How IIoT can Impact the Manufacturing Industry

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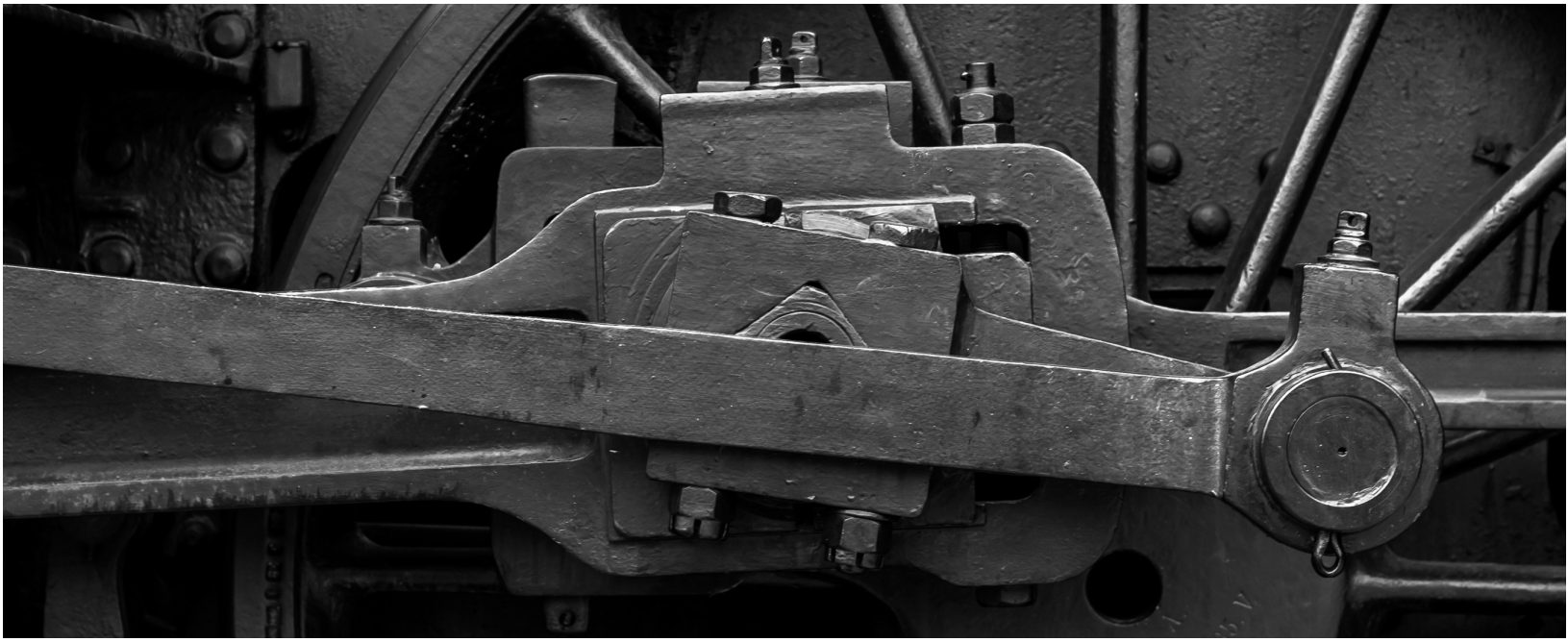
Industry 4.0 (or Industrie 4.0) is an initiative that was launched by the German government to describe advancements in the manufacturing industry propelled by the Internet of Things technologies that enable cyber-physical systems to provide productivity enhancements comparable to the efficiencies achieved in the previous Industrial Revolutions. Let's look at the impacts of the first three Industrial Revolutions and how this 4th Industrial Revolution will transform the global economy just like the previous three did.



THE FIRST INDUSTRIAL REVOLUTION

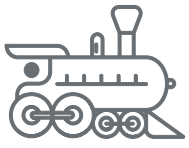
The First Industrial Revolution started in the late 1700s. Factories went from using hand tools and basic machines to rudimentary turbines powered by water and steam.

These new modes of production transformed commercial enterprises, particularly the textile industry in terms of employment, output value and capital investment. Invented by James Hargreaves, the Spinning Jenny was the first mechanical machine to hold more than one spindle of yarn. It was the first practical spinning frame with multiple axles that increased productivity and reduced the cost of thread. By the time Hargreaves died 14 years later, there were 20,000 Spinning Jennies across Britain. In fact, the word "engine" comes from Hargreaves' invention! Around the same time, James Watt (1770) improved the steam engine invented by Thomas Newcomen, which went to power many pieces of machinery in these newly "modernized" factories. Transportation via steam boats and steam locomotives also played a key role, as it helped expand the supply chain.

The First Industrial Revolution brought about a higher volume and variety of factory-produced goods that could be exported to new markets around the world. This influx of trade raised the standard of living for many people and laid the foundation for the middle class. Three elements igniting the spark that led to this revolution were:

Steam

Mechanical Machines



Transportation

THE SECOND INDUSTRIAL REVOLUTION

Historians have labeled the years from 1870-1914 as the period of the Second Industrial Revolution. While the First Industrial Revolution fueled the growth of industry and transportation infrastructure, the Second Industrial Revolution witnessed the expansion of electricity, petroleum and steel industries to satiate increases in consumption.

Henry Ford envisioned an affordable car that was designed and manufactured at scale for an emerging middle class. This radical concept led to a wholly redesigned factory with specialized tools and machines that were systematically positioned to work in unison. This new era of mass production eliminated unnecessary human motions by placing all work within easy reach on an assembly line. Mechanized factory logistics allowed for the scalable production of complex products consisting of thousands of individual parts for the first time in history. These efficiencies passed on the savings to the consumers, making the price of the Model T decline from $780 in 1910 to $360 in 1916. In 1924, 2 million T-Fords built on the assembly lines of Detroit retailed for $290 each.

The period from 1870 to 1890 saw the most considerable increase in economic growth. Again, living standards improved significantly in newly industrialized countries as the prices of goods fell dramatically. This second wave of industrialization was catalyzed by:

Steel

Electricity

Assembly Lines

THE THIRD INDUSTRIAL REVOLUTION

The Third Industrial Revolution, also known as the Digital Revolution, started in the late 1960s, when factories went from the use of mechanical and analog electronic technology to digital electronics. Before the invention of the Programmable Logic Controller (PLC), the manufacturing of automobiles was predominately composed of relays, cam timers, drum sequencers and dedicated closed-loop controllers.

Since these devices could number in the hundreds or even thousands in a factory, the process for updating such facilities for the yearly model change-over was very time-consuming and expensive. This was because electricians needed to rewire the relays to change their operational characteristics individually. As easily adaptable general-purpose programmable devices, PLCs and industrial PCs were soon applied to control industrial processes, causing exponential growth in productivity in many industries. The three elements that came together to spark the third wave of industrialization were:

Computers

IT

Automation

THE FOURTH INDUSTRIAL REVOLUTION

Today, we are in the midst of the Fourth Industrial Revolution or Industry 4.0, and just like the previous industrial revolutions, it is the result of the collision of multiple new technologies. These include sensors and connectivity, integration of cyber-physical systems, streaming and big data analytics tools, which are beginning to transform manufacturing once again. This revolution will bring incredible productivity gains, exponential in nature, in the manufacturing sector just as the last three revolutions did. The elements that will usher in the Fourth Industrial Revoltuion are:

Connectivity

Sensors

Analytics

Many manufacturing facilities have had connectivity and access to vast amounts of data for many years, however, the communication has been used mostly for the control systems, and significant amounts of data existed in silos and was not easily accessible for analysis and actionable insights.

The Industrial Internet of Things technologies such as connectivity, machine to machine communication, manageability, security and data analytics take data collection to the next level. Manufacturing entities can leverage this data in much more meaningful ways by making valuable insights available throughout the manufacturing enterprise and automating secure communication between sensors, automation equipment, factory tools, and other various systems. This includes yield optimization, predictive maintenance, process automation and real-time visibility across the factory floor and the entire supply chain.

MANUFACTURING OPERATIONAL EFFICIENCIES THROUGHOUT THE FACTORY FLOOR VIA INDUSTRIAL IoT

The key benefits of the Indusial IoT for manufacturing include:

- **Interconnectivity** for seamless, secure communication between sensors, machines, automation systems, business systems and people. These smooth interactions increase efficiencies by allowing more autonomous machine performance and streamlined manual processes.
- **Operational visibility and remote access** to the status of machines and their components allowing the factory managers to monitor systems and diagnose problems in real time before impacting machine availability, thereby, optimizing the yield.
- **Predictive analytics** for optimal planning of machine downtime for maintenance reducing costs and spare parts inventories.

Let's looks at these benefits in more detail.

Interconnectivity: Streamlining Factory Communication

Wireless communication and mobile computing have increased efficiency on the factory floor for the past decade. Mobile computing technologies such as laptops and tablets have untethered the factory workers from their machines. Instead of requiring machine operators to walk over to the line supervisor for assistance with a technical issue, a wireless system utilizing connected switches and light towers can alert managers when support is needed on a specific line.

Communication can also be done seamlessly from the machines and their control systems directly onto tablet computers, alerting line supervisors and floor managers on the status of the lines and any technical issues that need their immediate attention.

New devices such as augmented reality glasses and smart helmets are finding their ways onto the factory floor as well. Augmented reality glasses allow machine operators to access device settings and documentation while performing operations. These new tools also allow workers to connect directly to remote technical experts to resolve issues in real-time.

Visibility and Remote Access: Optimizing Factory Floor Productivity

To ensure efficient operational processes throughout the factory floor, machine operators must quickly and easily determine the status of machines at any time. The higher the visibility, the easier it is to identify and resolve problems and keep operations running smoothly. Traditional tower lights seen on many factory floors provide visibility wherever they are physically seen. Production lines and machines equipped with wireless communication capabilities, however, take real-time visibility to the next level by sending immediate alerts to various systems to identify operational problems regardless of whether the machine operator is physically present.

An additional benefit is data logging, which is used for OEE (Overall Equipment Effectiveness) calculations as the history of alerts can be stored and analyzed to track machine uptime, production volume, yield, rejected parts and other key metrics to make more informed decisions over time.

IIoT also provides visibility beyond just the factory floor. A truly connected factory extends visibility from the factory floor to the rest of its supply chain by connecting the various automation and SCADA systems to the business systems such as ERP (Enterprise Resource Planning), CRM (Customer Relationship Management) and other business tools.

Predictive Analytics: Minimizing Machine Failure and Downtime

In addition to real-time status monitoring, IIoT technologies can also be used to analyze large sets of data, as well as real-time streaming data from machines and sensors to predict future events. One application of predictive analytics is for maintenance purposes. Operational analysis and predictive models allow manufacturers to take a proactive role in maintaining their critical machines.

Predictive maintenance techniques offer substantial cost savings over routine or time-based preventive maintenance because tasks are performed when warranted. One example of predictive maintenance is using vibration data from accelerometer sensors mounted on rotating equipment like motors and pumps. By analyzing high-frequency streaming data from these sensors and comparing the vibration signatures against known patterns, factory managers can predict imminent failures and avoid the high costs of unforeseen breakdowns.

Of course, predictive analytics goes beyond the maintenance use case. Manufacturers can analyze large sets of data from inventory tracking, consumer behavior, weather forecasts and energy consumption to optimize production levels and, thereby, manufacturing margins.

IS YOUR BUSINESS IIoT READY?

The benefits of IIoT technologies are very real. Manufacturers that are not adopting IIoT will fail to reap the rewards of the Fourth Industrial Revolution and will be left behind, hence, why many countries have programs in place to accelerate investment in their manufacturing industries.

Although the benefits seem obvious, it can be challenging to know where to start and how to use these technologies to their fullest extent. Below are a few questions to help manufacturers prepare to move to Industry 4.0:

- What are the inefficiencies in your manufacturing operations?
- What type of data would help you overcome these efficiencies?
- What are the high-value critical tools in your factory and how are they maintained today?
- What communication processes need to be in place to utilize the data in a meaningful way?
- Who are other stakeholders in your supply chain that can benefit from having access to your production data?

Answering these questions can help manufacturing companies identify the IIoT technologies to meet their immediate business needs and start taking advantage of the long-term benefits of Industry 4.0.

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