Report to Lilly Endowment
March 2019
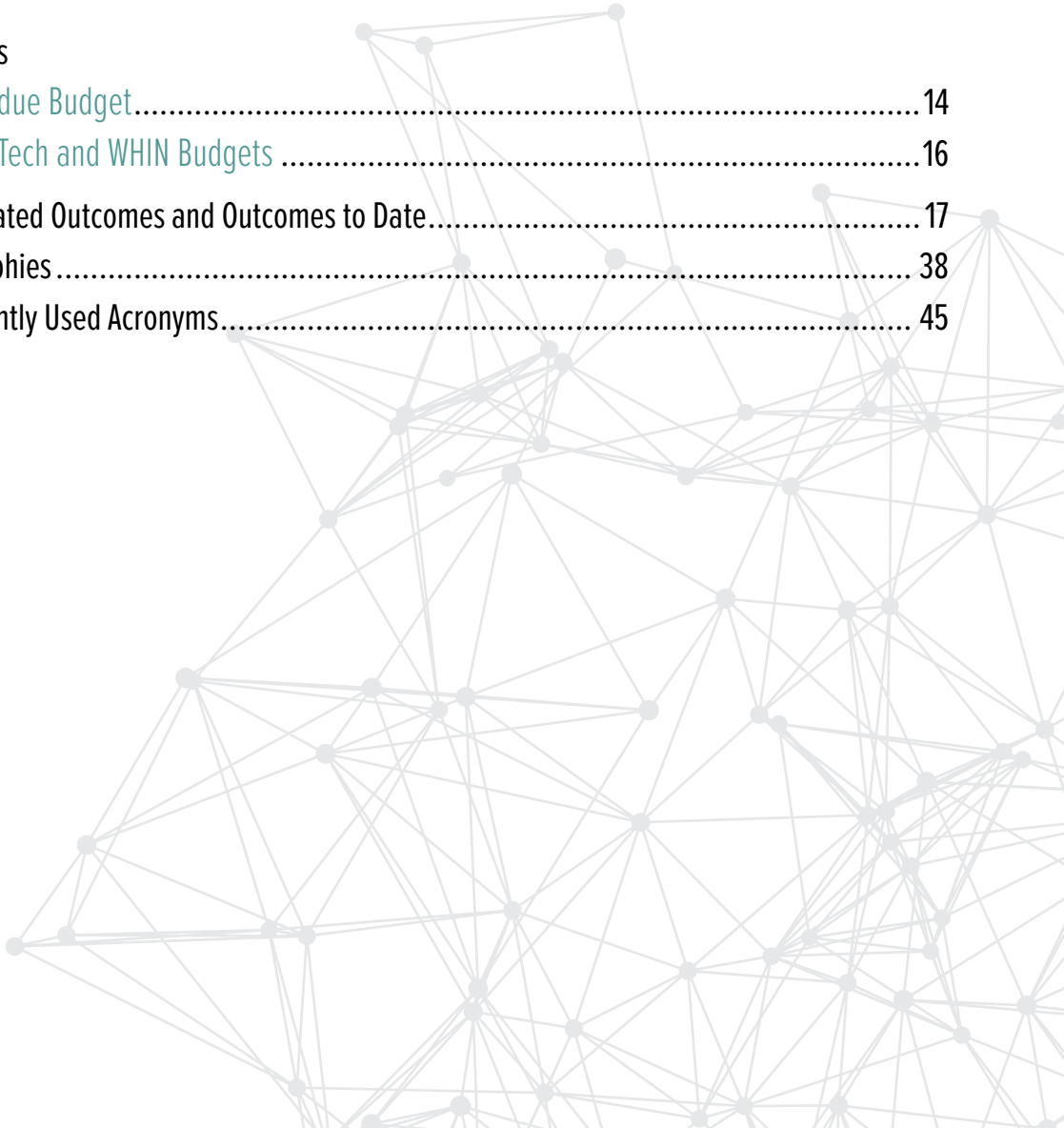
WHIN
WABASH HEARTLAND
INNOVATION NETWORK

Submitted by: Johnny Park, CEO, WHIN

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Appendices

Message from the Chairman: **Thank you**

Over the past months, I have thought several times that I wish I could share with Lilly Endowment the excitement and energy that is being generated by your investment in the Wabash Heartland Innovation Network. We are engaging with stakeholders throughout the region to share WHIN's message and vision. In each meeting, stakeholders gain further understanding of the projects and efforts that WHIN is undertaking and how they contribute to our objective to "cultivate a regional ecosystem that empowers globally-competitive businesses to plant and grow in the Wabash Heartland."

As Chairman, I have the distinct privilege to participate in many of the meetings with various stakeholder groups. The energy created in these meetings is palpable. From broadband connectivity to educational efforts and investments to sensor development and deployment to our Regional Cultivation Fund, our efforts at region-building are bearing fruit.

I am amazed by the accomplishments of our WHIN staff, led by our CEO, Johnny Park. Under Johnny's leadership, the great team he has assembled is advancing the WHIN goals and objectives every day. Each week is filled with new developments, the creation of new relationships, new opportunities, and steady progress on the many initiatives outlined in our proposal. As you know, the
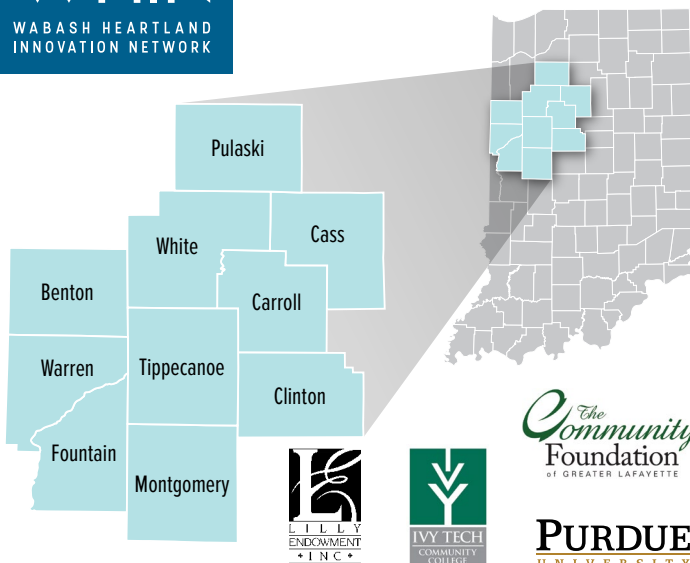
work we have launched is complex with many moving parts, while at the same time we are working to create a regional identity. Johnny and his team are focused and skilled — and I have no doubt they will succeed in delivering the results we envision.

Our faithful Board of Directors is also active and engaged. At this time, we are developing our Board Governance structure and policies under the leadership of board members Dave Luhman and David Bathe. Both our Manufacturing Advisory Council (MAC) and our Agricultural Advisory Council (AAC) are bringing together leaders from the region to guide and inform the development and creation of testbeds or "observatories" at Purdue and Ivy Tech, but also in other areas of our region. We have launched our Regional Cultivation Fund within the past month and our first Proposers' Day featured 34 speakers who provided outlines of work they envision for planning or implementation grants that focus on improving our region's quality of place. This report will provide much more information on these efforts, as well as the multitude of other work that has taken place since our last report. I hope in reading this report, you can get a sense of the great and exciting work that is underway because of your investment in the Wabash Heartland Innovation Network. We cannot thank you enough for the great gift you have provided. As I frequently state, this is a once in a lifetime opportunity for our region.

Gary D. Henriott, Chairman

WHIN
WABASH HEARTLAND
INNOVATION NETWORK

10 **Indiana Counties**
make up the WHIN region

Pulaski
White
Cass
Benton
Carroll
Warren
Tippecanoe
Clinton
Fountain
Montgomery

$38,900,000
for community development efforts
across the WHIN region

WHIN Initiatives

IoT Infrastructure & Data Analytics:
Development, Implementation & Engagement

Digital Agriculture
Engage agriculture producers/businesses in the region and develop agriculture IoT testbeds.

Next-Generation Manufacturing
Enable real-time analytics of manufacturing systems and develop manufacturing IoT testbeds.

Regional Cultivation & Living Lab Initiatives
Invest in innovative place-making projects that increase education, vitality, and connectivity.

The Community Foundation of GREATER LAFAYETTE
LILLY ENDOWMENT INC
IVY TECH COMMUNITY COLLEGE
PURDUE UNIVERSITY

WHIN Overview: **Data Decagon**

Johnny Park, CEO of WHIN

There is a worldwide revolution coming, the size and scope of which is unprecedented. The spread of innovation, miniaturization of sensors, and ubiquity of the Internet has led to an Internet of Things evolution. Moreover, this awakening is a once in a generation technological revolution. Think of how the printing press forever changed the way the world consumes information, or how the industrial revolution transformed the global standard of living, or how the electrification of the world moved civilization forward. Soon, the lights will be forever turned on and the world will be connected, analyzed, and understood like never before.

Pockets of innovators will embrace this technology faster than others, and benefit from the increased speed, better decision-making, and ability to predict the future. We, right here in the Wabash Heartland, have the opportunity to be one of those lucky clusters. This sensor and data technology won't grow in a vacuum. It will flow to where there are already industries with lots of manual inputs and time-sensitive decisions required. It will be built opportunistically on top of healthy communities with existing socio-economic ecosystems. It is estimated that by 2035, the average farm will generate about four million data points every day. Right here, among the 10 counties of North-Central Indiana, are some of the national leaders in agricultural innovation. We produce more corn and soybeans per acre than the national average, and we are the home of Purdue University, which boasts among the highest-ranked Colleges of Agriculture and Engineering in the country. This same region includes over 372 manufacturers accounting for over $4.5 billion of the state's economy. Indiana is also the No. 1 steel producing state in the U.S., the No. 2 auto producing state, and has the highest concentration of jobs in manufacturing in the nation!

Add to that some of the highest quality of life, best cost of living around, plus midwestern values and a legendary work ethic, these 10 counties, this Data Decagon, is better positioned than almost any place in the world to seize this opportunity. The time is now. Join us and be a part of making the Wabash Heartland a global leader in agriculture and manufacturing for the next generation.

We're smarter together.

September 2018 — February 2019: **Key Highlights**

Regional Engagement

2018 Regional Engagement Statistics:

- 165 individual regional stakeholders were directly involved in Purdue/WHIN gatherings during the year.

- 107 individuals were active participants in our Manufacturing Advisory Council, Ag Advisory Council, and Broadband Task Force, volunteering 2000 hours of time valued at nearly $50,000.

- 12 IoT and UAV demonstrations/events were hosted by WHIN, with 83 adults, 90 high school students, and 150 Purdue students in attendance.

- 56 individual Purdue students were directly engaged in WHIN-related projects or activities.

Regional Engagement *(Cont'd)*
WHIN Broadband Task Force (BBTF) Regional Collaboration:

For nearly a year, this group has been meeting on a monthly basis with the goal of increasing rural broadband access in the 10-county region. On March 4, 2019, the BBTF reached a milestone when its members (mostly Internet Service Providers, ISPs) agreed to share the specifics of their digital footprint with the PCRD in order to create an alternate map showing the "real" served and unserved areas of the region, challenging the FCC 477 data currently being used as the benchmark. The BBTF signed the official NDA & MOU and enjoyed a champagne toast to celebrate the accomplishment!

Figure 1:
(top) WHIN's Broadband Task Force toasts to regional collaboration and rural connectivity, as (middle) Benton LEDO Paul Jackson pops the cork and (bottom) VP of Regional Development, Melinda Grismer, pours the champagne.

Statewide Engagement
Skillful Indiana Engagement:

During the months of January and February 2019, the dialogue that began between WHIN and Skillful in the summer grew into meaningful collaboration. Ted Fiock, WHIN-Purdue Manager, is heading up the Skillful engagement with Indiana's new director Bill Turner, who was introduced to the WHIN team. Skillful shared their initial implementation plans for the WHIN region, and Purdue shared Purdue Extension's plans to support potentially five to six Extension personnel statewide to submit applications to the Skillful Governor's Coaching Corps. One of those applicants will be from the WHIN region.

Purdue Ag Fish Fry:

Every year on the first Saturday of February, the Purdue College of Agriculture hosts a statewide event showcasing its programs and partners during a mid-morning networking session followed by a luncheon at the Indiana State Fairgrounds. The event is always attended by state and national level officials, as well as Purdue dignitaries. This year, Purdue President Mitch Daniels highlighted WHIN's accomplishments in his introductory speech. WHIN was also present with a display, explaining to a statewide audience the significance of its regional work.

Figure 2: WHIN Booth at the Ag Fish Fry, manned by WHIN-Ivy Tech Manager Chad Martin and WHIN's VP of Regional Development, Melinda Grismer.

National Engagement

Microsoft:

In February 2019, WHIN hosted Dr. Ranveer Chandra, who leads Microsoft's FarmBeats program and is indirectly engaged with Microsoft's Indiana Airband plans. A majority of WHIN-Purdue representatives were engaged with Dr. Chandra during his visit, with multiple meetings, visits, tours, and presentations. Purdue and WHIN believe that a Microsoft partnership would have many benefits to all parties, especially the 10-county region. WHIN is hoping to engage Microsoft in at least one of the upcoming Regional Cultivation Fund planning and implementation grants.

National FFA Convention:

In October 2018, WHIN's CEO Johnny Park spoke at the FFA Blue Room on the Blue Stage.

Figure 3: Johnny Park speaks to FFA members on the "Blue Room" stage at the national FFA Convention on October 26, 2018.

International Engagement

Solinftec:

In November 2018, Solinftec (SOL-inf-tek), a digital agriculture company that grew quickly in Latin America by making sugar cane and row crop operations more efficient, announced that it plans to establish operations at its U.S. headquarters near Purdue University to bring high-tech solutions to American farmers, creating 90 jobs in 2019 and up to 334 high-wage jobs by 2022.

Another factor in Solinftec's decision was the opportunity to work with the Wabash Heartland Innovation Network (WHIN). "Just within the WHIN region in north-central Indiana, there are over 5,000 farms that could benefit from the insights generated by Solinftec's ability to capture data from various sources and use that data to create predictive analyses," said Johnny Park, CEO of WHIN. "They are an example of what is possible here and having them as a local leader will help us show others what is possible too. Together we can help our farmers be the best they can be."

Solinftec's CEO Daniel Padrão, pictured below, met with the WHIN Ag Advisory Council in March to discuss potential offerings for the WHIN Alliance and to receive feedback from local growers regarding how his technology could best be utilized and implemented.

Figure 4: Solinftec, a leading digital ag company based in Brazil, just announced the location of its U.S. headquarters near Purdue University. Solinftec connects machines and sensors to give farmers access to real-time information to help improve growing efficiency. *(Image provided by Brian Powell Photography.)*

Digital Agriculture: **From Theory to Practice**

In Fall 2018, 17 graduate students in Tony Smith's computer and information technology course at Purdue partnered with faculty and administration at Ivy Tech to tackle a WHIN digital agriculture project. The goal of the project was to create a sensor communication system consisting of currently available IoT devices, technologies, and practices to measure soil moisture, temperature, and weather conditions.

Divided into three student-led teams, they moved from the theoretical to the practical. The hardware team designed how the sensors would be housed in their casings (Figure 5) and how equipment would be put together both in the field and

Figure 5:
(below) Purdue Graduate Student and project leader, Trevor Mamer (right), works with his hardware teammates to encase and install the sensors (left) in Ivy Tech's field laboratory.
(Images provided by Brian Powell Photography.)

on the tower atop Ivy Tech's Lilly Hall. The software data team worked on the data collection system and analyzed a week's worth of data that was collected from the Ivy Tech field lab. The app team created a smartphone app for farmers to use in deploying predictive irrigation management. The app delivers data regarding the exact targeted amount of water needed for a particular acreage, helping them make better decisions that could lead to reducing over-application practices, saving water resources, and conserving energy usage.

"The students were successful in collecting the data and utilizing their problem-solving skills to initiate the first IoT sensor data collection on the Ivy Tech campus," said WHIN-Ivy Tech Manager, Chad Martin. "It allowed these students to have a location for testing and trouble-shooting."

The beta test helped Ivy Tech identify potential challenges with the field laboratory, such as the need for a sustainable power source for the sensors; solar is being investigated. In the future, projects at Ivy Tech's field laboratory will be staffed by both Purdue and Ivy Tech students.

"We launched this project looking to continue the relationship with the students in this particular class," explained Martin. "We are finding ways to involve Ivy Tech students so they can be involved in set up and maintenance of the sensors, as well as the end-to-end system."

Digital Agriculture: From Theory to Practice *(Cont'd)*

Learning to Fly

Purdue Extension finalized the UAV Signature Pilot Program, which was launched in the WHIN region in March 2019. The course reached its capacity of 18 adult learners a week before the course was scheduled to start.

The Purdue Cooperative Extension Service, in cooperation with WHIN, is piloting this UAV Signature Program teaching individuals UAV technology legal requirements, FAA Part 107 Remote Pilot Knowledge Test preparation, and useful UAV applications. "All participants receive hands-on experience flying manual and planned UAV flights," explained John Scott, Digital Ag Extension Coordinator for WHIN, "and they take home their own Tello UAV." This first pilot program was launched at the Clinton County Fairgrounds in Frankfort.

Figure 6: A participant in the UAV Signature Pilot Program spends time outside flying her drone for practice before taking the knowledge test.

Ag Engagement

Figure 7: Karen Plaut, Dean of Purdue's College of Agriculture, leads the WHIN Ag Advisory Council on a guided tour of the Indiana Corn & Soybean Innovation Center just outside of the Purdue University campus.

Figure 8: (right to left) CEO Johnny Park visits with Bob Hubner and his son, Doug, on top of their grain drying facility at their Warren County farm to discuss their need for and interest in the WHIN Alliance.

Next-Generation Manufacturing: We've Got a Match!

What happens when a metals recycling company, a spring manufacturer, and a fabricator all get in the same room? They learn about resources that they never knew existed before the WHIN-Purdue team connected them!

Andy: I really wish there were a spring manufacturer in this 10-county region.

Todd: I'm a spring manufacturer; in fact, there are three spring manufacturers in the WHIN region.

Andy: Are you kidding me??!!

Todd: Well, I'm glad I solved your problem, but I really need a company that can provide cut-to-length steel in this 10-county region.

Clem: That's a huge part of our business. When do you need it delivered?

Todd: I didn't know that!

Andy: We end up spending $60,000 on a company out of Indianapolis to rig our equipment, do you know of any riggers closer than that?

Clem: Yes, there's one right here in Lafayette!

HUH? How could three industry leaders from the same region not be aware of each other's core competencies? Well, according to the Purdue Center for Regional Development (PCRD), the manufacturing industry in the WHIN region has a total supply chain demand of $5.57B. But only $0.81B (or 15%) of the demand is supplied within the region, which leads to a supply chain leakage of 85 percent. WHIN believes one of the ways to reduce the leakage is to provide a digital supply chain tool that would allow the companies in the region to easily identify potential suppliers by specific capabilities and requirements needed for the job.

"We have companies in the WHIN region that are both suppliers and manufacturers, and they want to move up the value chain," said Steven Dunlop, Managing Director for the Management of Manufacturing Enterprises. "They can use the digital supply chain tool developed by Purdue University to optimize their ability to do that. WHIN can assist them in finding local suppliers, reducing their logistics costs, and making stronger connections in the region where they live, work, and play."

Figure 9: WHIN's VP of Engineering, Jack Stucky (left), explains the Digital Supply Chain Tool to a WHIN region manufacturer and receives feedback for implementation. *(Image provided by Brian Powell Photography.)*

Digital Supply Chain: On Display

An early prototype of the digital supply chain tool (Figure 9) was shown at Purdue's Global Supply Chain Management Initiative Conference on Feb. 15, 2019 (Figure 10). Companies based in the WHIN region who were attending the conference checked out the booth where WHIN's VP of Engineering showcased the design features and asked for feedback regarding enhancements.

"The tool has value, but the convening of people to understand what's available to them — and to "buy-in" to regionalism — is the real power of WHIN's digital supply chain," said Jack Stucky, VP of Engineering for WHIN. "The tool is the how, and regionalism is the why. At the end of the day, that's what it's really all about."
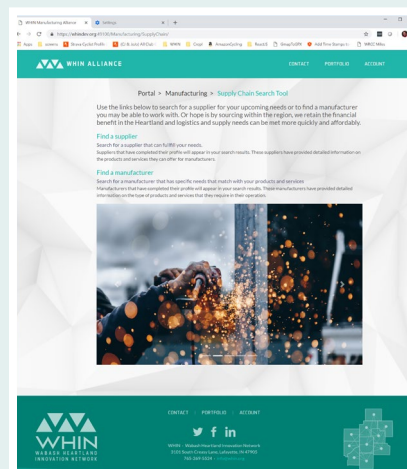
Figure 10: Screen shot of the prototype.

Peer Group Networking

WHIN's manufacturing education team formed the first WHIN regional peer group from non-competitive manufacturers in Pulaski, White, and Cass counties. Up to 10 company groups will meet six to eight times annually with the objective to inform, cooperate, and test out projects of common interest.

"Peer groups have created a platform for like-minded companies in close proximity to share best practices, problem-solve, and present the products and services their company has to offer," said one of the peer groups' first members, Bryce Brumm, president of Standard Industrial in Winamac. "They are able to use the experience and expertise of the Purdue facility to present topics of discussion that are relevant and helpful to every member of the group. The value of peer groups will be evident in those companies that tap into the wealth of information in their backyard."

Since they began meeting in late Fall 2018, peer groups have spawned other special interest groups in education and supply chain, as well as regional cooperation and project groups. The first of these is an ERP (Enterprise Resource Planning) Special Interest Group. Topic areas for this group include value-stream mapping, business cases for investment, coaching skills for supervisors, staff retention best practices, on-boarding, and leadership. Two regional cooperation and project groups will be launched in April 2019. Comprised of companies that are "next door" and non-competitive, there is a higher potential for real collaborative synergy to drive change and innovation.

Figure 11: It's all about collaboration! Even though the WHIN manufacturing education team pictured above (left to right: Dr. Angus McLeod, Roy Vasher, Steven Dunlop, and Dr. Ananth Iyer) knows that is true, it is still exciting when theory becomes practice like it has in the WHIN region.

Ribbon Cutting Ceremony

The Manufacturing Design Lab opened at Purdue's Indiana Manufacturing Institute (IMI) on January 30, 2019, with several hundred industry and distinguished guests in attendance. This is the first of two WHIN testbeds to be located at IMI. The Manufacturing Design Lab is a research space dedicated to the technology-driven future of manufacturing in Indiana and across the globe. "This laboratory provides a space to bring together Purdue resources and manufacturing expertise from across Indiana to create new ways to maximize the opportunities presented by digital manufacturing," said Purdue President Mitch Daniels.

Figure 12: Purdue President Mitch Daniels speaks at the Manufacturing Design Lab celebration on January 30, 2019, and afterwards Purdue and state officials hold a ribbon-cutting ceremony. *(Images provided by Brian Powell Photography.)*


Jan-Anders Mansson, a Purdue distinguished professor of chemical and materials engineering and the manufacturing lead faculty member on the WHIN-Purdue team, developed the laboratory. "This new space will serve as a testbed for Indiana companies developing advanced manufacturing systems — and will help amplify WHIN's work with industry leaders in the region."

The second phase testbed (Digital Manufacturing Enterprise Testbed) is scheduled for completion in June 2019, along with Ivy Tech's planned Advanced Manufacturing Testbed in Spring of 2019. "The tsunami of digital manufacturing is here, and Purdue and the state of Indiana are ready to tackle the challenge," Mansson said. "It is exciting to come to Indiana from Switzerland and use this space to test what is possible in manufacturing as we move into Industry 4.0, the next wave for advanced manufacturing."
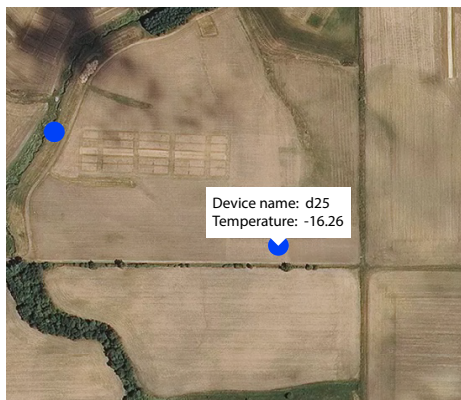
IoT Infrastructure and Data Analytics: **Proving Ground**

Arctic air blasted into central Indiana in late January, dropping temperatures to below -11 with wind chills that dipped to -42 at the Throckmorton-Purdue Agricultural Center (TPAC). While all the livestock were hunkered down in warm shelters to weather the storm, WHIN researchers Harris and Nithin were cheering from campus as their wireless Ag sensors continued to provide field data. This milestone test melted away any concerns about the ability of their WHIN-developed sensors to survive the extreme Indiana winters. (Figure 13)
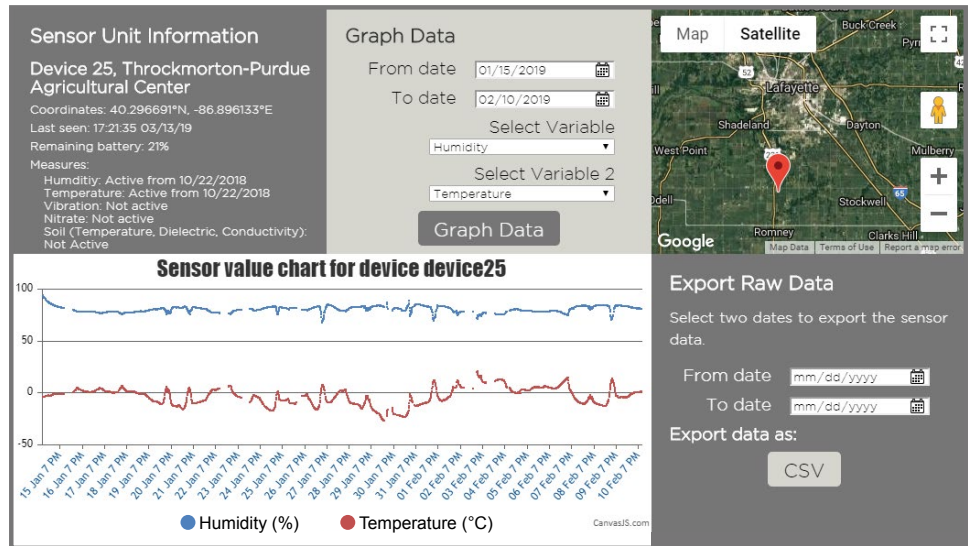
Figure 13: Temperature and humidity values collected by a sensor at the TPAC during the months of January and February 2019.

Figure 14: Close-up on the location of the sensor using the mapbox visualization module.

For the IoT infrastructure and Data Analytics team, the last six months have been an effort to optimize ag and manufacturing sensors and their packaging. Under the instruction of Professor Ali Shakouri, the Mary Jo and Robert L. Kirk Director of the Birck Nanotechnology Center, who is also the lead faculty for the WHIN-Purdue team, a dozen of students, postdocs, and researchers facilitate the work of making WHIN's sensors a reality for the region awaiting their implementation.

The team includes:

• Nithin Raghunathan, Research Scientist in the Birck Nanotechnology Center and Charilaos (Harris) Mousoulis, a Sr. Research Scientist at the School of Electrical and Computer Engineering, who work closely with the different research groups facilitating their collaboration and providing guidance and support. Professor Rahim Rahimi in Material Science and

Engineering is leading the digital ag sensor and deployment group.

• 3 students and researchers are working on low-cost sensors for soil nutrients and for machine health monitoring.

• 4 students design and program the embedded-electronics for each sensor node, perform the final layout, assembly, and packaging, aiming for endurance and robustness against the extreme weather conditions. They also work on the adaptive, low-power, wireless sensor network, as well as the data storage in the cloud and the open-access, online visualization.

• 3 students implement machine learning techniques for data- and physics-driven prediction of the custom, low-cost nitrate sensor. They also streamline in-sensor analytics for temporal and spatial data compression and anomaly detection.

"We have been collecting data for many months, and we have validated that the sensors are robust and work as they are supposed to," said Raghunathan. "Now, we are expanding the functionality to work with commercial soil sensors from METER Inc. that have been installed at TPAC. Dr. Margaret Gitau, Associate Professor of Agricultural and Biological Engineering uses them at a test sites in TPAC to check water runoff, soil moisture content, and other parameters. The next step is the validation and implementation of WHIN's custom nitrate sensors at TPAC, ACRE, and Ivy Tech. This is a critical next step for wider implementation across the region's emerging testbeds."

Sensor improvements over the past six months have included:

- Low-cost, scalable printing of hundreds of nitrate sensors (being perfected in the lab).

- Increased wireless capability (allowing for a dynamic, robust mesh-network that automatically reconfigures when a new sensor is added).

- Optimization to make sensors more efficient (with communication traveling longer distances).

- Sensor analytics, sending data only when necessary (in order to reserve power, increase the lifetime of the sensor, and make the data easier to monitor).

As impressive as all these improvements are, Mousoulis says the most rewarding part of his job is seeing the students' motivation and drive towards their goals — and the overall goal of regional connectivity and prosperity. "The weekly meetings with the students are very exciting to me because the benefit to them and to the community is apparent," said Mousoulis. They're making an important connection — seeing how their work solves the problems of regional stakeholders. It's something that I'm glad to see every week."

Figure 15: Purdue Graduate Student Jose Waimin (left) and Post-Doc Hongjie Jiang perform a routine check on the experimental IoT wireless soil sensor and install the newly developed nitrate sensor in the field water run-off at TPAC. *(Images provided by Brian Powell Photography.)*

Bio Town Ag: Sensors Come to White County

Members of WHIN's Agriculture Advisory Council, as well as WHIN-Purdue researchers, recently visited Bio Town Ag to further discussions about deploying commercial vibration sensors. When deployed later this spring, these sensors would monitor six motors in Bio Town Ag's energy center, similar to the pilot study currently ongoing at Tate & Lyle in Lafayette, IN.

"The manufacturing students and faculty engaged in the WHIN effort work very closely with the IoT group. We understand the industry-related challenges and can map these needs into technologies that the IoT team can then provide. Next we take their technologies and use them to help address our industry partners' needs," noted John Sutherland, the Fehsenfeld Family Head of Environmental and Ecological Engineering, and one of the world's leading authorities on smart/sustainable manufacturing. "Bio Town Ag is interested in improving the performance of one of their digestors, a piece of equipment that processes organic matter and produces methane gas. "We are helping Bio Town Ag keep this digestor operating at maximum efficiency which will improve profitability," noted Sutherland.

Smooth operation of the digester depends on it having the proper moisture content. Thus, the IoT group is developing a humidity sensor for the gas outlet of the digestor that the manufacturing group can implement. Because of its special application, this project will be executed through TAP40 program funds but observed by WHIN-Purdue researchers who will look for other similar applications in the WHIN region.

All of these real-world projects are bringing the research of the university to the farms and fields of WHIN region residents. "I love it when we (the IoT Infrastructure & Data Analytics team) visit one of the counties, and a farmer or manufacturer responds by saying: 'Wow! I could really use this!' said Mousoulis. "Knowing that there's an application for our work is the best part."

Figure 16: Aerial view of Bio Town Ag. *(Photo courtesy of Allen Furrer, Bio Town Ag, Inc.)*

Regional Cultivation Fund (RCF): **Round 1**

Winter 2019 was a whirlwind of activity for the WHIN staff as they officially launched the Regional Cultivation Fund on a tight timeline (Figure 17), inviting regional stakeholders to share ideas and engage with fellow community members in the pursuit of big impact, multi-county, IoT-related, quality-of-place initiatives.
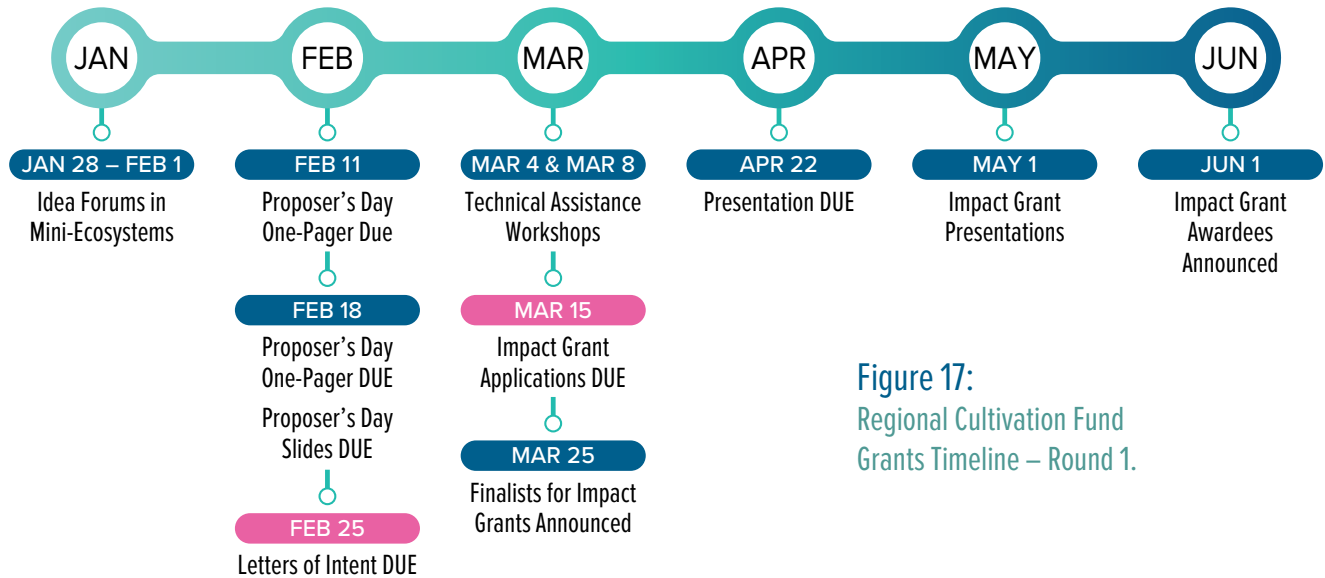

JAN — **FEB** — **MAR** — **APR** — **MAY** — **JUN**

JAN 28 – FEB 1
Idea Forums in Mini-Ecosystems

FEB 11
Proposer's Day One-Pager Due

FEB 18
Proposer's Day One-Pager DUE

Proposer's Day Slides DUE

FEB 25
Letters of Intent DUE

MAR 4 & MAR 8
Technical Assistance Workshops

MAR 15
Impact Grant Applications DUE

MAR 25
Finalists for Impact Grants Announced

APR 22
Presentation DUE

MAY 1
Impact Grant Presentations

JUN 1
Impact Grant Awardees Announced

Figure 17:
Regional Cultivation Fund Grants Timeline – Round 1.

December 2018: **WHIN on the Road**

Fifty regional stakeholders attended WHIN's Road Show held in Montgomery, Tippecanoe, and White counties in mid-December. The purpose of the Road Show was to explain WHIN's progress, roll out the Regional Cultivation Fund (RCF) process, point potential RCF applicants to recently developed online data resources, and obtain feedback about how WHIN can better serve the region's capacity-building needs. WHIN's CEO, Johnny Park, and Vice President of Regional Development, Melinda Grismer, received valuable input from the attendees that helped WHIN move forward into the launch of the Regional Cultivation Fund.

January 2019: **WHIN Forums Spark Ideas**

WHIN staff visited six of the region's counties with Idea Forums to spark community creativity and networking after the official announcement on Jan. 15, 2019, that WHIN's Regional Cultivation Fund was "open for business." In total, 97 regional stakeholders participated in Benton, Cass, Clinton, Montgomery, Tippecanoe, Warren, or White County Ivy Tech and Purdue Extension facilities, where the forums were held. Attendees were actively engaged in "speed networking" and "sticky wall" brainstorming activities. Their ideas were captured and categorized into the Top 10 most frequently mentioned priorities across all counties (Figure 19).
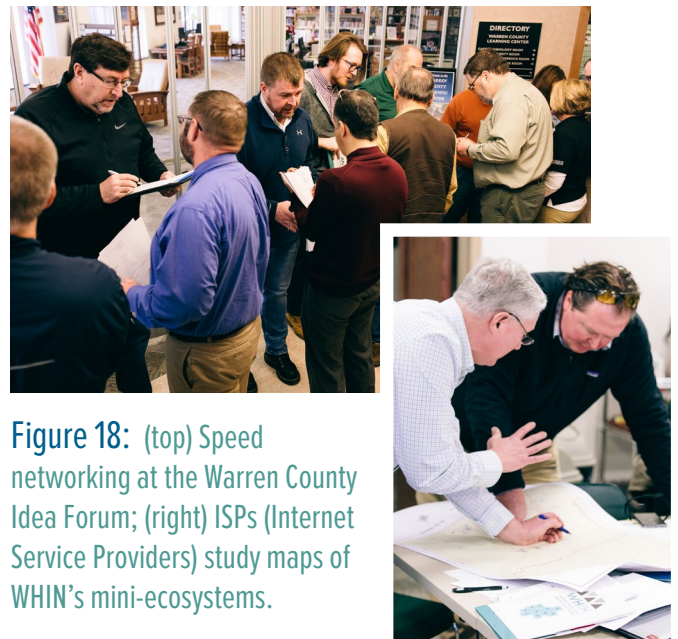

Figure 18: (top) Speed networking at the Warren County Idea Forum; (right) ISPs (Internet Service Providers) study maps of WHIN's mini-ecosystems.

Top **10** Ideas

1. Rural Broadband
2. Trails
3. Education
4. Innovation Hubs
5. Connecting Communities
6. Workforce Development
7. Healthcare
8. Waterways Access
9. Support and Potential Partners
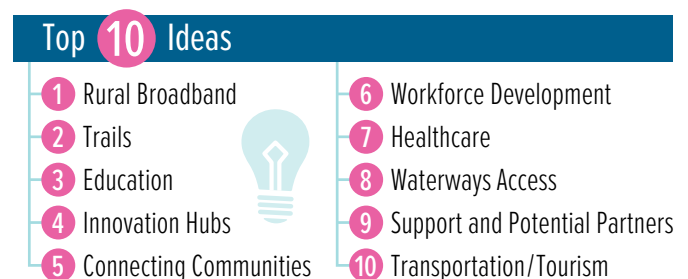10. Transportation/Tourism

Figure 19: Results of Stakeholder brainstorming forums.

Regional Cultivation Fund (RCF): **Round 1** *(Cont'd)*

February 2019: **WHIN Hosts Proposer's Day**

More than 110 people representing all 10 counties in the WHIN region attended Proposer's Day on Feb 18, 2019. The main purpose of Proposer's Day was to spur collaborations and partnerships for quality-of-place projects focused on vitality, education, or connectivity that will be funded through the $10 million Regional Cultivation Fund. Twenty-five organizations presented their ideas for planning and impact grants, and nine other organizations presented the resources and expertise they could potentially offer to support the project ideas. To jump-start the event, Purdue Coach Nick Holt gave an inspiring message about the importance of teamwork and the power of collaboration.

The proposed projects were wide-ranging but with several similar ideas that could merge into one project to receive grant money. "We're trying to see how many of them are like-minded and could join forces," said Ron Dickerson, who serves as the Montgomery County representative on the WHIN board. "There were some common themes that we saw. The idea now is to see if there's some collaboration that can occur across the region." The WHIN regional cultivation fund grants committee will review proposals and make recommendations to the WHIN board.

Some of the initial proposals included:

- Kara Webb, director of Workforce Development for the Greater Lafayette Commerce, proposed a 10-county plan that would provide K-12 students with activities, including robotics and coding, to educate and develop skills that are critical for careers in manufacturing.

- Craig Newby, Director at Wabash River Career & Technical Education Center, proposed the launch of a new precision agriculture course serving five regional high schools, which includes students from Warren, Fountain, and Benton counties.

- Three different projects based around connecting outdoors enthusiasts with information about various outdoor locations throughout the region were proposed. The ideas included a smart phone app or website where individuals can access information typically found in park brochures, check real-time conditions on hiking/biking trails at their favorite parks and where canoers can see water levels and water quality on rivers or creeks.

- Allyson Mitchell of the Indiana Recycling Coalition proposed a planning grant to scope out the possibility of a regionwide curbside recycling program.

- A rural broadband solution for installing access to underserved areas in ''mini-ecosystems'' throughout the 10-county region was proposed by Christy Householder, Cass County LEDO and member of the North Central Regional Planning Council.

From these efforts 35 LOIs (Letters of Intent) were submitted to WHIN for consideration. After an initial review process, nine planning grants and seven impact grant applicants were invited to move forward in this first round. In the month of March, technical assistance workshops will be held with each applicant to assist with the process of completing the application.

Figure 20:
(top left) WHIN Trails Team gets together during a break at Proposer's Day to discuss how to collaborate on a planning grant; (top right) Karthik Ramani discusses how he can implement his IoT technology at the Carroll County Rural Innovation Center; (middle left) Tetia Lee of Tippecanoe Arts Federation presents her case for IoT-enabled murals in all 10 counties; (middle right) Purdue Coach Nick Holt gives an inspiring Proposer's Day message; (left) CEO Johnny Park gives instructions for how proposers are to proceed with their four-minute presentations.

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 has begun construction. It is expected to be widely sensored by 2020. • The ABE building is well under construction; it will include large bay 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 human-centered design for digital agriculture solutions.
20 demonstrations and/or teaching initiatives per year.	• ABE Facility has begun construction. It is expected to be widely sensored by 2020.
Proposals submitted for 3 community-linked research projects connected with the facility per year, post sensor installation.	• ABE Facility has begun construction. It is expected to be widely sensored by 2020.
2 new technologies/intellectual property filings per year generated by the testbeds, which will result in new startups and products launched in the WHIN region.	• ABE Facility has begun construction. It is expected to be widely sensored by 2020.
$3.5 million of research expenditures in the testbeds from industry and government sources, post-sensor installation.	• ABE Facility has begun construction. It is expected to be widely sensored by 2020.

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).	• A master testbed elements plan is being formalized for the ACRE location. This plan incorporates focus areas of Micrometeorology, Postharvest research, Water Quality field station/sensors, UAVs, and Machine Data. Further details for each focus areas forthcoming. • Met with Jeff Fields of ASREC to discuss deployment of FarmMobile pucs and ISOBlue devices. • IoT meeting at ACRE in December 2018 with faculty and AgIT. Developing workshop on data flow out of ACRE facilities. • Dr. Somali Chaterji, who was hired as Research Assistant Professor in ABE, will be actively engaged in planning for data collection and analysis directly related to WHIN. • WIFI over TPAC design of experiment for connectivity is complete with plans for data collection through the growing season of 2019.
20 demonstrations and/or teaching initiatives each year.	• Scott presented UAV demo/talks during Crops Field Day at ACRE. Over 100 farmers/Ag professors (many from the WHIN region) attended. The field day event made the front page of Farm World newspaper. • Scott and Rossville FFA taught 5 classes showcasing UAV technology with over 100 students participating. Focused on row crop and other Ag-related uses. Plans to continue with future events. Ag Tech and Innovation class toured ICSC. • Ag Tech and Innovation Apps and Apps night in November 2018 with 9 student participants. • As part of the Digital Ag and Extension UAV websites being developed, the WHIN Ag group is looking to produce a series of four 5-minute videos on various digital Ag topics to be integrated into possible online courses, but also availability through the websites planned. • Dr. Chaterji gave invited talks on "Applied Data Science and Engineering for Healthcare and Precision Ag" in the following research centers/top institutes in January 2019. • Dr. Chaterji invited to UCLA for a talk on Applied Data Science and Engineering for precision medicine, talk also includes discussions about domain-specific cyber-infrastructures that she is building for genomics and precision ag. The goal is to disseminate digital ag and WHIN-related activities to top schools in the U.S. and abroad.

Proposals submitted for 3 community-linked research projects connected with the facility per year, post sensor installation.	• Although this activity is post-sensor installation, WHIN has a highly engaged WHIN Ag Advisory Council consisting of agricultural leaders from the region. These meetings have led to conversations regarding future projects in the region, as well as interested parties to hosting regional testbed sites. • NIFA NEEDS proposal prepared for USDA Masters fellowships in precision ag (Chaterji, Buckmaster, and others). • Dr. Chaterji and others submitted 2 proposals for papers on Precision-Ag-related topics through Purdue's Giant Leaps solicitations – one in which a new partnership was started with Microsoft Azure and another in which the team will use machine learning (ML) for desirable phenotypes in plants and livestock.
2 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 working on a new framework to adaptively change the configuration parameters of large-scale (NoSQL) databases, in clustered node environments, to deploy this framework for digital ag data, working with queries that come in to the "data lake" testbed.
$2 million of research expenditures in the testbeds from industry and government sources, post-sensor installation.	The WHIN-Purdue team has extensive grant opportunities pending: • FACT: Coordinated Innovation Network for Applications and Data Architecture for Real-Time Crop and Soil Data Systems – $1 million proposal submitted under the USDA's Food & Ag Cyberinformation Tools program is still pending approval. • USDA NIFA REEU proposal titled "Experiential Learning with Data Tools for Digital AgriScience and FACT" was funded for $500,000. This will help address Aim 3.1.4 (Buckmaster, Saraswat, Krogmeier, Ward). • Submitted a 2-page letter of intent to USDA's Rural Development Innovation Center's Rural Workforce Innovation Network (RWIN) initiative to enable rural partners to share solutions to complex issues, identify available resources, and increase access to workforce opportunities. Although WHIN-Purdue was not selected for writing a proposal, we subsequently partnered with North Carolina State and are now a finalist with an upcoming site visit in Raleigh, NC. Buckmaster and Ogbe will be attending that site visit on March 2019 on behalf of WHIN-Purdue. • CONTxT, a metadata app, is ready for roll-out soon (before the spring planting season) with an initial focus on UAV flight records. Later developments will target all field-going activity. • Agricultural Science and Extension for Economic Development (AgSEED) – a proposal competition led by the College of Agriculture for $75,000 – 8 proposals were received in late March 2019 for graduate funding to advance agribusiness and farmer education in the WHIN region related to digital agriculture. • Open Ag Technology and Systems Center (OATS) has new participation in upcoming conference from Solinftec, Chore-Time Brock, IN10T, ARVA Intelligence. • OATS held annual conference in February 2019 in Rosemont, Ill., with several companies involved. Jack Stucky of WHIN attended. • Visit by Microsoft's Ranveer Chandra in February 2019 will likely lead to several avenues of collaboration and installation of FarmBeats. • Purdue group of Buckmaster, Krogmeier, Verma, Oliver, and Deering are pursuing Center for Produce Safety proposal based on biomarker sensors.

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.	• Sensors were initially installed at the 60-acre Field Laboratory on Ivy Tech Lafayette's campus in Fall 2018 as part of a Purdue-Ivy Tech collaboration in which Polytechnic and Ivy Tech students worked together to develop and install Internet WiFi throughout the testbeds to deploy the IoT capacity needed for data collection (see Digital Agriculture feature story). By June 2019, water quality sensors will also be installed in the water outlets in the field laboratory. Advanced Manufacturing lab will have the following sensors installed by the end of April 2019: • IFM Vibration sensors on air compressors. • IFM Vibration sensor on ventilation system in the welding lab. • IFM Air pressure sensor. • Data collection software. • Mechatronics trainer IoT simulation. • Data collection and transmission to Purdue/WHIN.
7 new courses will be developed.	• The WHIN Manufacturing Advisory Council (MAC) has been actively engaged in providing guidance on the beneficial training for the students graduating from the program. Future engagement with MAC will include workshops for industry, as well as video training modules. Advanced Manufacturing curriculum under development: • PAET 107 – Newly created Unmanned Aerial Vehicle course, with 3 new drone purchases. • ITSP "Fundamentals of IoT" is a new course which was approved by the Ivy Tech Curriculum Committee. • Newly installed Mechatronics trainer in the Advanced Manufacturing Lab will involve new IoT curriculum integration. • Congruent curriculum development will continue to occur as the testbed sensors are installed and data collected.
80 students will be engaged with the teaching lab each year.	• An anticipated 80 Ivy Tech students (and approx. 30 Polytech students) will be engaged with the initial Polytech-Ivy Tech sensor project, but the number of Ivy Tech students will grow significantly as both labs become widely sensored by 2019.
4 community-linked research projects connected with the laboratory per year, post sensor installation.	While the sensors have not yet been installed, Ivy Tech has played an active role in WHIN community engagement efforts: • WHIN-Ivy Tech Manager, Chad Martin, coordinates the WHIN Agriculture Advisory Council (AAC). In the last 6 months, he has hosted 5 AAC meetings at these locations: Indiana Corn & Soybean Innovation Center and Ivy Tech Lafayette in Tippecanoe County, Bio Town Ag in White County, Warren County Learning Center in Williamsport, and Ivy Tech Frankfort in Clinton County. • WHIN's Board of Directors met in the board room of the Ross Administration Building on the Ivy Tech-Lafayette campus in the months of September, October, and November 2018 and January 2019. • Ivy Tech campuses hosted 3 community outreach meetings with public officials throughout the region in December 2018 and 3 Idea Forums in late January and early February 2019. • Ivy Tech-Lafayette is the home of WHIN's office suite with a growing staff (currently 5 members, soon to become 7 members).

AIM 3.1.3: Establish IoT Testbed(s) Throughout the Wabash Heartland Region with Industry Partners

Anticipated Outcomes	Outcomes to Date
3 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 Broadband Task Force meetings continue as results from these activities will have a dramatic impact upon future community based IoT projects with Ag applications. • Continued development of UAV programs, demonstrations, UAV mobile display station, and UAV website will all be engagement tools for use across the WHIN region. • Metadata App is nearing initial rollout and will leverage data collection for a deeper learning project collection for deeper learning. • Buckmaster facilitated the Research Roundtable and Workshop February 2019 with HPE, Digital Ag, and AgIT, regarding IoT, data capture and storage, and data processing requirements as related to research in the College of Agriculture.
10 counties throughout the region will be engaged each year in community-linked IoT platform projects or training.	• Buckmaster and Erickson met with DTN to discuss development of weather station network and DTN's education program. The Purdue Ag team and WHIN staff are working together on this effort. • Buckmaster, Scott, and Erickson met with Purdue University Research Repository and AgIT Business Relationship staff to discuss data hub for agriculture as a potential storage site for WHIN Data. A position statement draft has been created. • Park, Grismer, and Buckmaster had follow-up call with USDA folks regarding programs of broadband funding support. • Buckmaster identified as PI for a Telemon proposal to bring connected and automated agriculture. • Idea: Get the Personal Food Computer for each high school in the WHIN region. It can be an IoT demonstration/education unit.
$.5 M of research expenditures in the testbeds from industry and government sources.	• USDA NIFA FACT proposal, if funded, will have extensive testbed and regional impacts. • New connection with the MIT Media Lab and Caleb Harper made. Partnerships will likely develop.

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.	• Erickson held multiple meetings with local school teachers, counselors, and administrators about using Purdue resources to enhance high school agriculture instruction related to digital agriculture. Proposals submitted for the Regional Cultivation Fund. • Erickson and Buckmaster attended AgriNovus event in Indianapolis in November 2018. Meetings were held in December 2018 and February 2019 between Purdue and AgriNovus to discuss future joint opportunities associated with WHIN. Met with Dan Dawes of AgriNovus in December 2018 to discuss certificate programs. Erickson met with Melissa Rekeweg, who starts with AgriNovus in April 2019, to discuss possibilities related to WHIN. • College of Agriculture's digital ag website is in final stages, which should greatly aid WHIN's education and Extension work. Targeted to be live mid-March 2019. • Education poster of current and planned programs and progress displayed in October 2018 at the WHIN-Birck event. • General education updates from Erickson; evaluated second round of student projects for AGRY 598 Precision Crop Management. • Interviewed 4 candidates for Agronomy e-Learning Project Manager. • Hired a consultant to build Digital Agriculture website, interviewed candidate masters student to assist with digital agriculture education, signed e-Learning contracts with AGCO and PepsiCo.
25 BS graduates per year in digital agriculture.	• Buckmaster and Erickson working with Dr. Jeff Holland regarding the proposed data science minor. Drs. Holland and Buckmaster prepared Data Science for Agriculture outcomes to present to Ag Curriculum and Student Relations Committee. Buckmaster presenting at Purdue Data Science Education Ecosystem. • Met with Purdue Global chancellor Dr. Betty Vandenbosch December 2018 to discuss possibilities of future courses, certificates, and degree programs delivered through their system.
50 certificates per year awarded on digital agriculture topics.	• Erickson began Fall Agronomy e-Learning class with 84 students. Discussions began regarding use of existing agronomy e-Learning modules for Purdue's proposed winter agriculture short course. Purdue Agronomy e-Learning program has awarded more than 1200 certificates since the program began, for Agronomy Essentials, Precision Agriculture, and Nutrient Management courses. • Held first project meeting with Purdue faculty and staff who will deliver the funded USDA REEU program. Some of the students funded through this program will perform data analytics with WHIN data. • Proposed UAV short course planned to be offered as a certificate program.
8 professional MS degrees per year awarded in digital agriculture.	• Professional Masters of Ag program in conjunction with Kaplan Higher Education (KHE) was officially approved at the Ag faculty meeting in December 2018. The Online Masters Degree in Digital Agriculture is approved and will commence in January 2020. There are also university efforts in data science education which will help us package programming for students who will be well-positioned to move from sensor data to actionable insights. Student recruitment to begin soon.

AIM 3.1.4 (Cont'd)

25 positions filled in critical needs areas (projected from baseline occupational skills needs assessment).	• PCRD will launch occupational skills assessment in January 2019 as the first step to fulfill this outcome requirement. Meetings between PCRD and Krannert are ongoing to capture work activities performed by Krannert in Year 1 of WHIN to jump start the assessment process. • Need to identify a means to quantify – perhaps in conjunction with Career Fair and placement services or Interns for Indiana.

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.	• Continued meetings and discussions with WHIN region ANR educators on constructive development of WHIN programs throughout the region. • Attended WHIN Broadband Task Force meetings and participated in sub-committee to identify where improving infrastructure is viable, along with testbed creation, to help ensure farming areas are part of mini-ecosystem plans in the WHIN region. • WHIN-Extension presented a UAV poster with case studies from Andrew Westfall, Jon Charlesworth, and John Scott. Extension Poster from Ana Ona, Bob Nielsen's grad student, outlined how UAVs are used in corn production. • Recent Idea Forums, Proposer's Day, and other Regional Cultivation Fund events were well-attended by Extension with good discussions from ag regional shareholders on opportunities.
Investment in a marketing campaign to brand Purdue Extension as the primary and trusted source of information on science-based digital agriculture innovations.	• Purdue Extension UAV website is up and running (https://extension.purdue.edu/UAV) with links to the WHIN website.
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 Extension developed a 15-hour, introductory UAV certification course that was first launched in the WHIN region in March 2019. This is an expanded version of the program with greater emphasis on the FAA certification process along with more practical uses (18 attendees for the pilot program in Clinton County). • Officially commenced a metadata app project; if successful, this app will allow various ag data points to be integrated in a way which doesn't currently exist. • Initial discussions underway to re-design and promote the Purdue Ag Short Course program with Digital Ag updates. The short course will focus on 2 courses: agronomy and precision agriculture. Tentative timeline to come. • Pursuing development of a small flock livestock tracking and management program. Goal is to better manage herd health in a cost-sensitive manner and then continue as an extension outreach program through the region. • Working to collaborate with WHIN, Co-Alliance, and Purdue ABE to track and record machine movement.

AIMS 3.1.5 (Cont'd)

Adoption of digital agriculture strategies by at least 15 rural communities, agribusinesses, co-ops, and/or ag-related nonprofits by 2022.	• Presented 'Digital Diagnostics for Decision Making' in Montgomery County for PARP credit in December 2018 (18 attendees). • Presented "UAV uses in Row Crops' at Carroll County Ag Association meeting in January 2019 (10 attendees). • Presented WHIN overview and answered UAV questions at White County Winter School in February 2019 with Andrew Westfall (8 attendees). • Flew UAV at Bio Town Ag (White County) through cattle barn to demonstrate potential cattle inventory use. • Promoted WHIN at the Purdue Ag Alumni Fish Fry by flying a small UAV and discussing drone technology (250 attendees). • Attended and flew UAV at Pulaski Cover Crop field day with applications to cover crops and cattle grazing. • Flew the UAV to help Tippecanoe SWCD/NCRS look at waterways/WASCOBs/gullies and invasive weeds. Impact of UAV work could speed up their timeline on making repairs. • Attended a meeting with Robeson Farms (Carroll County) to install a device in their combine to gather machine data. Learned how they manage their data. • Attended second meeting with Hubner Seed (Warren County) to talk through what WHIN is doing and partnership opportunities.

AIM 3.2.1: Establish a Testbed to Demonstrate, Teach IoT to Companies and Students
AIM 3.2.2: Establish a Testbed to Showcase Real-Time Sensor and Network Capabilities of WHIN-Area Firms for OEMs
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
YEAR 1	
Identify a relevant use case for demonstrating connectivity between OEM and supplier for design, production (including supply chain), and sustainment.	• Through Council meeting discussions and follow-up visits with several manufacturers, there is a strong interest from multiple parties to develop and demonstrate "case studies" for connectivity between OEM and supplier base. • Testbed facility will accommodate the range of digital integration capabilities that span the manufacturing enterprise as identified with WHIN manufacturers, researchers, and industry thought-leaders. • Demonstration modules under development include: advanced metrology (quality management, adaptive machining); MBx (model-based definition, work instruction); production optimization (cycle time, plant simulation); unplanned downtime avoidance (predictive maintenance through advanced sensors, control schemes and AI). • 1 industry partnering agreement is secured (Infor, https://www.infor.com/solutions/), signed agreement to be a demonstration partner, more than 6 others (including Forcam, Anark, and Sage Clarity) are prospective demonstration partners currently under development. • Detailed planning for the DMET testbed is underway, gathering all of the ideas from each of the Purdue teams as well as linking the educational aspects/purpose of the DMET. WHIN presented its plans to the Manufacturing Council at the February 2019 meeting to obtain critical feedback and inputs.

AIMS 3.2.1, 3.2.2, and 3.2.3 (Cont'd)

YEAR 1 (Cont'd)

Deploy commercial software, hardware, and middleware, establishing the DMET digital sensor and networking architecture, between laboratories on West Lafayette campus for prototype workflow/infrastructure.	• Establishment of 2-way communication using "MT-connect" with a Raspberry PI Linux-based system for monitoring and control of machinery has had direct application in DMET at IMI. • Multiple regional stakeholders have great interest in implementation of having factory floor connections to their legacy equipment; WHIN is working to demonstrate those current and existing technologies where applicable. • Deploying sensors at Tate & Lyle. Network and communication infrastructure are under development. A test of accelerometer sensor made by WHIN IoT group is done. Audio signals from a stethoscope are captured and analyzed for robot movements.
Design and plan DMET physical location at Indiana Manufacturing Institute (IMI) in Purdue's Research Park.	• Site design and build-out plans continue for IMI testbed, target completion Q2, 2019. • All approvals were secured to begin construction in 2019, target completion Q2. • Developed vendor and industry partnerships (software and hardware) for external support of testbed. • Core technologies installed (but looking to expand). • Work continues on build-out of IMI for testbed. Master testbed equipment listing and implementation planning continues.
Identification of the minimum product and systems information model to communicate between OEMs and suppliers.	• Project examples with WHIN manufacturers (Tate & Lyle, Nucor, Caterpillar) provide case samples for applying data analytics and IoT sensors for improved asset utilization. Similar projects can be adopted across all tiers of the WHIN supply chain. • Data analytics techniques were applied to construct a motor predictive maintenance system at Tate & Lyle. Motor failures are under investigation. • Compared the data from the Bluvision sensor with the data from the Tate & Lyle monitoring system to check whether the method was able to identify the motor condition correctly. • Determined the tools and capability required to auto-generate Model Based Work Instructions (MBWI) for various use cases with WHIN region companies.

Map the capabilities of companies in the WHIN region using digital tools for supply chain prototyping.	• This year 1 objective was to map the capabilities of the "80" WHIN companies in the region, however, after the project began, nearly 400 companies were found in the region. Therefore, work continues to map all 397 companies, of which about 300+ have been mapped and less than 100 remaining. Efforts therefore continue to:
	  - Extract data from the company websites.
	  - Focus on gathering a few attributes (type of company, products, and certifications/equipment).
	  - Use a web scraping program to collect data for different links on the websites.
	  - Classify company products using NAPCS codes (more than 60 completed).
	  - Mine text with natural language processing and extract image data.
	• 25 company's data points were used to prototype WHIN search tool for deployment via the WHIN-Purdue Web Portal.

AIMS 3.2.1, 3.2.2, and 3.2.3 (Cont'd)

YEAR 1 (Cont'd)

Connect with LEDOs or other economic development groups across WHIN counties to deploy supply chain prototyping tool.	• Number of companies for which data has now been collected stands at 347. Current target is 397 companies. Continuing to use and develop effective tools to gather and collect information from websites. • Met LEDOs to discuss supply chain tool and its usages at the Indiana Technology Corridor (ITC) bimonthly meetings. • Received request from Jody Hamilton (Tippecanoe County) to provide a list of aerospace suppliers in the 10-county region to support her efforts in attracting a new aerospace company to relocate into the region. Supply Chain group responded with a list of 16 companies within 4 hours. Jody was extremely appreciative. This is an example of how the digital Supply Chain Tool will impact LEDOs' efforts in the future when the portal is completely developed.
Work with OEMs to prioritize approaches to reduce supply chain leakage and record extent of leakage reduction.	• Manufacturing Advisory Council members have great interest in this supply chain tool, both SMEs (Small and Medium-Sized Enterprises), as well as large OEMs. This is viewed as a great business-to-business connector tool to improve internal WHIN B2B activity and reduce supply chain leakage. • WHIN demonstrated a prototype of the Digital Supply Chain search tool (using 25 separate company information pages to link to the main website) at the Global Supply Chain Conference in February 2019.
Work with individual companies to seek opportunities to collaborate by pursuing new business jointly.	• Met with procurement managers from OEMs, including Oscar Winski, to discuss supply chain tool. Council members have asked WHIN to host B2B "matchmaking" events as part of this process. • Equipment information has been collected for 45 companies (out of 80 companies researched, only 45 had their information available online); this information to be integrated into the Digital Supply Chain tool. • NE region collaborative group will meet again in March 2019 with 2 or 3 additional groups being formed in April 2019.

YEAR 2

Develop methods and processes for digital product and process data validation that are congruent with specific production, supply chain, and sustainment activities.	• Planned for Year 2.
Assess and quantify the human impacts and economic costs models for the previous item.	• Planned for Years 2 and 3.
Identify the information model necessary to support additional stages of MBD/MBSE throughout the enterprise.	• Planned for Year 2.
Identify requirements for predictive analytics architecture via DMET model.	• Planned for Year 2.

AIMS 3.2.1, 3.2.2, and 3.2.3 (Cont'd)

YEAR 2 (Cont'd)

Build-out space at IMI to establish location of DMET and acquire and place hardware.	• Planned for Year 2.
Identify satellite locations for DMET architecture at companies throughout the WHIN region.	• Planned for Year 2.
Expand deployment of supply chain prototyping tools at LEDOs or other entities.	• Planned for Year 2.
Work with procurement managers at OEMs to implement usage of supply chain prototyping tool.	• Planned for Year 2.

YEAR 3

Deploy and assess the digital product and process information model with partner companies and their supply chains.	• Planned for Year 3.
Have deployed full digital enterprise sensor and networking architecture and infrastructure within the DMET location.	• Planned for Year 3.
Develop prototype predictive analytics architecture and tools.	• Planned for Year 3.
Finalize satellite locations for DMET architecture at companies throughout the WHIN region.	• Planned for Year 3.
Establish additional technology adoption opportunities through mobile demonstrations.	• Planned for Years 2 and 3.
Deploy the next version of the supply chain prototyping tools that includes targeted certification and skill development at firms.	• Planned for Year 3.
Develop mechanisms to enable ROI for smart tool investments across the supply chain.	• Planned for Year 3.

YEAR 4

Deploy supply chain prototyping tools as web based resources to attract new manufacturing investments to the WHIN region.	• Planned for Year 4.

AIMS 3.2.1, 3.2.2, and 3.2.3 (Cont'd)

YEAR 4 (Cont'd)

Develop a link between the supply chain prototyping tool and DMET to enable digital exploration of supply chain capabilities.	• Planned for Years 2-4.

YEAR 5

Evolve the digital supply chains in the WHIN region to incorporate emerging technologies for smart manufacturing.	• Planned for Year 5.

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.	• Ivy Tech-WHIN Project Manager Chad Martin attends all WHIN leadership meetings, including the WHIN-Purdue monthly operations meetings. Martin is responsible for facilitating the WHIN Agricultural Advisory Council, which meets bimonthly. WHIN-Ivy Tech Manager, Chad Martin, has also assumed a leadership role within the WHIN staff as 1 of the 4 technical assistance advisors for the Regional Cultivation Fund.
Year 2 will be focused on recruiting students and setting up the sensored lab in preparation for the pilot.	• Planned for Year 2.
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).	• Planned for Years 3 and 4.
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.	• Planned for Years 3-5.

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 5-6 consultations per month in order to visit all of them within the first year, if possible.	• Engaged with 247 WHIN region companies to date. Work continues into early Year 2, yet Year 1 objective of 77 manufacturers has been far exceeded. • Created a list of companies not contacted — and assigned 1 member of the team to attempt to contact all remaining companies in January and February 2019. • Continuing to collect data on IoT knowledge and usage by these firms as well as other tracking information.

AIM 3.2.5 (Cont'd)

Develop relationships with all adult education programs in the region to find ways to collaborate with them in effectively appealing to the underemployed (during Year 1).	• Made WHIN presentations to Wabash Lean Group and Montgomery County Chamber/Economic Development groups. • Deployed first version of WHIN county database. • Met with half of the adult education and LEDO groups in the region (completion in Year 2).

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 and 2).	• Course design strategy will be to educate company employees at all levels to implement "smart" eco-system principles. Initial focus will be small groups of company leadership teams.
	
	• Developed Corporate Competency Framework for the WHIN Project:
	  - Assessed 72 WHIN-companies for corporate health.
	  - Conducted gap-analyses for corporate health.
	  - Qualified the specific, expressed needs for WHIN-Ed.
	  - Drafted WHIN-Ed intervention strategy for corporate health.
	  - Drafted WHIN-Ed strategy for sustainable corporate development, including Smart Eco-System technology to carry forward from 2022.
	
	• Designed curriculum around the content most needed by employee tiers (as exposed in the gap analysis) to increase their "value creation ability" and productivity.
	
	• Launched first VSM-2 (value stream mapping) class in October 2018 — 4 workshops delivered to date attended by 19 employees from 14 WHIN-companies.
	
	• Developed preliminary Education Plan and Regional Project Meetings based on results of Gap Analysis.
	
	• Drafted a catalog of courses for employee tiers and types of skills scheduled for roll out in April 2019 (included information on Ivy Tech and MEP courses and workshops).
	
	• Conducted a combo Problem-Solving/VSM/Project-Reporting workshop in February 2019 with 20 participants attending from 8 different companies. 2 students presented their project reports from prior classes, as well.

Implement communication plan that includes WHIN website and periodic newsletter (Year 2).	• Drafted strategic communications protocol. • Published first WHIN manufacturing education newsletter in December 2018. • Published second WHIN manufacturing education in February 2019 — and distributed it at the Global Supply Chain Conference. • Presented annual report to WHIN Manufacturing Advisory Council in February 2019.

Engage with LEDO's and individual companies on a regional basis to promote education programs and encourage small project co-learning (Year 2).	• Feedback from companies at the DCMME reception in September 2018 highlighted regional educational needs and interest. • Conducted a group meeting for 25 attendees at Montgomery County Chamber of Commerce facility in November 2018. • First Regional Collaborative (Peer) Group met in December 2018, and the second one met in January 2019. From this initial meeting, the group has formed an ERP special interest group. Other groups are being formed around the region. • Reviewed 8 company projects and forwarded 4 to TAP and 4 are being assigned to students.
Select companies, based on the results of the gap analysis, that are interested in the work and are a good fit for the project (Years 2-5).	Although planned for Years 2-5, the team has: • Identified list of WHIN-area companies with management teams that have expressed a high interest in the WHIN program and have a high level of operations excellence. These companies will also form a core group that will be a target for the initial educational programs roll-out.
Design curriculum around the content most needed by employees (as exposed in the gap analysis) to increase their "value creation ability" and productivity (Years 2-5).	• Planned for Years 2-5.
Determine the best delivery system suited for the audience(s), adapt how the course is delivered (in-person, online or hybrid) during grant period based on the feedback received (starting in Year 1, continuing through Year 5).	• Planned for Years 2-5.
Arrange a training schedule based on company/employee needs (assessing opportunities for training at shift change, worker needs like transportation and childcare, and availability) (Years 2-5).	Although planned for Years 2-5, the team has: • Developed WHIN's initial outline for education and skill employee grouping. Completed development of first web-based micro-course pilot.
Deliver courses, on an as-needed basis, on-site at the manufacturing plant to current employees (Years 2-5).	Although planned for Years 2-5, the team has: • Conducted third value stream mapping face-to-face training course in August 2019 (8 students from 5 companies). A total of 11 people attended the first 2 courses.
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).	• Planned for the end of Year 5.

AIM 3.3: IoT Infrastructure and Data Analytics

Anticipated Outcomes	Outcomes to Date
YEAR 1	
Finalize the design of soil sensor (nutrients, moisture, temperature) and fabricate hundreds of sensors that will be placed at Birck's IoT testbed, College of Ag's ACRE as well as at Ivy Tech farm.	• Sensor installation at the field: Prototype boards were installed at the TPAC site collecting temperature and humidity conditions. The installation exhibited the functionality of the designed network, with concurrent real-time visualization of the conditions via online portal. • Sensor deployment: Prototype boards uploading real-time nitrate, temperature, and moisture measurements to the cloud were installed at Birck for long-term testing in a controlled environment. A total of 14 boards are up at 3 sites (4 at Birck Nanotechnology Center, 3 at the School of Electrical and Computer Engineering, and 7 at TPAC) continuously up-loading data to the cloud. • Flexibility demonstration of the sensing platform: The expansion capability of the sensing platform was demonstrated in the field, with the coupling of commercial soil-moisture and temperate sensing elements by Decagon. The online portal is currently being updated in order to relay real-time measurements from the Decagon sensing modules at the TPAC site. • The final design iteration of the soil sensor began in November 2018. The design will couple the custom sensing modules that have been extensively tested at various locations at Purdue with the robust design of the communication platform that was provided by an external company (Huwomobility) and has been already verified by Purdue. The final sensor will be packaged by an outside company and will be distributed to Purdue farms and WHIN farmers within the region.
Finalize the design of distributed temperature and humidity sensors and fabricate hundreds of sensors for Purdue's ACRE facility and IN-MaC's testbed.	• On-sensor analytics: The capability of performing data-related functions independently on sensors was developed. These functions include anomaly detection (i.e. transmit only when a measurement exceeds a certain range) and data compression (i.e. transmit condensed information less frequently saving power and bandwidth). These capabilities are now being transferred to the prototype boards. • The final iteration of the sensing platform will provide robust, modular functionality with temperature, humidity, and other measurement capabilities, along with long communication range and low power consumption for extended battery life, especially for outdoor applications.
Install sensors at main manufacturing partners: Caterpillar, Oerlikon, Wabash National; as well Frito-Lay and Tate & Lyle (monitoring of moisture during processing – synergy with post-harvest initiative at Purdue).	• Meeting with Tate & Lyle representatives was held to discuss status of vibration work and analysis of data to date on 5 of their motors. The next steps are to continue data analysis and also preparation 5 more "Birck" low-cost vibration sensors to implement alongside of commercial units. • The fabrication of the prototype modules for vibration (motion) and pressure measurements has been completed. Currently, the vibration sensors are being evaluated for compliance to the applicable ranges and resolution performance. A second generation of vibration sensor deployment is planned for Tate & Lyle, along with possible other testing sites, like Evonik and Bio Town Ag. • Plans to install second generation motor vibration sensors (Purdue's design) at Tate & Lyle should occur early in Q1 2019. Furthermore, plans are in process to install sensors at Evonik and also at Bio Town Ag in their Energy Center. Other industrial partnering opportunities are being investigated.

Develop a communication network and hub design (with initial installation at 5 locations throughout the community).	• Improvement of network configurations: Dynamic mesh configuration was successfully tested at TPAC using the LoRa protocol. Also implementing a short-range mesh-network capability. This functionality will reduce power consumption where this type of network is applicable (e.g. on the factory floor). • Evaluation of commercial sensing platform solutions: Group is collaborating with HuwoMobility for a communication and sensing platform to create a strong streamlined product which meets the diverse requirements that can read commercial sensors as well as Purdue's low-cost nitrate sensor. IoT group has developed the necessary firmware for the embedded electronics and tested the communication range of the platform at the TPAC farm. Based on these results, we are acquiring 100 units for testing and deployment. • Improvement of network configurations: The dynamic mesh configuration has been successfully implemented for both long- and short-range network. The added functionality allows the network to automatically reconfigure when a sensor is added or removed. Purdue's researchers are currently working on the remaining task of partnering the long- and short-range networks together.
Implement data storage in the cloud and user access through a cell phone app and computer network.	• Cloud data website with Mapbox continues to be enhanced with existing sensors at BRK and EE, with other sensors being added shortly. • Work continues adding live sensor data to Mapbox website as a demonstration tool for WHIN stakeholders. Enhancements planned. • An interactive display for Birck Center Atrium is up and running. Visitors to Birck can view "live sensor data" and historical data through this display as we continue to deploy sensors throughout the region. The intent is to update our Mapbox website to demonstrate and showcase our deployment efforts in the WHIN region.
Conduct guest lectures at community outreach workshops about IoT sensors and data analytics and their impact in improving the supply chain, condition-based maintenance and business operation, and by enabling new business models focused on quality of service and consumer experience.	• Starting in September, both Ag and Manufacturing Council meetings will focus on "themed" discussions each month, bring more focus on topic areas of most interest to council members and regional stakeholders. Ag Council meeting theme in September was "Asset Tracking and Management" best practices; Manufacturing Council theme was "Supply Chain Leakage," bringing sellers and buyer together in the WHIN region. • Purdue WHIN wide poster session was held in October 2018 at Birck Center. • Although testbeds at Purdue are not yet established, several WHIN region-based organizations, Bio Town Ag (White County) and Belstra Milling (Fair Oaks in Jasper County outside of WHIN region), and Benton County Soil & Water Conservation District as examples, have great interest in IoT/WHIN-related projects. • Plans are being discussed for various workshops to be held in 2019 for WHIN region stakeholders on various IoT topic areas. The IoT group, along with other WHIN Purdue groups (Ag and Manufacturing) will collaborate to create impactful and informative workshops to education, demonstrate, and inform stakeholders regarding emerging technologies.

AIM 3.3 (Cont'd)

YEAR 2

Obtain field data from 5-6 IoT nodes throughout the region.	• Currently, field data are being obtained from one IoT node (at TPAC). There are also two IoT nodes (ECE and Birck) providing continuous data from a dozen sensors (temperature, humidity, nitrate). • Planning has begun for the addition of the 4th IoT node at ACRE. • Currently, data being collected at 3 nodes (TPAC, BRK, and ECE). • Vibration data are being collected through commercial sensors at Tate & Lyle, and soon Evonik.
Purdue will help the local community testbeds to install their IoT sensors, data network, and to analyze the data. Birck faculty will give guest lectures on sensors and IoT platforms in collaboration with education partners (K-12, community colleges, local businesses).	• Planned for Year 2.
Study the field data from soil sensor (nutrients, moisture, temperature) and study sensor aging, drift, biofueling.	• The delivery of the fabricated electronics of the Ag sensor is anticipated the first week of February. The sensors will be split into two groups; the first, packaged by an outside firm (Indesign) for the incorporation of all the sensing modules (nitrate, soil moisture, temperature, and humidity) and the second, packaged in-house for faster field deployment. The deployment of the Ag sensors will begin at TPAC, then to ACRE. • The deployment of the latest version of the agricultural sensor began with installation at TPAC. The sensor will record air temperature and humidity, as well as soil dielectric permittivity, conductivity, and temperature. The measurements, wirelessly transmitted, will be stored on a server and soon to be available on the website. • More sensors of the latest version, some with nitrate sensing capabilities, are going to be installed at TPAC and ACRE.
Study the field data from distributed temperature, humidity and moisture sensors. Study sensor aging and drifts.	• In February 2019, WHIN began the analysis of the several months' worth of data from the deployed sensors at TPAC, ECE, and BRK (temperature and humidity) and Tate & Lyle (commercial vibration sensor). We are working on the development of a pressure sensor and an improved vibration sensor. Initial data indicates high reliability and stability of the temperature and humidity sensing modules. • Firmware tests for the vibration sensor was designed/developed, based on the manufacturing team requirements. It is currently being validated through bench-top measurements.
Use machine learning to identify key factors impacting the design of reliable and robust sensors.	• Machine Learning group are working with Manufacturing group to enhance their mini motor failure lab activities and enhance our machine learning efforts for vibration sensor analytics. • Much work continues in mini-motor failure lab for machine learning efforts by Manufacturing group.

AIM 3.3 (Cont'd)

YEAR 2 (Cont'd)

Evaluate communication fidelity and cloud storage data security (data from private companies will be anonymized).	• We are extending the current capabilities of LoRa mesh networking for communication fidelity. Once this goal is achieved, we will apply algorithms and techniques to ensure data transmission security. • Network infrastructure has been improved through the collaboration between the embedded programming and networking teams. The main focus has been for communication stability and fidelity. Once achieved, algorithms and techniques will be implemented in order to ensure data transmission security.
Expand sensor network to 15 locations throughout the community (commercial farms, small manufacturers, public building/services (in consultation with county's public work offices).	• Locations (currently 4) will increase with the deployment of the latest version of the agricultural sensor at ACRE and later Ivy Tech. • The networking and manufacturing teams are working on the deployment of additional vibration sensors in the region.
Finalize the design of pressure sensitive surfaces and pressure sensors (applications in pressure mapping and pressure measurement inside gearboxes and around key surfaces).	• We are currently working on the interfacing of the mainboard's electronics with a prototype pressure sensing module. Once finalized, we will evaluate the sensor performance with experiments in controlled environments.
Help community testbeds with IoT sensors, data network and data analytics.	• Multiple community groups, high schools, agribusinesses, and other manufacturers are showing interest in deployment of IoT technology and creation of regional testbeds/learning sites. • Much interest from High Schools with FFA farm ground for creating regional testbeds, through future R&D sensor activities as well as commercial technology through potential partnerships with Solinftec, Microsoft, and possibly others.
Guest lectures (K-12, community colleges, local businesses).	• Bio Town Ag wants to deploy vibration sensors in their energy center. Frontier H.S. and 1-2 others want to host Ag testbed at their school sponsored on FFA farm acreage. Nucor interested in vibration sensor deployment – February meetings – all groups scheduled. • Working on development of an IoT "Boot Camp" workshop to expose the region to IoT technology and uses.
Fabricate two dozen sensors for lab characterization.	• Planned for Year 2.

YEAR 3

Obtain field data from a dozen IoT nodes throughout the region.	• Planned for Year 3.
Purdue will help the local community testbeds to install and maintain their IoT sensors, data network, and to analyze the data.	• Planned for Year 3.
Help train company employees who should start to maintain the sensor network.	• Planned for Year 3.
Give guest lectures on sensors and IoT platforms in collaboration with education partners (K-12, community colleges, local businesses).	• Planned for Year 3.

AIM 3.3 (Cont'd)

YEAR 3 (Cont'd)

Test pressure sensors at 3-5 local manufacturers.	• Planned for Year 3.
Based on year 2 field data and analysis, optimize the design of soil sensors (nutrients, moisture, temperature) and fabricate several hundred that will be placed at Birck's IoT testbed, College of Ag's ACRE and Ivy Tech and in dozen of commercial farms throughout the Wabash Heartland.	• Planned for Year 3.
Based on Year 2 field data and analysis, optimize the design of distributed temperature and humidity sensors and fabricate several hundred for Purdue poultry facility, IN-MaC testbed, main manufacturing partners as well as a dozen of local small businesses.	• Planned for Year 3.
Finalize the design of water sensors for Purdue's Water Quality Field Station.	• Planned for Year 3.
Fabricate two dozen sensors for lab characterization and field test.	• Planned for Year 3.

YEAR 4

Continue to obtain field data from several hundreds of sensors in several dozen IoT nodes throughout the region.	• Planned for Year 4.
Purdue will help the local community testbeds to maintain their IoT sensors and to analyze the data.	• Planned for Year 4.
Oversee as local businesses take the responsibility to operate and maintain the sensor network.	• Planned for Year 4.
Give guest lectures on sensors and IoT platforms in collaboration with education partners (K-12, community colleges, local businesses).	• Planned for Year 4.
Test water sensors in a dozen of locations in the Wabash Heartland region.	• Planned for Year 4.

YEAR 5

Birck Nanotechnology Center will continue to obtain field data from several hundreds of sensors in several dozen IoT nodes throughout the region.	• Planned for Year 5.
Once the impact of IoT sensor data in different businesses is demonstrated, local companies will be responsible for the maintenance and operation of IoT devices through their IT department or by outsourcing (similar to what they do for their computer network and Internet).	• Planned for Year 5.

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.	• This is in the process of being measured by an inventory of local public-private partnerships and asset map of collaborating organizations (to be administered in 2nd Quarter 2019). A baseline assessment of current public-private in-vestments in all 10 counties will be tracked/reported annually.
There is better alignment between regional education and workforce efforts, yielding more youth and adults prepared for employment.	• This will be measured by a comprehensive occupational needs assessment of the region (administered in 2nd Quarter 2019). A baseline assessment of educational attainment and gaps in workforce in all 10 counties is currently ongoing and will be tracked/reported annually.

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.	• This approach is being examined to ensure it integrates thoroughly within the newly launched Regional Cultivation Fund process.
Implementation of Project Lead the Way (PLTW) into the 22 middle and high schools without research-based science, technology, engineering and math curriculum.	• This approach is being examined to ensure it integrates thoroughly within the newly launched Regional Cultivation Fund process.
3,000 high school enrollments in STEM career education courses region-wide (from the baseline of 1,558 current high school enrollments).	• This approach is being examined to ensure it integrates thoroughly within the newly launched Regional Cultivation Fund process.
750 "STEM-Ready" high school graduates (who have taken at least 1 STEM-related course).	• This approach is being examined to ensure it integrates thoroughly within the newly launched Regional Cultivation Fund process.
800 manufacturing and agriculture industry-recognized credentials awarded in high school (from the baseline of 420 current credentials awarded).	• This approach is being examined to ensure it integrates thoroughly within the newly launched Regional Cultivation Fund process.

AIM 3.5: Cultivation Fund

Anticipated Outcomes	Outcomes to Date
The region's population grows and the tax base is strengthened. This will be measured by a pre- and post-survey of regional residents regarding Quality of Place (administered in 1st Quarter 2018) and a baseline assessment of population and current tax base in all 10 counties, tracked annually.	• Population and gross assessed value of property on a county level are tracked by PCRD via their Indiana Rural Stats portal (https://pcrd.purdue.edu/ruralindianastats/) and updated annually.
Within less than 1 year, an RFP process will be established to evaluate proposals submitted by regional entities to address WHIN's Cultivation Fund goal: To create an incentive for 2 or more counties in the Wabash Heartland to work together to boost the education, vitality and connectivity of the region.	• The Regional Cultivation Fund was launched in January 2019, accepted Letters of Intent (LOIs) in February 2019, and applications in March 2019. Currently, applications are being reviewed with awards for planning and impact grants being announced in April 2019. The second round of the RCF will begin in July 2019.

AIM 3.5 (Cont'd)

Within 2-4 years, WHIN will fund $10 million in projects in the WHIN counties designed to increase the region's education, vitality, and connectivity.	• The first awards of the $10 million allocation will be made in April and May 2019.
In 5 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.	• Prior to the end of Year 5.
Pre-survey delivered by Purdue Center for Regional Development to all 10 counties in the region via county fairs, social media, LEDOs, Community Foundations, Chambers of Commerce help deploy/promote locally.	• Reports analyzing the results of the regional place-making survey were completed in September 2018, with both regional and county-level breakdowns given. Currently, WHIN staff and the metrics manager are in the midst of updating the survey and adding pertinent questions to the next version, which will be deployed in early May. This is a valuable tool in measuring residents' Quality of Place over WHIN's 5-year span. This survey will be re-evaluated and re-deployed annually.

Global WHIN Metrics

An annual growth rate of 3.13% in GRP over 5 years. • For every $1 of Lilly Endowment, Inc. investment, the Wabash Heartland region would generate approximately $3.24. (e.g. $126M).	• 3 reports analyzing the results of the regional place-making survey were completed in September 2018. These included the county fairs report (short version), online survey report (long version), and aggregate version (combined results). The WHIN Core Team provided feedback and Grismer produced a final report for team review in October 2018. • The WHIN Place-making County Level Survey Results were completed in January 2019 and released to the Community Foundation Directors the first of February 2019. • The second round of the WHIN Place-Making Survey is currently under development, incorporating feedback from regional stakeholders (as well as suggested questions and revisions).
2% job growth in next-generation manufacturing over 5 years and 3% job growth in digital agriculture over 5 years, resulting in 652 new jobs in the region over the same time span of the grant period.	• 18 ISPS on the Broadband Task Force are discussing the creation of an NDA/MOU process in order to share their actual broadband footprints in the WHIN region. As of early March 2019, 10 companies had signed. • WHIN is looking toward USDA's Reconnect Grant to leverage the Broadband Task Force work, which will bring connectivity and economic prosperity to rural, underserved areas. Work on that grant proposal with Tipmont is currently underway.
125 positions will be filled in critical-need areas over 5 years (such as data analytics, precision agriculture, and IoT-related manufacturing).	• Grismer, Kumar and Beaulieu discussed ONA methodology using new Burning Glass license for real-time data (see PCRD Plan of Work, January - December 2019 document). Anticipate continued collaboration with ConxusNEO, ROI, and others. • In January 2019, Kumar, Beaulieu, Dunlop, Fiock, Grismer, and Wiltse discussed the career pathway project. In February 2019, they took their next steps toward completing the career pathway project timeline and deliverables.

APPENDIX C: **Biographies**

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.
	Marianne Rose	President and CEO of the Community Foundation of Greater Lafayette, Indiana; 14 years with The Foundation.
	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.
	Suresh Garimella, PhD	Executive Vice President for Research and Partnerships; Goodson Distinguished Professor of Mechanical Engineering. Garimella is in charge of Purdue's diverse research enterprise as well as Purdue's global and corporate partnerships that advance innovation, research, education, and commercialization.

Ivy Tech Leadership (MEETS QUARTERLY)

	David Bathe, PhD	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).
	Melinda Grismer	Vice President of Regional Development.
	Jack Stucky	Vice President of Engineering.
	Jason Tennenhouse	Vice President of Strategy & Design.
	Ted Fiock	WHIN-Purdue Project Manager.
	Chad Martin	WHIN-Ivy Tech Project Manager.

WHIN Core Team (MEETS WEEKLY)

	Gary Henriott	Chair, Henriott Group (insurance and risk management services) and past chair Greater Lafayette Commerce Economic and Community Development Council. (Please see above for more in-depth bio.)
	Johnny Park, PhD	Chief Executive Officer (CEO).

	Marianne Rose	President and CEO of the Community Foundation of Greater Lafayette, Indiana; 14 years with The Foundation.
	Ali Shakouri, PhD	Mary Jo and Robert L. Kirk Director of Birck Nanotechnology Center; Professor of Electrical and Computer Engineering.
	Melinda Grismer	Vice President of Regional Development.
	Jack Stucky	Vice President of Engineering.
	Jason Tennenhouse	Vice President of Strategy & Design.
	Dennis Carson	City of Lafayette Economic Development Director.
	Ted Fiock	WHIN-Purdue Project Manager.
	Chad Martin	WHIN-Ivy Tech Project Manager

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 and Vice President of Regional Development for WHIN.
	Nathan W. Hartman, EdD	Interim Head of Computer Graphics Technology, Dauch Family Endowed Professor, and Co-executive Director of IN-MaC.
	Ted Fiock	WHIN-Purdue Project Manager.
	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.

	Mary Nauman	Director of Strategic Initiatives, Corporate and Foundation Relations, University Development Office, Purdue Research Foundation.
	Michael Ursem	Managing Director, 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.
	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.

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)

AgSEED ......Agricultural Science and Extension for Economic Development (a funding opportunity)

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

ASREC ....Purdue University Animal Science Research and Education Center

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

DMET..........The Digital Manufacturing Enterprise Testbed (a testbed within the IN Manufacturing Institute)

EDA.............The State of Indiana's Economic Development Administration

GCTC ....Global Cities Team Challenge

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

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

IoT ....Internet of Things

LEDO ....Local Economic Development Organization

MEP............Manufacturing Extension Partnership

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

NLP.............Natural Language Process

NSF.............National Science Foundation

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

OEM ....Original Equipment Manufacturer

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

PAWR ....Platforms for Advanced Wireless Research (a funding opportunity)

PCRD..........Purdue Center for Regional Development

PHERC........Purdue Post-Harvest Research and Education Center

RFP.............Request for Proposal

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

TPAC..........Throckmorton-Purdue Agricultural Center

UAV ....Unmanned Aerial Vehicle

WHIN..........Wabash Heartland Innovation Network

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