EDUCATION FOR DIGITAL AGRICULTURE

PURDUE UNIVERSITY

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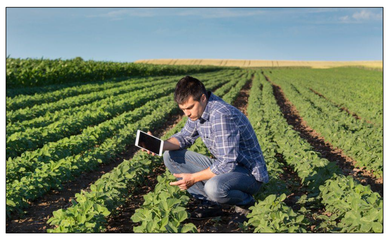
Technology adoption requires knowledge for successful integration into existing systems

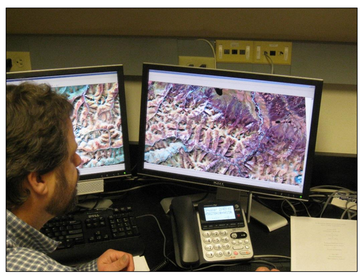
WABASH HEARTLAND INNOVATION NETWORK WHIN

HIGH SCHOOL

Proposed: Online instruction in digital agriculture to complement an internship program in schools throughout WHIN. Initial discussions have occurred with the Warren Co. Foundation, Seeger Memorial High School administration, and Wabash River Career and Technical Education.



UNDERGRADUATE



In Development: **Data Science**, an AgOnline course

Outcomes:

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

In Development: **Minor in Data Analytics/Digital Agriculture**

Existing: **Some Resident Courses at Purdue Related to Digital Agriculture**

ASM 540, Geographic Information System Application
AGRY 545, Remote Sensing of Land Resources
AGRY 598, Precision Crop Management
ECE 473, Introduction to Artificial Intelligence
STAT 242 Introduction to Data Science

GRADUATE

In Development: **Professional Master of Science in Digital Agriculture**

- Program launch planned for Summer 2019
- Tracks in addition to Digital Agriculture proposed in future
- 30 credits, fully online
- Admissions based on transcripts, letters of reference, statement of purpose

Course topics for Professional Masters:

- Project, people, and financial management, ethics, professionalism: 6 credits
- Communication and leadership: 6 credits
- Deep knowledge track: GIS, data methods, data analytics, remote sensing, sensors and instrumentation, etc.: 15 credits
- Project-based activity: 3 credits

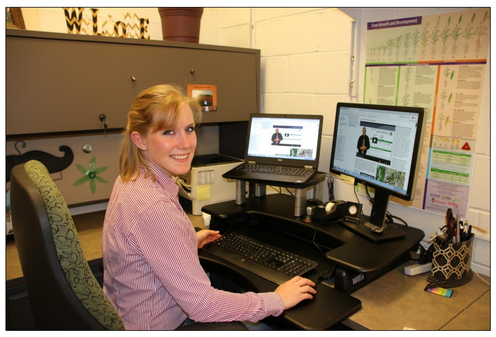
Existing: Numerous Resident Courses at Purdue Related to Digital Agriculture

PROFESSIONAL

Existing: **Precision Agriculture, Agronomy e-Learning Academy**

Winner of Best Professional Course at Purdue in 2017

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



PURDUE AGRICULTURE | AGRONOMY eLEARNING

PRECISION AGRICULTURE

ONLINE COURSE INSTRUCTORS

Bruce Erickson, PhD, CPAg
Course Designer & Instructor
Agronomy
Purdue University

John Fulton, PhD
Food, Agricultural and Biological Engineering
Ohio State University

Terry Griffin, PhD, CCA
Agricultural Economics
Kansas State University

Derek Heeren, PhD, PE
Biological Systems Engineering
University of Nebraska

Josh McGrath, PhD
Plant & Soil Sciences
University of Kentucky

Phillip Owens, PhD
Agronomy
Purdue University

Dharmendra Saraswat, PhD
Agricultural & Biological Engineering
Purdue University

Tim Stombaugh, PhD
Biosystems & Agricultural Engineering
University of Kentucky

COURSE MODULE OUTLINE

Introduction to Precision Agriculture
Scope and overview of the technologies and their applications

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

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

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

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

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

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

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

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

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

Telematics
Understanding telematics technology, wireless network applications, product comparisons

Precision Farming Economics and Adoption
Cost effectiveness of guidance systems, section controllers, site-specific management in various crops, regions, situations

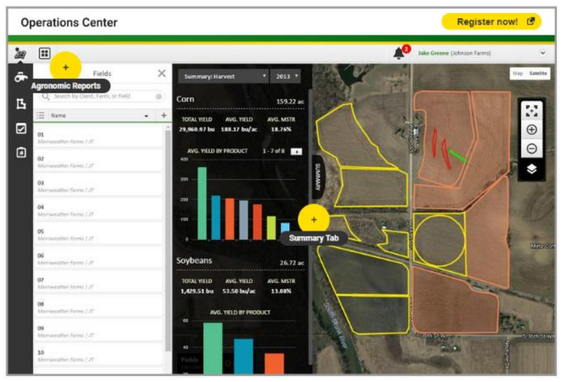
Acknowledgements: Thank you to the Wabash Heartland Innovation Network and Purdue University for supporting these programs.

EXAMPLES OF COMMERCIAL SOLUTIONS IN DIGITAL AGRICULTURE

PURDUE UNIVERSITY

Dennis Buckmaster, Bruce Erickson, John Scott

WABASH HEARTLAND INNOVATION NETWORK WHIN

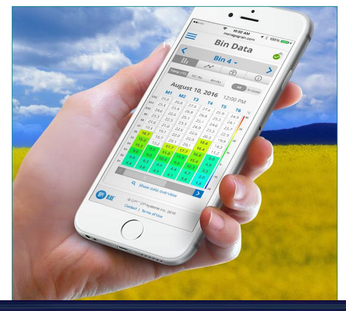


John Deere

- Suite of Digital Ag Products including MyJohnDeere, JD Link, and John Deere Field Connect
- MyJohnDeere is the cloud platform, JDLink is a cellular wireless data transfer service in some John Deere machines for sending real-time data to the cloud
- John Deere field connect is in field sensors used to monitor field conditions
- MyJohnDeere and John Deere field connect are API enabled platforms
- JDLink works in John Deere equipment
- MyJohnDeere can integrate with many platforms
- Ability to connect services to most infield machines to collect as-applied type data

Lely Astronaut

- Dutch machine company
- Cleans, attaches cups to teats, and milks autonomously
- Rapid adoption
- Saves labor, cows milked more often and on their schedule, increasing productivity



Teralytic

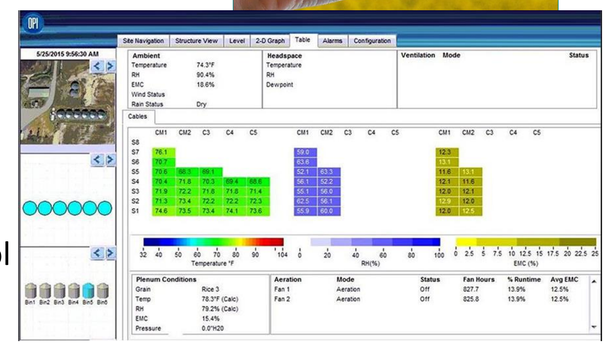
- Stationary wireless sensor
- Measures N, P, K, pH, aeration, respiration, air temperature, light, and humidity
- Each sensor costs a few hundred dollars

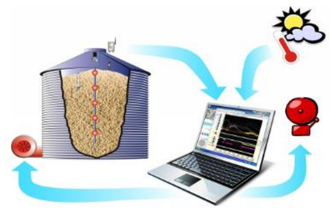
OPI Systems

- Moisture cables with measurements at 4 to 6 ft intervals up to 85 ft depth
- Temperature cables for up to 140 ft depth
- Insector insect detection system

Features:

- Wireless remote connectivity
- Remote logging/monitoring
- Alarms for temperature and moisture
- Inventory monitoring
- Automated and remote aeration control
- App or PC view



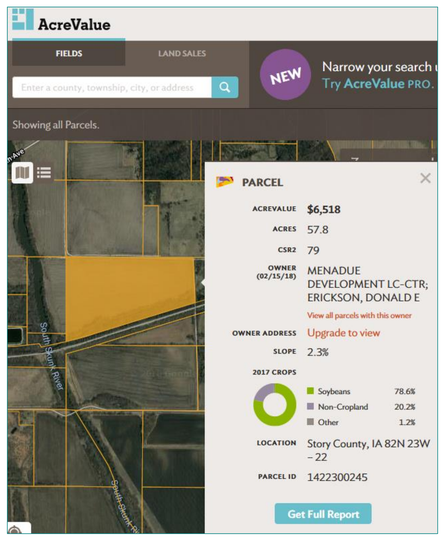


OPI™ Advancing Grain Storage Management

Climate Corp, subsidiary of Bayer

- A weather and data analysis company purchased by Monsanto, now part of Bayer
- Farm management information system
- Store and visualize field data
- Manage field variability by providing customized fertility and seeding plans
- Provides recommendations based on shared data

CLIMATE FIELD VIEW™



Granular, subsidiary of Corteva

- Farm management software
- Combines operational, financial and agronomic
- Acre value is popular site for land values

FARMERS BUSINESS NETWORK℠

https://www.farmersbusinessnetwork.com/

Farmers Business Network:

- Grouped benchmarking data from participating farmers used to make pricing decisions and for analytics
- Sales of chemical, fertilizer and seed on-line at low prices
- Software designed to help keep records, buy inputs, and sell crops
- Not yet profitable but a growing company with strong venture capital backing

Drone Deploy:

- Ability to integrate created maps with many existing ag software platforms
- Use with multiple drones/sensors
- Ability to upload images to be stitched even whencaptured manually
- Limits on number of images/map
- Limits on what drones/ tablets can be used effectively
- Reliance on outside drone software integration updates