber, and energy needed for our growing global population. While IET by itself will not solve these problems, it represents a big piece of the puzzle. With advances in IET, agricultural and biological engineers have access to low-cost data acquired from biological systems, algorithms to transform that data into information and subsequently into knowledge, models to simulate highly complex living systems, advanced controls to improve agricultural machines and machine system performance, and even agricultural robots that mimic intelligent behavior.

Many of these advances are well established in industry, such as the controlled environment of the factory floor. However, until recently, their application to agriculture has lagged. The reasons for this lag include the tremendous spatial, temporal, climatic, and geographic variability that is characteristic of agriculture; the economics of agriculture, with its low profit margins or low volumes; and the low number of people who are trained to work with both IET and agricultural systems.

Nevertheless, IET is transforming our profession by enhancing our ability to measure, monitor, and characterize the processes, parameters, and relationships of agricultural and biological systems. Before IET, this ability was limited. A generation ago, when low-cost computing power first started to become available, modeling and simulation programs made a big impact by providing unprecedented insight into how agricultural systems work, and how they change with changing conditions. Today, the costs of sensor technology and data processing are lower than ever, and we can better characterize highly uncertain parameters that vary in time and space. With this ability comes new knowledge and insight, new tools and technology, and safer, more efficient, more sustainable systems. This is an exciting time to be an agricultural or biological engineer!

In this special issue of *Resource,* we explore several examples of how ASABE members are enhancing our profession through IET research and applications. In the first article, Kelly Thorp and his colleagues discuss field-based, high-throughput phenotyping experiments for cotton in Arizona that use a variety of information technologies. This article provides a good example how



Field-based, high-throughput phenotyping experiments for cotton in Arizona use a variety of information technologies.

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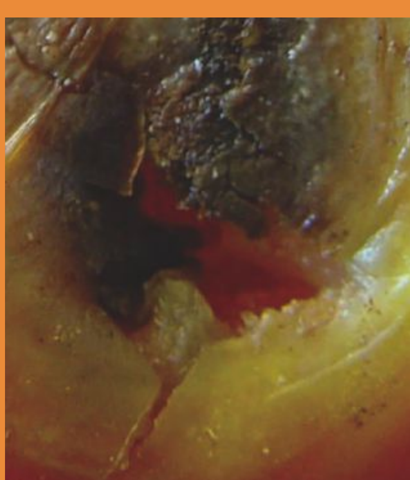
geneticists are relying on the skills of agricultural engineers to acquire the plant knowledge necessary to develop genetic improvements.

Similarly, the development of viable biomass production systems requires cost optimization. One important way of controlling production cost is effective management of the agricultural machinery. Traditionally, agricultural machinery management has been based on limited data collected manually in field studies. Now with the availability of vehicle data networks, onboard sensors, and GPS, machinery management data can be collected continuously and automatically. In the second article, Matt Darr explains how this is being done in the Midwest United States for corn stover production.

With the availability of vehicle data networks, onboard sensors, and GPS, machinery management data can be collected continuously and automatically.

Agricultural extension has been a key component of the U.S. land grant university system, and it has played a major role in the development of U.S. agriculture. Extension experts have always been eager to use the latest technology to share their knowledge with their clients. IET, in the form of personal computers, the internet, and now social media, has completely transformed ag extension. Jiannong Xin shows how ASABE members are at the forefront of developing technologies for the dissemination of Extension knowledge.



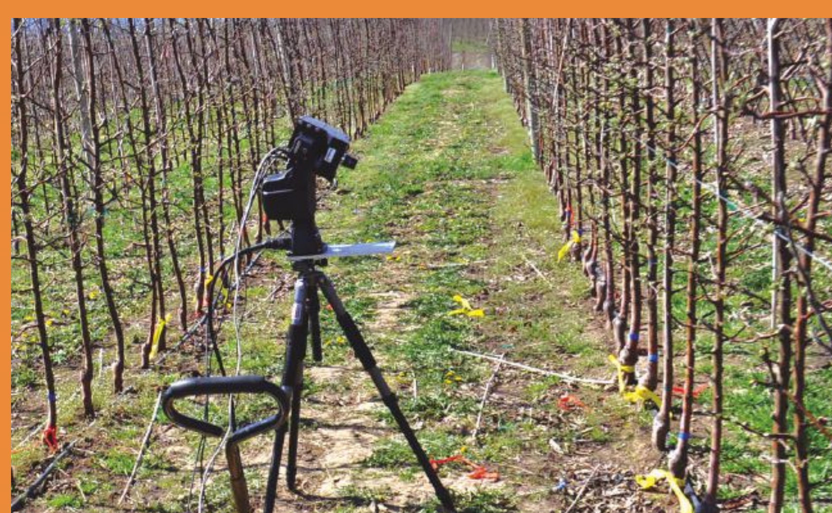
ASABE members are at the forefront of developing technologies for the dissemination of Extension knowledge.

Substantial progress has been made in the development and commercialization of precision agriculture and field automation technologies for major commodity grain crops. However, despite the need to reduce production costs, specialty crops have not yet benefited substantially from these new technologies. Several research groups around the world are working on IET for specialty crops. The last article, by Manoj Karkee and Qin Zhang, highlights work in the Pacific Northwest on automated pruning processes in orchards.

These articles represent only a small sample of the ongoing work of ASABE members in developing IET for agricultural and biological systems. While IET activities cut across all technical divisions within ASABE, the IET Division serves as ASABE's focal point for the organization of IET technical sessions, Standards activities, and publications. All ASABE members are encouraged to get involved in this exciting area.

It has been exciting for me to learn about this important work, and I'm eager to learn more. In addition, it has been a pleasure to serve as the guest editor of this special section of *Resource*. Special thanks to all of the authors, and to Sue Mitrovich, Glenn Laing, and Melissa Miller at ASABE.

Citation for the quotation in the first paragraph: From the introduction (p. 1), "Grand research challenges in information systems." Copyright 2003, Computing Research Association, Washington, D.C. Available at: http://archive.cra.org/reports/gc.systems.pdf.



Some IET work in the Pacific Northwest focuses on automated pruning processes in orchards.

Information Technologies for Field-Based High-Throughput Phenotyping

Kelly Thorp, Pedro Andrade-Sanchez, Michael Gore, Jeffrey White, and Andrew French

A pressing objective in the plant science community is to understand the connection between a plant's observable characteristics (phenotype) and its genetic makeup (genotype). Great advances in DNA sequencing have unlocked the genetic code for many important commodity crops, such as rice, sorghum, and maize. However, understanding how genes control complex plant traits, such as drought tolerance, time to flowering, and harvestable yield, remains challenging. Field-based, high-throughput phenotyping seeks to implement information technologies, including sensing and computing tools, to rapidly characterize the growth responses of genetically diverse plant populations in the field and relate these responses to individual genes.

In central Arizona, we have completed two seasons of field-based phenotyping experiments in two types of cotton. The experimental design included 25 extra-long staple (ELS) cotton cultivars and 100 upland cotton lines replicated under both full and limited drip irrigation. The ELS cotton experiment included pima cotton cultivars released over a period of 90 years (1918-2009) by breeding programs in Arizona, heat-sensitive Sea Island cultivars from the Caribbean, and a recently released commercial pima cotton cultivar. The upland cotton experiment consisted of 100 lines from a genetic cross between two parents that varied in their tolerance to heat and drought stress.

Proximal sensing

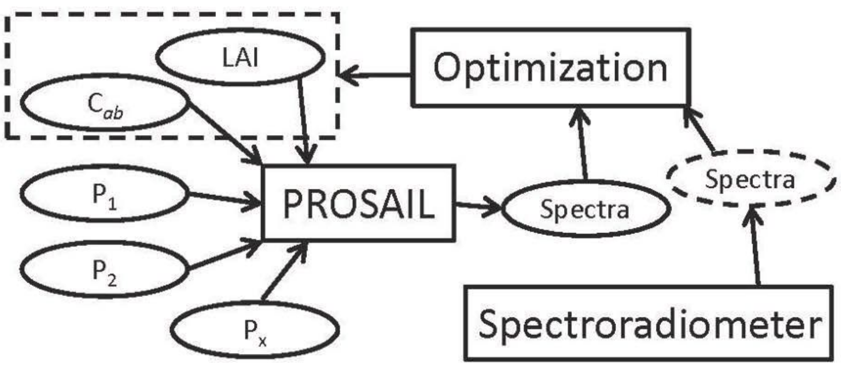
Field-based, high-throughput phenotyping hinges on the availability of a proximal sensing system, including a sensor platform and instrumentation, that can rapidly quantify phenotypic variation in the field. There are many potential options for sensor deployment: tractors, crane-like vehicles, cable robots, sprinkler irrigation machines, or unmanned aer-

Proximal sensing of cotton quickly quantifies phenotypic variations.

ial vehicles. We are currently using a high-clearance tractor for full-season field access. The instrument package includes four active radiometers for measuring canopy spectral reflectance in three wavebands, eight infrared thermometers for measuring canopy temperature, four sonar sensors that measure canopy height, and an RTK GPS receiver for horizontal and vertical positioning. A spectroradiometer has also been used to measure canopy reflectance in hundreds of narrow spectral wavebands. This year, we will deploy a LIDAR sensor in an effort to map canopy geometry.

Geospatial analysis

By nature, field-based phenotyping generates large volumes of spatial information. For rapid data processing, geospatial analysis is needed to locate data within field plot boundaries. We are developing a suite of open-source geoprocessing tools in the Quantum GIS environment (www.qgis.org). The software handles coordinate transformations from the GPS receiver position to the sensor positions and assigns a plot identifier to each data point based on its position in the field.



Inverse modeling diagram.

Inverse modeling

Proximal sensing is limited to measuring only a few crop canopy characteristics. By coupling the field observations with canopy radiative transfer models or crop growth simulation models, we can glean additional useful information. For example, PROSAIL is a radiative transfer model that simulates canopy spectral reflectance given information on solar geometry and plant canopy traits, including leaf area index (LAI), chlorophyll content (Cab), and others. For more information, see the article recommended under “For further reading.”

As shown in the accompanying diagram, using an optimization algorithm, we can adjust PROSAIL input parameters (i.e., LAI and Cab) while other parameters are held fixed (P1, P2, ... , Px) with the objective to minimize error between PROSAIL-simulated spectral reflectance (solid oval) and field-measured spectral reflectance (dashed oval). The resulting optimized plant canopy trait parameters add physical and biological meaning to the field observations and can be used in subsequent genetic analysis. Incorporation of process-based crop growth models that simulate plant growth and development over the growing season permits model inversion for time-series proximal sensing observations rather than observations at single points in time. This also allows for estimation of crop canopy characteristics at times between proximal sensing observations.

Genetic analysis

Genetic mapping studies are used to identify genes that control the observed phenotypic variation in the field. These analyses test for statistical associations between genotypic and phenotypic data collected from the experimental cotton population. This allows for the identification of genetic markers that can be used to rapidly develop cotton cultivars that are both high yielding and tolerant to environmental stress.

Field-based, high-throughput phenotyping using only manual labor is prohibitive because thousands of distinct genetic lines must be characterized. To overcome this obstacle, plant geneticists and breeders are turning to agricultural and biological engineers for sensor deployment solutions and information technologies that can rapidly quantify the phenotypic variation of genetically diverse plant populations in field conditions. Proximal sensing technologies, geographic information systems, crop growth simulation models, and other computational approaches may all play a role in unlocking the complex relationship between a plant’s genetic code and its observable growth characteristics in the field.

ASABE member Kelly Thorp is a research agricultural engineer with the USDA-ARS Arid-Land Agricultural Research Center, Maricopa, Ariz., USA (kelly.thorp@ars.usda.gov); ASABE member Pedro Andrade-Sanchez is an assistant professor in the Department of Agricultural and Biosystems Engineering, University of Arizona, Maricopa, USA (pandrade@ag.arizona.edu); Michael Gore is a research geneticist (michael.gore@ars.usda.gov); Jeffrey White is a research plant physiologist (jeffrey.white@ars.usda.gov); and Andrew French is a research physical scientist with the USDA-ARS Arid-Land Agricultural Research Center (andrew.french@ars.usda.gov).

For further reading

Jacquemoud, S., W. Verhoef, F. Baret, C. Bacour, P. J. Zarco-Tejada, G. P. Asner, C. Francois, and S. L. Ustin. 2009. PROSPECT + SAIL models: A review of use for vegetation characterization. *Remote Sensing of Environment* 113: S56-S66.

CAN Bus Technology Enables Advanced Machinery Management

Matthew Darr

A controller area network (CAN) provides the central communication link on virtually every modern agricultural machine. Tractors, combines, and other powered vehicles use CAN Bus technology to connect multiple individual electronic control units (ECUs) and exchange sensor and control data. The advent of CAN technology has improved vehicle diagnostics, simplified electronic control design, and enabled advanced implement management through standards such as ISOBUS.

In addition to serving the primary needs of electronic design in agricultural machinery, CAN Bus systems can also provide high-precision machinery performance and logistics information. In agriculture and bioenergy applications, parameters for machinery performance and management are widely used for equipment sizing and cost estimation. Direct measurement of CAN Bus metrics, including average operating speed, engine load, implement engagement, and fuel consumption, can help supply chain managers design equipment solutions that maximize field and transport efficiency while lowering equipment costs.

The CyCAN data logging platform

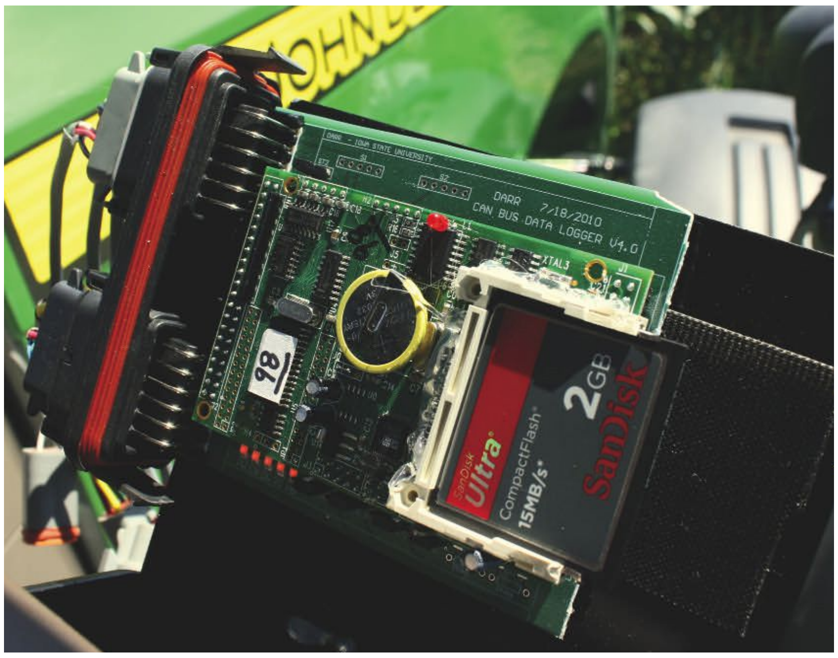
With that in mind, a research team at Iowa State University has developed a series of technology solutions to directly capture CAN Bus machinery management parameters. The CyCAN data logging platform is a standalone ECU specifically aimed at quantifying the key parameters of agricultural machinery. CyCAN data loggers connect directly to the ISOBUS diagnostic port in the tractor cab and provide direct access to all available CAN Bus information. The CyCAN data loggers can also merge this CAN data with GPS information to support spatial analysis of machinery systems.

Capturing essentials and more

To date, this technology was used to capture high-precision logistical data on over 6,000 ha (15,000 acres) of corn stover biomass production. The machinery operating state is determined automatically based on a matrix of CAN information. For example, the ground speed and PTO speed of the tractor used to bale the biomass can be analyzed to distinguish between in-field productive time, in-field downtime and maintenance, and over-the-road transportation time. Additionally, by capturing ISOBUS virtual terminal messages, information from ISOBUS balers, such as bale drop location, bale pressure, and bale length, can be captured to create yield maps of the harvested biomass.

More advantages

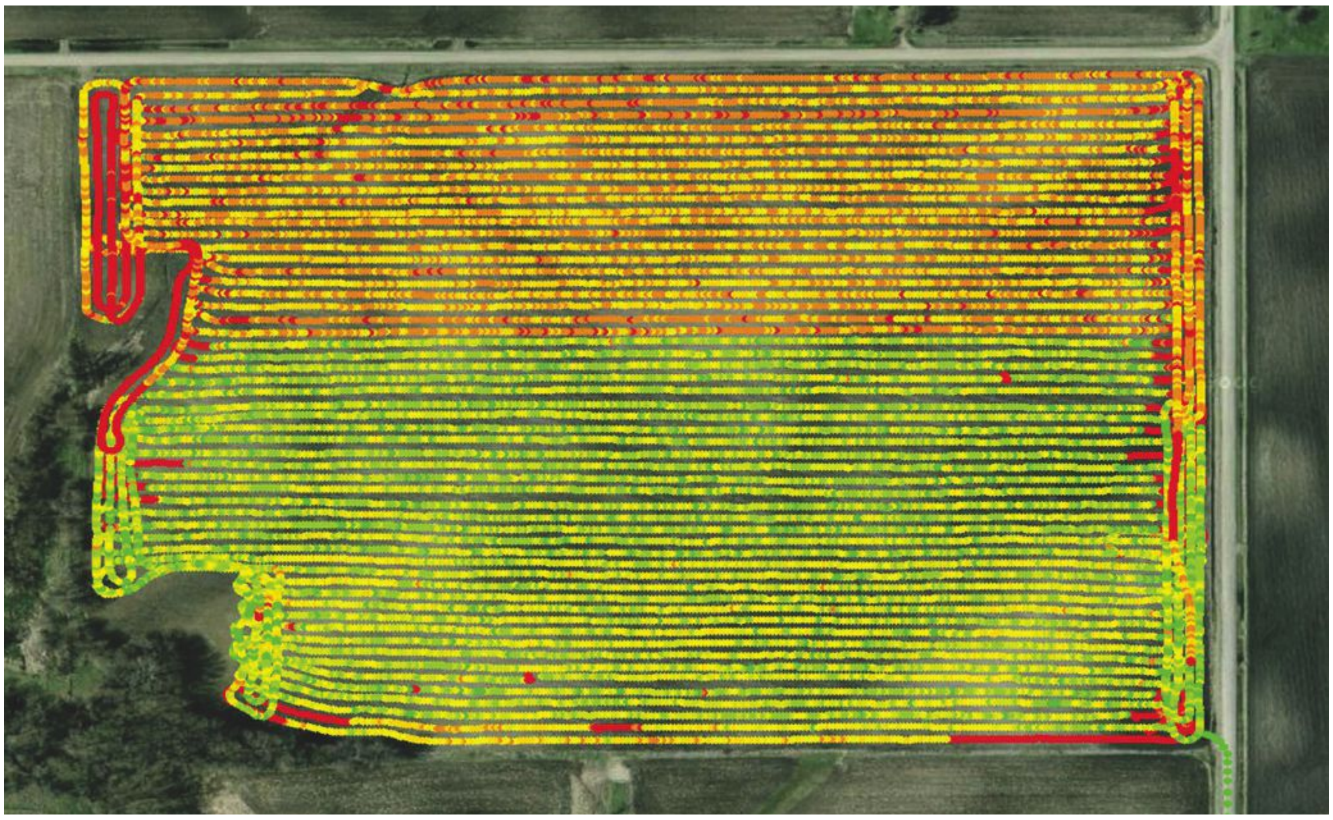
The automated and deployable nature of this technology also allows researchers to determine averages and distributions of machinery performance within a given supply chain. By integrating machinery performance into their event modeling systems, researchers can develop risk and cost distribu-



This CyCAN data image logger connects to the ISOBUS diagnostic port and provides direct access to all available CAN Bus information.

tion models for biomass supply chains and accurately model the impacts associated with modification to the supply chain. Additionally, analysis of engine loading provides a direct assessment of the power requirements for specific tractor-implement pairs and can be used to optimize tractor sizing for a specific application. The integration of GPS information allows all of these performance indicators to be compared for a variety of soil and terrain conditions.

The accessibility and standardization of CAN Bus technology has opened up tremendous opportunities for machinery performance researchers and will serve as the platform for new advances in machinery management and agricultural supply chain logistics. The possibilities are just beginning to be explored.



GIS analysis of fuel consumption while baling corn stover at two rates in a single field. Green indicates high fuel consumption, and red indicates low fuel consumption.

ASABE member Matthew Darr is an assistant professor, Department of Agricultural and Biosystems Engineering, Iowa State University, Ames, USA (darr@iastate.edu).

CAN Bus information can enable detailed assessment of new machinery systems, such as single-pass harvesting of corn grain and stover.

Leveraging IT for the Benefit of Cooperative Extension

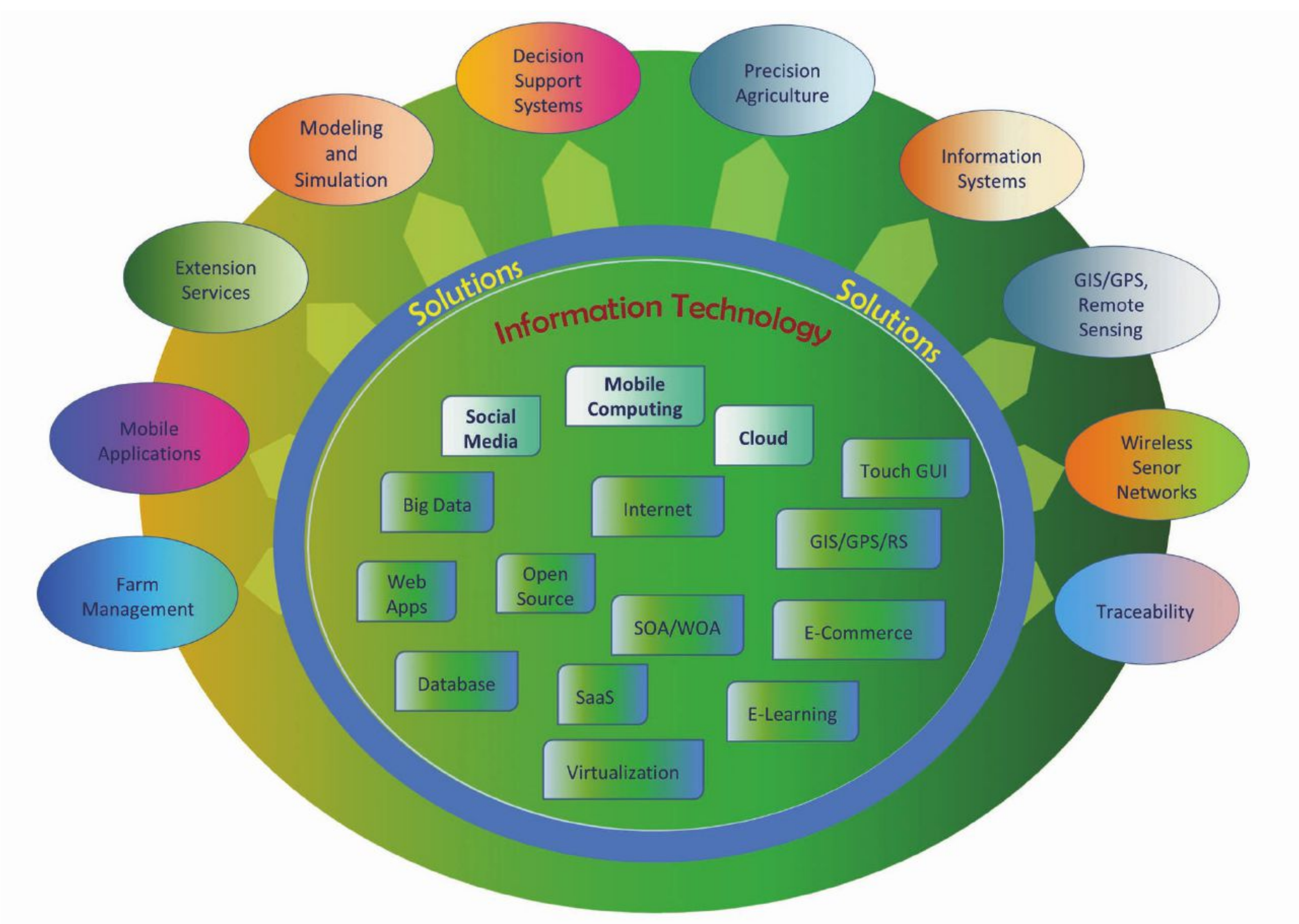
Jiannong Xin

Information technology (IT) has impacted our lives in many ways. Today's IT is no longer just about hardware or software; it's about finding new efficiencies and innovative ways of doing things that align with the mission of an organization. IT holds promise for expanding markets, increasing global integration, improving Extension services, and increasing productivity in all phases of agriculture.

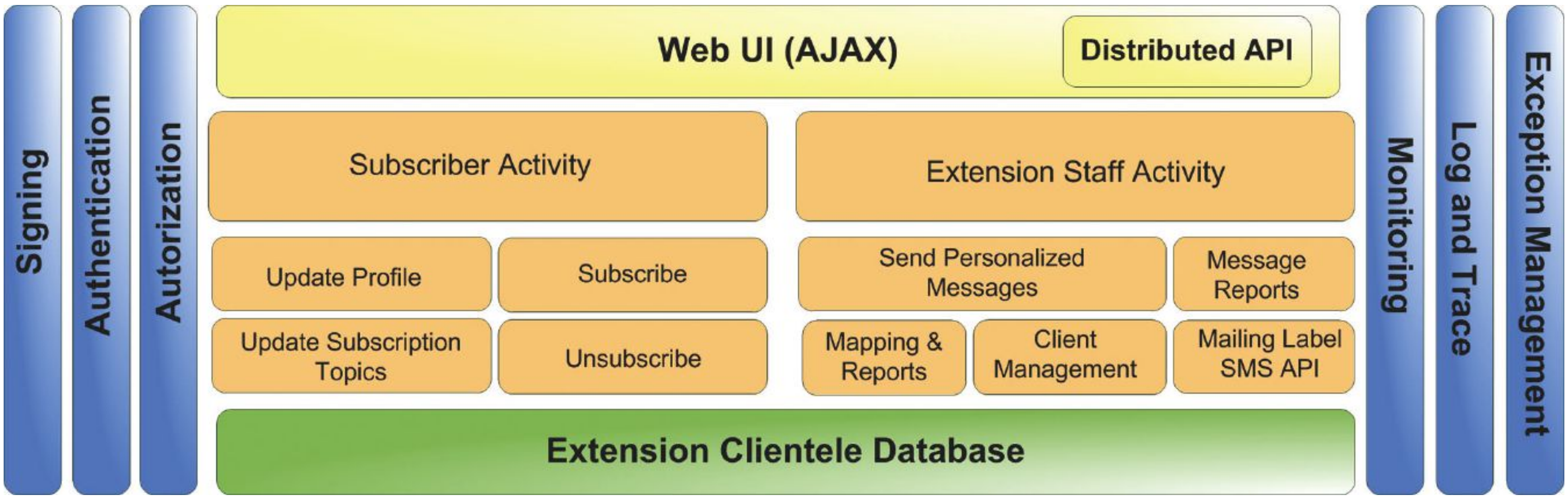
In Cooperative Extension, IT has fundamentally transformed the way we communicate, engage clientele, and deliver information to much broader audiences. This article briefly describes a few applications, developed at the University of Florida/Institute of Food and Agricultural Sciences (UF/IFAS), to illustrate the impact of IT in Cooperative Extension.

Hitting the bull's eye

Engaging and effective communication with Extension clientele is vital in the age of information overload. The real challenge, rather than blindly broadcasting information, is to deliver personalized, relevant, and up-to-date information to target audiences. The Subscription Management System (SMS) developed at UF/IFAS is a distributed subscription



Highlights of IT and its application domains in Extension.

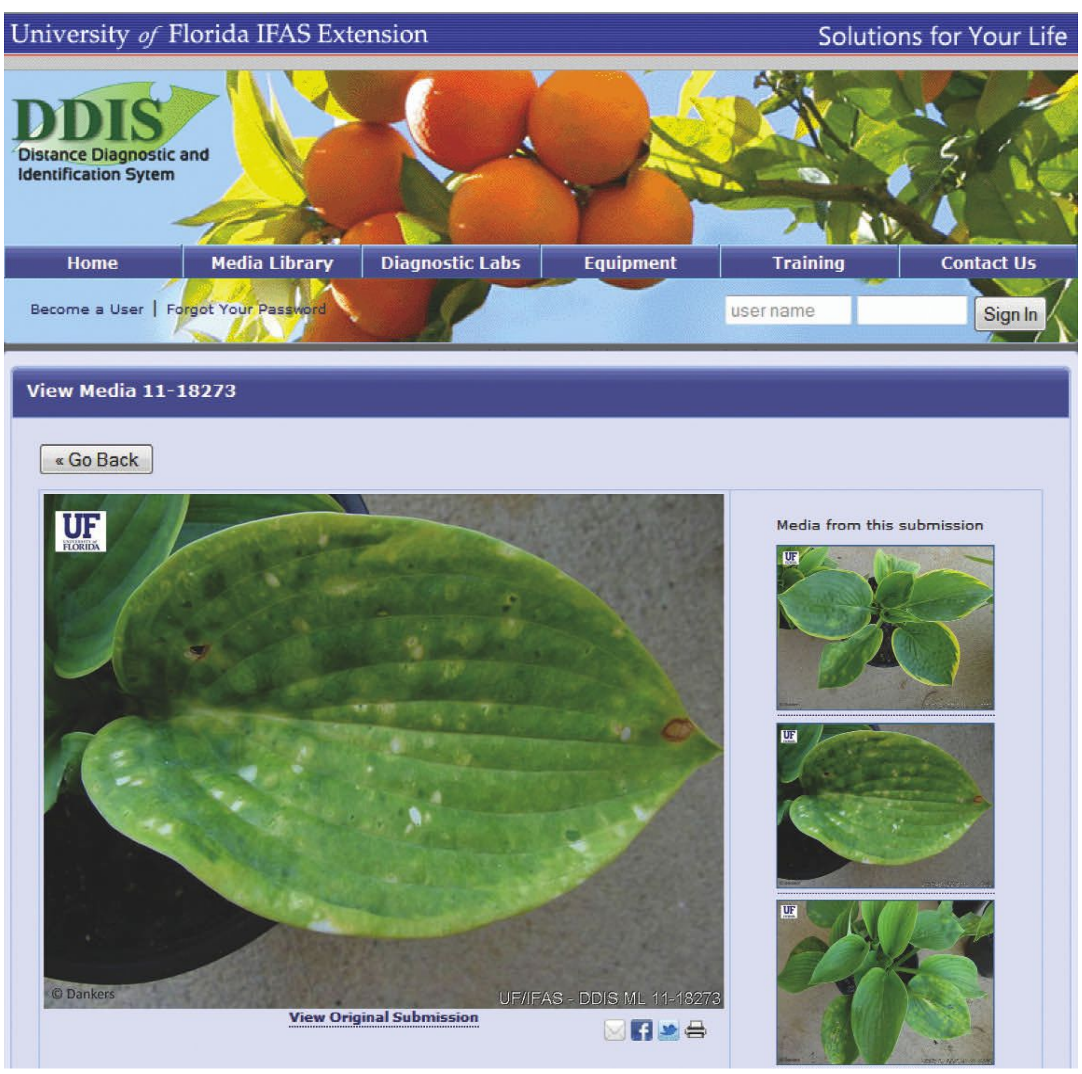


Structure of the UF/IFAS Subscription Management System.

and Extension clientele management system. This centralized system contains information about Extension program areas, newsletters, and clientele profiles. Extension agents can communicate with their clientele with personalized and relevant information tailored to a group of clients who are interested in publications, announcements, upcoming events, or pest outbreaks. The system provides Extension faculty with reports on clientele activities and their profiles to better understand their interests and to improve the delivery of Extension programs. As a result, the system has enhanced our ability to serve our clientele.

Connect, communicate, and collaborate

Early detection and accurate diagnosis of a pest problem is crucial for determining appropriate management options. The Distance Diagnostic and Identification System (DDIS) allows growers, Master Gardeners, Extension agents, and specialists at UF/IFAS and other locations to collaborate on the diagnosis of infestations, diseases, and other agricultural problems. The ability to quickly connect, communicate, collaborate, and address pest problems and to network with regional and national plant diagnostic systems can avoid potentially huge economic losses due to pests and mismanagement.



A screenshot of the DDIS website.

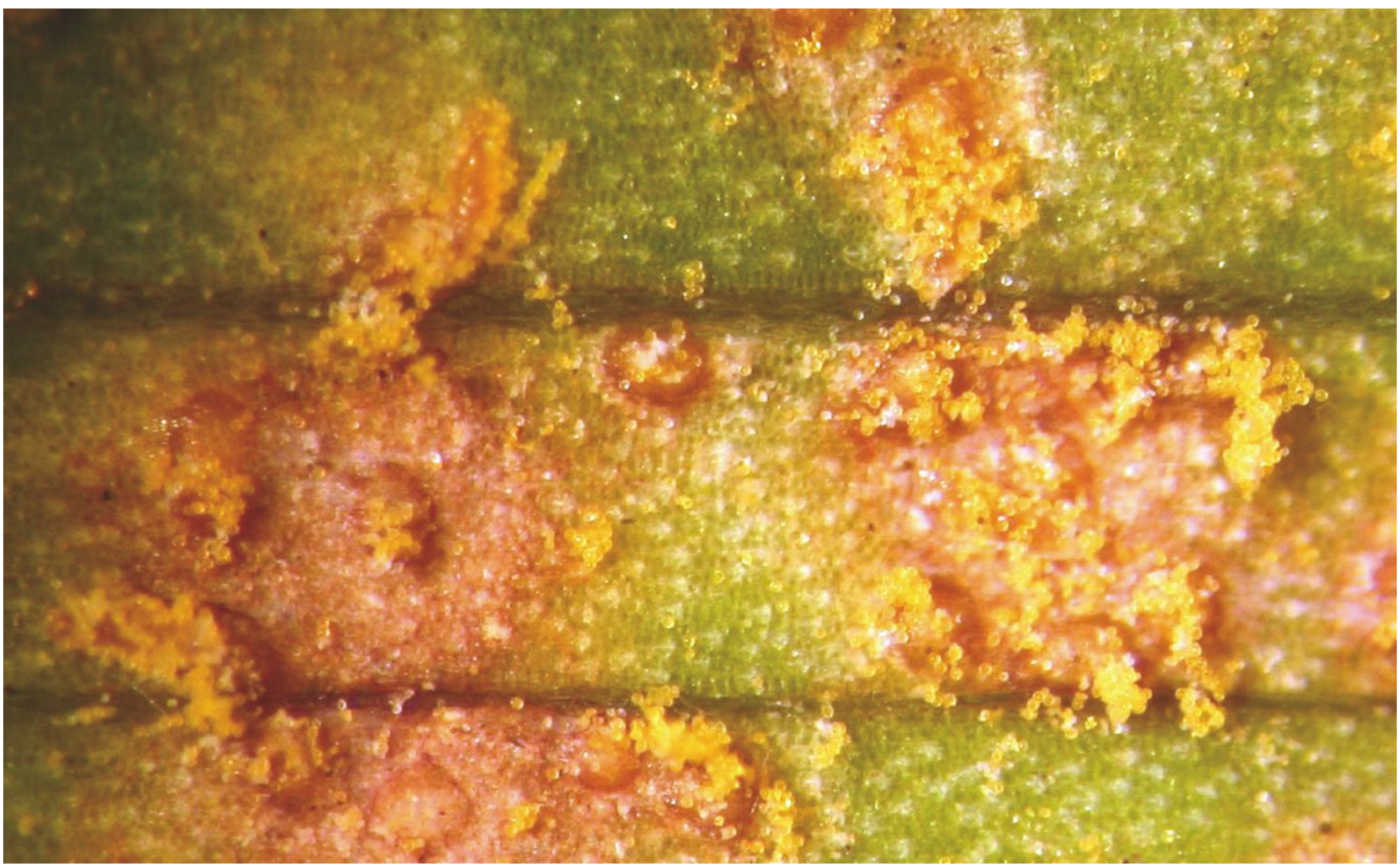
Information and tools for emergencies

The Florida State Agricultural Emergency Response System (SART) is another example of using IT for facilitating communication, locating county emergency resources, and dynamically mapping a disaster area to support emergency response during a disaster. With the readily available emergency resource information and data visualization tools, the system provides an effective collaboration environment for multiple agencies to coordinate emergency response activities.

All photos on this page and the following are from the collections of the DDIS media library, courtesy of the University of Florida, showing confirmed diagnosis and are used as reference for diagnosis. Above, anthracnose fruit rot (*Colletotrichum*). *Photo credit: Hank Dankers.*

Right, tomato blossom-end rot. *Photo credit: Eva Pabon.*

Below, daylily rust (*Puccinia hemerocallidis*). *Photo credit: Carrie Harmon.*



Tools at your fingertips

Dissemination of scientific knowledge to clientele is an essential component of Extension services. EDIS, an Extension publication system at UF/IFAS, provides a wide range of information at users' fingertips. The Florida Automated Weather Network delivers not only critical information for citrus cold protection but also farm management tools, which could help growers make informed management decisions. Additionally, our e-Learning environments provide Extension clientele with solutions for continuing their education, earning certifications, and obtaining pesticide licenses. As the staggering growth in mobile and social media usage continues, we are moving toward mobile webs or apps for pest diagnosis and other topic areas to meet the demands of users.

Tomato yellow leaf curl virus (TYLCV). ***Photo credit: Hank Dankers.***

Value-added technology

These are only a few examples of IT applications addressing the needs of Cooperative Extension. The value of IT in Extension is not only improving our ability to do what we can do better and more efficiently, but more importantly, it allows us to do things we couldn't do without the technology. To fully leverage IT, we should see it as a strategic partner instead of a mere support. As we move forward, we will experience increasing mobile usage, cloud-based applications, and rapid adoption of social media. As a result, we are seeing a shift of delivery platforms, communication, and collaboration channels. Advances in IT are constantly challenging us to rethink how to embrace the technology to achieve our mission. After all, it's not about the technology; it's about creating value with the technology. It's up to us to come up with new ideas and innovative solutions that leverage the potential of IT for the benefit of Cooperative Extension.

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Striped mealybugs. ***Photo credit: Lyle Russ.***

A digital sample of citrus mealybug (*Planococcus citri*) on foxglove. ***Photo credit: Theresa Friday.***

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Mechanization and Automation Technologies in Specialty Crop Production

Manoj Karkee and Qin Zhang

Agriculture has seen its most dramatic advancements in the past century. Recognizing the transformation, agricultural mechanization was ranked as one of the greatest engineering achievements of the 20th century by the National Academy of Engineering. However, specialty crops such as fruits and vegetables have not yet benefited fully from many of the technologies that have been successful in row crops. In this article, we discuss the current status, future possibilities, and potential implications of specialty crop mechanization and automation.

Current status

Mechanization and automation can play a crucial role in enhancing crop production and reducing labor demand. These technologies have been used in specialty crop production as well, although only to a relatively limited extent. Crop monitoring is one of the areas where non-contact sensors are used to reduce labor and provide nearly real-time information for effective pest management. Precision and variable-rate chemical application is another area where sensor and automation technologies have been helping production. GPS-based guidance has also been effective in land preparation and planting.

Some mass mechanization technologies are also available in specialty crop production. Hedging and topping of fruit trees is one example. Non-selective blossom thinning machines for tree fruit are also commercially available. However, these non-selective machines may not always achieve the desired results. Shake and catch mechanisms are widely used in harvesting berry crops, although fruit loss is still an issue. This technology has also been used to some extent in cherries, apples, and oranges destined for processing markets.

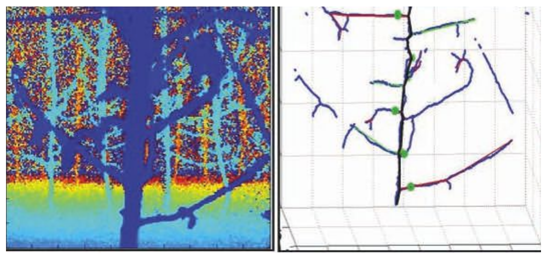
Unbounded possibilities

Even though there have been some successes in mechanization, specialty crop production still remains highly labor intensive. Labor availability is uncertain at best, and labor

Co-author Karkee stands amidst hyperspectral and 3D cameras scanning apple trees in a mechanization-friendly tall-spindle orchard. ***Photo courtesy of Allan Bros., Inc., Prosser, Wash., USA.***

costs have been steadily increasing. On top of the labor issues are more stringent regulations for quality and safety that reinforce the need for more automated production. Looking ahead, if no new mechanization and automation solutions are developed in the next five to ten years, the specialty crop industry could suffer greatly.

There are particular challenges for successfully applying mechanization and automation technologies in specialty crops, including complex plant structures, inconsistency in product shape and size, the delicacy of the products, and smaller economies of scale. But there are opportunities, too. New mechanization-friendly orchard architectures are opening up possibilities for automation. For example, the SNAP architecture (Simple, Narrow, Accessible, and Productive) represents these types of training systems that create very narrow two-dimensional canopies in which the majority of branches and fruits are visible and accessible to machines. Additionally, the availability of low-cost computational power, recent advancements in robotics, and new sensor technologies show good promise in automating specialty crop production operations.



Left: depth image of apple trees created by a 3D camera; right: automatically identified pruning points (green circles) for robotic pruning.

In addition, cross-disciplinary research efforts are in place across the country, ranging from consumer studies to horticultural system modification to developing advanced mechanization and automation systems. These ongoing efforts include automatic weeding in vegetable crops, mechanical fruit harvesting, mechanical blossom thinning, and auto-guidance in orchards. At the Washington State University Center for Precision and Automated Agricultural Systems (CPAAS), we are working on a variety of sensing and automation technologies.

For example, an intelligent bin dog for orchard application is under development. This utility vehicle will carry fruit bins, automatically unload full bins, and load empty bins as needed. The goal is that the bin dog will be capable of locating and following workers using proximity sensors so that workers don't have to walk to bins during harvesting.

Another project involves the development of a machine vision system and a rule-based decision making system for robotic pruning of apple trees. First, a sequence of images of tall-spindle apple trees was captured using a time-of-flight-of-light-based 3D camera. Then background and noise were filtered, followed by image skeletonization and tree reconstruction. Meantime, we studied pruning practices of experienced workers and learned about pruning strategies being used in tall-spindle apple orchards from growers and horticulturists. Based on these studies, pruning rules were developed that maintained specified distances between branches and branch lengths. These rules were then used to identify and locate branches that needed to be pruned. The results closely matched with the pruning results of experienced workers. The next step in this work is to develop an end effector and an arm for robotic pruning.

Other specialty crop mechanization and automation projects that CPAAS is conducting include sensor-based decision making, robotic hop twining, robotic apple harvesting, and a fixed system for chemical application systems for orchards. These integrated efforts of biological scientists, engineers, economists, and extension educators across the United States have potential to increase the robustness, decrease the cost, and increase the adoption rate of new technologies.

What does it mean?

Specialty crop production is not just labor-intensive; it is laborious. Few people will work on these farms when there are employment alternatives. The industry has already been hit by severe labor shortages in recent years. Both industry and government have realized that focused efforts are needed to develop new mechanization and automation technologies to deal with the serious issues facing specialty crop production, and agriculture in general. If these efforts continue, highly automated specialty crop production can become a reality.

What are the implications when that day comes? First, labor demand will be dramatically reduced and labor safety will be ensured, leading to a more competitive and sustainable industry. It is also anticipated that some consolidation of small farms will occur to justify the investment in automation. Therefore, some growers may be displaced. However, if no labor-saving technologies are developed, even more growers may have to abandon specialty crop farming in the future.

Finally, while automated farming will support fewer jobs, it will develop more skilled jobs that will pay a living wage all year long. No seasonal labor will be needed, and therefore there will be no seasonal towns, as we see in specialty crop production regions today: towns that barely survive when there are crops to be harvested and that vanish when the crops are gone. Instead, there will be more healthy, sustainable communities with year around residents.

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The ADM Institute for the Prevention of Postharvest Loss

Steven T. Sonka

In January 2011, the Archer Daniels Midland Company (ADM) presented the University of Illinois at Urbana-Champaign with a gift commitment of $10 million dollars ($2 million per year over five years) to establish the ADM Institute for the Prevention of Postharvest Loss. This collaborative effort is focused on reducing post-harvest losses of cereals and oilseeds in developing countries.

Why post-harvest loss?

Postharvest loss (PHL) refers to crops and products wasted after harvest, particularly during the handling, storage, transportation, and processing stages. In practice, losses during harvest also are relevant, as harvest activities can be tightly interwoven with losses in later stages of the food chain. PHL can be caused by wrongly timed harvests, extreme temperatures, drought, micro-organism and other contamination, spillage, and physical damage.

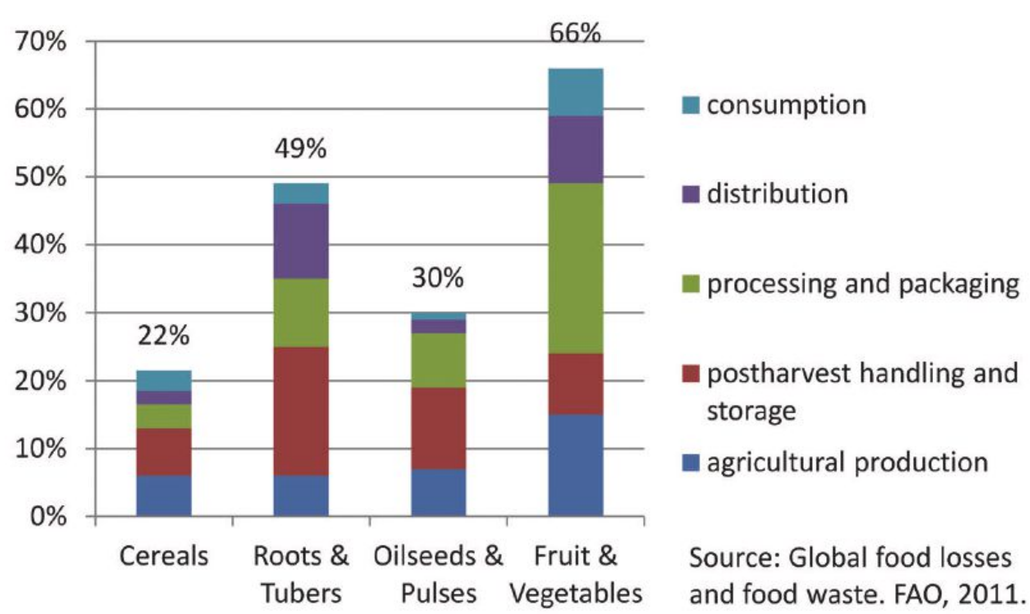
A commonly cited statistic is that, in total, about one-third of agricultural production is wasted and doesn't reach the food consumer. More detailed estimates of loss are shown in the accompanying graph. As indicated there, perishables suffer the most extensive losses. However, significant losses occur across commodity types.

In the past few years, post-harvest losses have become a topic of interest in the news, as international organizations such as the World Bank and the FAO have published influential papers and reports detailing the extent and causes of loss. PHL takes on even more importance because of its links to societal concerns regarding food security, sustainability, and poverty.

As the world's population advances toward nine billion by 2050, the global agriculture system must meet the food demands of that growing population. Many expect that crop production will need to double in the next 40 years. However, arable land, water, and energy are in limited supply. To lessen pressure on scarce resources, we must learn to do more with less.

Reducing PHL is expected to be an efficient means to respond to the increasing need for food. Less waste effectively extends scarce land and water resources. Investment required to reduce PHL could be modest, and technology

Postharvest losses estimate in South & Southeast Asia



Source: Global food losses and food waste. FAO, 2011.

advances could make reduction more feasible and less expensive. However, lack of awareness regarding the potential benefits of reducing PHL has historically hampered progress.

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The ADM Institute

To address these global concerns, the ADM Institute seeks first to serve as an international information and technology hub for evaluating, creating, and disseminating economically viable technologies, practices, and systems that reduce post-harvest loss in staple crops such as rice, corn, wheat, and oilseeds. The ADM Institute is research driven, and its resources are primarily focused on innovation and application of knowledge so as to reduce PHL in developing agriculture. In addition, the institute strives to heighten the understanding of this issue through sponsorship of conferences, support of undergraduate experiential learning, publications, and presentations, as well as by engaging the public through the institute's website and social media outlets.

Providing leadership and guidance for the institute are an external advisory board and its steering committee. The external advisory board is comprised of distinguished leaders from around the world and provides strategic guidance to the institute. The steering committee oversees the activities of the institute. Five University of Illinois faculty members and one representative from ADM serve on that body. I serve as director.

A research focus

During 2011, the ADM Institute allocated $2.5 million in funding for research projects, particularly focused on PHL in India and Brazil. More than 20 Illinois faculty members from four different colleges are engaged in this research. These faculty members are linked to a growing network of collaborators in developing nations. Not unexpectedly, the agricultural engineering faculty provide essential research and organizational leadership. The ADM Institute's research and development activities focus on the following four themes:

- Measurement and technology development efforts that strive to determine methods to better assess the extent of loss and create specific innovations that, if successful, can effectively reduce postharvest loss.
- Systems informatics and analysis investigations that focus on data organization, quantitative modeling, and results delivery, particularly at the supply chain and food system level.
- Policy analysis initiatives that concentrate on the effects of existing public and private sector policies and evaluation of potential enhancements.
- Education, training, and information transfer activities that serve to transfer knowledge and implement tools to enhance the performance of farmers and supply chain participants.

Raising awareness

Although post-harvest loss is not a new topic, analysis has shown that PHL reduction is under-publicized relative to its potential to contribute to societal goals. One responsibility of the institute is to increase awareness of the extent of PHL and, more importantly, the opportunities associated with reducing PHL. To address this need, the ADM Institute has adopted an ambitious agenda to provide leadership at significant conferences, sponsor key events, and disseminate findings through electronic and other media.

For example, the institute was a co-sponsor of the Indian Society of Agricultural Engineers' Annual Convention in February 2012. In March of that year, the institute supported an experiential learning program for undergraduates to examine agriculture and post-harvest loss in India.

Each year, the institute publishes several reports to document institute activities, future plans, trips, and publications. "PHL in the News," a weekly e-letter published by the institute, compiles recent news about PHL issues, projects, and opportunities. Additionally, representatives of the ADM Institute provide presentations at conferences around the world to better collaborate with entities involved in related areas of work. In addition to the recent convention in India, early 2012 keynote presentation venues included the 22nd International Food and Agribusiness Management Association World Forum and Symposium in Shanghai, China, and the XLI Congresso Brasileiro de Engenharia Agrícola in Londrina, Brazil.

Additional information on the activities and goals of the ADM Institute for the Prevention of Postharvest Loss can be found on the institute's website at http://postharvestinstitute.illinois.edu. For further inquiries, the ADM Institute can be reached by phone at 217-333-5115 or by e-mail at postharvestinstitute@illinois.edu.

To keep informed on the state of post-harvest losses around the world, subscribe to the institute's "PHL In the New" weekly newsletter at http://illinois.edu/gm/subscribe/6325.

Steve Sonka is the director, ADM Institute for the Prevention of Postharvest Loss, and Professor Emeritus of Agricultural Strategy, University of Illinois, Urbana-Champaign, USA (ssonka@illinois.edu).

The 10,000 Challenge

Can engineering schools answer the White House call for more engineers? Should they try? It depends on whom you ask.

Thomas K. Grose

For years, U.S. industry has repeated the mantra "We need more engineers." Now the White House is listening, with the President's Council on Jobs and Competitiveness declaring a national goal of graduating 10,000 more engineers a year—a jump of 14 percent from the 72,300 engineering bachelor's degrees awarded last year. To help the process along, companies have pledged to hire 7,000 more interns, and the Council has promised further, as yet unspecified, initiatives. But the Obama administration's challenge has thrown into sharp relief several pressing problems in engineering education: declining state support for public institutions, necessitating tuition hikes; a stagnant graduation rate relative to other academic majors; and poor retention.

To the question, do engineering schools have the needed capacity, the answer from many deans is yes—but the trend is not universal. "That is a very doable goal," says Feniosky Peña-Mora, engineering dean at Columbia University. Indeed, many are already doing so. Michigan Technological University plans to increase its graduation rate by around 15 percent by 2020. Cammy Abernathy, dean of the College of Engineering at the University of Florida, has seen enrollment there shoot up nearly 20 percent over the past five years to 5,500 and says, "We simply cannot graduate enough students to satisfy employers." Iowa State University says it's on track to increase graduate numbers by around 14 percent. A number of private engineering schools are also in growth mode. Yet Gary S. May, dean of the College of Engineering at Georgia Tech, says, "We are pretty close to full capacity," and with no additional state funds in the pipeline, expansion isn't in the cards.

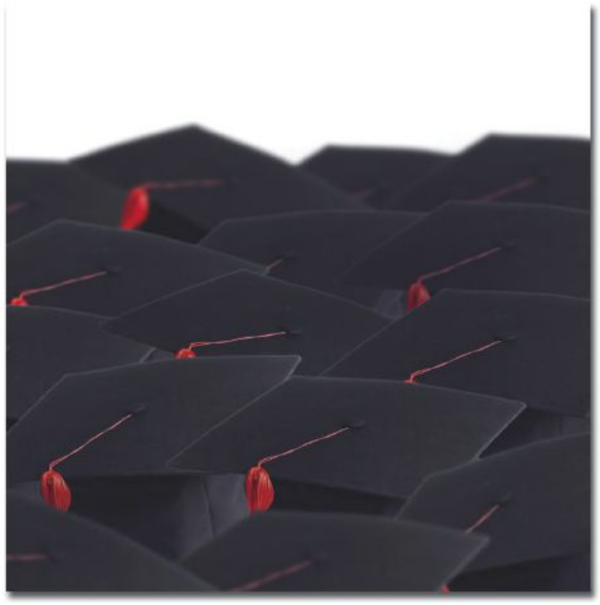
Not everyone is convinced that the White House goal is either reachable anytime soon or even desirable. C. Daniel Mote Jr., a mechanical engineering professor who was the long-time president of the University of Maryland, says that state schools will be hard-pressed to graduate that many additional engineers, especially given budget constraints. "There could be a real capacity problem," he explains, with some schools forced to overcrowd their classrooms, rely too heavily on adjunct and temporary faculty, and schedule Saturday classes. Mote is not surprised that most engineering deans welcome the White House plan and are keen to expand their programs. But he claims the surge isn't necessary. Currently, the nation has about 1.9 million engineers. Over the decades, American schools have typically graduated about as many engineers as industry needed, he says, and that's still largely true, except in a few narrow areas—the petroleum and cybersecurity industries, for example.

Increasing the supply of engineers won't create more jobs, Mote says, and it actually risks dampening demand and depressing salaries. "My heart says there should be more engineers, but I don't see that demand at the moment." He does not dispute that employers are snapping up recent graduates but says that's not proof of a supply shortage. The "young ones" are relatively cheap hires and have up-to-date skills. "Industry does not want to retrain employees," he says. If he's correct, the case for more engineers may lie less in the current state of the workforce—with the economy still in recovery—than in what National Academy of Engineering President Charles Vest anticipates will be a "wave of retirements in the coming years" as the baby boom generation ages.

The impact of tight budgets

The burden of increasing capacity will fall largely on public universities. Why? Around 36 percent of the nation's 641 institutions offering ABET-accredited engineering programs are private, but they account for slightly fewer than 20 percent of total graduates. "The bulk of America's engineers are produced at public universities," Abernathy says, and that's not going to change. That fact also exposes the complicated economics faced by public and land-grant universities. Budget-constrained state legislatures have been slashing higher-education funding. Leonard Bohmann, associate dean at Michigan Tech, estimates that most public schools now get less than 30 percent of their revenues from states. Accordingly, tuition increases have become de rigueur at many schools. "Public schools are becoming increasingly like private universities. That is just the reality," says Jonathan Wickert, Iowa State's engineering dean. For some, this is an incentive to increase enrollment. "The more students we have, the more money we have," Bohmann says. Iowa State's budget system likewise rewards growth. The engineering school's financial resources have expanded as its enrollment has increased. It is even adding 17 new faculty members this year.

In Iowa and some other states, the budget gods have tended to smile on engineering, relatively speaking. While Iowa State's appropriations have nosedived 25 percent over the past three years, lawmakers found $74 million to fund a new engineering building complex. And although Michigan Tech also plans to add faculty in coming years, Bohmann argues that additional teachers are not necessary nationally to reach Obama's goal. He estimates the current national BS degree to teacher ratio at around 2.75 percent; an additional 10,000 students could nudge it up to 3.1 percent, an average he calls "reasonable."



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While their numbers won't make a big dent in the national total, engineering deans at a number of private universities say they, too, are expanding operations. Since elite schools are reluctant to dilute their student bodies by adding many more students, this means drawing a bigger proportion to engineering. At Harvard, Dean Cherry Murray says her goal is to enroll 15 percent of the Harvard student body, which would more than double enrollment to around 1,000. Yale graduates around 70 engineers a year, and Dean T. Kyle Vanderlick says, "We could easily grow to 120 or 140, and it would still be an intimate setting." Columbia graduates around 400 engineering students a year, and Peña-Mora says it could boost that number by around 14 percent. At Princeton, engineering enrollment has climbed 20 percent in five years; this year's freshman class numbers a record 330, outpacing overall student enrollment growth. Princeton's undergraduate population, now 5,149, "grew by 10 percent over the last five years," explains H. Vincent Poor, engineering dean. "It's not going to grow again."

Retention: "Low-hanging fruit"

Attracting, and keeping, a bigger proportion of incoming students requires a reversal of more than two decades' graduation trends. The high-water mark in engineering education was 1985, when 77,572 undergraduate degrees were awarded, or 7.8 percent of the total number of bachelor's degrees conferred that year. A lengthy decline followed. While the numbers have ticked upward in recent years, engineering's share of the total number of degrees awarded has fallen to about 4 percent.

Deans at public and private schools agree that better retention would be the quickest, most economical way to increase graduate numbers. Georgia Tech's Gary May calls it "low-hanging fruit." A 2007 report in *Science* found that the average retention rate at U.S. engineering schools was just 56 percent, and at some schools it was as low as 30 percent. Few students drop out because they can't do the work, Florida's Abernathy says. "They are just not enamored with the first-year courses." So the notion is: fix that curricular defect, lose fewer students, and increase graduates.

Some deans sound confident this will happen. "There is a revolution going on in engineering teaching," Harvard's Murray says, one that should eventually improve retention rates. "It's one way to address the question of creating more engineering graduates without a huge amount of additional resources." For example, more schools are embracing active-learning techniques and entrepreneurship, and giving first- and second-year students hands-on projects that can include some engineering design to help keep them interested and staying put.

But tighter budgets can hamstring retention efforts. "We have not had the resources to scale up the successful pilot programs that we believe would have the biggest impact," says Abernathy. For instance, Florida cut a pilot scheme that placed engineering teaching assistants into freshman chemistry courses to help students see how they would eventually use what they were learning. Moreover, the reality is that, for several years now, many schools have tried hard to improve their retention rates with little to show for their efforts. In fact, Maryland's Mote argues that reducing student attrition won't increase graduation levels. Typically, public schools accept fairly large numbers of transfer students from community colleges to replace the freshmen and sophomores who drop out. If retention improves, there will be fewer places for transfer students, he says. "So, the overall numbers would not change much."

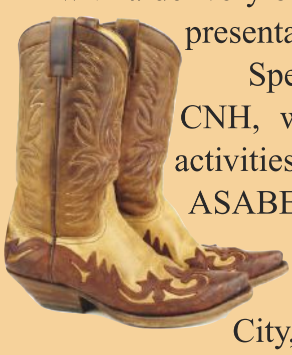
Clearly, many engineering deans and educators believe that the Obama administration's goal is necessary and reachable. But Mote, for one, hopes that the effort evolves at a leisurely pace. He would prefer to see degree numbers increase by only a few percentage points at a time, to see if the market accepts the new additions. "If we are going to try to do this, I'd do it slowly, in increments." Given austerity budgets and hard-to-change attrition levels, that may be the only way it's going to happen.

Thomas K. Grose, based in London, is chief correspondent for *Prism*, the magazine of the American Society of Engineering Education. This article originally appeared in the February 2012 issue and has been reprinted with permission.

Texas at the tail end of July was hot—and not just as registered by an outdoor thermometer. With 1,500 attendees, the 2012 ASABE Annual International Meeting in Dallas was one of the most well-attended in recent history, drawing guests from 29 countries and a high numbers of students as well.

The sprawling Hilton Anatole, with its lofty atrium and stunning collection of Asian artwork and artifacts, provided a satisfying cool serenity to four heady days of technical sessions; numerous educational, recognition, social, and networking events; and a full complement of committee meetings.

One of the highlights of this year's meeting was the well-received keynote address by Nestlé's Ramana Sundara, whose presentation on the company's research and development operations was capped off with a delivery of crowd-pleasing, Skinny Cow-brand treats. Sundara's presentation is available for review at www.asabe.org,



Special appreciation is extended to meeting sponsor CNH, which generously supports Foundation and student activities. Its strong presence is a valuable addition to the ASABE Annual International Meeting.

Mark your calendar now for next year's ASABE Annual International Meeting, July 21-24, in Kansas City, Mo. It promises to be a memory-maker as well.

The 2012 Robotics Competition required the design of an automated machine to deposit "feed" into a series of bins.

2012-2013 ASABE President Tony Kajewski acknowledged his predecessor, Sonia Maassel Jacobsen, the first woman to be elected president of the Society. Kajewski noted that historians would do well to credit Jacobsen for her vision and achievements as president.

The YPC Fun Run included a choice of a boot-camp-style course that combined running with calisthenics.

Fun with the sprayer hose was optional at the 2012 Fountain Wars competition, where students worked in afternoon heat that exceeded 100 degrees.

At the welcome reception, 2011-2012 ASABE President Sonia Maassel Jacobsen (center) visits with an attendee. Behind her, FFA Director of Individual Giving Ryan Gallagher (left) converses with ASABE Executive Director Darrin Drollinger and ASABE President-Elect Designate Lalit Verma.

Ramana Sundara of Nestlé Corporation provided the keynote address. Nestlé's 8,000 brands form the foundation of a company that works globally to bring value to customers and agricultural producers.

The International Breakfast provided opportunities to make new acquaintances and business contacts.

Black hat or white? The YPC-sponsored an "All-in-Good-Fun" contest that ventured into the wild, wild west, making Nerf-gun adversaries out of such sharpshooters as Joe Luck (left), Alex Thomasson (center), Kent Thoreson (dark shorts), and Darrin Drollinger (right).

Attendees peruse the poster session.

IMAGES of AGRICULTURAL and BIOLOGICAL ENGINEERING

VISUAL CHALLENGE 2

Engineers are proficient in science and technology – and are good communicators as well. In fact, engineers have a unique responsibility to communicate technical concepts to a larger audience. Though traditionally done with words and numbers, ***Resource*** asked readers to communicate in images.

To call attention to and celebrate the visual aspects of agricultural and biological engineering, we are delighted to present these selected entries received for our Agricultural and Biological Engineering Visual Challenge 2.

The beauty and meaning of one's work, research developments, and your Society's divisions come to life on these pages, showing those outside the ABE field: *This is what we do."* Acknowledging that the selection process was inevitably subjective, the ***Resource*** staff is confident that these photos provide a glimpse into the vast variety of activities, work places, and surprises an ag and bio engineering career can offer. Thank you to all respondents in our quest for ag and bio art. We look forward to showcasing entries again in Visual Challenge 3.

Submitted by:
Gary Feyereisen
Research Agricultural Engineer, USDA-ARS Soil and Water Management Research Unit, St. Paul, Minnesota, USA

"Surveying Ghana"

Photographed by Pete Maskal

Traveling with Engineering Ministries International, a group of eight engineers designed a reservoir to provide municipal and irrigation water for three villages in the Volta region. Project intern Carl Tompson (now eMi's Director of the Intern Program) surveys watershed boundaries and reservoir location, foundational to project success.

Photographer:
Benjamin Covington
Graduate Research Assistant, Agricultural and Biosystems Engineering Department, Iowa State University, Ames, USA

Before Storm Duet 1
"Flying Away"

At the end of the day before a storm, a flock takes flight during the wheat harvest in Highwood, Montana.

Photographer: Patrick Ransdell
May 2012 Hydropower Design Team Leader, Department of Civil Engineering, Purdue University, West Lafayette, Indiana, USA

Cameroon Quartet, *clockwise from top left*:

"Momanyi Works on Hydropower Turbine"
Momanyi, a Kenyan technician, works diligently in the small Cameroonian village of Bangang to better understand a new hydropower turbine design proposed by a student-lead team from Purdue University's Global Engineering Program in May 2012.

"Finished Shaft Seal"
A delicately fabricated, oil-impregnated bronze shaft seal, for use on a new hydropower turbine prototype, is held by a student from Purdue University during the trip to Cameroon.

"Student Fabricating a Basic Utility Vehicle"
Chester Magiera, a student in the College of Agriculture at Purdue University, grinds through a piece of angle iron during the fabrication of a basic utility vehicle design in Cameroon.

"Shaft Seal on the Lathe"
An oil-impregnated bronze shaft seal is spun around on the lathing machine during fabrication of a new hydropower turbine prototype design implemented by students from Purdue.

Photographer: Benjamin Covington

Graduate Research Assistant, Agricultural and Biosystems Engineering Department, Iowa State University, Ames, USA

Before the Storm Duet 2 "Blowing in the Wind"

Ripe fields during the wheat harvest in Highwood, Montana.

Photographer: AJ Both

Associate Extension Specialist, BioEnvironmental Engineering, Department of Environmental Sciences, Rutgers University, New Brunswick, New Jersey, USA

"A rose is a rose is a rose ... "

A supplemental lighting system (high pressure sodium lamps) shines over a greenhouse-grown rose crop.

Photographer: Robert "Bobby" Grisso

Professor and Extension Engineer, Biological Systems Engineering, Virginia Tech, Blacksburg, USA

"Energy Crop"

Field chopping of switchgrass, February 2012, near Vonore, Tennessee, creates a cloud of green haze. Operator is John Walton, University of Tennessee extension specialist.

Photographer: Scott Clark

Design Engineer, John Deere Harvester Works, Global Crop Harvesting Product Development Center, East Moline, Illinois, USA

"Do More With Less:
Feeding the World One Kernel at a Time"

Innovative technology and automation makes it possible for agriculturists to get more crop to the table quicker, as shown in this shot taken on the plains of western Kansas harvesting hard red water wheat.

Photographer: Tom Trout

Agricultural Engineer, Research Leader, USDA-ARS Water Management Research Unit, Fort Collins, Colorado, USA

"Taking the Heat"

Due to low moisture and high elevation, the U.S. High Plains commonly experiences wide ranges and extremes in temperature. The draught-tolerant sunflower is an excellent crop option for this area.

Photographer: Freddie Lamm

Research Agricultural Engineer, Kansas State University Northwest Research-Extension Center, Colby, Kansas, USA

"Driptape Job"

With the installation of subsurface driptape, the water is precisely placed in the soil root zone and uniformly distributed across the field to help maximize its productivity. Surface evaporation losses are minimized since the crop and soil surface are not wetted. Although the initial cost of drip systems is high, the resulting water conservation, high yields, and long life can combine to make drip systems a good economic choice.

Lab Trio: Today's Research, Tomorrow's Reality

Photographers: Matthew DiCicco/Suresh Neethirajan

Graduate Student/Assistant Professor,
BioNano Laboratory, University of Guelph, Canada

Top left "Seemingly Spotless Surgical Screw Studied Up-Close"

Stainless steel screw, used in canine orthopedic surgery, at scale 1.5 millimeters.

Illustrator: Mark Fletcher, Concept: Suresh Neethirajan

Undergraduate Student/Assistant Professor,
BioNano Laboratory, University of Guelph, Canada

Top right "Exploring the Great Red Sea"

Computer-assisted illustration of bionanorobots maneuvering through the blood stream in search of tumors.

Tomographers: Anup Suresh/Suresh Neethirajan

Undergraduate Student/Assistant Professor,
BioNano Laboratory, University of Guelph, Canada

Immediate left "3D Grain Kernel"

Real-time three-dimensional visualization of fissures and cracks Inside insect-infested durum wheat kernel using X-ray micro-computed tomography.

Illustrators:

Stephen L. Young

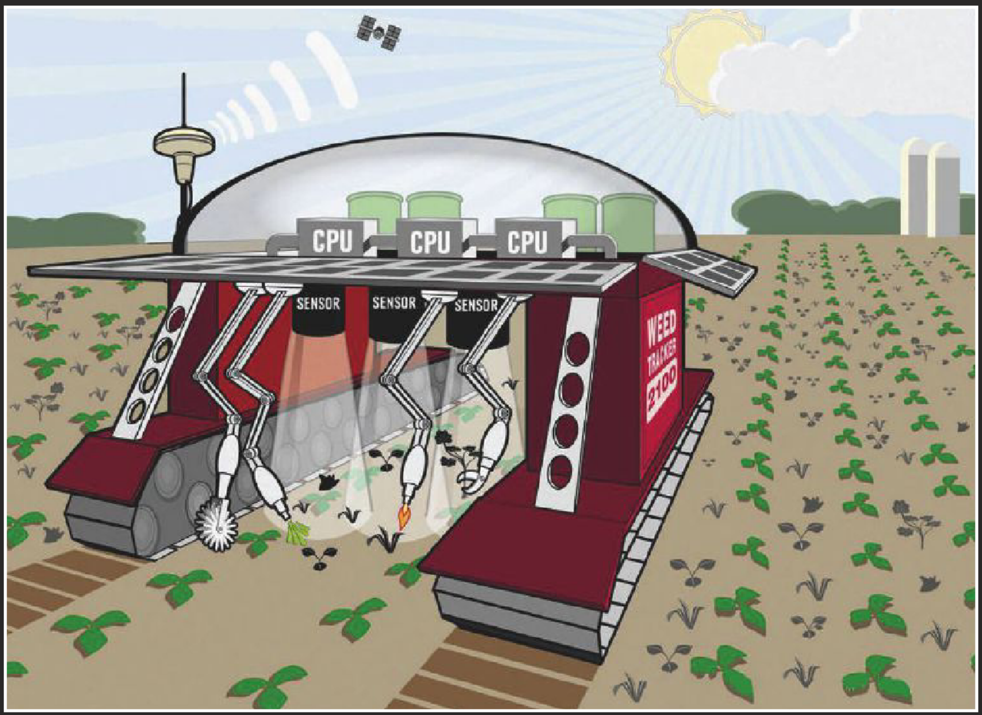
Weed Ecologist, University of Nebraska-Lincoln, North Platte, USA

Michael Heller

Graphic Artist, University of Nebraska-Lincoln, North Platte, USA

"The Future of Weed Control"

Robotic weed control will be an essential element of tomorrow's more targeted, integrated weed management in cropping systems. Researchers at UNL's West Central Research and Extension Center are looking at what these systems would need and how they could integrate the latest technologies in weed identification, biology, engineering, and control into a single platform.



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- Provide mentorship and design guidance to undergraduate extracurricular activities

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- Utilization of bio fuels in off-road vehicles
- Machinery systems in food, fiber and/or bio-based fuel production
- Utilization of hybrid power transmission in off-road vehicles

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Preferred: PhD degree, record of success in securing extramural funding. Eligibility to be licensed as a professional engineer. Knowledge of midwest USA agricultural machinery systems.

Other: If MS degree must be willing to obtain PhD degree in next 5 years

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Application: The application deadline is November 1, 2012 with screening following immediately and continuing until a suitable candidate is found. Submit a letter of application including a statement of teaching, outreach and research philosophy, resume, transcripts, and complete contact information for at least three professional references to: Dr. Joseph P. Harner, Professor and Head, Department of Biological and Agricultural Engineering, Kansas State University, 129 Seaton Hall, Manhattan, KS 66506-2906, Phone: 785-532-5580, Fax: 785-532-5825, Email: jharner@ksu.edu

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Some thoughts on design ...

and on who is responsible for the consequences

As I contemplated the recent passing of an old family friend, I recalled a conversation that he and I had about 20 years ago. I was visiting my home town, and my old friend Frank and I were discussing the "local" baseball team. Frank commented that only three or four of the players actually lived in the district. The rest came from surrounding towns that no longer had teams. Our conversation drifted from baseball to the local ice rink and the difficulty the town was having keeping it open. We agreed that it was a situation that was all too common in the rural areas of western Canada.

And then Frank shocked me by saying, "You realize this is all your fault." My shock must have been obvious because he quickly followed up by noting that by "you" he was referring to the engineering profession, not me personally. We left it there, but his comment kept haunting me.

Two or three years later, on another visit home, Frank and I were sitting in the shade, enjoying some of the end product of the previous year's barley crop, when I reminded him of his earlier comment. I asked him to explain what he meant. He thought a moment and then provided me with his observation of the link between engineering design and fewer prairie baseball teams.

At that time, Frank and his son were farming the land that he and my dad had farmed, plus the land that had supported four other families when I was growing up. They were able to do this because of the improvements in farm equipment that were the direct result of engineering design. Wider, bigger, faster, more efficient equipment let the two of them farm more land with less effort. So, the up side was that they farmed more land but didn't have to work as hard. The down side was that there were four fewer families associated with that particular land base. And the same story could be repeated for every farmer who was still functioning in the district.

Simply put, my home town was now about 33 percent of what it had been: 67 percent fewer ball players, 67 percent fewer students, and 67 percent fewer grocery stores. That explained much of what I saw when I looked around.

Frank acknowledged that engineers had simply responded to a demand for better equipment, and had responded very well. He agreed that this equipment allowed him to survive despite the fact that grain prices were about the same as when I had last helped him harvest. He assigned no fault to the engineering profession, but he saw a clear link between our "success" and rural depopulation.

In the intervening years, Frank and I revisited the issue as we watched the "local" ball team continue to play where I once played. I was never able to advance a plausible argument that de-linked engineering design from rural depopulation, but my discussions with Frank clarified my thinking on the responsibilities that our profession bears for the designs we create. Frank's insight provided me with the understanding necessary to explore Billy Koen's concept of "best change." "Best" depends on the perspective we bring to a question. The new machinery was "best" for Frank and his son. It was not "best" for population retention.

We engineers have the skills required to bring new and better "things" into existence. The world we live in today is the direct result of the successful application of those skills. Electricity, cars, computers, aircraft, artificial hips, skyscrapers, and farm machinery all exist because of engineering design. Our profession has created profound changes, and each change has had both positive and negative impacts. On balance, in my view, the changes have been positive. Others may disagree. However, because the application of our capabilities has allowed these changes to occur, we must accept both the credit and the blame.

Next time you find yourself pushed toward an "expedient" solution, think about the disappearance of the small towns of western Canada. We do have a responsibility. And as for my old friend Frank, not all engineering educators go to university and have numerous degrees.

ASABE Member Ron Britton is a professor, Faculty of Engineering, University of Manitoba, Winnipeg, Canada (Ron.Britton@ad.umanitoba.ca).

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