



Report to Lilly Endowment September 2018

Submitted by: Gary Henriott, WHIN Board Chairman

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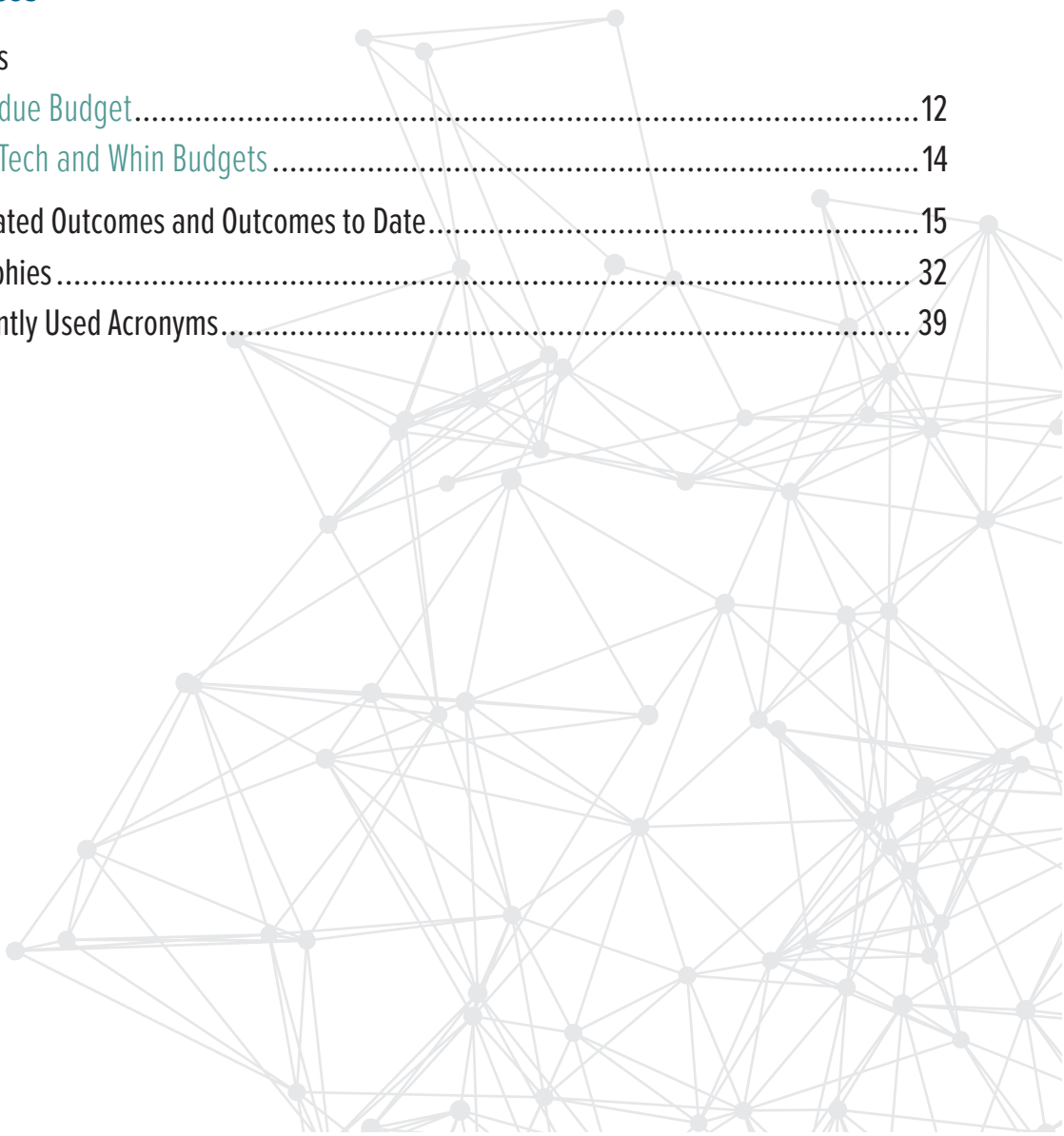
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Message from the Chairman: Thank you

A new momentum embracing the profound impact of smart communities is advancing throughout Indiana. Lilly Endowment’s generous grant

of \$38.9 million supporting the vision of the Wabash Heartland Innovation Network (WHIN) has helped drive the momentum for smart communities forward in the Wabash Heartland region.

With our new staff and CEO on board, WHIN is working to establish strong partnerships, develop new innovations, and seize opportunities to position our Region as the epicenter of digital agriculture and next-generation manufacturing in the years ahead. From hosting a national digital agriculture and rural broadband workshop to installing sensors at area manufacturing plants to providing new educational resources and insights for employers, WHIN is making a difference. Our diverse range of partners includes state agencies, corporations, foundations, and federal agencies. We are committed to engaging each relationship with a solutions-focused approach.

On September 4, Governor Eric J. Holcomb announced his plans for committing \$100 million to bring high speed, affordable

broadband access to unserved and underserved areas of the state. In addition, Governor Holcomb has recently named the state’s first Director of Broadband Opportunities, who is responsible for managing and expanding the state’s new Broadband Ready Community program.

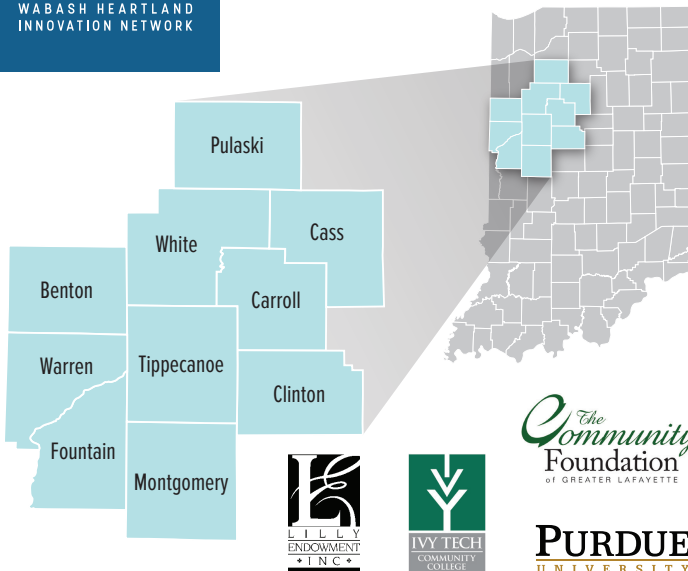
New research was also recently released stating Indiana could gain \$12 billion in economic benefits from rural broadband service. One of WHIN’s own team members conducted that research, the Purdue Center for Regional Development. Indiana Electric Cooperatives and Tipmont REMC commissioned the study, and CoBank funded it. A \$4 return to the local economy is estimated for every dollar spent on the infrastructure.

We truly appreciate this exceptional opportunity. As you will see within this report, the WHIN team is pursuing a “split vision” – addressing short-term projects that will have an immediate benefit to our region as well as conducting long-term research that help define the entire Wabash Heartland and the state of Indiana as global leaders.

Gary Henriott



10 Indiana Counties
make up the WHIN region



\$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.

WHIN Overview: Looking Forward, Aiming High

Within the past six months, WHIN has simultaneously addressed many immediate needs while looking far ahead to pursue ambitious, cutting-edge opportunities.

WHIN initiated an exciting first year by hiring an exceptional CEO, securing a highly talented staff, launching successful manufacturing and agricultural partnerships throughout the region, beginning to attract important funding opportunities, and implementing a robust sustainability plan.

The search for a CEO posed a unique challenge for WHIN due to the position's many, almost competing demands. The role requires: (i) a collaborative listener with in-depth knowledge about agriculture, manufacturing, and the region; and (ii) a bold, knowledgeable business leader with the expertise to pursue cutting-edge IoT innovations.



Johnny Park, CEO of WHIN

WHIN found this rare nexus within Dr. Johnny Park. The founder and former CEO of Spensa Technologies, Inc., Park raised \$8 million in investments and grants, achieving 98% average annual revenue growth in the last five years. A precision agriculture company focused on smart IoT devices and

data analytics to help growers better manage agronomic pests such as insects, weed, nutrient deficiencies, and disease, Spensa Technologies was named one of the Top 25 Most Innovative Ag-Tech Startups by *Forbes* last year.

Park, who earned his undergraduate, master's, and doctoral degrees all in the School of Electrical and Computer Engineering at Purdue University, has lived in West Lafayette since 1994. He has four children with his wife Lisa. Prior to establishing Spensa, Park was a principal research scientist and research assistant professor at Purdue University and has been awarded four patents in related areas.

"Johnny is a true entrepreneur, creative thinker, and risk taker," said WHIN's Chairman Gary Henriott. "His proven skill at creating a compelling vision along with concrete and innovative strategies and his broad and deep understanding and experience in the development of intelligent, connected sensors in the application

of agriculture and manufacturing will allow WHIN to leap ahead regarding research, talent, and IoT for the benefit of the region."

WHIN has many other key accomplishments throughout the past year:

- Began hiring staff members and moved into the WHIN office suites. As discussed in the Governance section, our new positions filled include: WHIN-Purdue Project Manager Ted Fiock; WHIN-Ivy Tech Project Manager Chad Martin; and Executive Assistant Caitlin Lambert. In addition, the WHIN office suites are located at Ivy Tech Community College-Lafayette, a centralized location with easy parking, readily available conference rooms, and easy access to Ivy Tech's manufacturing and agricultural testbeds.
- Established successful manufacturing and agricultural partnerships throughout the region. In addition to the extensive research efforts detailed within this report, WHIN has greatly increased our knowledge and insights about the region's needs by hosting numerous events, convenings, and meetings with a range of stakeholders throughout the region. These include:
 - Conducting monthly meetings with our two Advisory Councils comprised of more than 40 companies. WHIN meets each month with both our Agricultural Advisory Council and Manufacturing Advisory Council. These councils have provided invaluable expertise and insights regarding areas of focus, strategy, and opportunities.
 - Convening WHIN's Broadband Task Force on a semi-regular basis. This task force is establishing the first region-wide map identifying broadband access throughout the region.
 - Attending every county fair in our region to listen to residents, educate fairgoers about WHIN, and gather information for our Quality of Place survey. Completed by nearly 2,500 total respondents (Figure 1), the survey provided a baseline about Wabash Heartland-area residents' current quality of life and interests in IoT.
 - Facilitating three meetings May 21-24 in Lafayette, Monticello, and Crawfordsville to share WHIN's plans and listen to public officials. More than 30 public officials attended, creating a strong foundation of ongoing communication. A report published by WHIN member PCRD states that every \$1 spent in rural broadband infrastructure

generates \$4 in positive economic impact. WHIN plays a critical role in sharing critical information such as this with key policymakers and stakeholders.

- Begun attracting important funding opportunities as well as implementing a robust sustainability plan. Sustainability is a central, driving force for WHIN. A key WHIN goal is providing support to regional businesses by providing IoT analytics to accelerate the adoption of digital technologies among smaller manufacturers and farmers in the Wabash Heartland region of Indiana. To achieve this:

- WHIN is developing a member-based initiative – preliminarily called WHIN Alliance – that will provide a range of valuable services to industry members, from online courses to workshops. WHIN also is developing the foundation for digital co-operatives that will bring together community and industry leaders as well as startups and entrepreneurs. The goal is to generate anonymous, aggregated data through the distributed testbeds and the companies in the supply chain participating in the Alliance, which will have significant value. Members will be able to benchmark specific metrics in comparison to their anonymous peers, make any necessary adjustments, and realize cost savings.

- WHIN is also pursuing philanthropic and other funding opportunities. WHIN has secured a commitment from the North Central Health Services, which has stated it will match as much as \$1 million to select projects awarded through the Regional Cultivation Fund. WHIN also has numerous other funding opportunities in progress. In August, WHIN submitted a \$750,000 proposal to the Economic Development Administration (EDA) to fund two positions providing direct IoT/entrepreneurial assistance to businesses throughout the region. WHIN also is working closely with Purdue University and other partners in submitting a National Science Foundation (NSF) Platforms for Advanced Wireless Research (PAWR) grant that, if funded, would attract \$9 million in cash and \$15 million of in-kind contributions from PAWR’s industry consortium, which includes many global leaders such as Intel, Nokia, AT&T, Sprint, and Verizon.

These advances, as well as the many innovations described within, are a sampling of WHIN’s recent accomplishments and strong future plans.

“I’m looking forward to the many diverse opportunities and challenges ahead for all of us in WHIN’s 10-county region,” said Johnny Park. “We have the ability to leverage our Midwestern values, creativity, and strengths to attract innovative thinkers and doers who can help lift up our quality of place and quality of life.

“Together with the many collaborative groups and dedicated individuals we work with who are committed to improving and innovating agriculture and manufacturing, we can – and will – change the world,” Park said.



Figure 1: WHIN team members attended all 10 county fairs to promote WHIN’s Quality of Place survey answered by nearly 2,500 total respondents online (1,780) and paper (690).

Digital Agriculture: Feeding the World through Proven Practices and New Technology

The National Institute of Standards and Technology's (NIST) workshop was filled with active and engaged participants representing a diverse range of interests – growers and producers, higher education, global companies, non-profits, rural telephone companies, electrical co-ops, and government agencies, among others. All agreed on one key vision: increasing rural communities' access to digital agriculture and smart technology will open up unforeseen opportunities.

“When they first brought electricity to rural America, they thought it was just so everyone could have lights and other daily conveniences in their house,” said the workshop's co-leader Gabriel Youtsey, Chief Innovation Officer, University of California Agriculture and Natural Resources. “But electricity has completely transformed agriculture. We wouldn't have the modern dairy if we didn't have electricity. No one could have envisioned that in the 1930s.”

The first NIST Global Cities Team Challenge (GCTC) Smart Agriculture and Rural Broadband SuperCluster Workshop, was hosted by the Purdue University College of Agriculture on September 6-7. WHIN Chairman Gary Henriott served as an invited speaker on a panel titled, “Funding Rural Innovation.” Attendees included representatives from numerous nationally-recognized organizations such as Dell, Hewlett-Packard, Intel, University of California Davis, CoBank, and the National Telecommunications and Information Administration, as well as several independent growers and operators.

The workshop's goal was to identify and launch plans for implementing technological innovations that promote connected communities and smarter agricultural systems. The participants were tasked with developing specific achievable projects over the coming months. Prior to the end of the workshop, participants (including CEO Johnny Park, several Purdue faculty and staff) made plans to pursue next steps in launching participants' projects that include conducting IoT testbeds and living labs involving sensor development and testing, data flow, connectivity, and value analysis. The completed projects will be presented in February at NIST's annual GCTC Expo in Washington, D.C.

The Global Cities Team Challenge Expo has highlighted superclusters in numerous categories in recent years – such as transportation, public safety, and public utilities – but this is the first year there has been a supercluster dedicated to rural broadband. “Our goal is to identify an aggregation of projects, document them and share them with as many other communities as possible,” said Dr. Sokwoo Rhee, Associate Director of the Cyber-Physical Systems Program at the National Institute of Standards and Technology. “We want to pull together an excellent collection of case studies and best practices that can be replicated, publish them and share these with other communities looking for the same solution.”

As a regional initiative emphasizing community development, WHIN shares NIST's commitment to sustainable, replicable projects.

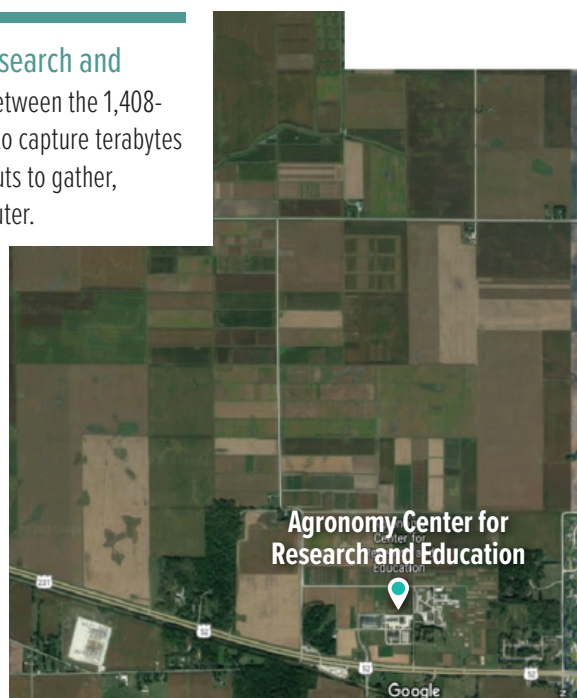
Figure 2: Aerial view of Purdue University's Agronomy Center for Research and Education (ACRE). Due to WHIN funding, there is now a high-speed connection between the 1,408-acre testbed at ACRE and Purdue's campus. This connection empowers researchers to capture terabytes of data from the field daily using multiple types of sensors, cameras and human inputs to gather, aggregate, process and transmit such volumes of data back to Purdue's supercomputer.

Early testbeds at ACRE related to WHIN objectives are:

1. Micrometeorology (Dr. Grant)
2. Postharvest Education and Research Center (Dr. Ileleji)
3. Water Quality Field Station (Dr. Brouder)
4. UAVs (Drs. Cherkauer, Saraswat, and others)
5. Machine data (Drs. Buckmaster and Krogmeier)

Aspects/Perspectives of the testbeds:

- A. Sensor testing
- B. Data flow (data models)
- C. Connectivity (cellular, LoRa, Wi-Fi, etc.)
- D. Value analysis
- E. Unmanned Aerial Vehicles (UAVs)



Two key building blocks for WHIN's success are: (i) the testbeds at Purdue and Ivy Tech; and (ii) WHIN's regional partners, with strong leadership from members of WHIN's Agricultural Advisory Council. During the supercluster workshop, representatives from both Dell and Intel expressed great interest in WHIN's two-pronged approach, as did Tipmont REMC, one of our regional infrastructure co-ops. Follow-up conversations are underway with these representatives.

As detailed further in Figure 2, the testbeds are the foundation for extensive digital agricultural advances. Through WHIN funding, there is a high-speed connection between the 1,408-acre testbed at Purdue's Agronomy Center for Research and Education (ACRE) and Purdue's campus. The first sensors also are being installed this semester at Ivy Tech's fully operational farm, due to a collaborative teaching partnership between the Purdue Polytechnic Institute and Ivy Tech (Figure 3).

In addition, the WHIN agriculture team is pursuing numerous federal grants that will further broaden WHIN's impact and capabilities. The team recently was invited to submit a full proposal for \$1 million to the USDA under the Food and Agriculture Cyberinformation Tools program, for a digital agriculture project entitled, "FACT: Coordinated Innovation Network for Applications and Data Architecture for Real-Time Crop and Soil Data Systems." An additional USDA-FACT proposal was submitted by WHIN faculty titled, "Experiential Learning with Data Tools for Digital AgriScience and FACT." If funded, it will attract \$500,000.

Furthermore, WHIN is one of the key team members in Purdue's submission to the NSF's Platforms for Advanced Wireless Research (PAWR) grant. The PAWR program aims to support advanced wireless research platforms that enable experimental exploration of robust new wireless devices, communication techniques, networks, systems, and services that will revolutionize the nation's wireless ecosystem. If funded, it will generate \$9 million cash but, as importantly, it will generate \$15 million of in-kind contributions from the PAWR Industry Consortium. The Consortium

includes companies such as National Instruments, Nokia Bell Labs, Samsung, Sprint, Oracle, AT&T, and T-Mobile – connections that will be invaluable assets to WHIN.

Education also is a top priority for WHIN. Both Purdue and Ivy Tech faculty are working with WHIN to pursue numerous digital agriculture education efforts from informal education to master's degree programs. With WHIN funding, the College of Agriculture hired Bruce Erickson as the Digital Outreach and Education Specialist. His efforts include engaging Steve Eberly, Director of Warren County Economic Development and Michelle Stucky of the Warren County Community Foundation to build a set of digital agriculture resources initially for high school students in Warren County, then throughout the WHIN region, to increase excitement about digital agricultural careers within the area. The Purdue College of Agriculture's professional master's degree in Digital Agriculture is set to launch in the summer of 2019, and discussions are underway with Purdue Global and Kaplan Higher Education (KHE) to provide this master's degree online.

John Scott, the Digital Agriculture Education Specialist hired through the WHIN grant is helping local extension educators, growers, and producers throughout the Wabash Heartland to understand a range of digital agriculture opportunities. His current work has largely focused upon educating residents about the opportunities drones can provide.

He can see the difference his work is making in the community. For example, while preparing for a recent drone demonstration, he found a patch of waterhemp weed growing in a farmer's carefully tended field. Waterhemp can produce more than one million seeds per plant, so catching it early is important.

"I noticed some anomalies – saw that this patch of weeds was a different color than the soybeans – so I flew the drone in closer and saw that it was waterhemp," said Scott. "It was a 50-acre field, and this spot was a 10-by-10-foot patch. [The farmer] may have seen it or he may not have, but this was an easy and quick way to spot the problem all the way from the other side of the

hill. He was very relieved to have caught the waterhemp early. This is one small but valuable demonstration."



Figure 3: Ivy Tech's 60-acre Agriculture Teaching Laboratory is in the process of becoming a widely sensed testbed.

WHIN Manufacturing: A Region with Vision

More than 230 companies.
At least 15 towns and cities. Ten counties.

The WHIN team is consistently meeting with and learning from manufacturers throughout the region, advancing its goal to apply IoT toward solving relevant problems in real-world contexts (Figure 4). Through these efforts, the team has learned that 54% of WHIN-area manufacturers do not have any IoT at their plants, and 5% have invested significantly in IoT and data analytics. The remaining 41% are just beginning to enter into the world of IoT; 26% have only one IoT-connected machine and 15% have several.

These transitioning companies are highly promising opportunities for significantly enhancing the region's IoT engagement, said Steve Dunlop, Managing Director of Dauch Center for Management of Manufacturing Enterprises (DCMME), which is a core member of the WHIN-Purdue team.

"Many are just at the very earliest stages of learning about IoT but, once they understand we are here to help them, they are interested to learn more," said Dunlop. "If it has the appropriate return-on-investment, then they are very interested."

The WHIN Manufacturing Team is working with companies at all stages move forward to their next step in becoming an IoT-engaged company, with a key focus on providing IoT educational resources. These tailored educational resources include improve best working practices, leveraging managerial competencies,

and promoting staff-retention. WHIN's goal is to provide the most relevant material in the most useful format, as categorized below:

- **Shop Floor Skills** – Behaviors, skills, training levels, opportunities for development of further skills and support for career development.
- **Operational Excellence** – Systematization on the shop floor.
- **NextGen** – Education, technology, application.
- **Management Agility** – Education, practice, openness to beneficial change across all areas of business.

The WHIN team has already begun teaching one course with very successful results, well before the planned schedule of 18 months after funding. The Value Stream Map program teaches mid-level managers to diagram an entire process, identify every transition point, determine if value can be added at that transition point and, if so, make the needed adjustments. To date, the WHIN Manufacturing Education Team has taught the Value Stream Mapping process at 14 companies. Unlike future classes, this class has been offered for free. The goal, said Dunlop, is to help small companies with little to no familiarity with IoT identify efficiencies and cost-savings while also gaining an understanding of IoT's value. Companies are already seeing its value.

"We are very excited about this opportunity and would like two of our best to participate in this workshop," said Gabe Widmer,

Supply Chain: The WHIN Connector

For WHIN, connectivity means more than digital access. It is about creating a regional identity throughout Wabash Heartland.

One key method for achieving this goal is through an initiative being led by the WHIN Manufacturing team. It is developing an online search engine designed to easily inform WHIN-region companies about manufacturing services, products, and resources of other manufacturers/suppliers within the WHIN region. This tool is designed to significantly reduce "leakage." This is a term describing when companies purchase their goods or services from outside their own region, despite local availability. Although this tool will begin as a web-based service, it is envisioned to grow to be much more.

"Firms are defined by their capabilities, i.e., equipment, certifications, employee skills, not just by their current products. Our research focused on decreasing supply chain leakage will characterize regional capabilities so that a supply chain of companies can create required products" said Ananth Iyer, Susan Bulkeley Butler Chair in Operations Management at the Krannert School at Purdue University.

"Access to information is critical, and companies just don't know what is available right now," said Steve Dunlop. "But we are also developing tools that will go beyond accessing services or inventory. Our vision is that it enables a truly unique, IoT-driven network for business-to-business connectivity."

the Engineering Manager for the Dayton-Phoenix Group. The Dayton-Phoenix Group designs and manufactures electrical and locomotive components for industrial and railroad markets worldwide.

Digital Manufacturing Enterprise Testbed

The Digital Manufacturing Enterprise Testbed (DMET) will be the epicenter of a development, demonstration, and education network that primes the Wabash Heartland to unlock new levels of productivity gains, rapid design, quality, and production flexibility. The DMET will do so by:

- conducting research to overcome digital connectivity barriers across the enterprise and demonstrate the “art of the possible,” especially for small and medium sized companies;
- being a central resource to develop methods and educational modules to prepare the next-generation manufacturing workforce; and
- providing technical expertise to accelerate local product development and entrepreneurship.

“The testbed will become a digitally linked resource that all manufacturers can utilize to address digital integration challenges, and will be used by educational centers, incumbent workers, and entrepreneurs to learn new techniques and methods to apply digital information in a smarter, more valuable way,” said Mike Ursem, Managing Director of IN-MaC.

Computer technologies are fundamental to nearly every aspect of manufacturing environments today, yet the knowledge, technologies, and even methods to digitally assemble and integrate the disparate information into a useful form is generally not known. Computers, PLCs, and various sensors are vital for the operation of production equipment, automation devices,

and managing the flow of goods through a factory floor. Systems to track order progression, manage production schedules, and respond to 11th hour customer change orders are often a blend of analog (paper) records and separate computer workflows, as are systems to manage product compliance to specifications, quality, maintenance, warehousing, and accounting. Each break in the seamless and timely flow of information stymies the best efforts of workers, supervisors, and management to optimally predict, plan, and mitigate inefficiencies or respond to critical issues before they become debilitating.

The Digital Manufacturing Enterprise Testbed will be launched at the Indiana Manufacturing Institute (IMI) in West Lafayette to research, validate, demonstrate, and support manufacturers of all tiers and abilities to bridge gaps in digital information flows and equip them to become more nimble, capable, and competitive. DMET will house a variety of equipment and tools representative of the predominant manufacturing sectors today plus many of those that will become more prevalent in the future. Subtractive CNC metal cutting, metal forming, joining, sub-assembly, and metrology areas will be complemented with composites preform, injection molding, additive manufacture, and rapid prototyping equipment. Central to the testbed will be a digital manufacturing network for product design, product and process simulation, and smart/adaptive monitoring and control throughout the physical and cyber-physical realms.

“The most successful manufacturers will be seamlessly integrated digitally across their shop floor and throughout their supply chains,” says Mike Ursem. “The testbed will include an array of equipment and operating environments to allow manufacturers to collaborate with University experts to solve their digital integration concerns in an environment familiar to them on the physical and cyber-physical levels.”

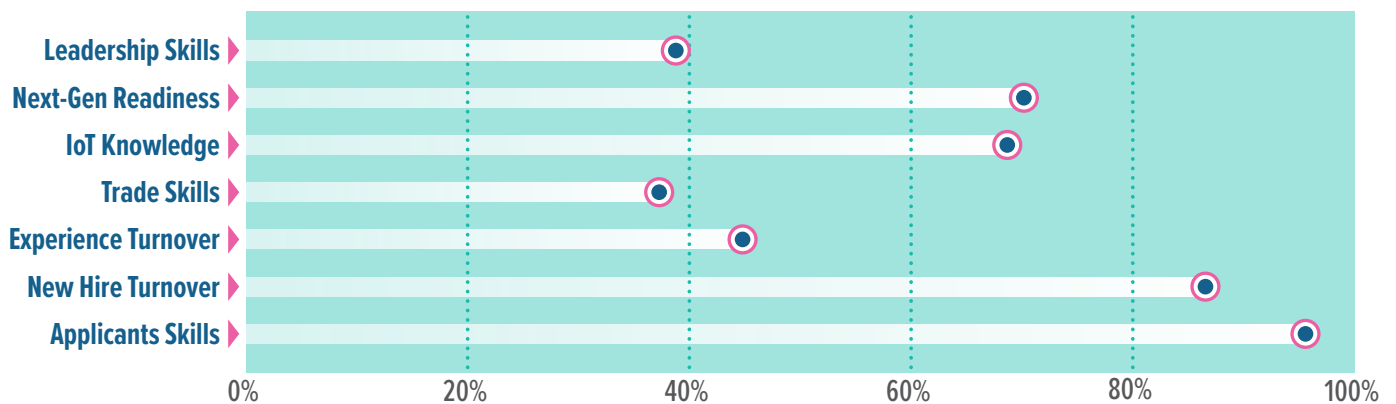


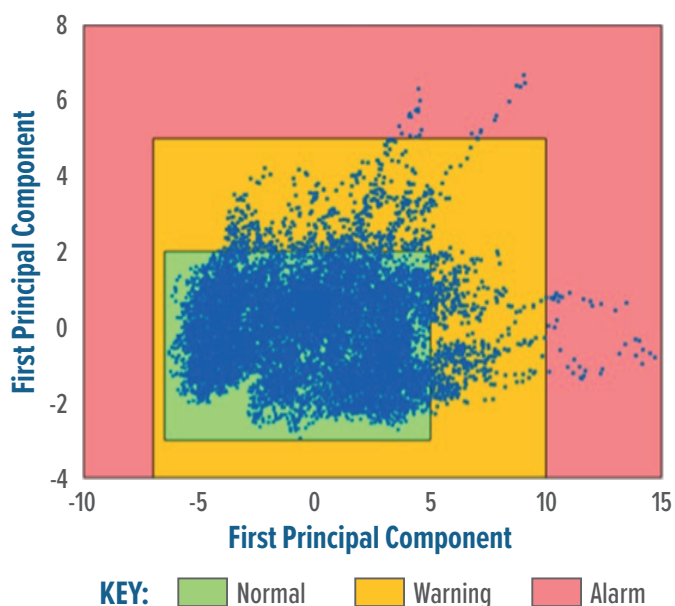
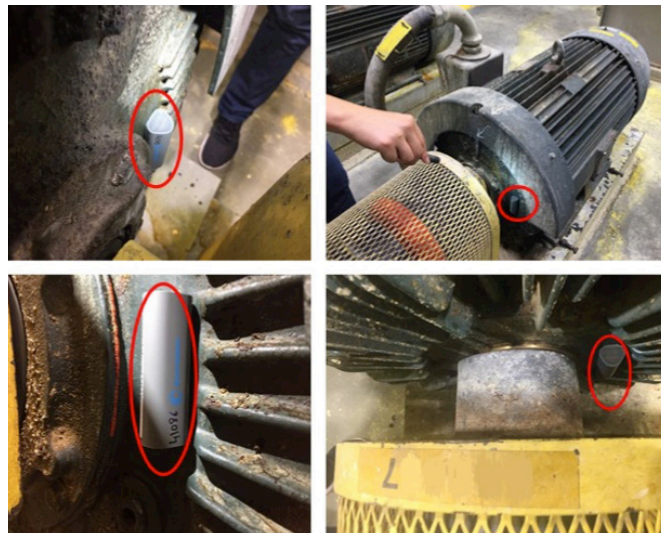
Figure 4: A survey of participating manufacturers identified several common factors and shared concerns among employers.

IoT Infrastructure and Data Analytics: Advancing Productivity through Sensors

Once every month, a contractor walks through the Tate & Lyle plant to examine every one of its 700 motors. The contractor is responsible for identifying any preventative maintenance needs and, ultimately, reduce future production delays.

Since June, WHIN's Networking and Sensor team together with the manufacturing group has led a pilot study at Tate & Lyle designed to provide continuous, real-time, and actionable information about its motors. Commercial vibration and temperature sensors are located on four Tate & Lyle engines – three of the engines are consistently reliable, one is frequently troublesome and anticipated to fail soon. Using battery-powered sensors, standard Wi-Fi, and appropriate security measures, data is sent continuously to communicate if any of the motors are displaying unusual vibrations or high temperatures which might lead to unscheduled production downtime (Figures 5-7). The pilot study has been providing continuous data since July and it is currently being benchmarked against state-of-the-art manual measurements with much more expensive spectrum analyzers. The team has already begun preliminary discussions with Tate & Lyle to expand the pilot study to more motors.

The WHIN IoT Infrastructure and Data Analytics team also is at the nation's forefront of "edge data analytics." Typically, sensors gather data, send it all to one hub-sensor where it is then uploaded to a central cloud-based site to be analyzed. Through edge data analytics, key decision-making is completed at the sensor-level, before data is forwarded to the central hub – saving battery life and ensuring users only receive valuable data. For example, for sensors designed to measure the level of nitrate in a farmer's soil, battery life is critical. By applying edge data analytics, updates are not sent at timed intervals but, instead, only when there is a meaningful change in the soil's nitrate level, requiring fewer uploads and, as a result, extending battery life.



Figures 5 and 6: The the vibration sensors are deployed on the motors at the Tate & Lyle plant, detecting behaviors that are measured within the ranges of normal, warning or alarm.

Furthermore, many users are often frustrated when provided with too much “meaningless” data. Farmers, for example, want to review information that succinctly conveys the nitrate level of their soil. Edge data analytics improves the ease of use and overall reliability by comparing data from neighboring sensors. If one sensor’s information is significantly different from its neighbors, a correction is made. Through this approach, a farmer seeking to learn the nitrate level of his soil is provided a succinct but informative report.

IoT Infrastructure and Data Analytics team is currently conducting this work, developing edge data analytics for agriculture and machine health monitoring sensors so that data is transmitted only when there is a significant change, minimizing communication energy. Users can view a Mapbox cloud data website with real time sensor data, historical data, export features, graphing of data, and battery life expectation at <http://purduewhin.ecn.purdue.edu/>.

Prof. Ali Shakouri, the Mary Jo and Robert L. Kirk Director of the Birck Nanotechnology Center, also is the lead faculty for the WHIN-Purdue team. Along with CEO Johnny Park, Prof. Shakouri is working toward this project’s long-term vision of accelerating the adoption of accessible digital technologies throughout the Wabash Heartland region through the formation of new clusters of firms.

“By building strong relationships with the small local businesses in the region and providing tangible services that accelerate their innovation, WHIN will build a new foundation for open innovation and cluster development in the region,” said Prof. Shakouri.

“Sustainability will develop from ‘network effects.’ This synergy will create dynamic opportunities for innovations in education, research, and entrepreneurship.”

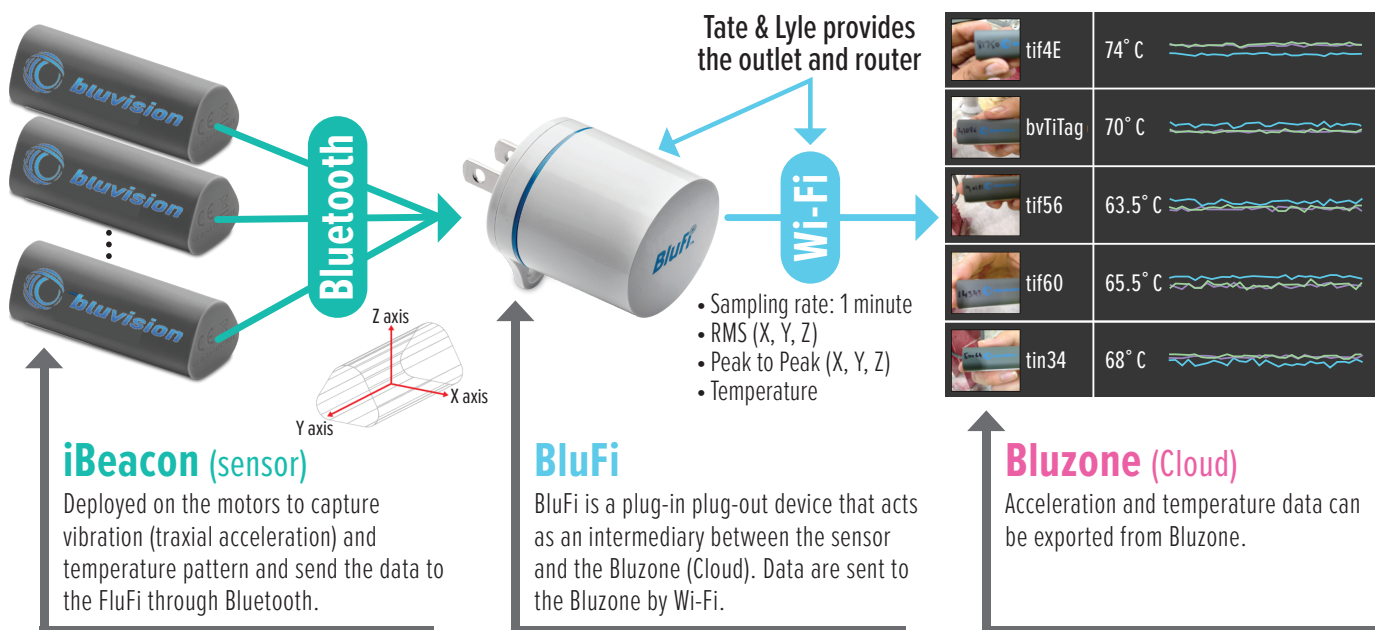


Figure 7: The Data Acquisition System used by the WHIN–Purdue team at Tate & Lyle.

WHIN: Governance and Cultivation Fund

A defining aspect for WHIN's governance was its CEO search. Although challenging, it ultimately provided perfect timing. During WHIN's initial search, Johnny Park was unavailable; he was still focused on the sale of his company, Spensa, to DTN. It was only during WHIN's extended search that Johnny was available to consider the position. Due to this fortuitous timing, he was selected as WHIN's new CEO. In this role, Johnny's business acumen, agricultural connections, engineering capabilities, and research experience brings a rare combination of energy and expertise to WHIN's governance.

WHIN's governance is further enhanced through WHIN's several other new hires. Caitlin Lambert recently joined the WHIN team as Johnny Park's executive assistant. Formerly of Purdue Marketing and Media, Caitlin brings extensive administrative skills and valuable knowledge about Purdue University.

In late spring, Ted Fiock was hired as the WHIN-Purdue Team Project Manager. He has more than 20 years of experience working in the manufacturing industry and a lifetime of personal farming experience. Shortly after, Chad Martin was hired as the new WHIN-Ivy Tech Project Manager. Previously, he dedicated 10 years to working for Purdue University as a Renewable Energy Extension Specialist, with an emphasis upon building statewide capacity for renewable energy education. Ted and Chad work together frequently, discussing upcoming or current projects multiple times per week. Ted's responsibilities include oversight of all Purdue projects and facilitating all aspects of the Manufacturing Advisory Council. Chad is responsible for all Ivy Tech projects for WHIN as well as facilitating all aspects of the Agricultural Advisory Council. Both advisory councils meet monthly. WHIN also has a Broadband Task Force, facilitated by Melinda Grismer of the Purdue Center for Regional Development (PCRD) and an RFP Development and Implementation Task Force, which is in the early stages and currently being facilitated by Johnny Park.

WHIN's sustainability is a top priority for leadership. WHIN is consistently pursuing numerous grants, foundation partnerships, and corporate engagement opportunities. WHIN recently submitted a \$750,000 Economic Development Administration (EDA) grant that, if approved, would play a vital role enhancing WHIN's long-term sustainability. Preliminarily called the WHIN Alliance, WHIN's sustainability plan is to provide a range of valuable services to local businesses. With the support of the

EDA grant and tiered membership fees paid by participating businesses, WHIN Alliance members will receive: (i) consulting services from an IoT strategist and businesses advisor; (ii) valuable IoT and related workforce/professional development opportunities; (iii) participation in management and executive-level peer group discussion networks facilitated by WHIN to discuss ongoing challenges; and (iv) access to Purdue and Ivy Tech students with IoT-relevant skills, hackathon competitions, etc.

Furthermore, the WHIN Alliance is developing digital co-operatives (co-ops) that bring together community and industry leaders as well as startups and entrepreneurs. The goal is to generate anonymous, aggregated data through the distributed testbeds and the companies in the supply chain participating in the WHIN Alliance, which will have significant value to both regional and national industries. Participating members will be able to benchmark specific metrics in comparison to their anonymous peers, make any necessary adjustments in collaboration with WHIN, ultimately to improve their global competitiveness. Digital co-ops and living laboratories are effective ways to build sustainable university-industry collaborations. Testbeds mitigate the risk that individual companies face in researching and implementing IoT solutions on their own. Living laboratories combine a push/pull commercialization strategy that accelerates early adopter applications and creates significant measurable benefits. By bringing together manufacturing, agriculture, university, and government resources, the digital co-op will accelerate the development and deployment of IoT solutions within the region.

It is within this increasingly robust framework that WHIN is beginning to develop its "Request for Proposal (RFP)" process for the Cultivation Fund and Living Lab initiatives. Although still in the early stages, a task force comprised of experts in grant management have been identified with the role of ensuring the RFPs are developed and administered in a transparent and fair process. The WHIN core team recognizes the critical importance of maximizing this funding so it has a multiplier effect far beyond the direct beneficiary.

WHIN's governance is steadily working to establish an environment of technology, talent, and data analytic solutions, making these assets available to all members within a successful, sustainable infrastructure.

Conclusion: **Why WHIN Will Succeed**

The following is a speech given by WHIN's new CEO, Johnny Park. He was an honored speaker at the 2018 Ivy Tech Lafayette Evening on the Farm Thursday, September 13. His speech focuses upon why WHIN has a strong future ahead:

My wife and I met in 1994 when we were both freshmen at Purdue. We have four wonderful children. Both my wife and I are not from Indiana. My wife is from the Chicago area and I grew up in South Korea. Even though we are not from here, we both grew to love this place and we proudly consider Indiana our home. When we began dating 20 something years ago, we would have never imagined that we would still be residents of West Lafayette more than two decades later. But here we are and we could not be happier. So in a sense, our family is a testament that this community is not only a welcoming community; it is also a wonderful place to raise a family. It is a community full of opportunities to pursue your dreams personally and professionally.

As Chad [Martin] mentioned, I was recently hired as the CEO of Wabash Heartland Innovation Network. WHIN is a 10-county consortium in North Central Indiana that includes Benton, Carroll, Cass, Clinton, Fountain, Montgomery, Pulaski, Tippecanoe, Warren, and White counties. Our goal is to develop this Wabash Heartland region into the global leader of high tech agriculture and next-generation manufacturing. We want to cultivate a regional ecosystem that empowers globally competitive businesses to plant and grow in the Wabash Heartland, that will ultimately lead to prosperity in this region. We are grateful for Lilly Endowment's generous gift of nearly \$39 million to get this initiative started. It is an incredibly ambitious goal. Ambitious goals personally motivate and excite me.

Furthermore, I am extremely optimistic that the Wabash Heartland region has a legitimate chance to be the global leader in digital agriculture and next-generation manufacturing. We already have a strong and leading industry base in agriculture and manufacturing. We have the premier research institution, Purdue University, right in our backyard. We have a world-class community college, Ivy Tech, generating a highly skilled workforce. And let's not forget that good old Midwestern values are a huge competitive advantage.

I recently read a short article that talks about what Silicon Valley can learn from good old Midwestern values. And the article came out in the midst of unethical behaviors of the executives in prominent Silicon Valley companies. The point of the article is that, as a tech startup, developing innovative products is important, but it is even more important that the company establishes a culture of strong work ethic, a culture of integrity and a culture of helping one another – which are all known to be the main pillars of Midwestern values.

Do we have a chance to turn our region into a global epicenter of IoT, agriculture, and manufacturing technology? Absolutely. If we can leverage and strengthen the culture of strong work ethic, high moral values with an attitude of helping one another and serving others in need, I think we have a chance to build something truly powerful and unique right here in the Wabash Heartland.

Thank you for allowing me to be part of this incredible success story that we will create together.

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 other sections. This reflects collaboration, not duplication, of efforts or expenses.

AIM 3.1.1: Establish IoT Platform Testbeds at Purdue to Advance Digital Agriculture

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 sensed 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.	<ul style="list-style-type: none"> • ABE Facility has begun construction. It is expected to be extensively sensed by 2020. • Members of the WHIN-Purdue team visited CNH Technical Center in New Holland, PA regarding support for IoT research at Purdue. <ul style="list-style-type: none"> - The New Holland site is the North American headquarters of the New Holland Agriculture and New Holland Construction brands and a global Center of Excellence for Hay and Forage products with dedicated R&D.
20 demonstrations and/or teaching initiatives per year.	<ul style="list-style-type: none"> • ABE Facility has begun construction. It is expected to be widely sensed by 2020.
Proposals submitted for 3 community-linked research projects connected with the facility per year, post sensor installation.	<ul style="list-style-type: none"> • ABE Facility has begun construction. It is expected to be widely sensed 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.	<ul style="list-style-type: none"> • ABE Facility has begun construction. It is expected to be widely sensed by 2020.
\$3.5 million of research expenditures in the testbeds from industry and government sources, post-sensor installation.	<ul style="list-style-type: none"> • ABE Facility has begun construction. It is expected to be widely sensed 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).	<ul style="list-style-type: none"> • The wireless IoT build at ACRE is complete, with 100% coverage with wireless backbone. <ul style="list-style-type: none"> - A data map is established at ACRE to document all of the sensors, data flow, etc; laying the groundwork for WHIN testbed development and implementation. • In conjunction with OATS Group, the use of mobile tablets is being explored to record audio and accelerations to provide metadata regarding equipment operations for machine learning analytics. - The TPAC (Throckmorton-Purdue Agricultural Center) farm was Wi-Fi mapped for signal strength variations providing insight into future sensor locations and application success.

AIM 3.1.1.B (Cont'd)

<p>20 demonstrations and/or teaching initiatives each year.</p>	<ul style="list-style-type: none">• Purdue hosted NIST Ag Rural Broadband SuperCluster meeting on September 6-7. Although hosted by Purdue, WHIN played a vital role in Purdue College of Ag joining and being selected as host. More than 90 distinguished attendees from throughout the nation participated.• UAV (Unmanned Air Vehicle) field demos were held at ACRE on June 26, July 26, and Sept. 6, 2018. The Sept. 6 event was titled, "UAV: Agriculture Uses Outside of Row Crops."
<p>Proposals submitted for 3 community-linked research projects connected with the facility per year, post sensor installation.</p>	<ul style="list-style-type: none">• WHIN has established a highly engaged Agricultural Advisory Council, which meets monthly involving a range of agricultural leaders from throughout the region. This has led to several conversations anticipated to become projects. Other conversations the WHIN team has been engaged with:<ul style="list-style-type: none">- Biotown Ag is a progressive farm operation in White County (Brian Furrer is a member of the WHIN Ag Advisory Council). The September 17 Advisory Council meeting was held on Furrer's farm operation showcasing their asset management programs which incorporate IoT. They also are in the development of IoT enabled sensing on their crop, livestock, and biogas energy facilities to incorporate real-time detection of performance on the farms. John Scott has assisted the Furrers with the use of drones for their cattle operation to detect numbers of cattle on feed and other production indicators.- Summit Livestock has offered support for IoT and Digital Agriculture with WHIN involvement.- Beck's Hybrids has offered support for IoT and Digital Agriculture to complement WHIN.
<p>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.</p>	<ul style="list-style-type: none">• By providing 100% connectivity at ACRE, WHIN is significantly streamlining research and expanding opportunities to the College's \$2 million plant sciences innovation fund designed to provide critical startup support. WHIN applied for an EDA innovation and entrepreneurship grant on Aug. 29, 2018. If the \$750,000 proposal is funded, two new positions (IoT Strategist and Regional Business Advisor) will assist in boosting the number of technology and IP filings.

AIM 3.1.1.B (Cont'd)

\$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:
 - LOI accepted, invited to submit a full proposal to the USDA under Food & Ag Cyberinformation Tools program which includes WHIN connections and others; titled: *FACT: Coordinated Innovation Network for Applications and Data Architecture for Real-Time Crop and Soil Data Systems*. \$1,000,000.
 - Submitted USDA NIFA REEU proposal titled: *Experiential Learning with Data Tools for Digital AgriScience and FACT* which helps address Aim 3.1.4 (Buckmaster, Saraswat, Krogmeier, Ward). \$500,000.
 - Agricultural Science and Extension for Economic Development (AgSEED) – a proposal competition led by the College of Agriculture for \$75,000 – the goal is to advance agribusiness and farmer education in the WHIN region related to digital agriculture.
 - The Platforms for Advanced Wireless Research (PAWR) Grant – NSF/Ignite – (being submitted in collaboration with the Sensors team) – approximately \$9M cash from NSF/\$15M in-kind contributions from the PAWR Industry Consortium – PAWR program aims to support advanced wireless research platforms that enable experimental exploration of robust new wireless devices, communication techniques, networks, systems, and services that will revolutionize the nation’s wireless ecosystem.
 - Submitted a two-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. The network also will collaborate to ensure rural workers have access to training that aligns with the skills employers need.
 - Faculty who are not currently engaged with WHIN, but whose work is very complementary to WHIN, are expressing strong interests in collaborations. Dr. Klein Ileleji of ABE, for example, has funding from INFOSYS to improve data measurement and connectivity at PHERC. Although not linked to WHIN yet, he is interested in future collaborations.

AIM 3.1.2: Establish Sensors Throughout the Ivy Tech Community College–Lafayette Agriculture Teaching Laboratory

Anticipated Outcomes

Ivy Tech Community College–Lafayette Agriculture Teaching Laboratory will serve as a testbed and be widely sensed by 2019.

Outcomes to Date

- Both the Advanced Manufacturing Lab and the 60-acre Farm Laboratory are scheduled to be widely sensed by 2019. Sensors are initially being installed in Fall 2019 as part of a Purdue-Ivy Tech collaboration in which Polytechnic students and Ivy Tech students work together to develop and install Internet Wi-Fi throughout the testbeds to deploy the IoT capacity for data collection.

AIM 3.1.2 (Cont'd)

<p>7 new courses will be developed.</p>	<ul style="list-style-type: none"> • An IoT degree program currently is being developed by Ivy Tech. Existing courses will incorporate WHIN objectives into the curriculum within the Agriculture and Advanced Manufacturing programs. The WHIN advisory councils will be actively engaged in providing guidance on the beneficial training for the students graduating from the program. Certificate training programs will be initiated in the area of Ag Data Sciences, relying on pulling courses from the Agriculture and the School of Information Technology programs.
<p>80 students will be engaged with the teaching lab each year.</p>	<ul style="list-style-type: none"> • An anticipated 80 Ivy Tech students (and approximately 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 sensed by 2019.
<p>4 community-linked research projects connected with the laboratory per year, post sensor installation.</p>	<ul style="list-style-type: none"> • The sensors have not yet been installed, but Ivy Tech has played an active role in WHIN community engagement efforts: <ul style="list-style-type: none"> - The WHIN Manufacturing Advisory Council meeting held on June 28, hosted by Ivy Tech, touring Ivy Tech labs and active discussion on testbed development at Ivy Tech and other locations. - WHIN’s August Board meeting held at Ivy Tech-Lafayette campus. - Ivy Tech campuses hosted three community outreach meetings with public officials throughout the region. - Ivy Tech-Lafayette is the home of WHIN’s office suite.

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

Anticipated Outcomes	Outcomes to Date
<p>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.</p>	<ul style="list-style-type: none"> • Regional stakeholder visits and WHIN Ag Council inputs have indicated a need for IoT applications in animal production systems. Animal IoT sensors are a high-priority topic in the region. Several WHIN stakeholders have expressed interest in being an animal IoT testbed site. Continued conversations and strategizing for data management of drone project, Data Hub.
<p>10 counties throughout the region will be engaged each year in community-linked IoT platform projects or training.</p>	<ul style="list-style-type: none"> • WHIN-Purdue needs to evaluate opportunities in this area for sensor development and testbed opportunities at ASREC (Animal Science Research and Education Center). Initial discussions held with Animal Science department head. • Investigating the possible implementation of weather stations in each of the 10 counties as an initial testbed build; adding future sensors and capabilities as technology advances. • Met with Summit Ag to discuss how IoT technology can help with the well-being of both swine and human employees in pork production.
<p>\$.5 M of research expenditures in the testbeds from industry and government sources.</p>	<ul style="list-style-type: none"> • NSF – PAWR grant (proposal call came out in July 2018).

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.	<ul style="list-style-type: none"> • Bruce Erickson was hired as the Digital Outreach and Education Specialist. Recent projects include: <ul style="list-style-type: none"> - Engaging Steve Eberly, Director Warren County Economic Development and Michelle Stucky of the Warren County Community Foundation to build a set of digital agriculture resources for high school students initially throughout Warren County, then the WHIN region, to increase excitement about digital agricultural careers. - In early development of online UAV (Unmanned Air Vehicle) course.
25 BS graduates per year in digital agriculture.	<ul style="list-style-type: none"> • WHIN Ag Education Group (Erickson, Scott, Fiock, Martin-Ivy Tech) have been meeting to define our education plans and offerings. AgriNovus and others to be included into plans as appropriate. Design and proposal of undergraduate programming related to Digital Ag and Data Science are under development by Jeff Holland and Dennis Buckmaster.
50 certificates per year awarded on digital agriculture topics.	<ul style="list-style-type: none"> • Launched our eighth offering of Precision Agriculture June 13 – a fully online, twelve-week class for agricultural professionals that is part of the Agronomy e-Learning Academy and our Crop Professional Certificate program. • Developing a Data Literacy Toolkit and planning July Data Literacy Symposium aimed at farmer education. • Discussions with American Society of Agronomy regarding online courses with the Purdue Agronomy e-Learning Academy.
8 professional MS degrees per year awarded in digital agriculture.	<ul style="list-style-type: none"> • Professional Master’s Degree in Digital Agriculture set to launch in summer of 2019. Buckmaster and Erickson are part of the leadership team for this development. • Met with Kaplan Higher Education and possible collaboration related to the online Professional Master’s in Digital Ag for 2019.
25 positions filled in critical needs areas (projected from baseline occupational skills needs assessment).	<ul style="list-style-type: none"> • PCRD is planning to launch the baseline occupational skills needs assessment (ONA) in January 2019. Positions are anticipated to be filled by Year 5.

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
<p>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.</p>	<ul style="list-style-type: none"> • Digital Extension Specialist John Scott was hired June 11 to coordinate the outreach and deployment of “digital agriculture” strategies relevant to the region: <ul style="list-style-type: none"> - Various activities ongoing with drones for multiple uses, including water application variations in irrigated fields and drone applications for livestock use. UAV Data Management activities continue with all Ag and Natural Resource (ANR) educators in the WHIN region. - Flying drones over Ivy Tech Agriculture Teaching Laboratory to collect images for detection of crop diseases and weed pressures have been helpful for creating teaching aids for the Ivy Tech Agriculture Crops courses and extension programming. The extension program is in collaboration with their future efforts to establish the Ivy Tech farm testbed.
<p>Investment in a marketing campaign to brand Purdue Extension as the primary and trusted source of information on science-based digital agriculture innovations.</p>	<ul style="list-style-type: none"> • Digital Extension Specialist John Scott was hired June 11 to coordinate the outreach and deployment of “digital agriculture” strategies relevant to the region. WHIN will work closely with him to develop and implement a marketing campaign. Purdue will be hosting the AgBot challenge in 2019 at ACRE. This could be a great outreach opportunity with all of the local WHIN region schools. Leadership is Ron Turco, Cory Gerber, and Dennis Buckmaster. • WHIN and Purdue Extension were featured in several radio/newspaper interviews, particularly related to their joint outreach efforts surveying local residents at all the county fairs. One example was a WIL0 radio interview on July 13 in Clinton County.
<p>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).</p>	<ul style="list-style-type: none"> • UAV Data Management group met and are working on approaches to facilitate easy and seamless handling of data for image files to enhance Purdue Extension’s drone programs and improve metadata collection as UAVs become more widely adopted.
<p>Adoption of digital agriculture strategies by at least 15 rural communities, agribusinesses, co-ops, and/or ag-related nonprofits by 2022.</p>	<ul style="list-style-type: none"> • Currently working with ANR educators on using drones during the growing season to better understand how this technology can be used to help farmers. • WHIN traveled to all 10 county fairs in the region with the Technology Trailer to promote both the WHIN mission and digital agriculture. • Education program provided to all campus specialists on current drone research being delivered to the county extension educators.

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.

- Research progress continues according to a plan that will be the basis for demonstration modules in model-based work instructions, predictive maintenance (motors, bearings), and middleware based machine monitoring (MT connect).
- A partner agreement for testbed support (software and hardware) has been entered with “Infor” to utilize its tools and applications to integrate equipment across the shop floor to the front office and across the value chain.
- Partnering discussions with other enterprise integration hardware, software, and middleware developers and providers that utilize Amazon Web Services and various open source software platforms continue.
 - The DMET will host a variety of enterprise integration providers as part of its mission to demonstrate and train integration across a variety of active software environments.

Deploy commercial software, hardware, and middleware, establishing the DMET digital sensor and networking architecture, between laboratories on West Lafayette campus for prototype workflow/ infrastructure.

- Research applying new methods, standards, and integration protocol have been validated that will become central to demonstration, showcase, and education features in DMET.
 - First year highlights include establishment of a 2-way communication using MTConnect™ using a Raspberry PI Linux-based system that will allow for future monitoring and control of machinery using open source code platforms.

Design and plan DMET physical location at Indiana Manufacturing Institute (IMI) in Purdue’s Research Park.

- Site design and build out plan for test bed at IMI is complete; target completion is summer, 2019.

Identification of the minimum product and systems information model to communicate between OEMs and suppliers.

- Researchers have developed testbed architecture and configured initial software tools for use in DMET research and demonstrations.
- Discussions with OEMs and suppliers as prospective research and demonstration partners are expected to lead to several partnering agreements during the first half of program year 2.
- 3 technical assistance projects have been launched with WHIN manufacturers (Tate + Lyle, Nucor, Caterpillar) that will provide exemplar cases for applying data analytics and IoT sensors for improved asset utilization (scheduled maintenance/ failure prediction) and human-proofing semi-automated assembly with IoT sensors.
 - These projects will demonstrate minimum IoT product and systems methods and technologies (low-cost, simple to operate) that can be adopted across all tiers of the supply chain.

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

YEAR 1 (Cont'd)

Map the capabilities of companies in the WHIN region using digital tools for supply chain prototyping.	<ul style="list-style-type: none"> Supply Chain Regional Mapping is partially complete to identify company locations in the region. Started confirmation of data with all targeted companies; goal is to complete this activity in September.
Connect with LEDOs or other economic development groups across WHIN counties to deploy supply chain prototyping tool.	<ul style="list-style-type: none"> To date – analysis of 227 companies. We are continuing the manual collection of data for another 50 companies. <ul style="list-style-type: none"> Total target is still 397 companies. Efforts continue to identify company attributes, like process capabilities, equipment, certifications, product codes, and special technologies, etc.
Work with OEMs to prioritize approaches to reduce supply chain leakage and record extent of leakage reduction.	<ul style="list-style-type: none"> Updating of regional supply chain maps as work continues. Set up Github for program and data collections, improvising the model in order to faster scrape websites with better quality of extracted data through use of Natural Language Process (NLP) as an example. Starting now to focus data into a few attributes, i.e. company type (manufacturer, distributor, etc.) and other major groupings, i.e. equipment, products, certifications, and NAPCS product codes. Continuing use of NLP software when keywords are not sufficient to identify page category from Web sites.

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.
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.

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

YEAR 3

Deploy and assess the digital product and process information model with partner companies and their supply chains.	<ul style="list-style-type: none"> Planned for Year 3.
Have deployed full digital enterprise sensor and networking architecture and infrastructure within the DMET location.	<ul style="list-style-type: none"> Planned for Year 3.
Develop prototype predictive analytics architecture and tools.	<ul style="list-style-type: none"> Planned for Year 3.
Finalize satellite locations for DMET architecture at companies throughout the WHIN region.	<ul style="list-style-type: none"> Planned for Year 3.
Establish additional technology adoption opportunities through mobile demonstrations.	<ul style="list-style-type: none"> 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.	<ul style="list-style-type: none"> Planned for Year 3.
Develop mechanisms to enable ROI for smart tool investments across the supply chain.	<ul style="list-style-type: none"> Planned for Year 3.

YEAR 4

Deploy supply chain prototyping tools as web based resources to attract new manufacturing investments to the WHIN region.	<ul style="list-style-type: none"> Planned for Year 4.
Develop a link between the supply chain prototyping tool and DMET to enable digital exploration of supply chain capabilities.	<ul style="list-style-type: none"> Planned for Years 2-4.

YEAR 5

Evolve the digital supply chains in the WHIN region to incorporate emerging technologies for smart manufacturing.	<ul style="list-style-type: none"> Planned for Year 5.
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AIM 3.2.4: Establish the Ivy Tech Next-Generation Center Pilot Program

Anticipated Outcomes

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.

Outcomes to Date

- Ivy Tech-WHIN Project Manager Chad Martin attends all WHIN leadership meetings, including the WHIN-Purdue bi-weekly operations meetings. Also attends research team meetings for the WHIN Agriculture and WHIN Manufacturing teams. Martin is responsible for facilitating the WHIN Agricultural Advisory Council.

AIM 3.2.4 (Cont'd)

Year 2 will focused on recruiting students and setting up the sensed lab in preparation for the pilot.	<ul style="list-style-type: none"> 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).	<ul style="list-style-type: none"> 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.	<ul style="list-style-type: none"> 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.	<ul style="list-style-type: none"> A total of 182 companies contacted. <ul style="list-style-type: none"> Completed first assessment of IoT usage in WHIN region companies. 54% of WHIN companies have no IoT usage. Only 5% say they use sensors and perform some data analytics. Completing the initial population of Salesforce database for WHIN staff use for company contact tracking/engagement management.
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).	<ul style="list-style-type: none"> Met with officials from LARA discussing how we can engage and work together in the future – they have over 150 certificate programs for tier one employee (underemployed).
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).	<ul style="list-style-type: none"> Have started the definition process for education and skill employee grouping. Begin development of first Web-based micro-course pilot. <ul style="list-style-type: none"> Identifying list of WHIN companies with management team that has expressed a high interest in the WHIN program and have a high level of operations excellence. These companies will form a core group that will be a target for the initial educational programs roll-out.
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).	<ul style="list-style-type: none"> Although planned for Years 2-5, the team has: <ul style="list-style-type: none"> 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).	<ul style="list-style-type: none"> Planned for Years 2-5.

AIM 3.2.5 (Cont'd)

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).	<ul style="list-style-type: none"> 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).	<ul style="list-style-type: none"> Although planned for Years 2-5, the team has: <ul style="list-style-type: none"> Developed our initial outline for education and skill employee grouping. Completing 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).	<ul style="list-style-type: none"> Although planned for Years 2-5, the team has: <ul style="list-style-type: none"> Conducted third value stream mapping face-to-face training course on August 14th. (8 students from 5 companies). A total of 11 people attended first two 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).	<ul style="list-style-type: none"> 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.	<ul style="list-style-type: none"> Testing and Evaluations of nitrate sensors (multiple sensors) continues using actual water runoff samples from the TPAC (Throckmorton-Purdue Agricultural Center) farm. Purchased soil moisture sensor packages for September installation/integration at TPAC farm. Design and manufacture of 40 wireless sensor boards completed (900MHZ LoRA + 2.4G GHz ANT/BLE). Networking tests for MESH protocols and power consumption. At the end of May, 14 sensors were deployed (7 in Birck and 7 in MSEE) to measure temperature and humidity in building environments. Live data at: http://ece-73-18.dhcp.ecn.purdue.edu:5000/. Improvements in sensor power consumption continuing as operating sensors now have an expected life of six months. Work continues to reach one-year target. Manufacturing of nitrate sensors is being optimized to reduce defects (bubbles) in the membrane. Continued lab testing of nitrate sensors in water and in sand with different nitrate concentrations. Measurements over 10's of hours to a week time period. Sensor quality assessments for roll-to-roll manufacturing of sensors continuing on uniformity of ion selective membranes, thickness variations of the sensors in the manufacturing process, and effects of these variations on sensor performance.

AIM 3.3 (Cont'd)

YEAR 1 (Cont'd)

<p>Finalize the design of distributed temperature and humidity sensors and fabricate hundreds of sensors for Purdue's ACRE facility and IN-MaC's testbed.</p>	<ul style="list-style-type: none">• Approaching a final sensor board design with multiple communication type capability to be compatible with temperature, humidity, air pressure type sensing devices, along with future nitrate sensor compatibility.• Discussions with Animal Science faculty about potential use of sensors and collaboration with animal farms in the region.• Different sensing elements are currently being evaluated for industrial and agricultural use with regional partners those include sensors for temperature, humidity, pressure, vibration, moisture to name a few. Working with several companies to identify future applications in WHIN region.
<p>Install sensors at main manufacturing partners: Caterpillar, Oerlikon, Wabash National; as well as Frito-Lay and Tate & Lyle (monitoring of moisture during processing – synergy with post-harvest initiative at Purdue).</p>	<ul style="list-style-type: none">• Looking to engage both Tate & Lyle along with Wabash National representatives in the next Manufacturing Advisory Council meeting. Building upon our live sensor implementations at Tate & Lyle, along with Wabash's sharing to their current use of IoT and future desires using IoT.• Starting discussions with Ivy Tech on development of their farm testbed, to avoid duplication of efforts and better facilitate the use of WHIN resources and grant funds.• Met with WHIN Manufacturing Advisory Council leadership team gathering their inputs into regional manufacturing engagement and testbed development ideas/concepts.
<p>Develop a communication network and hub design (with initial installation at 5 locations throughout the community).</p>	<ul style="list-style-type: none">• Cloud data Web site with Mapbox continues to be enhanced with sensors at BRK and EE. Fully functional, with real-time sensor data, historical data, export features, graphing of data, and battery life expectation added this month. http://purduewhin.ecn.purdue.edu/.<ul style="list-style-type: none">- Looking to expand Mapbox usage to display live vibration sensor reading from the local Tate & Lyle facility. Based on data from Tate & Lyle, commercial accelerometers for testing have been identified and ordered. This is a step forward to creating our own low-cost, open-source platform vibration sensor for manufacturing applications.• Machine learning group is using experimental nitrate sensor data as well as models to predict ion concentration without the need for the sensor reading to saturation.
<p>Implement data storage in the cloud and user access through a cell phone app and computer network.</p>	<ul style="list-style-type: none">• Edge data analytics developed for temperature and humidity sensors so that data is transmitted only when there is a significant change (minimizing communication energy).• IBM has provided to Purdue information regarding their platforms for machine monitoring, maintenance, and data analytics tools. Software is available to universities free of charge for use in research activities. Evaluations for use in WHIN–Purdue research areas being evaluated.

AIM 3.3 (Cont'd)

YEAR 1 (Cont'd)

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.

- Wi-Fi and network evaluations have been performed in conjunction with ITAP (Information Technology at Purdue) such that implementation at TPAC was completed by first week of July.
- Design of the sensor board was completed in early July so that it can now read larger voltages from commercial ag soil sensors.
- Engaged with Monsanto in two telecons (5/8, 5/17). They recommended start-up companies that we can leverage for our digital ag testbeds.
- Jose Hamilton and Kara Webb (Greater Lafayette Commerce) visited Birck on 5/17. They plan to include Purdue in the statewide Manufacturing Week activities (Oct. 1-5).
- Worked with Tate & Lyle, obtaining vibration data from their maintenance programs. We can now order and outfit accelerometers to our sensor boards. In early July, we tested multiple units at Birck, then integrate them into Tate & Lyle for sensor data through Wi-Fi.
- In June, sensor team visited Throckmorton-Purdue Agricultural Center (TPAC: Prof. Margaret Gitau, ABE) and field tested WHIN wireless platform, as well as nitrate sensors. Our sensors were compared side-by-side with existing commercially installed wired sensors (soil moisture and temperature).
- Prof. Nancy Denton (MET) and her student (Khizar Roof) started in mid-May to study different sensors for machine health monitoring using vibration analysis. They will provide vibration data to the manufacturing group.
- Alam and Ribeiro submitted NSF BIGDATA grant “Physics-Driven Deep Learning Priors for Fast Chemical Sensing,” with a budget of \$1M.

YEAR 2

Obtain field data from 5-6 IoT nodes throughout the region.

- Planned for Year 2.

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.

- Planned for Year 2.

Study the field data from distributed temperature, humidity and moisture sensors. Study sensor aging and drifts.

- Planned for Year 2.

Use machine learning to identify key factors impacting the design of reliable and robust sensors.

- Planned for Year 2.

Evaluate communication fidelity and cloud storage data security (data from private companies will be anonymized).

- Planned for Year 2.

AIM 3.3 (Cont'd)

YEAR 2 (Cont'd)

Expand sensor network to 15 locations throughout the community (commercial farms, small manufacturers, public building/services (in consultation with county's public work offices).	<ul style="list-style-type: none">• Planned for Year 2.
Finalize the design of pressure sensitive surfaces and pressure sensors (applications in pressure mapping and pressure measurement inside gearboxes and around key surfaces).	<ul style="list-style-type: none">• Planned for Year 2.
Fabricate two dozen sensors for lab characterization.	<ul style="list-style-type: none">• Planned for Year 2.

YEAR 3

Obtain field data from a dozen IoT nodes throughout the region.	<ul style="list-style-type: none">• 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.	<ul style="list-style-type: none">• Planned for Year 3.
Help train company employees who should start to maintain the sensor network.	<ul style="list-style-type: none">• Planned for Year 3.
Give guest lectures on sensors and IoT platforms in collaboration with education partners (K-12, community colleges, local businesses).	<ul style="list-style-type: none">• Planned for Year 3.
Test pressure sensors at 3-5 local manufacturers.	<ul style="list-style-type: none">• 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.	<ul style="list-style-type: none">• 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.	<ul style="list-style-type: none">• Planned for Year 3.
Finalize the design of water sensors for Purdue's Water Quality Field Station.	<ul style="list-style-type: none">• Planned for Year 3.
Fabricate two dozen sensors for lab characterization and field test.	<ul style="list-style-type: none">• Planned for Year 3.

AIM 3.3 (Cont'd)

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 will be measured by an inventory of local public-private partnerships and asset map of collaborating organizations (administered in 1st Quarter 2018). A baseline assessment of current public-private investments 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 1st Quarter 2018). A baseline assessment of educational attainment and gaps in workforce in all 10 counties 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.	<ul style="list-style-type: none"> • This approach is being examined to ensure it integrates thoroughly within the entire RFP process.
Implementation of Project Lead the Way (PLTW) into the 22 middle and high schools without research-based science, technology, engineering and math curriculum.	<ul style="list-style-type: none"> • This approach is being examined to ensure it integrates thoroughly within the entire RFP process.
3,000 high school enrollments in STEM career education courses region-wide (from the baseline of 1,558 current high school enrollments).	<ul style="list-style-type: none"> • This approach is being examined to ensure it integrates thoroughly within the entire RFP process.
750 “STEM-Ready” high school graduates (who have taken at least one STEM-related course).	<ul style="list-style-type: none"> • This approach is being examined to ensure it integrates thoroughly within the entire RFP process.
800 manufacturing and agriculture industry-recognized credentials awarded in high school (from the baseline of 420 current credentials awarded).	<ul style="list-style-type: none"> • This approach is being examined to ensure it integrates thoroughly within the entire RFP 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.	<ul style="list-style-type: none"> • The regional place-making survey was deployed on June 4, 2018. To date, nearly 2,500 total surveys have been completed both online (1,780) and on paper (690). The survey closed on Tuesday, Sept. 4, at midnight. Results for 2018 are currently being tabulated, analyzed, and reported. This is a valuable tool in measuring residents’ Quality of Place over WHIN’s five-year span. This survey will be re-evaluated and re-deployed 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 one 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 two or more counties in the Wabash Heartland to work together to boost the education, vitality and connectivity of the region.	<ul style="list-style-type: none"> • The RFP process is under development. It was temporarily delayed due to the extended hiring process of WHIN’s CEO.
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.	<ul style="list-style-type: none"> • Planned for Years 2-4.

AIM 3.5 (Cont'd)

<p>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.</p>	<ul style="list-style-type: none"> • Prior to the end of Year 5.
<p>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.</p>	<ul style="list-style-type: none"> • The regional place-making survey was deployed on June 4, 2018. To date, nearly 2,500 total surveys have been completed both online (1,780) and on paper (690). The survey closed on Tuesday, Sept. 4, at midnight. Results for 2018 are currently being tabulated, analyzed, and reported. 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

<p>An annual growth rate of 3.13% in GRP over 5 years.</p> <ul style="list-style-type: none"> • For every \$1 of Lilly Endowment, Inc. investment, the Wabash Heartland region would generate approximately \$3.24. (e.g. \$126M). 	<ul style="list-style-type: none"> • PCRD used EMSI (Economic Modeling Specialists International) data to study temporal growth in the Gross Regional Product (GRP) since 2007. PCRD found the annual growth rate between 2012 and 2016 to be around 3% by using both simple and compound growth rate methods. PCRD assumed that the lingering effects of the Great Recession would be minimal by 2012. PCRD also assumed that ceteris paribus (all else held constant), the GRP will grow annually by approximately 3% up to the end of the grant period in 2022. PCRD asserts that investments through WHIN will bump the overall growth rate of GRP up to 3.13% by 2022. Hence, each dollar from the initial \$38.9 million investment by LEI should leverage more than three times (3.24 to be precise), bringing an additional ~\$126 million to WHIN's regional economy.
<p>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.</p>	<ul style="list-style-type: none"> • Roberto Gallardo completed the WHIN Broadband Report, providing critical information re broadband infrastructure throughout the agricultural community; a follow-up survey to agricultural producers within the 10 counties is planned. • As part of the WHIN Broadband Report, PCRD began meeting individually with Internet Service Providers (ISPs) on Friday, Aug. 31, and will continue through the end of October 2018, to verify the digital footprint and solicit feedback in regards to cost of build-out. • Currently, PCRD is in the process of gathering information from the WHIN PIs regarding the "parity comparison" study, gathering information regarding which regions (nationally and internationally) are WHIN's competition—and to benchmark against them.
<p>125 positions will be filled in critical-need areas over 5 years (such as data analytics, precision agriculture, and IoT-related manufacturing).</p>	<ul style="list-style-type: none"> • Purdue Center for Regional Development is conducting an Occupational Needs Assessment (ONA) which will require close contact with local human resource directors who hire employees in these critical-needs areas, once the first cohort group of data-certified professionals has graduated/deployed into the workforce. • If the EDA innovation and entrepreneurship grant (submitted Aug. 28, 2018) is awarded, the hiring of both an IoT Strategist and a regional Business Advisor would greatly contribute to filling these positions by creating an entrepreneurial ecosystem.



APPENDIX C: Biographies

WHIN Board		
	Gary Henriott	Chair of Henriott Group (insurance and risk management services) and past Chair of Greater Lafayette Commerce Economic and Community Development Council; City of Lafayette Housing Authority; President of Board of Works and Safety – City of Lafayette, IN; Lafayette Community Bank Board; The Community Foundation of Greater Lafayette Board, and Chair of Community Commitment to Education Committee.
	David Bathe, PhD	Chancellor of Ivy Tech overseeing Lafayette, Logansport, Crawfordsville, Frankfort, and Monticello campuses. Leadership roles include Greater Lafayette Commerce, the Greater Lafayette Convention and Visitors Bureau, and the City of Lafayette Economic Development Commission.
	JoAnn Brouillette	Purdue Board of Trustees and managing partner and president of Demeter LP – privately owned grain and commercial warehouse business – Benton County, IN. Community leadership roles include the Executive Committee of the Indiana Chamber of Commerce, Lafayette Bank and Trust Advisory Board, and the National Grain and Feed Association Board.
	Ron Dickerson	Retired Vice President / General Manager – Nucor Steel Indiana and has most recently served as President of the Montgomery Economic Development organization; Community Foundation of Montgomery County.
	Dick Giromini	Executive Advisor, former CEO at Wabash National Corporation. Leadership roles include Central Indiana Corporate Partnership (CICP) Executive Committee and CICP's Ascend Indiana; Indiana Manufacturers Association (IMA); Board of Greater Lafayette Commerce (GLC) and GLC Economic & Community Development Council.
	Gary Lehman	Purdue University Board of Trustees, retired Chairman of the Board of Oerlikon Fairfield and President of Oerlikon AG-Americas, and the founder of Cannelton Group. Gary's leadership roles include Board of the Indiana Chamber of Commerce, Indiana Manufacturers Association, North Central Health Services, Ivy Tech Corporate College, and Greater Lafayette Commerce, Chair.
	Stephanie Long	President/CEO of North Central Health Services (NCHS), River Bend Hospital – a private inpatient psychiatric hospital, and capital grantmaker to eight of the ten counties in the WHIN region. Previously served as CEO at IU Health White Memorial Hospital. Community leadership roles include White County Economic Development Board of Directors; Greater Lafayette Commerce Board of Directors; and Community Foundation of Greater Lafayette.

WHIN Board (Cont'd)

	David Luhman	<p>Of Counsel to the law firm of Hoffman, Luhman & Masson, PC in Lafayette, Indiana. Leadership roles include Tippecanoe County Attorney (1997-2014) and counsel for Wabash River Enhancement Corporation, Tippecanoe County Parks and Recreation Foundation, and The Community of Greater Lafayette Board of Directors, Chair (2013-2016).</p>
	Todd Miller	<p>President/CEO Myers Spring, Logansport, Indiana. Community leadership includes Indiana Chamber of Commerce, Cass County Logansport Economic Development Organization, Logansport Municipal Utilities.</p>
	Marianne Rose	<p>President and CEO of the Community Foundation of Greater Lafayette, Indiana; 14 years with The Foundation.</p>
	Steve Schultz	<p>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.</p>

Purdue Leadership

	Jay T. Akridge, PhD	<p>Provost and Executive Vice President for Academic Affairs and Diversity. He also served as Principal Investigator for the WHIN-Purdue.</p>
	Suresh Garimella, PhD	<p>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.</p>

Ivy Tech Leadership

	David Bathe, PhD	<p>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.</p>
	Todd Roswarski, PhD	<p>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.</p>
	Andrea Schwartz	<p>Dean, School of Advanced Manufacturing, Engineering & Applied Science, Ivy Tech.</p>

WHIN Staff

	Johnny Park, PhD	<p>Chief Executive Officer (CEO).</p>
	Caitlin Lambert	<p>Executive Assistant.</p>


WHIN Core Team

	Gary Henriott	<p>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.)</p>
	Johnny Park, PhD	<p>Chief Executive Officer (CEO).</p>

WHIN Core Team (Cont'd)

	Marianne Rose	President and CEO of the Community Foundation of Greater Lafayette, Indiana; 14 years with The Foundation.
	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.
	Melinda Grismer WHIN-Purdue & WHIN Operations Committees	Community and Regional Development Specialist, Purdue Center for Regional Development.
	Mary Nauman WHIN-Purdue & WHIN Operations Committees	Director of Strategic Initiatives, Corporate and Foundation Relations, University Development Office, Purdue Research Foundation.
	Dennis Carson	City of Lafayette Economic Development Director.
	Ted Fiock	WHIN-Purdue Project Manager.
	Chad Martin	WHIN-Ivy Tech Project Manager
	Caitlin Lambert	Executive Assistant.

WHIN-Purdue Operations Team

	<p>Ali Shakouri, PhD WHIN-Purdue & WHIN Operations Committees</p>	<p>Mary Jo and Robert L. Kirk Director of Birck Nanotechnology Center; Professor of Electrical and Computer Engineering.</p>
	<p>Dennis Buckmaster</p>	<p>Assistant Dean and Associate Director of the Office of Academic Programs, Professor of Agricultural & Biological Engineering, Dean's Fellow for Digital Agriculture.</p>
	<p>Lionel J. "Bo" Beaulieu, PhD</p>	<p>Director of the Purdue Center for Regional Development and Assistant Director of the Extension Community Development Program.</p>
	<p>Steven Dunlop</p>	<p>Managing Director of Dauch Center for the Management of Manufacturing Enterprises (DCMME) and Global Supply Chain Management Initiative (GSCMI).</p>
	<p>Melinda Grismer</p>	<p>Community and Regional Development Specialist, Purdue Center for Regional Development.</p>
	<p>Nathan W. Hartman, EdD</p>	<p>Interim Head of Computer Graphics Technology, Dauch Family Endowed Professor, and Co-executive Director of IN-MaC.</p>
	<p>Ted Fiock</p>	<p>WHIN-Purdue Project Manager.</p>
	<p>Jason R. Henderson</p>	<p>College of Agriculture Administration, Associate Dean and Director of Purdue Extension.</p>
	<p>Ananth Iyer, PhD</p>	<p>Senior Associate Dean, Krannert School of Management; Susan Bulkeley Butler Chair in Operations Management.</p>

WHIN-Purdue Operations Team (Cont'd)

	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.

WHIN-Ivy Tech Operations Team

	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
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