Penn State researchers to help revive manufacturing enterprises

By using artificial intelligence and machine learning, small- and medium-sized American manufacturing can be cleaner and cheaper

Kumara explained that it is important now more than ever to help small and medium sized manufacturers for the success of American businesses.

Image: FG Trade

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UNIVERSITY PARK, Pa. — A team of Penn State researchers, in collaboration with Texas A&M University and The University of Texas Rio Grande Valley (UTRGV), has received funding from the Clean Energy Smart Manufacturing Innovation Institute (CESMII) to help small- and medium-sized American manufacturers be at the forefront of new smart technologies to improve their processes.

Housed at the University of California, Los Angeles and funded by the Department of Energy, CESMII provided funding to Soundar Kumara, Allen E. Pearce and Allen M. Pearce Professor of Industrial Engineering; Satish T.S. Bukkapatnam, Rockwell International Professor of Industrial and Systems

Engineering at Texas A&M; and Anil Srivastava, professor of manufacturing and industrial engineering at UTRGV.

The team of Penn State researchers includes Hui Yang, professor of industrial engineering, and computer science and engineering faculty members John Sampson, associate professor; Mahmut Kandemir, professor; and Vijaykrishnan Narayanan, A. Robert Noll Chair of Electrical Engineering and Computer Science.

The team will research how to predict machine breakdowns by using sensor data analytics, artificial intelligence, machine learning and the Industrial Internet of Things (IIoT), which will lay down a new foundational digital infrastructure and science for smart manufacturing.

Additionally, with the help of Tanna Pugh, director of the Pennsylvania Technical Assistance Program and a participating member of the project, the team aims to share this technology with three small-to-medium Pennsylvania companies and implement their research and development efforts.

“By helping small-to-medium sized manufacturers, which are often the largest producers of local employment in their local areas, we are hoping to strengthen local communities and contribute to the United States of America becoming more independent as a nation, and less dependent on global supply chains,” Kumara said. “We didn’t even think of COVID-19 when we wrote this proposal, so it’s more important now than ever to help these small-to-medium sized manufacturers.”

In a manufacturing facility, the window of time for making a repair after a machine breakdown has been discovered is small, meaning that undiagnosed machine failures can shut down the whole factory line. Kumara explained that this can be a tricky process, as the type and timing of machine sensor data can affect which algorithms are used for fault detection and recovery.

Kumara added that transforming legacy machines to smart machines will take the U.S. economy to the next level. Narayanan and his team are investigating how self-energizing sensors help in this effort. The team hopes to make a significant impact on energy savings in manufacturing.

“We need to know what data is required, what sensors should be used and how we can represent this data in order to help transition these facilities into ‘smart’ entities,” Kumara said.

Bukkapatnam noted that a major innovation gap in the current smart manufacturing practice is the lack of systematic guidelines and applications for making informed decisions, which has impeded the current efforts to advance industrial productivity and energy efficiency.

“Equally as important, transforming legacy machines into self-aware smart manufacturing systems will have a significant impact on small-to-medium sized industries by enabling improvements in the productivity levels,” Bukkapatnam said. “This will positively impact every single citizen and society as a whole directly through lowering the cost of goods and services, improving the economy and generating jobs, while also ensuring America’s global economic dominance in advanced manufacturing.”

Due to the improved accuracy of breakdown prediction to help reduce downtime while improving productivity, companies may also experience direct energy-savings. These technologies, such as IIoT sensing and analytics, can be conducted via cloud computing, which requires less energy consumption.

Bukkapatnam further explained that the main challenges in smart manufacturing are inherently interdisciplinary.

“They lie at the nexus of manufacturing and materials sciences, operations research, data science and AI, sensors and instrumentation technologies,” Bukkapatnam said. “It is imperative that the experts in these domains work together to address these challenges. More generally, integration of principles, methods and philosophies from a wide range of disciplines not only provides a novel framework to promote innovative manufacturing paradigms, but also enriches the overall learning experience of researchers, especially students, who are involved in the project.”

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