SMART SHOPFLOORS AND CONNECTED PLATFORMS IN INDUSTRY 4.0

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Digital transformation, market challenges and diversified production networks have led to the need for shorter time-to-market and products enhanced by service values. To achieve such goals, modern technologies are becoming essential, starting from the Industrial Internet of Things (IIoT) to the cloud and machine-learning technologies.

Industry 4.0 Or IIoT?

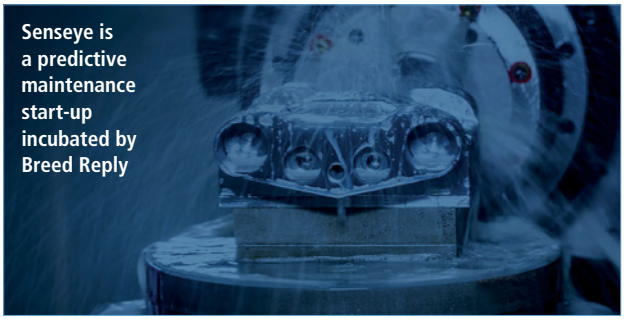
Industry 4.0 is the technological response to the complex scenario faced by manufacturing nowadays. However, it is important to avoid misconception about Industry 4.0 – it is a lot more than just IIoT. The two terms came from two different sides: Industry 4.0 from the German efforts, led by Bosch, Siemens and the Fraunhofer Institute, whereas the Industrial Internet came from the US, led by General Electric.

The German approach is 'horizontal' inside the manufacturing industry: any kind of technological innovation or new manufacturing process is a part of the Industry 4.0 definition. Whereas the American vision starts from the IoT, referring to enhanced integration and communication between objects, events, products, robots and people. This is a vision that can be applied to all sectors, not just manufacturing.

The European vision has been aligned to the German proposition, and similar initiatives have sprung up in other countries, such as 'Fabbrica 4.0' in Italy or 'Factory of The Future' in the UK.

Why Industry 4.0?

The digital transformation we've experienced over the past decade has changed consumer habits and expectations, and is now impacting how manufacturers make products, too. Increased product individualisation, full process-transparency and shorter time-to-market are requiring significant changes inside factories.



Senseye is a predictive maintenance start-up incubated by Breed Reply

Industry 4.0 combines different technologies and software to enable seamless and flexible production. Information technology is changing the way operational technology connects (IoT, OPC-UA, fog computing) and how data collection is used to support processes and enable new scenarios.

Cloud computing is an important part of this landscape; it allows to concentrate data from dispersed production networks to easily monitor conditions remotely, aggregate and analyse that data and even apply machine-learning algorithms for predictive or prescriptive maintenance.

What in the past was bound to local HMI inside the factories, and stored in different data silos – one for each equipment producer, can be now managed as a whole, providing new capabilities, enhancing the underlying process and predicting potential problems and downtime.

Shopfloor And Equipment Integration

To enable end-to-end communication between people and machines, a connected shopfloor solution needs to integrate different protocols to communicate with equipment and tools. Here, open protocols are essential to transparent integration of sensors and equipment.

New IoT technologies help sensorise and integrate the shopfloor with low-cost electronics that can natively connect to the cloud. Integration of industrial standards is still important, such as the renewed OPC-UA protocols being adopted by most common OEM and PLC producers. And in the cloud connection, the lightweight messaging protocol MQTT and other technologies are quickly becoming important because of their low bandwidth and power consumption.

The Importance Of Standardisation

In the last few years, the main impediment to a full shopfloor digitalisation was the wide range of protocols used by different OT players. The factory's shopfloor is populated by various equipment from different producers. A full digitalisation, with manufacturing execution systems (MES) and others, required high integration costs in configuring PLCs, connecting lines and wiring workstations. Here, modern technologies have become essential, but they require a foundation layer – the standardisation of equipment data. Progress has been made on such goals, and the OPC-UA (OPC-Unified Architecture) and even the IoT approach (mainly based on MQTT) are certainly now a part of it. The OPC-

UA helps in the communication with different equipment, whereas MQTT provides a robust and low-energy protocol to send data outside the factory.

The Human-Machine Collaboration

Intelligent shopfloor is not just a matter of equipment integration and connection; it involves interoperability between all elements: products, equipment and operators.

Recent technologies such as wearables, augmented reality (AR), virtual reality (VR) and even the rising importance of the user experience approach, are changing the way we interact with surrounding environments, bringing improvements inside the factory, too. Assisted solutions can help workers during operations, reducing error rates, and AR devices can reduce operator training times. Low-cost wearable devices improve mobility and reduce displacements during production line operations.

Edge, Fog And Cloud Computing

When connecting a sensor network to the cloud, two important considerations are bandwidth and power consumption. In a real-time connectivity scenario, where there's a need for constant shopfloor or environment monitoring, the 'edge computing' concept comes into its own.

Edge computing relies on near-user edge devices to read and store local information, applying local screening when required prior to sending information to other systems or cloud platforms.

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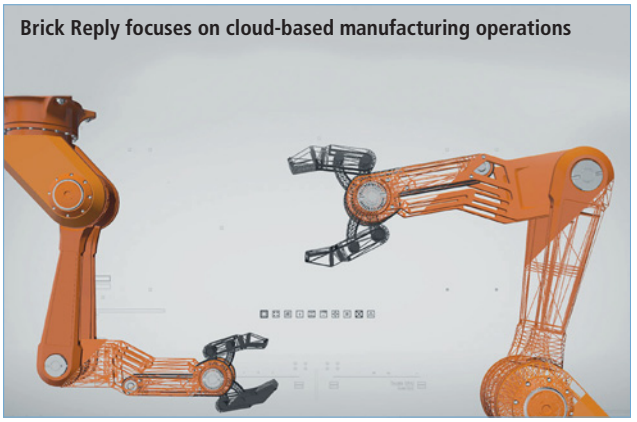
In a scenario where equipment has high reading rate, edge computing is used to determine whether to send the read value to the cloud platform or not. It is the element nearest to the equipment that leverages new standardisation protocols, such as OPC-UA or event IIoT, to effectively interact with a wide range of equipment from different sources.

Fog computing, on the other hand, isn't just focused on data gathering, but also on data intelligence. In factory settings, it can make decisions without communicating again with the cloud or a central system, improving speeds and reliability. It is a kind of local intelligence able to understand the meaning of data, take decisions in enhancing shopfloor communications and enable point-to-point communication between different stations or equipment.

Digital Twin Concept

In shopfloor digitalisation, it is also important to mention the 'digital twin' topic. Until recently, digital twin was used almost exclusively by big enterprises, due to the computing and storage requirements needed and the limitations of available technologies. In the last three years, however, costs have significantly fallen, and better technologies now make digital twin an affordable solution for many manufacturers.



Brick Reply focuses on cloud-based manufacturing operations

Digital twin is the digital version of a physical object or machinery via sensors, and real-time data and measurement collection. It is a full digital version of the object, used to simulate, prevent and understand problems during equipment testing, production-line design and even during production. Essentially, it is a virtual replica of what's happening on the factory floor.

Its potential is immense: it improves quality, starting from the design and prototypes, to enhance security by simulating equipment, space and movements and, finally, by ensuring coordination between different shopfloor elements.

Cloud Computing Scenarios

Many scenarios can be created once data reaches the cloud platform. Most cases are related to predictive maintenance, where data from sensors is used to build predictive models and avoid downtime, with machine learning the foundation of this landscape. Machine-learning algorithms have been around since the 70s, but they came into widespread use only recently because of the high computing power they require, now provided by cloud platforms.

Either way, at a first glance, cloud computing provides a standardisation of data collection, which means enhanced factory connection with the external world, where remote monitoring and process management can be standardised across the entire production network.

In this context, cloud-based business intelligence tools are just the tip of the iceberg. Data visualisation can show results of predictive maintenance models and data-relation-based information. The ability to correlate information from different sensors in different places of the factory, or the production network, give management the ability to prevent problems, react quickly and even provide additional services to customers.

Security

Shopfloor systems (ICS, Scada, OPC based devices) in the past were offline, disconnected from the Internet. This is no longer the case, with IT and OT boundaries disappearing. The factory

is now exposed to the Internet, and perimeter protection is no longer sufficient. Vulnerability reports are increasing, and the new Industry 4.0 scenarios need improved security patterns and solutions. Risk mitigation and security improvements are based on two essential pillars: machine-learning-based engines to detect intrusion and recognise network anomalies, and encryption of sensitive data before it reaches public networks.

The first pillar is related to intelligent software solutions able to continuously monitor the network, comparing traffic with statistical models to detect changes or anomalies in the data exchange. This type of monitoring has no impact on network usage: it is based on a passive model, provided by software or even dedicated hardware ready to be connected to the industrial network.

The second pillar, related to encryption and communication protection, is based on IT standard security procedures (encryption, two-factor authentication methods, protected VPN, etc). The important change is the trend: a shift from perimeter defence to point-to-point communication protection. ●

THE REPLY EXPERIENCE

Reply, a European system integrator, is working on Industry 4.0, from shopfloor integration, to production and warehouse management, with vertical proficiencies in security, sensors and process management.

In the shopfloor management context, Reply is launching Brick Reply, an Industry 4.0 platform that manages manufacturing operations. It integrates ERP (Enterprise Resource Planning) for optimised manufacturing execution, and connects equipment and machinery in order to process and monitor results. Depending on the requirements, various cloud services can be chosen and scaled flexibly: from SaaS (Software as a Service) to IaaS (Infrastructure as a Service), or as an on-premises solution. Collaboration with IoT gateways producers, as well as the ability to deliver a personalised local connection, makes Brick Reply a platform well suited to support Industry 4.0 applications within the shopfloor intelligence context.

Brick Reply is currently being rolled out globally.