WHIN

WABASH HEARTLAND
INNOVATION NETWORK

Report to Lilly Endowment

March 2020

Submitted by: Johnny Park, CEO, WHIN

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Message from the Chairman: **Teamwork**

The old expression that time flies runs true to me. One bit of evidence to support the truth of that statement is that this report to Lilly Endowment marks the halfway point of our five-year grant!

Another time-related expression is that time flies when you are having fun. Although we have had a lot of fun along the way, I know that the Wabash Heartland Innovation Network is really excited about the creative and innovative developments, partnerships, and projects that are coming into focus. Seeing the hopes and dreams of so many coming to life, and the excitement in the eyes of those in our communities as they begin to see the possibilities of the impact of the work that we have started, makes the days pass quickly. In a few words, all of those involved in our work, directly or indirectly, are running very hard toward the digital IoT epicenter that we envisioned several years ago.

First and foremost, we must never stop thanking Lilly Endowment for giving us this opportunity. We all hoped that the investment of the Endowment resources would bear the positive fruit of regional development, the creation of regional identity, the acceleration of prosperity, and new opportunity for the citizens of the Wabash Heartland region. We anticipated that the plan of work outlined in the proposal funded by Lilly Endowment would be impactful and lead to the results we anticipated. But, little did we know what the journey would hold and what doors would be opened to us. This was only possible because you challenged us to think outside the box — to dream big. Your gift to us, and the faith and trust you placed in us, allows us to do this work. **Thank you!**

Next, our Board of Directors should, again, be acknowledged. This group has been together since late 2014 as we developed the Wabash Heartland Innovation Network, and this same group has led our growth and development. Because of their guidance, commitment, wisdom, experience, and leadership this organization has a wonderful foundation upon which to grow and impact the future of this region in unimaginable ways.

Thank you to my colleagues, mentors, and friends for all you have selflessly done to advance the Wabash Heartland region!

Next, I want to thank Johnny Park, our CEO, and the wonderful team he has assembled. Their passion, commitment, insight, and experience have taken this project in ways that were unthinkable just a couple of years ago. Charting the course to be the global epicenter of digital agriculture and next generation manufacturing has not been done before, to my knowledge. Cultivating an ecosystem that empowers globally competitive businesses to plant and grow in the Wabash Heartland is not for the faint of heart. It is hard work. This team is talented, focused, and committed to the long-term health and prosperity of the citizens of this ten-county region. This group is fully aware that the Wabash Heartland Region can demonstrate to the state, the nation, and the world how embracing technology can positively impact our collective future. From our cities to our towns and to our rural communities, lives will be impacted and changed by the trajectory of the work we have undertaken.

Finally, I want to acknowledge and thank our partners in this work: Purdue University and Ivy Tech Community College. They have and continue to do all they can to provide their talents, skills, and vast resources to make the WHIN vision achievable. It seems that hundreds of professors, researchers, scientists, and grad and under-grad students are involved in both large and small ways. Thought leaders of both institutions strive to make WHIN what it rightfully should become — an essential partner and collaborator both today and tomorrow. WHIN can and will be an organization that will partner in critical and impactful ways with both institutions far after the plan of work in our proposal has been successfully completed. As we all know, the implementation of the Endowment proposal was only the initial step in realizing our hopes and dreams. The work will continue far into the future and our educational partners have been, and remain, absolutely critical to our success. I want to thank all those in these two great institutions that are contributing to WHIN in ways large and small.

Gary D. Henriott, Chairman

WHIN Overview: **Accelerating on All Fronts**

Over the last six months, WHIN has made not only strides, but leaps and bounds. Halfway through our grant period, we find ourselves with a model, WHIN Alliance, that is field-tested and already accelerating both the widespread adoption of IoT technology in the region and the research that is advancing that technology. WHIN Alliance is also WHIN's route to sustainability.

In particular, WHIN Alliance has allowed us to develop a simple but comprehensive strategic framework. All of our activities are not only true to, but are actually guided by, the fact that WHIN is a 501(c)(3) organization whose purposes are scientific, educational, and charitable. The Alliance is a workhorse that does it all.

To briefly refresh, WHIN Alliance is the engine of a regional ecosystem that includes growers and manufacturers, tech partners, Purdue University, and Ivy Tech Community College.

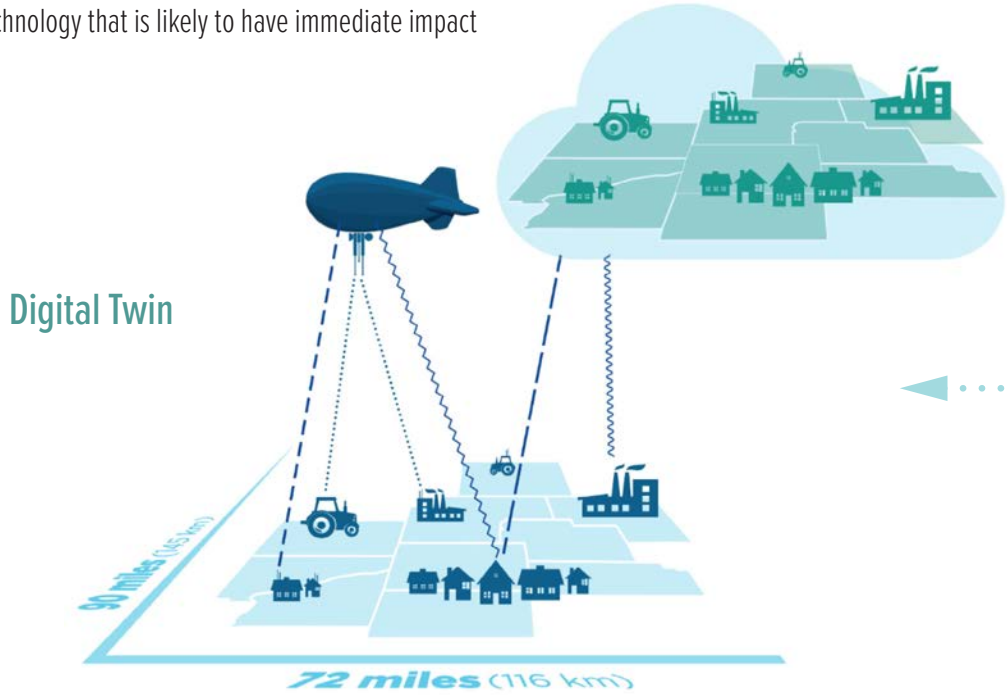
WHIN recruits progressive growers and manufacturers throughout the region who want to adopt IoT, but who need a nudge and some assistance navigating the complex world of IoT technologies.

Alliance members rely on WHIN to vet commercial and near-commercial technology that is likely to have immediate impact on their operations. That technology comes from tech partners identified by WHIN as having robust IoT products that provide networked data — data that can help catch motor failure before it happens, remedy nutrient-deficient soil, keep stored grain cool and dry, organize farm operations according to ideal weather conditions, and provide timely information from planting to harvest about the health of crops.

But most important, that same real data is licensed to WHIN, creating a vast data lake for educators and researchers.

Because the data comes from technology that is replicated throughout the region, the data sets are both real and consistent. WHIN's large and growing array of weather stations helps not only growers, but provides key contextual data for researchers and educators. In fact, the weather stations themselves form one of the densest arrays in the country and WHIN already has a year's worth of data from a region that is on a sensitive climate change boundary.

In short, to borrow a term from manufacturing, WHIN Alliance is creating a digital twin of a 4,321 square mile region, accessible by researchers and educators in agriculture, ag tech, digital manufacturing, IoT, data science, networking, broadband, meteorology, and probably a few areas we haven't thought of yet.



WHIN Overview: **Accelerating on All Fronts** *(Cont'd)*

The financial side of WHIN Alliance is equally remarkable and unique. Growers and manufacturers pay a nominal membership fee. Growers benefit by receiving WHIN-owned weather stations and all members receive deeply discounted starter kits of technology. Tech partners must share in the cost of those discounts. The discount is reduced in the second year, and by the third year, if users are finding value and continue to use the technology, WHIN begins to receive revenue from the tech partners.

The model aligns incentives to encourage active participation by members and delivery of value by tech partners.

WHIN also receives income from fees to license its data for use in research grants. The educational use of WHIN data is licensed for no cost. Overall, the model is expected to sustain basic WHIN operations beginning in 2025.

Of course, our virtual living lab is only possible because growers and manufacturers are willing to be radically repositioned with respect to research. We owe them much for their enthusiastic embrace of WHIN.

One of the ways we ensure members get the most out of their Alliance experience is to provide summits so they can share experiences and learn from each other. We are also ramping up proactive customer service as Alliance membership grows.

An entirely intended consequence of the Alliance model is that member growers and manufacturers have literally signed on to be part of a research team. As WHIN-powered Purdue researchers pursue boots-on-the-ground research opportunities in the region, those growers and manufacturers will be, we believe, more accessible.

In fact, as WHIN originally planned, growers and manufacturers are already benefiting from specific research projects designed to solve problems that commercial technology cannot yet address. Thanks to the many ways Purdue and Ivy Tech are making the WHIN vision real, the region and the IoT industry are moving forward.

And, as the stories in this report also illustrate, WHIN is emerging on the national stage as not only the center of IoT, but as a key player in the very hot topic of rural broadband.

The bottom line is that we think we now know what it might mean, in very concrete terms, to be the global epicenter of digital ag and next-generation manufacturing. It is a great time to be WHIN!

Johnny Park, WHIN CEO

February 2020, Ag Alliance Summit

Leveraging WHIN Resources: **PAWR Up!**

From an early WHIN investment in regional broadband

WHIN became aware early on that it would have to find ways to address rural broadband for the region. WHIN Quality of Place surveys consistently show improved connectivity to be a very high priority for residents. Connectivity for digital ag is a WHIN-powered research interest for Purdue. And as the Alliance model came online, WHIN itself needed affordable connectivity. Broadband is one way to put the I in IoT.

But fiber is not the only way and, in rural areas, broadband will not be achieved by running fiber everywhere underground, or at least not soon enough to conquer the digital divide. And connectivity is necessary for digital ag and manufacturing to move forward as fast as they must. WHIN has become committed to finding more affordable connectivity solutions that utilize a variety of wireless technologies in conjunction with limited fiber backhaul, and take full advantage of available spectrum.

As a first start, a Round 1 RCF grant was awarded to the North Central Indiana Regional Planning Council to identify broadband assets and gaps in the region. The grant led to a very strong partnership with WATCH Communications.

In the 2018 Connect America Fund II auction, WATCH was awarded just over $52 million to expand rural broadband services in Indiana, Illinois, and Ohio. Through the RCF grant, WATCH has been contracted to design a unified network in the ten-county WHIN region. The network would allow access to IoT platforms, high speed Internet, voice, video, and a segmented routed virtual network. WATCH understands the rural landscape and is willing to utilize vertical assets that are already in place, such as grain legs.

The WATCH partnership is a very important asset for WHIN. WATCH is generous with its expertise as well as its network assets and is a very willing collaborator in WHIN broadband projects.

Watch Communications Vertical Asset

the WHIN region is in the running to be the national open research platform for rural broadband

What can you do with a 4,321 square mile IoT network, supported by WATCH and available to find new solutions for rural broadband?

Turn it into an enormous community contribution to leverage a $16 million federal grant. Platforms for Advanced Wireless Research (PAWR) is an NSF- and industry-funded program to facilitate university and industry wireless research in the U.S. Two previous rounds addressed the needs of mid-sized cities. The third and final round is for a research platform for rural broadband. WHIN had been in touch in August, 2019, with U.S. Ignite, the organization sponsoring the research, and knew a Request for Proposal (RFP) would be out in late September. Purdue had the RFP on its radar as well.

But when the time came, the logistics were very complicated. The RFP required a complex relationship among university, community, and industry — with an edge to community. Yet typical applicants for such grants are universities. When the dust settled, Purdue tossed a lateral to the WHIN staff to develop the proposal and be the primary beneficiary of the grant.

The result was an incredible team effort: WHIN designed the plan that would lay the platform network over the Alliance network, and Purdue and the other grant partner, Notre Dame, provided the physics the proposal required. WHIN would operate the platform, Purdue would direct its enabled research, with an assist from Notre Dame. Among many other things, just creating the proposal gave us a glimpse into how WHIN's regional living lab can lead to very creative and powerful collaborations.

There will be only one award, announced in the 3rd quarter of 2020. But our PAWR team found out at the end of February that its project, called Testbed for Open Wireless Experimental Research (TOWER), has been selected for a site visit. We are a finalist. Even as this report is going to press, the team is hard at work preparing for the April 27 site visit.

Alliance Bank

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PO Box 188
Francesville IN 47946
Phone: 219 567 9151
Fax: 219 567 9154

December 5, 2019

Mr. Joe Kochan
Project Director
PAWR Project Office
Washington, D.C.

Dear Mr. Kochan:

On behalf of Alliance Bank, I would like to express our support for the PAWR Round 3 project "Testbed for Open Wireless Experimental Research in Rural Communities," submitted by Purdue University. I understand that the Wabash Heartland Innovation Network (WHIN) is a subcontractor on the proposal.

Alliance Bank has served northeast Indiana for 90 years. Our seven offices are pillars of the communities they serve, investing heavily back into the community. Our 81 employees and board members are rooted in traditional core values and emphasize relationships with our commercial and ag clients.

Access to broadband is crucial for our small deteriorating towns to attract and retain residents and businesses. We are excited about the IoT technologies WHIN can bring to our region, but they are only as good as the connection back to the network and research partners. The availability of broadband in our rural area will determine the success of our communities, and our institution, in years to come.

Alliance Bank supports the project's concept of utilizing WHIN's sensor network to advance rural broadband research. We are pleased to be part of WHIN's living lab and look forward to working with Purdue and WHIN, should this project be awarded.

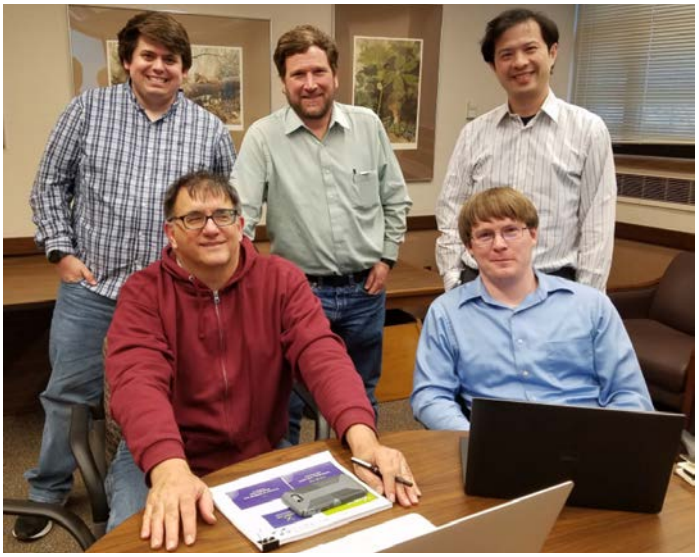
I believe the proposed project is well-conceived and that it takes advantage of the WHIN region's many assets to advance research for a technology that is very important to rural America. I encourage you to give this proposal your careful consideration.

Sincerely,

Shane Pilarski
President/CEO

Francesville Monon Monticello Otterbein Oxford Rensselaer Winamac | myalliancebank.com

One of 46 letters of support that WHIN was able to secure in less than two weeks.



Front row: Prof. Jim Krogmeier and WHIN-sponsored Graduate Researcher Andrew Balmos. ***Back row:*** Prof. Chris Brinton, Jack Stucky (WHIN), and Prof. Chih-Chun Wang.
Not pictured: Prof. David Love, Prof. Nicholas Lineman (Notre Dame), and Johnny Park (WHIN).

WHIN in Digital Ag: **Sow 1, Cow 0**

WHIN-sponsored research is improving conditions in farrow barns

That is one happy sow!

Professor Robert Stwalley and graduate student Tyler Field are making the lives of pig moms a little easier and the business of pork production more profitable.

Sow metabolism has increased up to 80% as a result of selective breeding for higher production. Sows easily overheat, causing stress and a reduction in milk projection, among other problems. Dr. Stwalley and Dr. Alan Schinkel have developed a patent-pending cooling pad that provides welcome relief to sows while allowing farrow barn temperatures to remain in the 90s for the welfare of piglets.

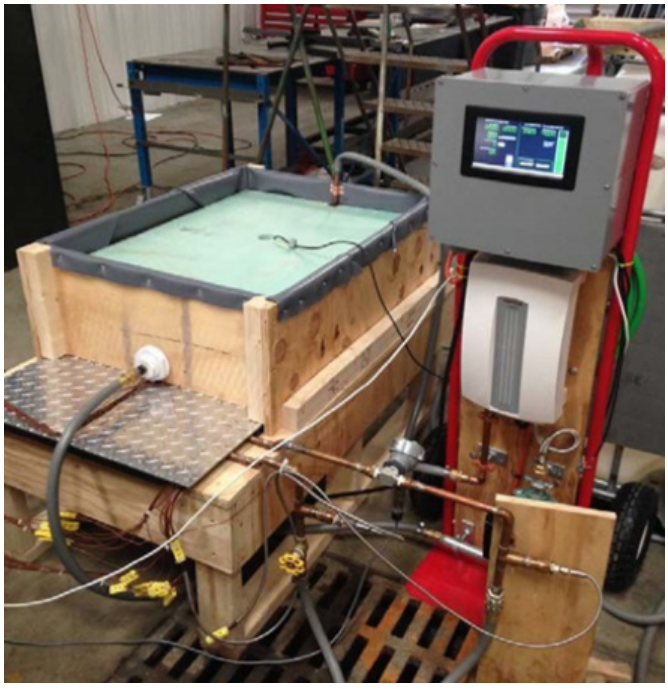
The temperature differential between sow and piglet means barn air-conditioning and similar solutions won't work, even if they were cost effective which they are not. The pads allow moms and piglets to stay together safely and comfortably in individual stalls. For successful commercialization, however, the technology needs to be improved in ways that make it cost effective for pork producers to adopt.

With funding from WHIN, Tyler is working on IoT technology to control the pads automatically, with sensors and a processor that controls coolant flow depending on the needs of the sow. Automation not only ensures sow comfort, it optimizes energy usage and reduces labor costs. Tyler uses data from the stalls to improve the process.

One big problem? Working farrow barns are not only hot, they are humid with the corrosive vapor of urine. Digital technology acts as a magnet for the ammonia in the air and for the dust and dirt of the barn. The sensitive microprocessors and wiring fail in that environment without the casing that Tyler has developed to protect them.

Automating and protecting equipment are but two of the problems to be solved on the way to commercializing the pad technology. Tyler and Dr. Stwalley will eventually add the I to their IoT solution, networking the stalls and connecting them to the Internet to enable producers to keep an eye on their barns remotely.

The industry is already very interested and an article about the new technology will be published in the April 2020 issue of ***National Hog Farmer***.



"Virtual Pig" bench testing apparatus

and enhancing bovine health

The cow is less enthusiastic as graduate student Josiah Davidson collects a nasal swab to use in an IoT project that is tackling the problem of Bovine Respiratory Disease (BRD).

Under the direction of Dr. Mohit Verma, WHIN-powered researchers are developing a sensor that can quickly identify the top three bacteria that are causing the disease in a cow. The device will perform a DNA-based assay that can also be easily adapted as bacteria mutate. When it is fully developed, test results will be communicated to a producer's mobile phone, along with the recommended antibiotic treatment.

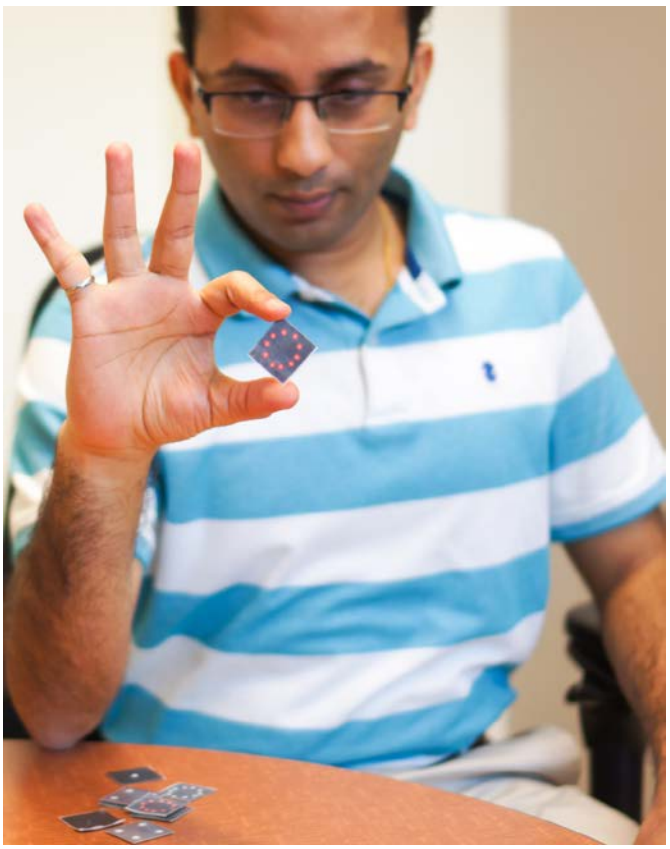
The research is expected to have an enormous impact on the beef cattle industry, as BRD affects 15-20% of beef cattle in the U.S. The disease can be caused by a variety of bacteria and the resulting pneumonia is often fatal.

At $30-$100 per test, the current laboratory methods for identifying the culprit bacteria are prohibitively expensive. Producers typically guess and the trial and error method of selecting an antibiotic fails one out of three times.

Aside from the cost of trial and error, guessing results in overuse of antibiotics, which can lead to antibiotic-resistant strains of bacteria developing. Consumers also increasingly object to the presence of antibiotics in beef products, putting pressure on the industry to minimize their use.

Purdue's approach to sensor technology is to develop devices that can be mass-produced inexpensively. Dr. Verma's research aims to develop a sensor that will deliver results in thirty minutes for much less than $10 per test, making it cost-effective for producers to test sick animals, and administer the correct antibiotic the first time.

Dr. Verma expects that a prototype device will be ready for testing on animals within about a year.



Dr. Mohit Verma

WHIN in Digital Ag: **Friendly Skies**

Purdue Extension's WHIN-powered, Unmanned Aerial Vehicles (UVA) solving problems

Purdue Extension's UAV program has been a workhorse for WHIN. Ag and Natural Resource educators who have been licensed to pilot the UAVs not only assist farmers who suspect problems or who are experimenting with new practices, they also take on interesting problems in turf management.

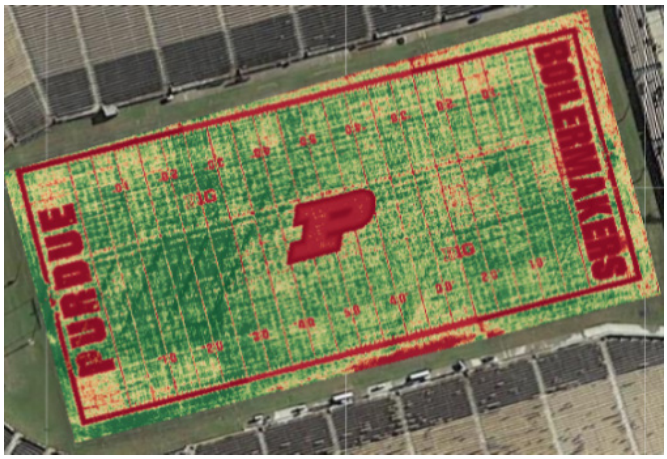
Such as Ross-Ade Stadium.

Purdue Extension teamed up with Purdue Athletics to fly Ross-Ade through the 2019 season. Infrared images give the picture of plant health, allowing groundskeepers and turf managers to develop strategies to mitigate wear and tear.

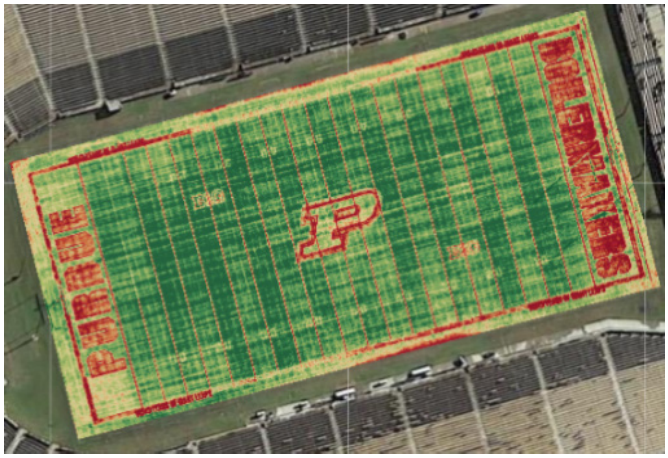
In the last 12 months, the Purdue Extension team has hosted 45 events, including presentations, demonstrations, and programs reaching out to over 850 WHIN region stakeholders, which include high school students, farmers, and agribusinesses.

The 2019 developed UAV certification program, piloted in the WHIN region, is now offered statewide. The program is taught by qualified extension educators and prepares individuals for their FAA certification exams.

In the last year, the Purdue Extension team has hosted 45 events, reaching 850 WHIN region stakeholders, including high school students, farmers, and agribusinesses.



Aerial view of Ross-Ade field after the third home game



The difference a week of informed turf prep makes

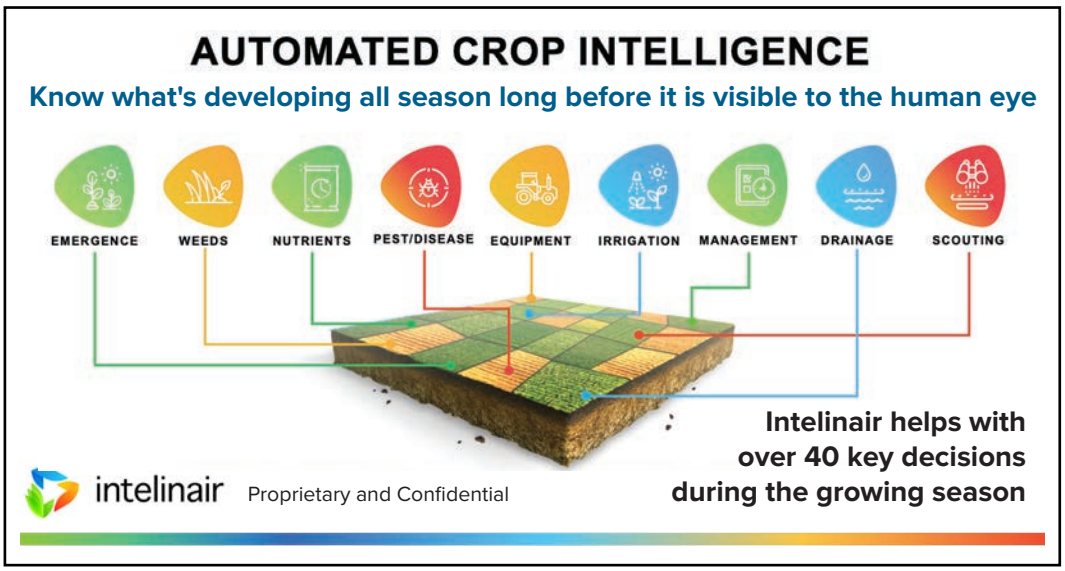
Meet John Scott, WHIN-sponsored Purdue Digital Ag Extension Coordinator

John has an A.S. in Ag Economics and B.S. and M.S. degrees in Agronomy from Purdue. He also brings experience in ag retail to his extension position. John is a licensed UAV pilot and is a key resource in training Ag and Natural Resource Educators to help farmers become informed adopters and users of digital technology. Under his leadership, Purdue Extension piloted a UAV Signature Program in the WHIN region, teaching UAV technology legal requirements, FAA Part 107 Remote Pilot Knowledge Test preparation, and useful UAV applications. Qualified extension educators are now preparing individuals statewide for their FAA exams.

Unmanned Aerial Vehicle (UAV)

while a new WHIN Ag Alliance tech partner, Intelinair, prepares to provide systematic imaging for Alliance member farmers throughout the growing season

The Purdue UAVs were also on hand to help Ivy Tech ag students bring in their harvest.



WHIN held its second Ag Alliance Summit at Ivy Tech on February 25, 2020, with over 90 attendees. Two new tech partners were introduced, including RogoAg, a soil sampling robotics company with roots in Purdue, and Intelinair, an aerial imaging company from Illinois. Intelinair flies fixed wing (manned) aircraft with very high-resolution imaging, supported by advanced mapping and analytic tools. As with other Alliance tech partners, Intelinair's services are discounted to members for the first and second years of use. The company will also license the data from Alliance flights to WHIN, greatly enhancing the data lake WHIN is developing for researchers and educators.

Closer to the ground, RogoAg enables much more accurate and consistent soil sampling.

WHIN Educating: IoT Workforce of the Future

Round 2 Regional Cultivation Fund grants open doors to IoT careers

Indiana West Advantage (IWA), the economic development organization for Montgomery County, was awarded $899,250 to advance workforce development for precision agriculture in the WHIN region. Along with about $400,000 in contributions from Ivy Tech, industry, and individuals, the grant will allow Ivy Tech to construct and equip a precision ag laboratory and hire faculty. A mobile precision ag demonstration vehicle will travel to high schools throughout the region. The grant will also allow Ivy Tech to credential high school ag teachers to offer dual credit classes and provide training for communities for the new program. The Round 2 grant follows successful completion of a Round 1 planning grant to IWA that conducted research related to workforce needs for precision ag in the region. The new program is especially important as WHIN Alliance accelerates the adoption of commercial IoT technology among farmers in the region.

IVY TECH COMMUNITY COLLEGE

- Associate of Applied Science in Precision Agriculture Equipment Technology
- Technical Certificate — Precision Agriculture Specialist
- Technical Certificate — Precision Agriculture Technician
- Technical Certificate — Agricultural Equipment Service Technician

The Eleven Fifty Academy was awarded a $99,400 planning grant. The Fishers-based academy offers coding immersion training programs, or coding "boot camps," to help anyone who wants to quickly launch a technology career. Eleven-Fifty Academy is a Registered Software Development Apprenticeship program and also accepts GI Bill® Funds for transitioning veterans. With over 1,000 placements to date, Eleven-Fifty Academy is meeting a critical workforce need for Indiana employers while reducing barriers to career entry. The RCF planning grant will allow Eleven Fifty to partner with corporations, Chambers of Commerce, school corporations, and other agencies in the WHIN region to identify the region's specific coding program needs.

while Purdue is spreading the word about its WHIN-powered degrees and certifications in digital agriculture

Education for Digital Agriculture

Technology Adoption Requires Knowledge for Successful Integration

PURDUE UNIVERSITY

WHIN
WABASH HEARTLAND INNOVATION NETWORK

For more information, contact:

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Agriculture Online, Department of Agronomy

Dennis Buckmaster, dbuckmas@purdue.edu
Dean's Fellow for Digital Agriculture

John Scott, scott42@purdue.edu
Digital Ag Coordinator, Purdue Cooperative Extension

HIGH SCHOOL

Precision Agriculture and IoT Course: Wabash River Career & Technical Education and originating at MSD of Warren County. Includes Southeast Fountain, Covington, Attica, North Vermillion, South Vermillion, Southwest Parke, and North Central Parke schools. Partnering with Ivy Tech Community College–Lafayette. Includes a local externship. Supported by WHIN Regional Cultivation Fund.

Digital Agriculture Testbeds at Regional High Schools: Turn FFA plots managed by partner schools into digital testbeds and living labs for students, area farmers, and ag businesses. Supported by WHIN Regional Cultivation Fund.

UNDERGRADUATE

Certificate in Applications in Data Science: 16 credits, many fit into other requirements for majors. Available to all Purdue undergraduate students.
https://www.purdue.edu/data-science/

Data Driven Agriculture Minor: 21 credit requirement, dovetails with Data Science Certificate (see above). One course from each pillar:

- **Statistical Methods** STAT 30100
- **Data Literacy, Management, and Analytics** ENTM 24200
- **Computation** ASM 10500, HORT 53000, or CS 17700
- **Data Science for Agriculture** AGR 33300 (see below)
- **Data Acquisition**, choose from list of six courses
- **Data Architecture and Usage**, choose from list of ten courses
- **Data to Decisions**, choose from list of 21 courses

OVER 40 Undergrad Courses at Purdue Related to Digital Agriculture

Integrating Data Science and Applied Digital Agriculture, AGR 33300: **Contributing departments:** Agricultural and Biological Engineering, Agricultural Economics, Agronomy, Animal Sciences, Entomology, Food Science, and Forestry and Natural Resources. **Outcomes:**

NEW August 2020

1. Source different types of data
2. Transform and format data for analyses
3. Detect trends in data as part of hypothesis generation
4. Communicate findings to different audiences through appropriate graphics and animations, including through web pages
5. Write R scripts to accomplish all of the above

Crop Management Drone Flight and Imaging, AGRY 598: ***First offered January, 2020.*** Includes regulations, aviation meteorology, UAV maintenance and performance, flight plans, image uploading map generation, data interpretation, multiple case studies.

Data and Information Systems: Concentration of Agricultural Systems Management in Ag and Biological Engineering.

GRADUATE

Over 20 Resident Graduate Courses at Purdue related to Digital Ag

Graduate Certificate in Spatial Data Science
https://online.purdue.edu/programs/online-certificates/

- Courses include: GIS Applications, Advanced Spatial Ecology, Remote Sensing of Land Resources, Environmental Informatics
- Fully online
- Program launch May 2020

PROFESSIONAL

Purdue Digital Ag Resources Website

Launched January 2020: Includes a directory of people, information by topic, links to related Purdue programs, calendar of events, glossary.
https://ag.purdue.edu/digital-ag-resources/

UAV Certificate Program

Taught statewide by qualified Extension Educators, including in the WHIN ten county region

Global Positioning Systems: Global navigation systems used around the world, how they work, equipment, factors affecting accuracy

Differential Correction: Ground-based and space-based correction systems, levels of accuracy, manual guidance and autoguidance

Sensors: Satellite, aerial, UAV, and proximal sensing platforms; active vs. passive sensing; spectral, spatial and temporal resolution; soil, crop and weather sensors

Soil & Water Spatial Variability: Soil formation and change across landscapes, soil mapping technology, precision land management, irrigation and drainage

Nutrient Spatial Variability: Grid and zone sampling approaches, developing management zones, nutrient-specific sensors, equipment for nutrient VRT

Crop Spatial Variability: Yield monitors for grain and non-grain crops, calibration of monitors, data cleaning, yield map interpretation, yield stability, crop quality sensors

Geographic Information Systems (GIS): GIS coordinate systems, map scales and standards, capture, storage, editing, analysis, display, image classification

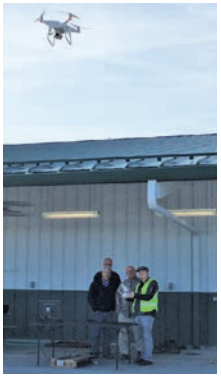
Automation: Implement steering, VRT seeding, planter unit controllers, variable hybrid/variety planting, spray boom and nozzle controllers, boom leveling

Data Analysis: Experimental design, data quality, compatibility, privacy, interpretation and correlation, product comparisons

Telematics: Understanding telematics technology, wireless network applications, product comparisons

Precision Farming Economics and Adoption: Cost effectiveness of digital technologies and site-specific management in various crops, regions, situations

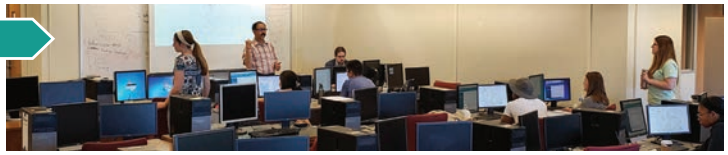
https://ag.purdue.edu/agry/ADE/Pages/default.aspx



Precision Agriculture Course

Winner of Best Professional Course at Purdue in 2017

- About 100 short-form HD videos, professionally edited and annotated
- Organized into modules/lessons for easy navigation — so adult learners can dovetail into their day
- Modules include an "online textbook" listing learning objectives and with reading, graphics, glossary, links to more information
- Test at end of each module helps ensure comprehension — can't proceed to next module until you pass!
- Non-credit; Certificate awarded with successful completion



USDA REEU: The Research and Extension Experiential Learning for Undergraduate program equips participants with data science skills that complement their agricultural discipline knowledge. It is a student-centered, research-based active learning environment. In 2019 there were eight students representing six institutions and six states. The program continues through 2023.

WHIN in Manufacturing 4.0: Olympic Dreams

Taking high performance to scale

Purdue's WHIN-powered Intelligent Manufacturing Testbed (IMT) is open for business, allowing regional manufacturers to try on Manufacturing 4.0 without disrupting their own operations.

Dr. Jan-Anders Mansson,
IMT Director and Co-Director of IN-MaC

Intelligent Manufacturing Testbed

The IMT comprises about 13,000 square feet usable area, with usable ceiling up to 26 feet. The cutting-edge intelligence of the IMT rests in its ability to integrate smart machines into smart factories and smart enterprises, including creating digital twins and performing technical cost modeling. Among its many features and capabilities, the IMT offers

- Subtractive machining (milling and lathing)
- Polymer and composites manufacturing
- Injection molding
- Composite prepregging
- Intelligent manufacturing, assembly, and packaging
- Production integrated automation and robotics
- Automated guided vehicles (AGV) and collaborative robots (Cobots)
- Fix and mobile metrology

Jan-Anders Mansson, age 6

Sometimes it is impossible to separate man from machine. To begin to grasp the Olympic size, intelligence, and potential of the IMT is to get a glimpse into the vast life and vision of Dr. Jan-Anders Mansson, the citizen of the world and Purdue professor for whom the IMT represents the fulfillment of a dream: to enable all manufacturers to have access to the transformative power of digital technology.

Dr. Mansson is a lifelong manufacturer, born, as he says, on the factory floor. His family founded the Swedish firm, KB Components, a Tier 1 and Tier 2 supplier to VOLVO, SAAB, Electrolux and other Swedish companies. KB Components manufactures plastic and composite components and systems. Dr. Mansson curated his own education, interrupting it as a teenager in order to work, before achieving his MS in 1977 in Mechanical Engineering and PhD in 1981 in Polymeric Materials, both from Chalmers University of Technology in Gothenburg Sweden.

But just as important, Dr. Mansson learned the business of manufacturing from his parents in the fire of rebuilding a Europe recovering from the ravages of World War II. That experience forged a deep, practical commitment not only to advancing the family business, but also to his nation's industry. And, eventually, to the prosperous and peaceful future of the world.

Dr. Mansson's academic accomplishments and appointments are too numerous to include here. But there is another dream that the IMT is set to fulfill for this remarkable man.

Along with manufacturing, Dr. Mansson has a lifelong love of sports – his own passion was tennis. Some years ago, his position as Director and Vice President at École Polytechnique Fédérale de Lausanne in Switzerland led to interesting opportunities to combine manufacturing and sports.

First, Dr. Mansson lent his skills with game theory and materials to the Swiss America's Cup team, enabling Switzerland to become the first landlocked country to win the Cup – not once, but twice!

Dr. Mansson went on to work with the International Olympic Committee, where he now oversees the management of sports-related innovation, such as swimsuit materials. For Dr. Mansson, the affiliation with the Olympics is the perfect marriage of practical arts and science, sports, and his profound affection for, and belief in, people. Even better? The relationship puts all of that in service to a peaceful and prosperous future for the world.

Recently, Dr. Mansson created the Ray Ewry Sports Engineering Center at Purdue, with a close link to the International Olympic Committee. Indeed, for WHIN, Purdue, and the IMT, the sports connection potentially adds yet another dimension of outreach and impact. The IMT is already on the frontlines in researching innovative materials for sports.

Dr. Mansson would love for the next addition to the lab to also be focused on sports technology, and for Purdue to become a global center for developing that technology. Given his lifelong record of making big dreams come true, that goal seems entirely within reach.

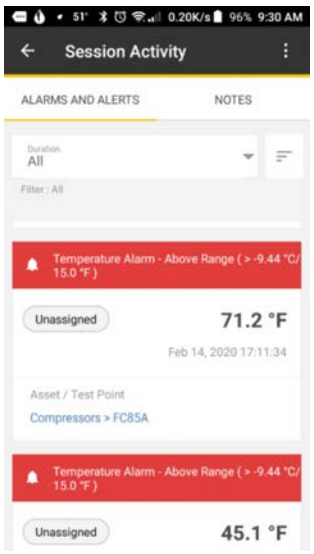
WHIN in Manufacturing: **Good Vibrations**

Keeping plants humming

KA Components in Otterbein is one of thirteen pilot regional manufacturers to join WHIN's Manufacturing Alliance after the Alliance launched in late October, 2019. The company makes wood components that are sold through lumber dealers.

KA Components made the decision to join because, like virtually all manufacturers, their operation relies on motors and air compressors to run machinery. In their case, that includes a lumber grinder and a variety of presses. If the motors fail or air compressors leak, the business loses productivity and money.

Vibration sensors help manufacturers monitor motor and compressor performance remotely so that preventative maintenance can be scheduled conveniently, avoiding unplanned downtime. One of WHIN's Manufacturing Alliance tech partners, Fluke, was chosen in part because it offers a vibration sensor solution to address a universal need.



With the help of Kirby Risk, another Manufacturing Alliance member and also the local distributor for Fluke products, KA Components installed the entire Alliance Fluke starter kit of sixteen vibration sensors, serving its grinder, air compressors, eight presses, and five presets.

The sensors are connected wirelessly to a gateway that was mounted on the ceiling. The gateway moves the data into the cloud, where it is stored for the use of WHIN's data lake, and for the app that comes with the product so that plant technicians can make real time decisions.

Next up for KA Components? The WHIN Alliance Fluke starter kit also includes power monitors that report the kinds of power usage irregularities that go unnoticed in normal operations, but that can wreak havoc with a plant's electric bill. Another universal need that WHIN can address region-wide, while collecting data to generate research questions and support IoT education.

WHIN Alliance is WHIN's mechanism for introducing manufacturers to the world of IoT at the operational scale.

while fine-tuning the solution

Tate and Lyle produces corn syrup and related products at two plants in Lafayette. Their operations rely heavily on the efficient operation of approximately 700 motor/pump combinations. An unexpected failure of one of these units can be very expensive.

But so is keeping an eye on them. To minimize failure, the plant performs three complex and highly sensitive tests manually on every pump, every month. There is a commercial IoT vibration solution that offers enough sensitivity to replace the manual tests, but the labor of this effort is also quite expensive.

Tate and Lyle partnered with Purdue's WHIN-powered IoT and manufacturing groups to search for a more feasible and cost-effective solution.

Researcher Nithin Raghunathan, professors John Sutherland and Bruno Riberio, along with a group of graduate students, started by outfitting the motor/pump units with commercially available, wireless IoT vibration sensor solutions, and slowly introduced lower cost but effective solutions under development at Purdue.

Using very precise but expensive handheld piezoelectric based vibration sensors, and the less precise but affordable Fluke technology for comparison, the team was able to find an innovative and intelligent, i.e AI-based, solution that would be affordable.

Developing predictive ability from the new kind of data involved adding machine learning to the project.

This also encouraged the development of a flexible, commercially viable, SMART film-based vibration sensor which is currently being tested.

Purdue's IoT lab is increasingly tapped to solve specific problems in the region. BioTown Ag, a member of both the WHIN Ag and Manufacturing Alliances, generates electricity by burning waste from its dairy operation and turning it into methane gas. The gas is then used to power large engines which turn electrical generators to produce electricity. Recently one of their large engines exploded, leading to extended downtime and costly repair. Had vibration or other IoT devices been installed onto the engine, this situation could possibly have been avoided.

BioTown Ag asked Purdue's Manufacturing/IoT team to help. The team installed both commercially available and, later, research sensors onto the engines to capture data that could be used to detect operational anomalies.

Bottom line? The engaged research and Alliance models are complementary, allowing manufacturers to solve many problems immediately with commercially available IoT while working with Purdue and vendors to enhance the solutions.

And when Purdue and WHIN partner together with manufacturers in the region, emerging technologies are pushed out of Purdue's research environment into real world applications with the potential of creating commercialization opportunities.

It's a WHIN-WHIN. And it is how global epicenters are born.

WHIN Rising: State and National Recognition

Ivy Tech receives statewide award for WHIN partnership

Each year, the Indiana Department of Education recognizes unique partnerships that expand and exemplify career and technical education in the state. WHIN and Ivy Tech Lafayette received the 2020 Award for Excellence for WHIN-funded testbeds established in collaboration with Purdue research teams. The campus's 65-acre farm field hosts WHIN weather stations and soil monitoring sensors and its next-generation manufacturing lab includes preventative maintenance and energy management sensors.

Ivy Tech's faculty use the testbeds to demonstrate real-world applications. The partnership enables Ivy Tech students to better understand IoT technology and its systems installations, data communication strategies, data measuring insights with commercially-available and early market sensors, and the data analytics and actionable insights for real time decision making. Ivy Tech Lafayette serves the WHIN region. Its graduates are usually employed in the region and the WHIN-powered testbeds are helping them prepare to work in major industry clusters within the region.

THE STATE OF INDIANA

CAREER AND TECHNICAL EDUCATION

AWARD FOR EXCELLENCE

PARTNERSHIP RECOGNITION

WHEREAS, *Excellence in career and technical education is exemplified in achieving the maximum potential of groups working in partnership to promote, deliver, or support career and technical education;*

Excellence in career and technical education involves partnerships between representatives of educational agencies and institutions, government, business, industry, agriculture, and other groups interested in contributing to the best career and technical education experience possible;

Excellence is achieved through Indiana's career and technical education delivery system;

Excellence in career and technical education in Indiana is an important component of the total educational process;

Excellence in career and technical education should be recognized.

THEREFORE,

WABASH HEARTLAND INNOVATION NETWORK (WHIN)

Ivy Tech Community College - Layafette

Is hereby presented the

PARTNERSHIP AWARD FOR EXCELLENCE FOR 2020

This 18th day of February, 2020

ATTESTED BY:

P.J. McGrew

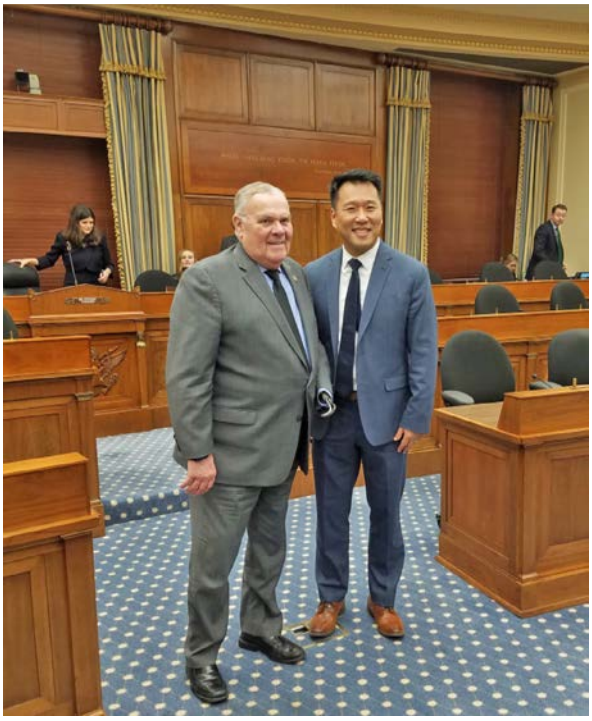
Executive Director of the Governor's Workforce Cabinet

The Ivy Tech / WHIN team

WHIN

WABASH HEARTLAND INNOVATION NETWORK

while WHIN CEO Johnny Park testifies before U.S. House subcommittee



Congressman Jim Baird and Johnny Park

At the invitation of Congressman Jim Baird, WHIN CEO Johnny Park testified on February 5, 2020, before the U.S. House Subcommittee on Research and Technology, about his experience when he was CEO of Spensa with the Small Business Innovation Research (SBIR) program. The SBIR program is designed to support the very early part of the commercialization runway, where promising ideas whose roots are usually in university research are still too risky for conventional venture capital investment. Johnny joined three other very distinguished panelists and shared how SBIR grants enabled the success of Spensa, which was named by Forbes as one of the Top 25 Most Innovative Ag-Tech Startups in 2017 before being acquired in a successful exit by DTN.

But Johnny stressed that SBIR funding was only one benefit of the program. Johnny told the committee that what he learned from SBIR has had a lasting impact, enabling him to go on to lead WHIN as a start-up. He shared the WHIN story, including its highly innovative Alliance model, as further evidence that the return on SBIR investment is enormous.

and hosts the Federal Reserve Bank of Chicago

In December of 2019, WHIN hosted a roundtable on rural development for the Federal Reserve Bank of Chicago. Johnny Park and Chicago Fed President Charles Evans moderated a ten-member panel consisting of WHIN Ag and Manufacturing Alliance members as well as WHIN tech and broadband partners. Purdue Trustee JoAnn Brouillette represented the WHIN Board on the panel. The Community Foundation of Greater Lafayette CEO Marianne Rose, Board Chairman David McGaughey, and Ivy Tech Chancellor David Bathe joined Purdue Trustee Gary Lehman as observers.

The panel provided President Evans with articulate and incisive accounts of the issues facing their families, businesses, and communities. The discussion ran over the allotted time and Fed officials stated it was one of their most productive roundtable events.

"[Entrepreneurship is] customer-centered innovation that accelerates change through the strategic, value-sensitive, and nimble deployment of resources. And 'resources' include not only financial capital and intellectual property, but also the team's talents, time, and passion. The entrepreneurship model is thus a resource engine. As each new asset comes to fruition, it becomes the basis for new deployment and generation of value."

– Dr. Johnny Park, WHIN CEO

(Written testimony to the U.S. House Subcommittee on Research and Technology)

Round 1 Regional Cultivation Fund (RCF) grant results are pouring in…

Public Art!

Community-themed public art projects are coming to life throughout the region thanks to the $150,000 grant administered by the Tippecanoe Arts Federation. Artists work with community members to develop each mural. The grant supports the RCF goals of vitality and connectivity.

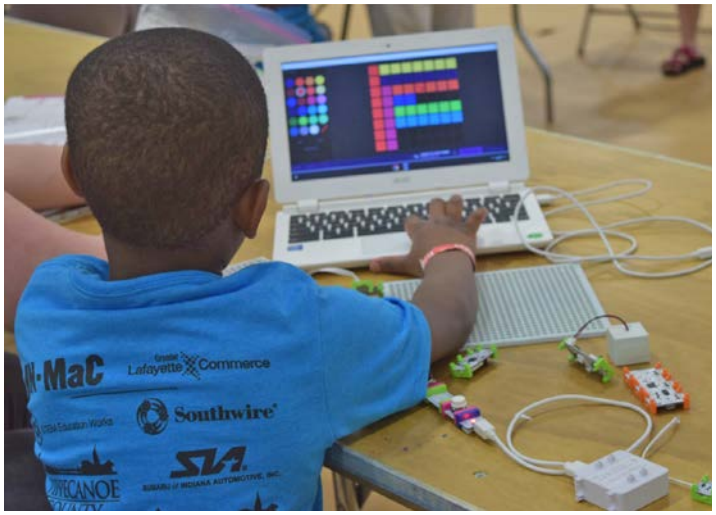
Muralist Sandra Fettingis

Muralist COBREArt

Muralist Jenna Morello

CoderDojo Strike!

Traditional workforce development efforts focus on apprenticeships, certifications, and other adult education programs. But in 2016, Greater Lafayette Commerce took on the workforce of the future with CoderDojo Strike, a volunteer-led computer coding club, at the Matchbox Coworking Studio in downtown Lafayette. Strike's mission was to introduce local K-12 students to computer programming and encourage them to pursue careers in engineering, robotics, and advanced manufacturing.



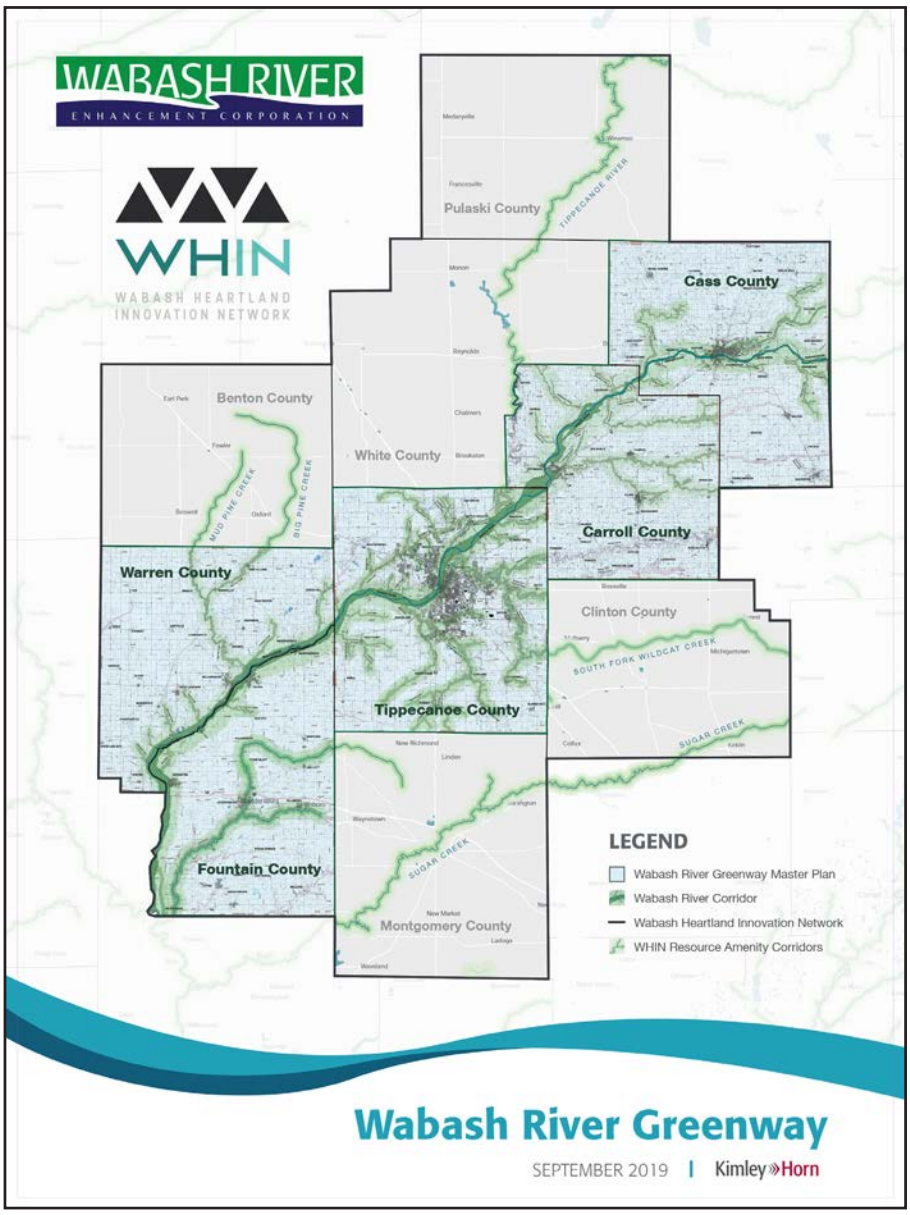
Now known as the Next Generation Manufacturing Ecosystem, the project's expanded offerings include Manufacturing Week, Robotics in Manufacturing Camp, and IN-MaC Design and Innovation Studio. A $360,000 Round 1 RCF grant to Tecumseh Area Partnership, Inc. is enabling Greater Lafayette Commerce and its partners at IN-MaC, Purdue University, and Region 4 Workforce Board to expand the Ecosystem throughout the ten-county WHIN region. Over the two-year grant period, each county will have two new CoderDojos and a design and innovation studio. Six additional weeks of Robotics in Manufacturing Camp will be offered and Manufacturing Week will grow.

To date, six new CoderDojos have opened across the region with four more scheduled to open in 2020. Additionally, new Manufacturing Week events were hosted in Clinton and White County in October of 2019, serving more than 3,300 students. Seven weeks of Robotics in Manufacturing Camp will be hosted in Clinton, Tippecanoe, Warren, and White counties this summer.

Planning to Plan!

Wabash River Enhancement Corporation's (WREC) $35,000 Planning to Plan grant was awarded by WHIN to position the region to develop a corridor master plan (CMP) for the 90-mile Wabash River Greenway (WRG). The Greenway extends through the five WHIN river corridor counties (Fountain, Warren, Tippecanoe, Carroll, and Cass). The plan will also connect the five outer WHIN counties to the WRG through resource amenity corridors of river tributaries and proposed or existing trail/active transportation corridors.

Planning to Plan organized the five counties, selected a planning firm to lead the project, began corridor resource inventory and analysis, and developed a work scope, work schedule, and cost estimate for the Corridor Master Plan Development Project.



WHIN Regional Cultivation Fund: **Results** *(Cont'd)*

A steering committee is now in place, supported by committees in each county. Kimley-Horn, a nationally-known, locally-based planning and design firm, was selected to assist WREC in leading the Planning to Plan process and will be retained for the future CMP development project. The work scope, schedule, and cost estimate created in Planning to Plan is being used to support fundraising efforts for the CMP Development Project and to identify the greenway development pilot projects that will be constructed first.

Planning to Plan has already generated $921,840 dollars from North Central Health Services, Western Indiana Community Foundation, and Warren County Community Foundation. The funding sets the stage for the future WRG CMP Development Project as well as funding two pilot projects. WREC has applied for funding in RCF Round 2 to supplement those funds in order to complete the plan and to provide the local match for an upcoming Indiana Department of Natural Resources Next Level Trails grant for a third pilot project.

APPENDIX B: **Outcomes**

Please Note: Due to the connection between projects, there are outcomes listed in the Sensor Development and Implementation section that are also relevant in the Digital Agriculture section. This reflects collaboration, not duplication, of efforts or expenses.

AIM 3.1.1: Establish IoT Platform Testbeds at Purdue to Advance Digital Agriculture Demonstrations, Teaching, and Research

AIM 3.1.1.A: Implement Sensors Within the ABE High-Tech Ag Facility

Anticipated Outcomes	Outcomes to Date	%
Due to the construction timeline of Purdue's ABE Building, the ABE High-Tech Agricultural Facility is expected to be widely sensored by 2020 (Year 3, assuming a January 2018 start date). In the meantime, work will begin by investing in a planner/administrator to cultivate industry partnerships, investigate logistics, and train/recruit qualified staff.	• ABE Facility is under construction. It is expected to be widely sensored by the end of 2020. It will include large space for equipment, high-tech labs for processing and environmental analysis, as well as instrumentation and controls for agricultural production and processing applications. There will also be a design studio to improve health-centered design for digital agriculture solutions. Classes will commence in this ABE High-Tech Agricultural Facility in January 2021.	70%
Twenty demonstrations and/or teaching initiatives per year.	• Purdue started offering "Machine Learning & High-Performance Computing for Digital Ag & Biological Eng [ABE 591]" in February 2020. It will cover foundational and applied material on algorithms for IoT in digital Ag. It is a new one-credit stackable data science and engineering course developed by Dr. Chaterji. Thirteen graduate students from Ag and Engineering are enrolled. The course website is at: https://schaterji.io/teaching.html.	20%
Proposals submitted for three community-linked research projects connected with the facility per year, post sensor installation.	• Living Lab funding that originally supported this outcome is being directed by the WHIN Administration.	0%
Two new technologies/intellectual property filings per year generated by the testbeds, which will result in new startups and products launched in the WHIN region.	• Dr. Chaterji is filing two patents on scalable databases for IoT workloads using leading-edge noSQL databases, currently in process with the Office of Technology & Commercialization (OTC). Dr. Stwalley has a first disclosure to OTC on a biosensor that detects bovine respiratory disease.	100%
$3.5 million of research expenditures in the testbeds from industry and government sources, post-sensor installation.	• During this six-month period, three funding sources (Disease Diagnostic Vectors Challenge, the Center for Produce Safety, and the Army Research Lab) have invested $226,000 in sensor-related research.	1%

AIM 3.1.1.B: Implement Sensors Within the Indiana Corn and Soybean Innovation Center, Located on the Agronomy Center for Research in Education's (ACRE) Farm		
Anticipated Outcomes	**Outcomes to Date**	**%**
Purdue's ACRE Farm site is expected to be extensively instrumented by late 2018 (Year 1, assuming a January 2018 start date).	• Six new digital ag research projects were launched with WHIN funding: 1. Agricultural & Biological Engineering (ABE): Dr. Saraswat utilizes UAVs in close proximity to crops for weed monitoring and develops data resolutions/analytics for weed mapping. 2. Agricultural & Biological Engineering (ABE): Dr. Verma designs, fabricates, and tests sensors for farm use to determine if infection is bacterial or viral. 3. Agricultural & Biological Engineering (ABE): Dr. Chaterji is creating machine learning models for (approximate) computation on data acquired from heterogeneous sensors on edge devices for low bandwidth (e.g., anomaly detection for online sensor health tracking) and for higher bandwidth tasks (e.g., object detection). 4. Agronomy: Dr. Ackerson tests a new framework to generate improved high-resolution soil maps for fertilizer recommendations, management zone delineation, and targeted IoT sensor installation. 5. Agricultural & Biological Engineering (ABE): Dr. Stwalley establishes a sensor network to monitor feed and water consumption, activity, production metrics, and physiological data. 6. Agricultural Science Education & Communication: Dr. Wang partners with high school teachers to co-develop data-based decision-making and integrated STEM materials, including co-instruction with Purdue scientists. • Overcoming the lack of Internet access is a primary challenge limiting the adoption of digital agriculture technology. Purdue-WHIN staff created an inexpensive mobile data-sharing network between combines, semi-trucks, and grain carts that does not rely on Internet access. The result is more efficient harvesting through improved logistics.	100%
Twenty demonstrations and/or teaching initiatives each year.	• Digital Ag Roundtable was held on September 10th at the Agronomy Center for Research and Education (ACRE) farm. The day-long event with nearly 100 attendees, attracted many WHIN stakeholders as well as others from all over Indiana. Attendees saw various presentations, tours of research and activities at the ACRE farm and campus locations, and networked with Purdue faculty, staff, and students during a lunch time poster session. • The Open Ag Technology and Systems (OATS) Center demonstrated how the ISOBlue HD technology can advance the ability to share data through connected devices at the Joint Transportation Research Program's meeting at ACRE. • Presented "Current and Potential Future UAV Impacts" to the West Lafayette Kiwanis Club. • Balmos, Ault & Krogmeier presented at AgGateway attracting industry attention for WHIN-Purdue testbed use.	85%
Proposals submitted for three community-linked research projects connected with the facility per year, post sensor installation.	• Living Lab funding that originally supported this outcome is being directed by the WHIN Administration.	50%
Two new technologies/intellectual property filings per year generated by the testbeds, which will result in new startups and products launched in the WHIN region.	• One provisional patent awarded and one provisional patent pending (Dr. Chaterji). The provisional patent pending is on edge-cloud computing platforms for low-latency applications. • Potential partnership meetings were conducted with: Microsoft, Infosys, John Deere, and Sweetwater Urban Farms.	50%
$2 million of research expenditures in the testbeds from industry and government sources, post-sensor installation.	• Microsoft FarmBeats donated sensor boxes and assorted sensors valued at approximately $13,206. • An additional gift of Azure Compute resources is valued at $25,000. • These investments are in addition to the $500,000 investments made to date.	27%

AIM 3.1.2: Establish Sensors Throughout the Ivy Tech Community College – Lafayette Agriculture Teaching Laboratory		
Anticipated Outcomes	**Outcomes to Date**	**%**
Ivy Tech Community College–Lafayette Agriculture Teaching Laboratory will serve as a testbed and be widely sensored by 2019.	• In Fall 2019, the first set of sensors were installed at Ivy Tech and began collecting data. The sensors installed collect nitrate levels in the soil, soil temperature, soil moisture, and electro-conductivity. • Ivy Tech faculty and staff have been engaged in selecting the locations of the sensors according to soil type and crops produced in the field. The cover crop production trials will also be integrated with sensors to measure nitrate levels. • Data from the Ivy Tech farm sensors have been collected by the Purdue Birck Team and provided to Ivy Tech faculty to be integrated into the course curriculum for the Computing and Informatics students as well as the Agriculture and Precision Agriculture and Equipment Technology courses.	100%
Ivy Tech will develop campus-based curriculum, and work in conjunction with the Krannert School of Management and IN-MAC, in developing online curriculum.	• There is ongoing curriculum in development to support the emergence of the Precision Agriculture Equipment Technology program. These courses include: - AGRI 200 Precision Farming Technology (will be refreshed and eventually listed as PAET 100 Precision Farming Technology) - PAET 201 GPS Guidance Systems - PAET 222 Agriculture Applications of Geographic Information Systems - PAET 202 Application Control - AGRI 101 Agricultural Data Management (refresh) • Dual credit programs in the area of Precision Agriculture Equipment Technology have been approved at the statewide level in order for Ivy Tech to train high school vocational Agriculture teachers on PAET curriculum. This will enable students to use high school earned credits toward an Ivy Tech degree or certificate program.	85%
Proposals will be submitted for four community-linked research projects connected with the laboratory per year, following the sensor installation in conjunction with Purdue University.	• Purdue Extension Educators from the ten counties have been invited to see the Ivy Tech Community College Agriculture testbed to help them know more about the certificate and degree programs emerging at the campus. • IWA (Indiana West Advantage), in collaboration with Ivy Tech, has been awarded a WHIN Regional Cultivation Fund grant award to develop a Precision Ag Equipment Technology facility to train students throughout the WHIN region. • Bane Welker has engaged with the Ivy Tech Community College–Lafayette campus location to train Case IH technicians about precision Ag technologies, including planting demonstrations in the teaching laboratory. • Ivy Tech has submitted a proposal for funding to the USDA NRCS program to research and demonstrate cover crops integration within the farm to demonstrate to students the impacts this type of farming practice can manage nitrate flows in the farm fields. The Birck sensor team will be placing nitrate sensors within the cover crops sections of the farm to measure nitrate retention in the ground water through IoT data collection. • WHIN and Ivy Tech were recently awarded a grant from the Indiana Office of Energy Development (OED) through their Rural Energy Innovation grant program. This two-year grant will involve the deployment of IoT based energy monitoring devices on manufacturing floors to determine power quality and monitoring on individual pieces of equipment and throughout the facilities. The data collected from these systems will be analyzed by engineering consultants and power management plans will be provided to the manufacturers. Ivy Tech faculty will utilize this data and real-world power management plans to create curriculum to be used in the Advanced Manufacturing courses.	100%

AIM 3.1.3: Establish IoT Testbed(s) Throughout the Wabash Heartland Region with Industry Partners		
Anticipated Outcomes	**Outcomes to Date**	**%**
Three of the community-based research projects above will be community-linked IoT platform/research projects each year, after sensor installation in the Purdue testbeds.	• WHIN has deployed 47 weather stations in the Living Lab across all ten counties composed of farms, high schools, and community gardens. An additional 53 weather stations, already on-hand, are to be deployed this spring, including installations at each of the ten Purdue County extension offices.	40%
Ten counties throughout the region will be engaged each year in community-linked IoT platform projects or training.	• WHIN has deployed digital Ag technology through Tech partnerships with Solinftec, RogoAg, Telesense for the Ag Alliance members. • WHIN continues to work with Purdue to engage Ag related stakeholders for R&D projects such as nitrate sensors.	50%
$.5 M of research expenditures in the testbeds from industry and government sources.	• WHIN has received investments from tech partners (such as Solinftec, RogoAg, Telesense, Fluke, and Guardian) totaling $550,971.	100%

AIM 3.1.4: Develop "Career Ready" Educational Programs in Applied Data Analytics in High-Tech Agriculture: Providing Middle-Skills Certifications, Undergraduate, and Graduate Education		
Anticipated Outcomes	**Outcomes to Date**	**%**
A full-time educational specialist that leverages opportunities between Purdue and AgriNovus.	• Hosted an "Experience the Tech" event for the Ag Tech and Innovation Learning Community class at the ADM Ag Innovation Center. • Dr. Chaterji developed an Applied Data Science and Engineering course (ABE 591) for practical applications in genomics, digital Ag, and IoT for delivery in the second five weeks of spring semester 2020. The Machine Learning and High-Performance Computing course will teach foundational data science and engineering concepts/algorithms to seniors and graduate students in both the Colleges of Agriculture and Engineering.	100%
Twenty-five BS graduates per year in digital agriculture.	• To date, 30 students have graduated with a BS that included at least four digital agriculture courses. • Data-Driven Agriculture Minor was presented at the College Faculty December 2019 meeting and approved. This included a new course for fall 2020, AGR 33300 Data Science for Agriculture now also approved and scheduled. Dr. Chaterji began offering a Data Science and Engineering course in January 2020.	100%
50 certificates per year awarded on digital agriculture topics.	• Twenty-two certificates issued in December 2019 for Precision Agriculture in the Agronomy e-Learning Academy. These certificates are in addition to those earned by adult learners since Spring 2018 when John Scott was hired as the full-time digital agriculture specialist.	69%
8 professional MS degrees per year awarded in digital agriculture.	• To date, three students have graduated this academic year (Year 3 of the grant) with an MS that included at least one digital agriculture course. This is in addition to the two previous MS degrees (with at least one course in digital agriculture) earned in years 1 and 2 of the grant.	62.5%
Twenty-five positions filled in critical needs areas (projected from baseline occupational skills needs assessment).	• Information has been requested from the WHIN Administration but to date, has not been supplied.	0%

AIM 3.1.5: Develop Extension Programs to Strengthen the Purdue Extension Program's Ability to Serve Agricultural Producers and Agribusinesses in the 10-County Region with Regard to "Digital Agriculture"		
Anticipated Outcomes	**Outcomes to Date**	**%**
A full-time extension specialist coordinating the outreach work of the Purdue team involved in the deployment of "digital agriculture" strategies relevant to the region.	• Since September 2019, digital agriculture specialist, John Scott has conducted: - Presentations with a total of 349 attendees - Demonstrations with a total of 265 attendees - Programs with a total of 242 attendees • Scott was interviewed for a U.S. Farm Report story by reporter, Tyne Morgan, about Purdue Extension's UAV Initiative and UAV uses in general. The U.S. Farm Report is a weekly television news program reaching 500,000 people nationally. • Scott and Buckmaster participated in the Forbes Ag Tech Summit in September 2019 and staffed the Purdue/ WHIN Digital Ag booth.	100%
Investment in a marketing campaign to brand Purdue Extension as the primary and trusted source of information on science-based digital agriculture innovations.	• Discussed Purdue Extension curriculum development goals with FFA Advisors at the National Agronomy CDE during National Convention. Strong interest was expressed in our development of an ag tech curriculum nationally. • The Purdue Extension UAV Website is in the process of being updated. All highlighted material from 2019 has been submitted to Purdue's Agricultural Communications Department. • Collaboration has been ongoing with several ANR Educators both in the WHIN region and across the state, along with coordination with Purdue Agriculture Communications.	50%
Development of a suite of 15-20 extension-related products that inform, educate, and increase access through Purdue Extension channels (such as the Purdue Extension website and the Education Store).	• Purdue Digital Ag Resources website went live in February 2020 with new information from 2019 on Animal Agriculture, Corn and Soybean, Diversified Crops, Natural Resources, Structures, Marketing, and Turf. • Agriculture Technology curriculum for High School, 2 year colleges, Career Centers, early professionals underway. Targeted completion date of August 2020. • Associate Certified Crop Advisor credential: Planning and early development of Associate CCA credential for High School, 2 year colleges, Career Centers, early professionals underway. Targeted completion date January 2021.	50%
Adoption of digital agriculture strategies by at least 15 rural communities, agribusinesses, co-ops, and/or ag-related nonprofits by 2022.	• Since the last reporting period, six weather stations have been installed/digital adoption strategies taught at these locations: - Ivy Tech, Logansport (Cass County) - Fairgrounds (Carroll County) - Fairgrounds (Fountain County) - Throckmorton Center (Tippecanoe Co) - Cumberland Park Community Gardens (Tippecanoe Co) - Chatham Square Community Gardens (Tippecanoe Co) • This is in addition to the two weather stations installed during the last reporting period.	50%

AIM 3.2.1: Establish a Testbed to Demonstrate, Teach IoT to Companies and Students		
Anticipated Outcomes	**Outcomes to Date**	**%**
Design and plan Intelligent Manufacturing Testbed (IMT) physical location at the Indiana Manufacturing Institute (IMI) in Purdue's Research Park.	• The third phase of the testbed launch was completed on Jan. 31, 2020.	100%
Establish IMT Testbed to showcase IoT sensor/network capabilities to companies and students.	• The public launch event for the IMT was planned for March 25, 2020, but this was postponed due to COVID-19 restrictions. • Since the last report, industry gifts totaling $51,800 were received by the IMT to help offset testbed operating costs.	90%
Establish additional technology adoption opportunities through mobile demonstrations.	• Purdue researchers continue to engage companies in field research. • Ongoing activities include the following WHIN company sites: Standard Industrial, Tate & Lyle, DrugPlastics, and BioTown.	30%

AIM 3.2.2: Establish a Testbed to Showcase Real-Time Sensor and Network Capabilities of WHIN-Area Firms for Original Equipment Manufacturers (OEMs)		
Anticipated Outcomes	**Outcomes to Date**	**%**
Identify a relevant use case for demonstrating connectivity between OEM and supplier for design, production (including supply chain), and sustainment.	• Model-Based Work Instruction (MBWI) Project Update: - Created a usability test plan to outline goals and methods for upcoming usability testing. - Developed tutorial mode to introduce users to inter-reacting with augmented reality applications. - Updated user experience based on data collected during initial usability study at Collins Aerospace. - Prepared demo walk-through and presentation for fall 2019 Digital Enterprise Summit.	75%
Deploy commercial software, hardware, and middleware, establishing the IMT digital sensor and networking architecture, between laboratories on West Lafayette campus for prototype workflow/infrastructure.	• Predictive Maintenance: - Two Fluke sensors have been deployed to monitor two generators in Bio Town Ag. - An RPM invariant was further studied to improve the previously developed deep learning model. - Vibration data are continuously collected from pumps at Birck. • Sensor/Communication (collaboration with the IoT group): - An updated TI-design accelerometer module has been deployed at Birck. - A flexible vibration sensor from the sensor group has been tested in mini-motor testbed. Both time and frequency domain data were obtained. - Exercised on Raspberry Pi and Microsoft Azure (clouding system) for deployment in companies. We successfully connected a Raspberry Pi to Azure cloud system for data visualization. • Exercise middleware technology for the generation of digital twin: - Robots and input devices in the testbed are connected by ROS to control machines in real-time. - Collaboration with Standard Industrial; Web pages are being developed to visualize the information collected from MTConnect and Raspberry PI. - Development of part dimension measurement system using 2-D vision (collaboration with Oscar Winski). - Calibration and measurement programs are developed for the system. - Created a usability test plan to outline goals and testing methods for upcoming usability testing.	60%
Finalize satellite locations for IMT architecture at companies throughout the WHIN region.	• Identified three satellite locations in the region.	100%
Deploy and assess the digital product and process information model with partner companies and their supply chains.	• Actively deployed 20% of the supply chain tool.	20%
Have deployed full digital enterprise sensor and networking architecture and infrastructure within the IMT location.	• Progressing with establishment of secure private subnetworks specific to testbed.	25%
Develop prototype predictive analytics architecture and tools.	• Prototype tools on track for deployment by September 30, 2020: - Monitored machine health using sound signals in a remote area. - Collaborated re: sensors/communication with the IoT group. - Exercised middleware technology for the generation of digital twin.	50%

AIM 3.2.3: Establish a Digital Supply Chain Tool to Increase the Visibility of WHIN's IoT Capabilities to Procurement Managers Discover WHIN-Area Firm Capability		
Anticipated Outcomes	**Outcomes to Date**	**%**
Work with OEMs to reduce supply chain leakage and record extent of leakage reduction. Work with individual companies to seek opportunities to collaborate by pursuing new business jointly.	• Continued developing capacity modeling as part of the Digital Supply Chain Tool (DSCT) to enable companies with excess capacity to assist companies with temporary requirements. • Continued to discuss supply leakage at Peer Group meetings. • Continued development of a process for companies to self-validate their Digital Supply Chain Tool (DSCT) information pages.	50%
Map the capabilities of companies in the WHIN region using digital tools for supply chain prototyping.	• Digital Supply Chain Tool (DSCT) Update: - Added company profile description narrative for all DSCT companies to provide an overview of each company's business. - Created a two-page profile document for first 35 companies so they could validate content and approve for publishing in search tool. Seventy-five percent of the companies in the database have been contacted. - Continued to validate company data and provide additional sourcing information to the companies (on as-needed basis).	50%
Connect with LEDOs or other economic development groups across WHIN counties to deploy supply chain prototyping tool.	• Met with LEDOs discussing format for training LEDOs and companies on how to use the Digital Supply Chain Tool (DSCT). • Conducted a training session with LEDOs and demonstrated the supply chain prototyping tool. Continued to dialogue about the supply chain needs for the companies in their counties. • Met with the 2030 workforce team and toured the new technology center. Presented WHIN-Purdue activities and discussed further facility utilization and collaboration. • Tippecanoe County LEDO requested help for a local company that wanted to know which companies can produce iron castings; DSCT provided a list of three companies within 16 hours.	50%
Work with OEMs to prioritize approaches to reduce supply chain leakage and record extent of leakage reduction.	• During training session, engaged in detailed conversation about how to use the supply chain tool aspects for supply chain reduction. • Continued discussion with OEMs on leakage reduction during MAC meeting.	25%
Work with individual companies to seek opportunities to collaborate to go after new business.	• One of the iron-casting companies requested help with identifying new customers – they are very interested in using the supply chain tool. • Conducted 3 regional group meetings and a Special Interest Group meeting and discussed the importance of having companies participate in the supply chain portal validation process. • Added new companies from Tippecanoe county to the database: Heartland Automotive, Lafayette Venetian Blinds, Window World. Met with KA components to discuss about new potential projects.	25%
Expand deployment of supply chain prototyping tools at LEDOs or other entities.	• Met with LEDOs discussing format for training LEDOs and companies on how to use the supply chain tool. • Steve Dunlop presented Supply Chain Initiative at workforce 2030 council and invited to be a member.	25%
Work with procurement managers at OEMs to implement usage of supply chain prototyping tool.	• Met with OEMs to present and explain the supply chain prototyping tool and its application.	25%

AIM 3.2.4: Establish the Ivy Tech Next-Generation Center Pilot Program

Anticipated Outcomes	Outcomes to Date	%
The first year of the grant will be focused on fostering greater collaboration between Ivy Tech and Purdue in terms of IoT expertise and student need assessment.	• Students have been engaged with locating the sites for the sensors in the farm field at the Ivy Tech farm field. Students located and set GPS locations for where the sensors are to be placed in the farm field.	100%
Year 2 will be focused on recruiting students and setting up the sensored lab in preparation for the pilot.	• In early September 2019 at the beginning of the Fall semester, 20 students in the Introduction to Crop Science course where given an in-the-field demonstration of the sensors and the data being collected for use in their course work. • Recruitment is ongoing for bringing students into the Precision Agriculture Equipment Technology (PAET) program from the region's high school vocational agriculture programs.	95%
Years 3 and 4 will be implementation-focused, working with 80 Ivy Tech students per year, spanning several disciplines in agriculture and manufacturing (for a total of 240 students in Years 3-5).	• Students have been engaged in the farm field (Introduction to Crop Sciences course) via introduction to field sensors installed at Ivy Tech, and how data is collected and analyzed for real-world and practical experiences. • To date, 100 students have been involved in the ITCC Agriculture Testbed. • The WHIN (Ag & Manufacturing) Alliance Membership will be provided insights from the sensor deployment at the ITCC testbeds. This could involve workshops, field days, and short-course training programs. • Data that has been collected in the WHIN testbeds will be provided to ITCC faculty and students to utilize for course projects. • As curriculum is deployed and integrated into the course work, more students will become engaged with the WHIN objectives across several schools and programs, including School of Advanced Manufacturing, Engineering, and Applied Sciences, as well as the School of Information Technology.	50%
A minimum of 20 students will participate in summer internships during years 3-5 (located at both the Ivy Tech and Purdue University campuses), stemming from the pilot program.	• Ivy Tech has begun hiring interns for the Summer of 2020. It is anticipated three to five interns will be assisting with the testbeds, as well as with the WHIN weather station network. Also, students may likely have the opportunity to engage with WHIN Alliance members at both Agriculture and Manufacturing businesses. Additionally, database management tasks will be a part of the intern efforts. • Additional planning in terms of recruitment, development of opportunities, and implementation will be occurring shortly in order to provide those opportunities/place those students during the academic calendar year in addition to the summer months.	5%

AIM 3.2.5: Establish Workforce Engagement and Training for Smart Manufacturing and IoT

Anticipated Outcomes	Outcomes to Date	%
Reach out to all 77 manufacturing companies identified in the region (during Year 1), targeting five-six consultations per month in order to visit all of them within the first year, if possible.	• Conducted 235 company engagements in fiscal year 3 and 840 from the start of the grant. • The Purdue team has launched a master website: www.purdue.edu/whin. This will allow WHIN stakeholders to find a direct link to Purdue's activities under the LEI grant or to WHIN.org.	75%
Use the gap analysis process to develop customized courses (aggregated as company needs align) to help build the capacity of their employees to increase their "value creation ability" by using IoT and related smart tools (during Years 1 & 2).	• Analyzed company needs by six employee groups (leadership, change agents, maintenance, first-level supervisor, operations workers, new applicants across three skills categories (People, Business, and Technology). • Started a new Smart Technology special interest group to introduce companies to smart technologies.	75%
Implement communication plan that includes WHIN web-site and periodic newsletter.	• Continued to publish periodic newsletter. Created eight posters along with multi-page brochures that are handed out at face-to-face meetings. • Launched Education Portal that includes over 80 courses and resources.	75%

AIM 3.2.5 *(Cont'd)*		
Design curriculum around the content most needed by employees (as exposed in the gap analysis) to increase their "value creation ability" and productivity.	• Concluded three workshops to date: Transitioning to Industry 4.0, Onboarding and Staff Retention, and Digital Tools to transform for manufacturing. Approximately 120 WHIN stakeholders from 40 different manufacturing firms attended these workshops. • Conducted Problem Solving and Value Stream Mapping (VSM) course. • Created 20 mini-courses for Smart People and Smart Business in lean area. • Expanded participation in Advanced Manufacturing Workforce Development group. • Continued meetings with Purdue MEP staff to discuss coordination and mutual deployment of various course material. • Ongoing conversation with companies to better design courses for their short-term needs.	45%
Engage with LEDOs and individual companies on a regional basis to promote education programs and encourage small project co-learning. Select companies, based on the results of the gap analysis, that are interested in the work and are a good fit for the project.	• Presented at the Manufacturing Advisory Council meeting. • Developed training session with LEDOs – deployed in January 2020. • Attended MAC and Lafayette LEAN meetings with WHIN-Purdue companies. Further progressed on two case study projects with WHIN companies leading to completion.	50%
Determine the best delivery system suited for the audience(s), adapt how the course is delivered (in person, online or hybrid).	• Provided a small group of companies with access to Web-Portal to obtain company feedback prior to launch in 2020. • Soft-launched the WHIN Education website and the portal, accessible to public. Received more than 400 views in the first ten days of the launch.	75%
Arrange a training schedule based on company/employee needs (assessing opportunities for training at shift change, worker needs like transportation and childcare, and availability).	• Special Interest Groups have been established as a spin-off from our regional peer groups focusing on specific topics. An example is 5S best practices that includes six companies. • Discussion and accumulation of 34 small projects in an interest list. These projects are being brought to the Purdue team by our manufacturers. They are seeking assistance with technical and non-technical issues affecting their operations. Purdue is using a variety of funding sources to fulfill these needs at little or no cost to the manufacturer. • Prepared to launch a new Special Interest Group for SMART technology, especially low-investment technology of wider interest to our SMEs.	50%
Deliver courses, on an as-needed basis, on-site at the manufacturing plant to current employees (Years 2-5).	• Five manufacturing peer groups are now active throughout the region involving nearly 30-35 manufacturers. • Facilitated/presented at three regional non-compete meetings with themes from both gap-analysis and stated corporate needs within the groups.	75%
Engage at least 30% of the 77 companies (for a total of at least 25 companies implementing/operating courses designed and deployed by DCMME) (by the end of Year 5).	• Over 50 companies have attended at least one face-to-face class, workshop, or peer group meeting. • 223 classes have been taken by 125 employees across eight counties.	100%

AIM 3.3: IoT Infrastructure and Data Analytics – Digital Ag Sensor		
Anticipated Outcomes	**Outcomes to Date**	**%**
Study the field data from soil sensors (nutrients, moisture, temperature) to study aging, drift, biofouling.	• The design of printed ag sensors has been optimized, including: a) composition and thicknesses of sensing layer, b) manufacturing process, and c) packaging. The goal is to provide high resolution, robust, and stable sensors that require reduced conditioning time while maintaining low-cost and scalable manufacturing. While the optimization goal has been met, these sensors continue to be tested both in lab and in field locations. The main focus is on nitrate sensors, but low-cost devices for phosphate and microbial activity characterization have also been developed.	100%
Fabricate two dozen sensors for lab characterization and field test.	• During this period, several modules in Birck's roll-to-roll system for the real-time in-line characterization of sensors (e.g. optical imaging, thickness, dielectric constant) were added. This will enable machine-learning algorithms to be used to correct for sensor variability and aging – and obtain accurate results with low-cost sensors. Around 2700 sensors were fabricated and characterized (approximately 1200 in-line and 400 off-line, respectively).	100%
Finalize the design of water sensors for Purdue's Water Quality Field Station.	• The lab-scale sensor testing examines the performance of new sensors initially in water and later on in soil. During this period, 271 nitrate sensors were tested over periods of up to a week, monitoring sensor drift and aging. Data acquired in different nitrate concentrations is used in conjunction with physics-based machine learning models to help compensate for sensor variability.	100%

AIM 3.3: IoT Infrastructure and Data Analytics – Next Generation Manufacturing Sensor		
Anticipated Outcomes	**Outcomes to Date**	**%**
Study the field data from distributed temperature, humidity and moisture sensors.	• The Bluetooth low-energy interface was developed for the transmission of vibration measurements that can be used to create a full frequency spectrum. The pressure sensor has been integrated, as well, and these functionalities were added to our sensor nodes and receivers. Currently, performance is being validated prior to deployment at manufacturing sites. Some sites (e.g. BioTown Ag and Birck Nanotechnology Center) already have off-the-shelf sensors that are being used for baseline measurements. • A half-dozen custom sensors as well as off-the-shelf wired and wireless manufacturing sensors (including vibration, humidity, pressure, and gas sensors) have been tested. These tests allow for the collection of baseline measurements from real environments, as well as the development of post-processing analytical and predictive techniques.	80%
Study aging and drifts.	• The Birck Nanotechnology Center's facilities, as well as BioTown Ag's facilities, have been utilized for the deployment of Purdue's sensors. Vibrations are being monitored in medium and large pumps in conjunction with sound, temperature, and humidly in collaboration with the manufacturing group.	50%

AIM 3.3: IoT Infrastructure and Data Analytics – Communication and Networking		
Anticipated Outcomes	**Outcomes to Date**	**%**
Evaluate communication fidelity and data security.	• The next version of the sensor electronics and packaging was developed in collaboration with an external vendor. The updated nodes feature increased robustness and extended connectivity, i.e. more ports for connecting custom and commercial sensors. The firmware was updated for lower power consumption and increased stability. In addition, the Bluetooth interface was added for enabling node usage in manufacturing environments, which is currently being validated.	80%
Implement edge analytics, security and machine-learning to improve the design of reliable and robust sensors.	• Anomaly detection at sensor nodes was demonstrated so that energy for communication could be saved. On the ag side, combination of physics-based models and machine learning has been used to classify sensor response and predict stable reading after 24 hours using initial reading in the first two-three hours.	75%

AIM 3.3: IoT Infrastructure and Data Analytics – Field Data from WHIN Region		
Anticipated Outcomes	**Outcomes to Date**	**%**
Obtain field data from 12 IoT nodes from region. Sensor network at 15 locations (farms, manufacturers, public buildings).	• Four farmers in Benton county have met with the Sensor/IoT group to identify deployment locations in the fields. Farmers in Warren and Fountain counties have also been involved in discussions. In addition, the group met with the Evonik team who provided specific locations (in five machines, including boiler fans, compressors, and a chiller) for manufacturing sensor deployments. The Sensor/IoT group is working with the manufacturing group and has devices installed at BioTown Ag and Tate & Lyle. The Ivy Tech farm's IoT node (to include soil and water sensors at half a dozen locations) has been added to the portal, with soil nitrate monitoring capability to be activated in Spring 2020.	50%

AIM 3.3: IoT Infrastructure and Data Analytics – Education Program, Guest Lectures		
Anticipated Outcomes	**Outcomes to Date**	**%**
Guest lectures (K-12, community colleges, local businesses).	• Sensors and IoT platforms were featured at local, national, and international workshops and conferences. SMART industry consortium at Birck Nanotechnology Center in December 2019 brought 50 students and researchers together with 30 or so participants from manufacturing and technology companies as well as local businesses. NextFlex Conference at Purdue in October was a national conference with 70 participants from across the U.S. doing research in flexible hybrid electronics with applications to advanced manufacturing, digital ag, and supply chain. Two papers were presented at the international IEEE Sensor Conference in Montreal Canada in October 2019. We have scheduled workshops for industry collaborators in April and are planning to collaborate with the State's 4-H office during the summer.	75%
Help community testbeds with IoT sensors, data network, and data analytics	• Community Testbeds Update: 1. The Web portal has been updated with faster and mobile-friendly pages. 2. The manufacturing sensors are being integrated into the portal, streamlining the process. 3. Instructional wiki pages are being developed for the deployment of IoT networks. 4. Access and directions have been provided to our collaborators at Ivy Tech, so the students can collect and analyze the data. 5. The Sensor/IoT group has been working with its Digital Agriculture partners for expansion of their CONTxT application so that farmers and researchers can easily collect and store sensor-related data.	75%

AIM 3.4.1: Build Capacity and Connections Through RFPs		
Anticipated Outcomes	**Outcomes to Date**	**%**
There is better collaboration between public and private entities in the region--and a net increase in financial and social capital.	• WHIN staff members and partners continue to reach out to the public and private entities in our region. Some of these meetings in the past six months included: - Warren County Commissioners Meeting - WHIN Manufacturing Alliance Launch Event - Manufacturing Advisory Council Meeting - WHIN Ag Advisory Council Meeting - Benton County LEDO/Community Foundation Visit - Partnerships secured with Guardian, Fluke, Realm5 and RTO Wireless	45%
There is better alignment between regional education and workforce efforts, yielding more youth and adults prepared for employment.	• The Regional Cultivation Fund approved grants for Precision Agriculture Workforce Training, Coder Education Program, and Learning Laboratory.	50%

AIM 3.4.2 : Educate the Region's Future Workers		
Anticipated Outcomes	**Outcomes to Date**	**%**
Implementation of I-STEM curriculum into the 26 elementary schools in the region without comprehensive, research-based science, technology, engineering and math curriculum.	• Within the WHIN region, through the Tecumseh Area Partnership RCF grant, 5,000 elementary school students were instructed via design and innovation studios and 150 elementary school students attended robotics camp.	50%
Implementation of Project Lead the Way (PLTW) into the 22 middle and high schools without research-based science, technology, engineering and math curriculum.	• A method for tracking this quantitatively does not currently exist, however, progress for creating student interest in STEM careers is increasing through the Tecumseh Area Partnership grant. • 3,192 middle school students attended Manufacturing Week made possible through the Tecumseh Area Partnership RCF grant.	50%
3,000 high school enrollments in STEM career education courses region-wide (from the baseline of 1,558 current high school enrollments).	• Seventy-five middle school and high school students were trained through the Tecumseh Area Partnership CoderDojo programs. Seven new CoderDojo locations were added within the region.	25%
750 "STEM-Ready" high school graduates (who have taken at least 1 STEM-related course).	• Several of WHIN's Round 1 RCF grantees specifically address research-based science, technology, engineering, and math curriculum, such as: Digital Agriculture Testbeds at Regional High Schools grant (fiscal agent: Frontier School Corporation), the Regional Precision Agriculture Study grant (fiscal agent: Indiana West Advantage) and the Wabash River Career & Technical Education Program grant (fiscal agent: MSD of Warren County).	20%
800 manufacturing and agriculture industry-recognized credentials awarded in high school (from the baseline of 420 current credentials awarded).	• In February 2020, a Round 2 RCF grant was made as a follow-on to the Regional Precision Agriculture Study grant (fiscal agent: Indiana West Advantage) which should support this outcome.	20%

AIM 3.5: Cultivation Fund		
Anticipated Outcomes	**Outcomes to Date**	**%**
The population grows and the tax base is strengthened. This will be measured by a baseline assessment of population and current tax base in all ten counties, tracked annually.	• Population and gross assessed property value on a county level are tracked by PCRD via their Rural Indiana Stats portal (http://pcrd.purdue.edu/ruralindianastats) and updated annually. The property value data is on a two-year data lag (based on a report provided annually by Dr. Larry DeBoer). According to his 2016 report, the aggregated gross assessed property value for the Wabash Heartland Region was $928,065. American Community Survey (ACS) has a five-year rolling sample that provides the updates for our remaining CVIs. According to 2018 data, the aggregated county population increase for the Wabash Heartland Region was 2,546 people (a slight increase overall in the WHIN region even though every county but Tippecanoe is declining).	100% of target, 40% of goal over 5 years.
Within two-four years, WHIN will fund $10 million in projects in the WHIN counties designed to increase the region's vitality, education, and connectivity.	• WHIN Board of Directors approved a Round 2 RCF planning grant of $99,400 and impact grant of $899,257 at the Jan. 28, 2020 meeting.	20% (Just over $2 million granted.)
In five years, WHIN will have a positive impact upon educational opportunities, vitality, and connectivity of the Wabash Heartland Region as a result of the funded projects.	• The Round 1 RCF Watch grant (rural broadband) continues to progress and has offered the Wabash Heartland Region opportunities to collaborate with internet service providers and enhanced connectivity. • A master plan trails RFP has been drafted that would greatly increase connectivity throughout the region via a trail system throughout ten counties. • This outcome will be evaluated in the mid-point economic impact analysis (to be completed in year 3/4) and with ripple-effect mapping at the end of the five-year grant period.	To be tabulated at end of Year 5.
Pre-survey delivered by Purdue Center for Regional Development to all ten counties in the region. Surveys completed by regional residents at county fairs, via social media, and with the local deployment/promotion assistance of LEDOs, Community Foundations, Extension, Chambers of Commerce, and other community partners.	• The third round of the WHIN Placemaking Survey was deployed in November 2019. To date, 50 regional residents have responded. Response data will be analyzed in August 2020 after the summer survey collection at the region's ten county fairs has been completed.	100% of target, 40% of goal over 5 years.

APPENDIX C: **Biographies**

WHIN Board (MEETS BIMONTHLY)		
	**Gary Henriott**	Chair of Henriott Group (insurance and risk management services) and past Chair of Greater Lafayette Commerce Economic and Community Development Council; City of Lafayette Housing Authority; President of Board of Works and Safety – City of Lafayette, IN; Lafayette Community Bank Board; The Community Foundation of Greater Lafayette Board, and Chair of Community Commitment to Education Committee.
	**David Bathe, DA**	Chancellor of Ivy Tech overseeing Lafayette, Logansport, Crawfordsville, Frankfort, and Monticello campuses. Leadership roles include Greater Lafayette Commerce, the Greater Lafayette Convention and Visitors Bureau, and the City of Lafayette Economic Development Commission.
	**JoAnn Brouillette**	Purdue Board of Trustees and managing partner and president of Demeter LP – privately owned grain and commercial warehouse business – Benton County, IN. Community leadership roles include the Executive Committee of the Indiana Chamber of Commerce, Lafayette Bank and Trust Advisory Board, and the National Grain and Feed Association Board.
	**Ron Dickerson**	Retired Vice President / General Manager – Nucor Steel Indiana and has most recently served as President of the Montgomery Economic Development organization; Community Foundation of Montgomery County.
	**David Lasater, PhD**	President and CEO of The Community Foundation of Greater Lafayette, Indiana. Previously served in a variety of capacities for 17 years with Purdue University and the Purdue Research Foundation, most recently as Senior Associate Vice President.
	**Gary Lehman**	Purdue University Board of Trustees, retired Chairman of the Board of Oerlikon Fairfield and President of Oerlikon AG-Americas, and the founder of Cannelton Group. Gary's leadership roles include Board of the Indiana Chamber of Commerce, Indiana Manufacturers Association, North Central Health Services, Ivy Tech Corporate College, and Greater Lafayette Commerce, Chair.
	**Stephanie Long**	President/CEO of North Central Health Services (NCHS), River Bend Hospital – a private inpatient psychiatric hospital, and capital grantmaker to eight of the 10 counties in the WHIN region. Previously served as CEO at IU Health White Memorial Hospital. Community leadership roles include White County Economic Development Board of Directors; Greater Lafayette Commerce Board of Directors; and Community Foundation of Greater Lafayette.
	**David Luhman**	Of Counsel to the law firm of Hoffman, Luhman & Masson, PC in Lafayette, Indiana. Leadership roles include Tippecanoe County Attorney (1997-2014) and counsel for Wabash River Enhancement Corporation, Tippecanoe County Parks and Recreation Foundation, and The Community of Greater Lafayette Board of Directors, Chair (2013-2016).

WHIN Board (Cont'd)

	**Todd Miller**	President/CEO Myers Spring, Logansport, Indiana. Community leadership includes Indiana Chamber of Commerce, Cass County Logansport Economic Development Organization, Logansport Municipal Utilities.
	**Johnny Park, PhD**	Chief Executive Officer (CEO).
	**Steve Schultz**	Chief Legal Officer for Purdue University. Previously with Barnes & Thornburg, Indianapolis; Fried, Frank, Harris, Shriver & Jacobsen, London, England; General Counsel with Irwin Financial, Columbus, Indiana; and Chief Counsel to former Indiana Governor Mitch Daniels.

Purdue Leadership (MEETS QUARTERLY)

	**Jay T. Akridge, PhD**	Provost and Executive Vice President for Academic Affairs and Diversity. He also served as Principal Investigator for the WHIN-Purdue.
	**Theresa S. Mayer, PhD**	Executive Vice President for Research and Partnerships. She is also a Professor of Electrical and Computer Engineering.

Ivy Tech Leadership (MEETS QUARTERLY)

	**David Bathe, DA**	Chancellor of Ivy Tech overseeing Lafayette, Logansport, Crawfordsville, Frankfort, and Monticello campuses. Leadership roles include Greater Lafayette Commerce, the Greater Lafayette Convention & Visitors Bureau, and the City of Lafayette Economic Development Commission.
	**Todd Roswarski, PhD**	Ivy Tech-Lafayette Vice Chancellor for Academic Affairs & Professor of Psychological Sciences. Roswarski oversees all academic programs, grants, secondary initiatives, library services, and testing and assessment. He also serves on the Campus Academic Officers' Committee that sets all academic policy for the Statewide Community College System. Dr. Roswarski serves as Principal Investigator for WHIN-Ivy Tech.
	**Andrea Schwartz**	Dean, School of Advanced Manufacturing, Engineering & Applied Science, Ivy Tech.

WHIN Staff (MEETS WEEKLY)		
	**Johnny Park, PhD**	Chief Executive Officer (CEO).
	**Jack Stucky**	Vice President of Engineering.
	**Jason Tennenhouse**	Vice President of Strategy & Design.
	**Greg Ottinger**	Vice President of Strategic Partnerships.
	**Pat Corey**	Interim Vice President of Engagement
	**Ted Fiock**	WHIN-Purdue Managing Director.
	**Chad Martin**	WHIN-Ivy Tech Project Manager.
	**Zach Mason**	Senior Software Engineer.
	**Audette Taylor**	Director of Finance.

WHIN Staff (Cont'd)

	**Jessica Strasburger**	Communications Coordinator.

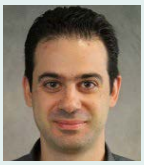
WHIN-Purdue Operations Team (MEETS MONTHLY)

	**Ali Shakouri, PhD** WHIN-Purdue & WHIN Operations Committees	Mary Jo and Robert L. Kirk Director of Birck Nanotechnology Center; Professor of Electrical and Computer Engineering.
	**Jan-Anders Mansson, PhD**	Distinguished Professor of Materials & Chemical Engineering; Director of Purdue's Composite Manufacturing Simulation Center (CMSC) and Co-Director of IN-Mac. Dr. Mansson is also the founder of the composites companies EELCEE Ltd. and QEESTAR Co. Ltd., which are active in the field of high-volume composites and additive manufacturing.
	**Dennis Buckmaster**	Professor of Agricultural & Biological Engineering, Dean's Fellow for Digital Agriculture.
	**Lionel J. "Bo" Beaulieu, PhD**	Director of the Purdue Center for Regional Development and Director of the Extension Community Development Program.
	**Steven Dunlop**	Managing Director of Dauch Center for the Management of Manufacturing Enterprises (DCMME) and Global Supply Chain Management Initiative (GSCMI).
	**Melinda Grismer**	Community and Regional Development Specialist, Purdue Center for Regional Development.
	**Nathan W. Hartman, EdD**	Head of Computer Graphics Technology, Dauch Family Endowed Professor, and Co-executive Director of IN-MaC.

WHIN-Purdue Operations Team (Cont'd)

	**Ted Fiock**	WHIN-Purdue Managing Director.
	**Jason R. Henderson**	College of Agriculture Administration, Associate Dean and Director of Purdue Extension.
	**Ananth Iyer, PhD**	Senior Associate Dean, Krannert School of Management; Susan Bulkeley Butler Chair in Operations Management.
	**Michael Ursem**	Director of Business Development & Facilities, IN-MaC.
	**David Snow**	Center Director, Manufacturing Extension Partnership.
	**John Sutherland, PhD**	Professor and Fehsenfeld Family Head of Environmental and Ecological Engineering.
	**Nithin Raghunathan**	Research Scientist, Birck Nanotechnology Center.
	**Martin Jun**	Associate Professor of Mechanical Engineering.
	**John Scott**	Digital Agriculture Extension Coordinator.

WHIN-Purdue Operations Team (Cont'd)

	**Bruce Erickson**	Digital Agriculture Education & Outreach Director.
	**Maria Wiltse**	Metrics Manager, Purdue Center for Regional Development (PCRD).
	**Charilaos Mousoulis**	Project Manager of IoT Infrastructure and Data Analytics, Senior Research Scientist, School of Electrical and Computer Engineering.
	**Somali Chaterji**	Assistant Professor of Agricultural and Biological Engineering.
	**Andrew Balmos**	Data/Software Engineer in Agricultural Research and Graduate Education.
	**Nancy Denton**	Professor & School of Engineering Technology Associate Head.

WHIN-Ivy Tech Operations Team (MEETS MONTHLY)

	**Andrea Schwartz**	Dean, School of Advanced Manufacturing, Engineering & Applied Science, Ivy Tech.
	**Chad Martin**	WHIN-Ivy Tech Project Manager.
	**Bryce Eaton**	Program Chair, Advanced Automation & Robotics Technology.
	**Kraig Bowers**	Program Chair, Agriculture.
	**Andrew Gibbs**	Department Chair, School of Computing & Informatics.
	**Bruce Sillery**	Farm Manager and Crop Production Faculty.
	**Todd Roswarski, PhD**	Vice Chancellor of Academic Affairs.

Frequently Used Acronyms

ABE.....Purdue School of Agricultural and Biological Engineering

ACRE .....Purdue College of Agriculture's Agronomy Center for Research and Education (a testbed site)

ANR .....Purdue Extension's Agriculture and Natural Resources

AR.....Augmented Reality

BRD .....Bovine Respiratory Disease

CMP .....Corridor Master Plan

DCMME.....Dauch Center for the Management of Manufacturing Enterprises

DSCT.....Digital Supply Chain Tool

EDA.....Economic Development Administration

GCTC .....Global Cities Team Challenge

IMI.....Indiana Manufacturing Institute (located at Purdue Research Park)

IMT .....Intelligent Manufacturing Testbed

IN-MaC .....Indiana Manufacturing Competitiveness Center (located at Indiana Manufacturing Institute)

IoT .....Internet of Things

ISP.....Internet Service Provider

IWA.....Indiana West Advantage

LEDO .....Local Economic Development Organization

MBWI .....Model-Based Work Instruction

MEP.....Manufacturing Extension Partnership

MET .....Manufacturing Education Team

NIST.....National Institute of Standards and Technology (a federal government organization)

NSF.....National Science Foundation

OATS.....Open-Agriculture Technology and Systems Group (a Purdue Ag and Engineering research team)

OED .....Office of Energy Development

OEM .....Original Equipment Manufacturer

ONA.....Occupational Skills Needs Assessment (a survey to be conducted to assist with metrics)

OTC.....Office of Technology & Commercialization

PAET.....Precision Agriculture Equipment Technology

PAWR .....Platforms for Advanced Wireless Research

PCRD.....Purdue Center for Regional Development

RCF.....Regional Cultivational Fund

RFP.....Request for Proposal

RWIN.....Rural Workforce Innovation Network (a USDA public-private partnership)

SBIR .....Small Business Innovation Research

TOWER .....Testbed for Open Wireless Experimental Research

TPAC.....Throckmorton-Purdue Agricultural Center

UAV .....Unmanned Aerial Vehicle

VR.....Virtual Reality

WHIN.....Wabash Heartland Innovation Network

WREC .....Wabash River Enhancement Corporation

WRG .....Wabash River Greenway