Smart Factory: Introduction

What is the Smart Factory?

The concept of the ‘Smart Factory’ represents the digitization of traditional manufacturing processes and machinery. There is no single technology that makes a factory smart. Instead, several Industrial Internet of Things (IIoT) systems come together to give rise to Industry 4.0.

In a smart factory, manufacturing equipment communicates to the factory’s own network. This connects all manufacturing processes, from supply chain to production. This wholistic approach provides maximal visibility to operational efficiency.

What are the Advantages of Smart Manufacturing?

There are several benefits to this type of smart manufacturing. For instance, the ability to scale production with demand. Additionally, remote operators have immediate access to information specific to their role. All the while, data gathered by sensors can identify trends to prescribe maintenance and optimize efficiency.

It is also useful to simulate the smart factory digitally. This helps to quickly generate operational data from the factory floor. Then, these data can train machine learning models. With machine learning and automation, machines can self-optimize and report their status.

Even so, the smart factory does collect a considerable amount of data. Cloud computing is a great option to store and process this large amount of data. Then, a more granular insight is possible by comparing these ‘big data’ over time.

What Technologies are Behind Industry 4.0?

There is no single piece of technology that can make a factory smart. Several systems must work together to gather, transmit, process, and analyze data from the factory floor. For example, an Industrial IoT solution may include various physical sensors. Next, a cellular network sends the data to the cloud. A cloud computer can then organize and process it.

With this in mind, consider the following example of how a more connected manufacturing process can streamline production.

Contemporary textile plants use predictive maintenance schedules to maintain factory uptime. And if no equipment fails, quality control randomly pulls from finished batches.

Comparatively, smart factories uses sensors on textile equipment to measure multiple factors. Some such examples are temperature, humidity, vibration and sound. These sensors are modular, and are inexpensive for retrofitting existing equipment. This additional information can provide more information than if a machine is just running or stopped. For instance, sensors could detect a machine running with torn fabric that is producing a defective product.

Additionally, a smart factory can perform quality control constantly instead of at random. Also, in real-time instead of post-production. In this case, cameras monitor the equipment described above. Then, AI will have monitored the feed via cloud computing. That way, any

issues detected will halt production. Finally, even if a technician is off-site, they will receive a smart alert about the issue.

At the same time, a separate alert notifies the factory manager of the failure. The manager notes that these failures happen when the factory is too warm and humid. To remedy this, the smart factory recommends a 10% reduced production on warm, humid days.

How Can You Upgrade to a Smart Factory?

With the right help, upgrading an existing factory to a smart factory is actually much simpler than most assume. Wireless sensors can retrofit most existing manufacturing equipment. A centralized hub then receives the data from all the sensors. Then, a cloud service can monitor and analyse from offsite.

These solutions are upgradable, so additional sensors or cloud services are easy at add later. This gives established factories the ability to upgrade at their own pace. It also keeps the upgrade cost low in the beginning as the solution scales.

Several technologies have advanced in parallel over the years. The interactions of these in smart factories have set the stage for Industry 4.0

Data availability is nothing new for contemporary manufacturing processes. However, what makes a factory ‘smart’ is how accessible these data are to key stakeholders. An abundance of manufacturing data is useless unless operators can gather it, interpret it, and act on it. Further, the importance of these data correlates with the speed of this sequence. Many smart factory technologies are able to communicate their data in real-time.

In an earlier blog of this series, we explored how various smart factory technologies come together to create a wholistic solution that is more than the sum of its parts. This is because each of the smart factory technologies not only solves its own intended issue but also provides data and a remote connection back to the platform.

Smarter Data Collection

At the heart of all smart factory technologies is data. Remote access to real time data allows a greater opportunity for the entire smart factory to work together. Data also provides the insights, through advanced analytics, that help to optimize manufacturing processes over time. There are several means of data collection with several options within each. These two examples differentiate conditions that managers may consider when planning to adopt smart factory technologies.

Industrial Sensors

The advancements in wireless-enabled, battery-operated sensors cannot be overstated. Sensors are available in hundreds of different forms. That way, technicians can easily retrofit almost any type of equipment. For example, there are bolt-size sensors that are waterproof and dustproof for industrial use. They even come with built-in WIFI and a 10+ year battery

life. They fit on the cap of bolts and detect movement. Then, the sensors transmit their data to the smart factory's gateway.

Operator Input

There are still many use cases that require a human operator. In these cases, technicians often bear the burden of administrative paperwork. However, even a simple customized solution could expedite this work by digitizing it. For example, a phone's camera can scan and convert documents instantly. Also, companies can create digital forms with benefits like auto-fill, data validation, and contextual drop-down lists.

Smart Manufacturing

Remotely monitor shop floor

Real-time feedback

Smart automations and alerts

Data driven efficiency

Data Transfer Technologies

In order for a smart factory technologies to work together, they must be able to communicate. However, when building a connected solution, there are several options for wireless transmission. Each wireless communication channel offers its own strengths and weaknesses. **Two examples follow to contrast the differences between two familiar options for wireless data transfer.**

WI-FI

Although WI-FI may be the most familiar wireless standard, it becomes more complicated when scaled to a smart factory. The choice of which of the two WiFi frequencies, 2.4GHz and 5GHz requires thoughtful consideration. Factors such as speed, interference, range, fidelity and energy usage vary based on the use case and even location intended.

Cellular 5G/LTE

Cellular capabilities not only offer longer range, but also mobility. These connections are also typically more secure. Although, they are also more expensive to operate, data-restrictive, and energy intensive. Several mid-range options are emerging, but nothing as ubiquitous or wide-scale as cellular LTE currently exist.

Smart Decision Making

Ironically, in smart manufacturing, the human operator is the limiting variable in terms of decision making speed. Machines are able to interpret incoming data and compare it with historical trends almost instantly [1]. All the while, these computers can also cross-check real-time consumer demand, warehouse inventory, and estimated delivery times. However, certain applications will always require human intervention for key decision points. In these cases, smart factory technologies can provide their information in a human-readable format. The following examples will compare the differences assumed in each solution.

Industrial Internet of Things

IIoT is a broad term that describes the technology behind smart automation in manufacturing. The internet of things parallels the internet of people, which mainly facilitates peer to peer intercommunication. Similarly, the internet of things facilitates machine to machine intercommunications, just on a different internet space. There are several benefits to use IIoT solutions. Some include, improved security, propriety of information, complete ownership of the solution, greater customization, and reduced operational costs.

Supervisory Control and Data Acquisition

The primary focus of SCADA systems is to centralize data to a human machine interface. Automations play key roles in filtering and organizing these data to present to an operator. Some examples of such human readable formats include maps, graphs and images. Importantly, this automation also works in reverse. This gives the operator control at the top level. A single action from an operator can cause various automation to execute and carry that decision out.

Smart Factory Emergence

Up to this point, we have discussed various smart factory technologies and their place in the structure of the smart factory. As laid out above, each of these technologies has a role to play. Though, each of these smart factory technologies also contributes a small portion to a greater ability.

As mentioned earlier, data is the heart of these smart factory technologies. And, manufacturing data is intrinsically valuable. This is largely due to the law of large numbers, as factories produce volumes over time. The smart factory represents an opportunity to tap into this potential value. It represents the notion of peak efficiency.

AI Analytics

Some data sets are simply too large for humans to process. Even with the help of computers, some tasks may prove too expensive to invest human capital. Analytics solutions have a

proven track record to create meaningful ROI from raw data. After all, these data are a by-product of the smart factory in the first place.

Machine Learning

The goal of the smart factory is to achieve maximum efficiency at the lowest possible operational cost. However, this is an iterative process. After the smart factory runs for a while, it will present trends to the factory manager. This person will then make decisions based on the data. Then, the factory will run again to collect new data, and the feedback cycle will continue. However, with access to all this data, the smart factory can actually start to predict what will happen. This enables predictive maintenance and can avoid factory downtime.