



Industry 4.0: Smart sensors and data in manufacturing offer value to many industries

By the University of Cincinnati Online

Hard-coded into our human DNA is the ability to sense and feel — a shift in the direction of the wind, a burned batch of cookies in the oven, an ice cube that gets stuck to a finger. Our sensory perceptions, the ability to process stimuli in our environment, help keep us alive and thriving in the physical world.

Sensors are also thriving on the factory floor and in machinery of all types and sizes. Detecting stimuli of all types, from sound to motion to temperature, the digitization of this collected data yields information that tells manufacturers how their technology-enabled equipment and products are performing.

Smart sensors

Mohamed (Mo) Abuali, Ph.D., is an adjunct professor at the University of Cincinnati's [College of Engineering and Applied Science](#). He's passionate about smart sensors' business value and how they provide timely and critical data to the manufacturing industry and other digitally connected business sectors.

"A smart sensor, one that detects vibration in a piece of machinery, for example, comes with a platform, microprocessor and a storage element," Abuali says. "It can take the raw vibration signal data and convert it into actionable insights, which makes it so much more than a traditional sensor."

Abuali says that, though sensor technology has been around for decades, it was mainly used in safety-critical industries, such as aerospace and utilities. Smart sensors are one of the elements of Industry 4.0, which many describe as the evolution toward interconnectivity, automation, machine learning and decisions based on real-time data acquisition.

Today's advancements in sensor technology can be attributed to several factors, including the internet, acceleration of computational speeds and the lower costs of scaling platforms and producing data analytics.

"We've taken the knowledge from what we learned in the more traditional industries and applied it to other industries," says Abuali. "And with today's lowered costs comes greater adoption and a world of new opportunity for manufacturers."

Types of sensor data

One of Abuali's expertise areas is industrial machinery, where sensors are used to ensure consistent, reliable, and predictable functions. Smart sensors benefit a variety of business use cases, including minimizing downtime, outpacing the competition and meeting the demands of customers and new markets.

Abuali says that manufacturers use smart sensors to collect these types of data:

- Acoustic – sensing the sound of the machine, its intensity, etc.
- Chemical – measuring pH (acidity or alkalinity) and other biological types of data.
- Electrical – monitoring voltage, current, power and energy.
- Environmental – assessing temperature, light, etc.
- Image – digitizing pictures, for example, of parts produced on a factory line.
- Motion – evaluating vibration and other forces.

“In manufacturing, knowing the ‘health’ of a machine is critical,” says Abuali. “Measuring sensor data helps you detect and predict when it will fail before the machine goes down. This enables manufacturers to move away from reactive maintenance — fail and fix — to a predict-and-prevent operation model.”

Analytics inform decision-making

The “digitization of everything” means that manufacturers and other businesses that rely on smart sensors and other Industry 4.0 technologies must also focus on mining the data. Through thoughtful data analysis processes, businesses can make more informed decisions and focus on continuous improvement.

The science of data analytics is complex, but Abuali simplifies some of its key concepts. He says that predictive analytics reveals what may happen next, prescriptive analytics informs how you can influence a process, and immediate and actionable analytics brings the next-best actions to the forefront.

Connected systems, connected workers

Using sensors and data to improve manufacturing assets and products is at a maturity point in many organizations. Now, leading manufacturers are shifting their focus to the connected worker. While the concept may sound futuristic, a connect worker

is anyone whose tasks are monitored and supported by a network of digital tools and applications.

Abuali says there are two motivations for manufacturers wanting connected workers. First, there’s the aging workforce that still holds much of its institutional and tribal knowledge. The other driver is the digital native workforce, those who work in manufacturing today and those the industry wants to recruit. “These technology-savvy individuals come from the other side of the spectrum,” he says, “and are comfortable with augmented reality or mixed reality, a blend of real and virtual worlds.”

Connected workers on the manufacturing front line are the wave of the future, and Abuali says the future is now. “Today’s leaders in manufacturing connect everything — their assets, products, workers and their supply chain.”



Industry 4.0 in the classroom

As one of the professors in UC Online’s Master of Engineering in Mechanical Engineering program, Abuali brings his forward-looking and upbeat perspectives to the students he talks with every day.

The master’s program incorporates the essential cutting-edge technical skills in big data, smart sensors, artificial intelligence and machine learning, additive manufacturing (3-D printing) and cyber-security. Classes are 100% online, and there is no on-campus attendance requirement.

While technical skills and expertise are essential, manufacturing organizations also value other professional skills that are enhanced through the

university's program, Abuali says, including leadership, problem-solving and culture-building.

Abuali teaches the engineering degree's foundational course, Industry 4.0 Domains of Knowledge, which provides students with a broad understanding of the industrial internet of things (IIOT). It encompasses physical production and operations with smart digital technology, machine learning and big data analysis. Abuali calls these areas part of the "connected ecosystem" of manufacturing production and the supply chain.

"Getting our engineering students to focus on more than just the technology piece — the business cases, return on investment and value of capturing real-time data — is what we emphasize in our program," Abuali says.

Opportunities for manufacturing professionals

Abuali and the other professors at UC Online are optimistic about the technical and management manufacturing roles awaiting their students. They believe their graduates have endless opportunities because of where manufacturers are today related to Industry 4.0.

"Each manufacturer has its own level of maturity and must assess where it is on the digital transformation scale," he says. "Their journey to 4.0 may take months or even years. One thing is for sure, these are unprecedented times for manufacturing businesses worldwide."

The University of Cincinnati's online Master of Engineering in Mechanical Engineering immerses students in the next advancements in technology within the manufacturing space, Industry 4.0. For more information about the master's degree program, read the [program's highlights](#) or call 833-556-7600 to speak with an Enrollment Services Advisor.