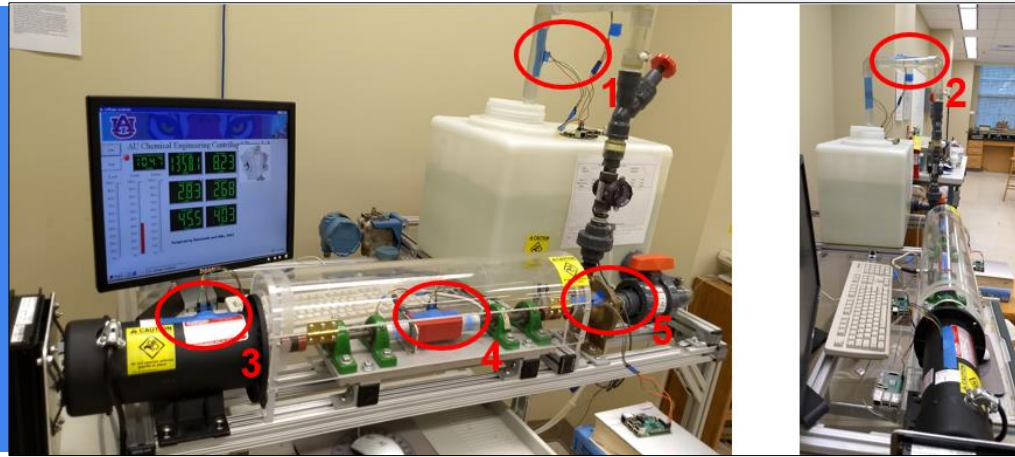


## PROJECT CASE STUDY

### IoT-Enabled Manufacturing Testbeds for Democratizing Smart Manufacturing Training



#### PROJECT LEAD

Auburn

#### PROJECT TEAM

Linde, Rayonier

#### PROJECT OBJECTIVE

The goal of this project is to develop a suite of data-enabled Smart Manufacturing (SM) Jupyter Notebook modules using real data and applications from two Internet-of-Things (IoT) enabled laboratory-scale SM technology testbed examples.

[MORE ON CESMII.ORG](https://www.cesmii.org)

## Auburn Develops IoT Testbeds to Train the Next Generation of Manufacturing Engineers

#### BENEFITS TO OUR NATION

Training engineering students in smart manufacturing techniques is a strategic investment for the United States. By equipping engineers with IoT and Data Analytics expertise, America can maintain its competitive edge in the global marketplace. This also ensures that these young people will be well-positioned to lead in sustainable manufacturing practices, reducing resource consumption and environmental impact. Training engineering students in smart manufacturing is a win-win for America, fostering innovation, economic vitality, and a more sustainable industrial future.

#### BENEFITS TO INDUSTRY

By providing engineers with expertise in cutting-edge technologies like IoT, advanced sensing, and data analytics, American industry gains a skilled talent pool that can drive efficiency, innovation, and competitiveness. These engineers will have the skills needed to develop and implement advanced manufacturing processes, reducing operational costs, and improving product quality. This not only bolsters the strength of individual industries but enhances the nation's overall industrial capabilities. Ultimately, training young engineers on smart manufacturing technology makes American manufacturers more agile, adaptable, and prosperous.

# PROJECT DESCRIPTION

## TECHNICAL APPROACH

Internet-of-Things (IoT) enabled Smart Manufacturing testbeds, which provide real data and applications for SM training modules, are leveraged to develop Smart Manufacturing modules on the Jupyter Notebook platform. The modules are integrated into the CESMII Smart Manufacturing Innovation Platform.

## ACCOMPLISHMENTS

- Demonstrated implementation of the SM testbed utilizing IoT vibration sensors for pump-flow condition monitoring
- Demonstrated implementation of the IoT Wi-Fi sensors for estimating moisture content in wood chips
- Developed reusable machine learning models for pump motor speed and water flow rate
- Developed reusable artificial neural network models for moisture content prediction
- Demonstrated feasibility of implementing low-cost, contact free IIoT sensors

## DELIVERABLES

- Delivered Complete Smart Manufacturing Testbed Documentation Package
- Delivered Complete Smart Manufacturing Profiles
- Delivered complete interactive Jupyter Notebook modules covering the entire data science life cycle:
  - Data preparation and processing
  - Data exploration and visualization
  - Data transformation and feature engineering
  - Machine learning
  - Deep learning
  - Performance metrics in machine learning

## REUSABLE OUTCOMES

- Raw data, video and documentation packages are available for other CESMII members training and research needs
- Low-cost, noninvasive sensing system documentation package

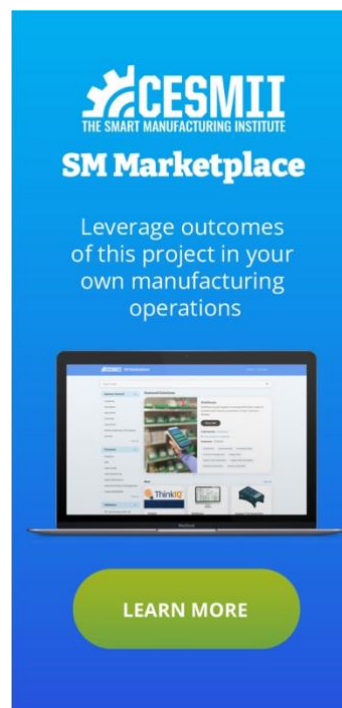
# RESULTS

6

Developed six Jupyter Notebook training modules covering the complete manufacturing data science life cycle.

17

Delivered Data Analytics and Machine Learning course to 17 Auburn University Chemical Engineering undergraduates.



The banner features the CESMII logo at the top, followed by the text 'THE SMART MANUFACTURING INSTITUTE' and 'SM Marketplace'. Below this, it says 'Leverage outcomes of this project in your own manufacturing operations'. A laptop screen displays a dashboard with various charts and data. At the bottom, there is a green button with the text 'LEARN MORE'.

## PROJECT DETAIL

Budget Period: BP4 – BP5  
Submission Date: 1/27/2023  
Sub-Award (contract) Number:  
4550 G YA229  
SOPO: 2320

## FOR MORE INFORMATION CONTACT

Name: Peter He  
Position: Associate Professor  
Phone: 334-844-7602  
Email: qhe@auburn.edu