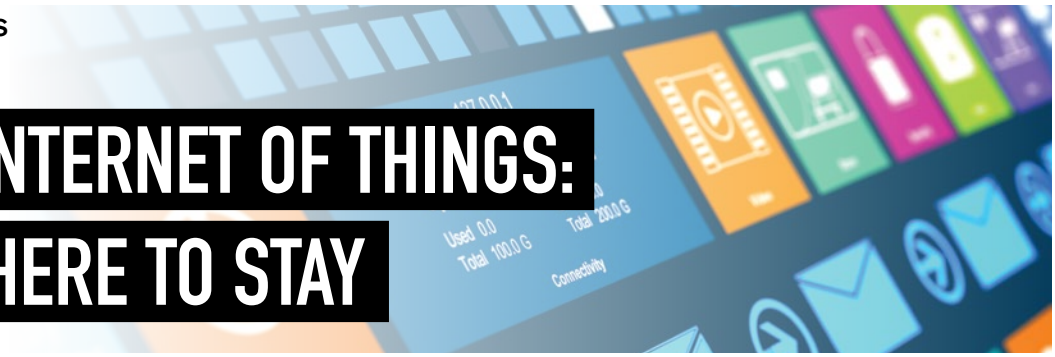

INDUSTRIAL INTERNET OF THINGS: HERE TODAY, HERE TO STAY

With its global reach, the IIoT is transforming our world.

The Internet of Things (IoT) isn't just a catchphrase; it's a reality. Most of us are already connected via *consumer* devices, including cellphones, smart TVs, and other everyday objects. We're also enmeshed in the *Industrial* Internet of Things (IIoT) via far bigger "things" and systems, such as transportation networks, utilities, and the factories that manufacture those devices we use every day.

The IIoT's full potential is unlimited. It forges a world of smarter, hyper-connected devices and infrastructures in which manufacturing machines, transportation systems, and the electrical grid are outfitted with embedded sensing, processing, control, and analytical capabilities. Once connected, they create a smart network of systems, sharing data among devices across enterprises and in the cloud. These systems generate incredible amounts of this big analog data—massive volumes of information from real-world things. That data is analyzed and processed to inform business decisions, ultimately improving safety and operational efficiency and increasing the uptime of critical assets and equipment.

"It's important that leaders in more organizations investigate this incredible technology revolution and the impact it can have on their businesses," says Nicholas Butler, senior group manager of embedded systems product marketing at National Instruments (NI), a company that has been helping engineering systems connect since the 1980s.

The Power of 1 Percent

Even small efficiency gains can have massive impact. According to widely cited research by General Electric, if the aviation industry used embedded sensing, processing, and analytics to make jet engines just 1 percent more efficient, it could save $30 billion on fuel over 15 years. In rail transportation, a 1 percent increase in efficiency could yield a $27 billion fuel savings over 15 years; in health care, a 1 percent reduction in process efficiencies could save $63 billion over the same period of time. A 2015 report from the McKinsey Global Institute estimates the economic impact of the overall IoT market at $4 trillion to $11 trillion annually by 2025. The IIoT could account for much of that, mainly in the manufacturing, energy, and transportation industries, as well as in life sciences and agriculture.

Adopters are already reaping the benefits, says Richard Mark Soley, executive director of the Industrial Internet Consortium (IIC), a nonprofit formed in early 2014 to accelerate the development, adoption, and widespread use of interconnected machines and devices, intelligent analytics, and people at work. The IIC counts NI among its more than 250 members from industry, government, and academia worldwide.

But because the IIoT's real power comes from the interdependence of all its users, there will never be a single IIoT "winner" in the market. "The Industrial IoT has to be enabled by connectivity," Soley says. "The entire point is connecting the supply chain or value chain across companies. That means that interoperability, standardization, security, and privacy become paramount. That's a major part of the IIC's testbed development activity."

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>
> — Richard Mark Soley, Executive Director, Industrial Internet Consortium

About 20 percent of companies worldwide are currently adopting IIoT solutions, says NI's Butler, and he estimates that about 50 percent of companies are currently considering such solutions. And they're all asking the same key questions about how to make their machines or factories "smart."

ECONOMIC IMPACT OF THE IoT:

$4 TRILLION to $11 TRILLION

annually by 2025

Source: *The Internet of Things: Mapping the Value Beyond the Hype*, McKinsey Global Institute, 2015

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In health care, a 1 percent reduction in process efficiencies could save **$63 billion** over 15 years

Source: *Industrial Internet: Pushing the Boundaries of Minds and Machines,* General Electric Co., 2012

Compute, Connect, Control

The answer, Butler says, lies in thinking about those questions in human terms: we sense, think, and act. "To sense, we need sensors. To think, we need processing, computation, and analytics. To act, we need the ability to move or the ability to change how we're operating," he says. An IIoT solution needs to integrate all these capabilities. NI provides the computation, connectivity, and control tools to do just that.

Butler recommends a platform-based approach. "NI's platform combines modular, rugged, flexible hardware with system design software that can customize hardware functionality, along with the services, support, and ecosystem of partners that surround that platform to customize it and augment its capabilities over time," he says.

Central to NI's approach is its LabVIEW software, which has a graphical programming syntax that makes it simple to visualize, create, and code engineering systems. LabVIEW allows users to program many different types of hardware with a single software toolchain, instead of having to cobble together software products from multiple vendors and then get those to interoperate in a complete system.

LabVIEW can also be used to program incredibly powerful "chips"—field-programmable gate arrays (FPGAs) that can be used for intensive signal or image processing, complex control, or creation of extremely customized timing or triggering algorithms. "An FPGA, or the combination of an FPGA and a processor, is critical to solving implementation of the IIoT," Butler notes.

for the IIoT. It's part of an ongoing cycle, Butler says: "You have innovation that's adopted and feedback that goes to the providers who then further innovate. That's how National Instruments equips end users with ways to become more efficient and safe and reliable."

> "It's important that leaders in more organizations investigate this incredible technology revolution and the impact it can have on their businesses."
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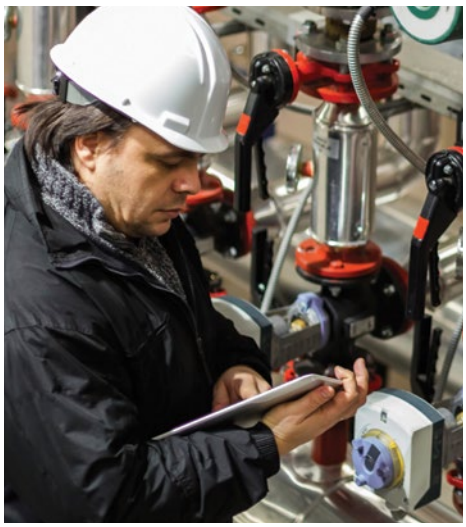
> — Nicholas Butler, Senior Group Manager, Embedded Systems Product Marketing, National Instruments

NI's products, research, and development are helping businesses overcome the challenges inherent in implementing the IIoT, including data analysis and storage, bandwidth constraints, privacy issues, and security challenges. On the last, NI is among the few companies offering an off-the-shelf, validated, real-time operating system based on security-enhanced Linux. That allows a company to both customize its system and ensure that only approved users gain access.

Disruption and Innovation

These challenges present opportunities for disruption because the solutions will fundamentally change how people design, deploy, and operate machines. That disruption, in turn, leads to innovation when companies such as NI develop methods, products, and systems

For more about National Instruments, please visit the NI website. For more about LabVIEW, please visit the LabVIEW home page.



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