The Internet of Energy:

Smart sensors, big data, and manufacturing 4.0

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Global manufacturing

Global manufacturing is in a state of transformation. Improved efficiencies, intelligent automation, and a growing market appreciation for product quality have breathed new life into western manufacturing.

At the heart of this transformation are two technological developments that promise to power smart manufacturing for generations to come.

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Manufacturing 4.0 is defined by increased operational reliance on automation, advanced robotics, and closed-loop data feedback. The goal is to digitally capture, analyze, and refine every element of the manufacturing process in real time.

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The Internet of Energy is philosophically related to Manufacturing 4.0, but extends beyond the factory floor and offers more granular insights in its efforts to digitally map and optimise energy assets and infrastructure. This white paper will provide a practical examination of Manufacturing 4.0 and the Internet of Energy as well as a primer on how smart companies are now beginning to combine and leverage both to mind-blowing effect.

Introduction

The Internet of Energy – a sub-system within the Internet of Things – refers to the digitisation of energy assets and infrastructure.

As a system, the Internet of Energy is a whole that is informed upon and shaped by its own components. It is dynamic, responsive and interconnected.

You might not see it, but every part is constantly communicating with the whole and the whole is constantly communicating with every part. This latent interconnectedness, coupled with automated monitoring and reporting combine to form a discrete hyperawareness that ensures all systems are running efficiently.

In practice, a smart grid interacts with smart substations, which interact with smart sensors, which interact with all manners of smart devices, which all interact together. Each link in this chain is constantly responding to the information accumulated, evolving and reshaping itself to better meet the needs of the whole.

It's not just about the data collected by these objects but how that data is instantly communicated up and down a series of purpose specific terminals, ensuring that relevant information is always in the right place to be intelligently acted on.

This framework is capable of automating a great deal of human efforts and business processes, such that objectives are accomplished more quickly, more easily, and ever more intelligently.

Highlights

- What's driving Manufacturing 4.0 and IoE
- New operational capabilities introduced by "smart" manufacturing
- Wireless sensors as the secret ingredient
- The case for IoE powered Manufacturing 4.0

The technology of today

This is not the technology of some distant future, it is the technology of today – and for many it's already hooked into everyday life through items like smart refrigerators.

Smart technology and the rapid automated exchange of information for improved operational awareness and process refinement is exciting for businesses across all sectors of the economy. But when it comes to the Internet of Energy, manufacturing is particularly well positioned to benefit.

Using the smart grid as its springboard, the Internet of Energy promises and delivers on improved reliability, increased efficiency, added flexibility, and proven sustainability. Smart components capable of sending and receiving data work together to obtain deep insights into asset performance at any given time, supplying the information necessary for operational and energy efficiency. The data insights uncovered from such technologies hold immeasurable value on the long and constant journey towards operational improvement.

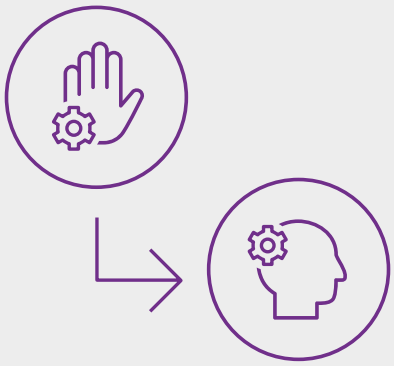
Just like the digital revolution and the assembly line before it, the Internet of Things – and within it, IoE – is unlocking potential for faster and more accurate production than was ever thought possible.

Internet of Energy and Manufacturing 4.0

We know that the era of Manufacturing 4.0 is upon us, but what exactly does that entail for manufacturers? How is that practically implemented?

Manufacturing 4.0 is based on the convergence of information technology and operational technology. Once operating as two separate entities, IT and OT come together here to enable "smart" manufacturing: automation, increased productivity, and optimised production. Advanced robotics, highly synchronised production line interactions and constant machine-to machine communication are the hallmarks of this new age.

In the "smart factory", not only is everything mechanised and automated, but everything is thinking. To achieve this feat of futurism, manufacturers rely on embedded or retrofitted sensor technology, capable of pulling and relaying otherwise invisible data points from real life scenarios.



"Whereas previous industrial revolutions represented mechanical improvements over human hands, this latest revolution is rooted in mechanical improvements over human minds."

Wireless sensor and communication technology: the common denominator between IoE and manufacturing 4.0

At the heart of both the Internet of Energy and Manufacturing 4.0 is the proliferation and miniaturisation of wireless sensors.

Whether they're inductive distance measuring sensors, oscillatory sensors, heat sensors, particle sensors, or energy sensors, these devices are the eyes and ears of every smart system.

For manufacturing, wireless sensor technology is the secret to identifying improvements on the factory floor. Smart sensors can collect and relay granular data all day every day – without requiring any sort of additional equipment or energy upgrades. Every issue, from detecting machine idling and sequencing issues to identifying issues such as air leaks or inefficient chillers, can be identified through granular-level data.

The ultimate goal – to achieve operational excellence – is accomplished by reducing total downtime, both planned and unplanned, courtesy of predictive maintenance. Since downtime inducing problems do not arise ex nihilo, but originate as much smaller mechanical ills that metastasise, you can create a data dragnet to catch and attend to these precursor ills before they can develop into something more. Implementing such an approach requires incredibly precise information and surgical intervention. When done successfully, it also means practically no operational disruption and no unnecessary maintenance.

Best of all, machinery doesn't need to be "smart" right out of the gate in order to be a part of this self-diagnosing, interconnected system. Retrofitting smart, wireless sensors to existing equipment makes for an affordable, effective, and convenient solution for manufacturers looking to better leverage the combined force of connected devices and big data. Such after-market sensors turn elite operational capabilities into low-hanging fruit for operations everywhere.

Top-end snap-and-play sensors can be fit onto any piece of equipment in the manufacturing facility, looping it into the larger IoE family. These wireless sensors are no bigger than 9-volt batteries and are powered by the circuit's magnetic fields – requiring no additional energy source. This sort of "smart" technology is not only economical, but designed with the value of streamlining in mind. All the sensors needed to monitor an entire manufacturing facility can be installed in just a few hours, without needing to shut down any part of production at any time in order to do so. And in the spirit of the second great industrial revolution, the same wireless sensors are uses across the production line, regardless of the age or type of equipment.

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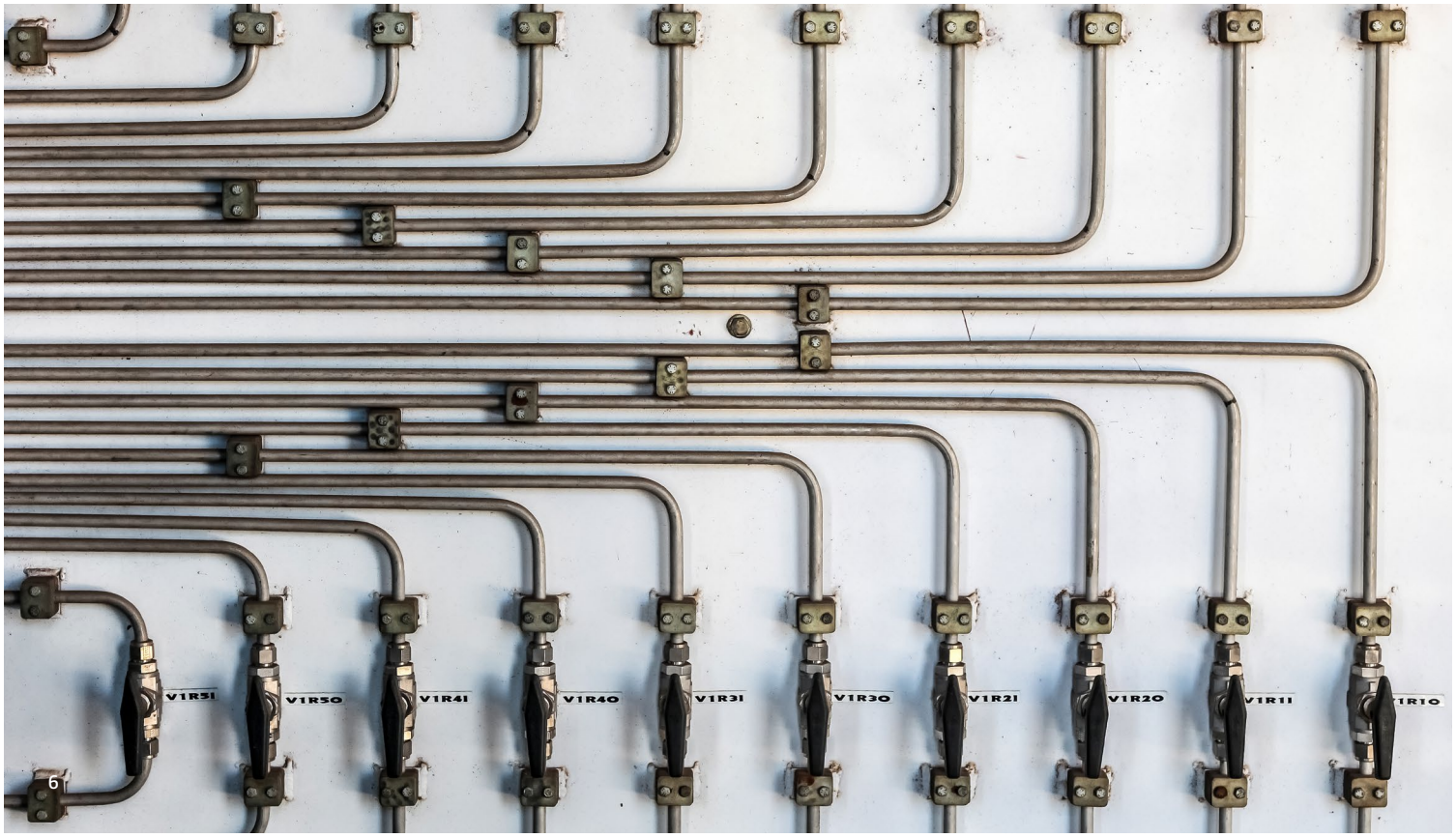
Real-time energy monitoring and IoE

Before machine learning and real-time data analysis, there could be days – if not weeks – between data collection, processing, and relevant informational output.

While the process still exposed valuable information about what was going on "under the hood" of equipment, the timing made it a challenge to capitalise on this information and manufacturers missed out on the benefits of more immediate interventional actions. These missed opportunities add up to lost production and money wasted.

IoE makes real-time energy management an accessible reality for manufacturers. Power surges (or even dips) can be the cause or the effect of malfunctioning equipment and the surges can come from the utility company, the equipment itself, equipment interactions, or the supporting electrical infrastructure. The constant elemental communication of the Internet of Energy ensures that cause and effect are clearly delineated for quick and convenient redress.

Immediate or near-immediate responsiveness is enabled when devices like wireless sensors extract and extrapolate the data produced by these machines. The result isn't just knowing what machine is being used when and how; it opens the doors for an entirely new operational paradigm. New boundaries and capacities can be pushed for each piece of equipment; processes can be rearranged for maximum output; problems can be accurately predicted and resolved before they ever materialise.



Decrease machine downtime with preventive and predictive maintenance

Imagine the time, headache and money that could be saved by predicting problems ahead of time and addressing them before they impact operations.

Cost of repair and maintenance is up to 7.5% of a facility's budget

Predictive maintenance can save anywhere between 30% to 40% of an organisations operational budget

That's the domain of predictive maintenance – a hallmark of Manufacturing 4.0 – and a process made considerably more effective and efficient in conjunction with the Internet of Energy.

Equipment failure is a grave concern for those in the manufacturing industry; a malfunctioning machine can result in delays that impact the entire supply chain down to the delivery of the goods. That's valuable hours, days or even weeks lost at every stage, from manufacturing to shipping to delivery.

Suppose a piece of equipment on the assembly line has a 5-year life expectancy. Preventive maintenance would schedule maintenance based on that life expectancy, decreasing the chance of emergency shutdowns that delay production and blow through the operation's budget. Of course, preventative maintenance also means that the repairs needed will be performed at an earlier stage, thus minimising the extent of damages and keeping corrections quicker, easier, and cheaper. That's a nice prospect, considering the cost for repairs and maintenance is up to 7.5% of a facility's total operations budget.

Predictive maintenance based on Big Data analytics takes that a step further. Instead of having less failures, a predictive maintenance program aims to eliminate them altogether. Not only that but predictive maintenance also aims to eliminate unnecessary maintenance – thus preventing avoidable downtime and wasteful servicing costs. In fact, according to the U.S. Department of Energy, predictive maintenance can save an organisation anywhere from 30% to 40% of their operations budget. For organisations using reactive maintenance models, which remains the majority, studies have found that predictive maintenance can reduce the cost of normal operating maintenance by 20 times.

The Internet of Energy enables real-time monitoring and management, making it possible to respond immediately whenever the slightest problem rears its head. This minimises the risks associated with equipment failure and substandard operation. Before production is ever affected, a machine will express precursor indications of malfunction in its energy signature. Tapping into this information, the Internet of Energy can report these findings forward to the relevant manager, allowing him or her to intervene with minimal impact on the normal production schedule.

> "Even if a machine is performing within the range specified for its make and model, the Internet of Energy can tell you if it's performing beneath its own machine-specific standards."

Improving the manufacturing process

One of the biggest benefits of data analysis is the intricate, detailed insight it can provide – catching blips that could never be seen by the naked eye.

For example, with the benefit of a complete data dragnet, manufacturers can intelligently push machines harder than previously specified or assumed.

Predictive maintenance is a component of this, but energy data tells an even bigger story about the functioning and upper limits of your equipment.

Even if a machine is performing within the range specified for its make and model, the Internet of Energy can tell you if it's performing beneath its own machine-specific standards. This information, properly actioned, holds the potential to dramatically increase the production capacity of any operation. With Manufacturing 4.0 and the Internet of Energy, facilities are correcting "problems" they never even knew they had!

By studying energy patterns, the manufacturer can determine just how much use a particular component in the assembly line can handle under what conditions. Maybe the estimated 5 years of life expectancy can be pushed to 6 under controlled conditions and with proper care. Maybe the component can actually produce 450 items per day as opposed to the specified range of 300-400.

Surges, dips and other unusual changes in the flow of energy indicate that there may be a problem. Deploying IoE technology in the context of Manufacturing 4.0 enable the rapid identification of problem areas that previously eluded the detection of managers. Consider the example of the German manufacturer that – within two weeks of installing its IoE solution – discovered and corrected for the fact that an HVAC mis-calibration was triggering a chain reaction that crippled production.

Two technological transformations, one incredible combination

The transformations of modern industry into Manufacturing 4.0 and energy monitoring into the Internet of Energy are each remarkable in their own rights.

> "The increasingly interconnected, interwoven network of smart devices – all sharing a common language in electricity – is shedding light on the manufacturing process in ways previously unimaginable."

Put together however, they have a complementary effect, unbounding their collective potential. Both are rooted in the concepts of connectivity and synchronicity and technology of wireless sensors. Both smart, thinking systems, one is reminded of the adage, "two heads are better than one."

Together, Manufacturing 4.0 and IoE make it possible to maximise capital yield, minimise downtime, and optimise the efficiency of the manufacturing process – all without any need for asset upheaval or augmenting energy distribution systems.

There can be no question that the future of Manufacturing 4.0 will be powered by the Internet of Energy. The revolution is afoot. The only question is whether you're prepared to join its ranks.

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