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WHITE PAPER

Introduction to IoT in Manufacturing

*"We cannot become what we want to be by remaining
what we are."*

-Max DePree





CONTENT

IoT AND MANUFACTURING TODAY	3
FUNDAMENTAL IoT COMPONENTS FOR MANUFACTURING	4
IoT USE CASES IN MANUFACTURING	6
WHY INVEST IN IoT FOR MANUFACTURING	7
HOW CAN MOMENTA PARTNERS CAN HELP YOU SUCCEED	7
REFERENCES	8

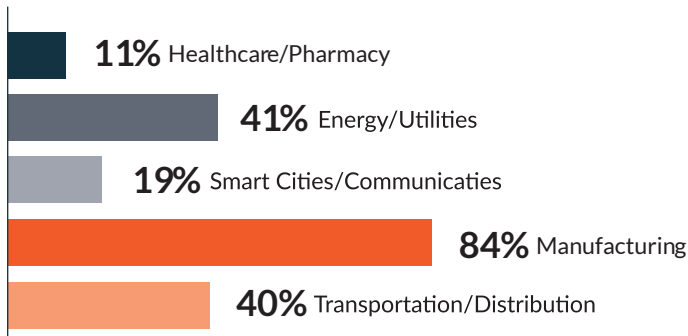


IIOT AND MANUFACTURING TODAY

The industrial revolution and the Internet of Things (IIOT) is re-shaping what's possible for the world of manufacturing today. According to industry experts, the IIOT in Manufacturing market is expected to grow to 45.3 Billion by 2022, at a Compound Annual Growth Rate (CAGR) of 29.0% from 2017-2021.¹ The key factors driving IIOT in the manufacturing space is the growing need for predictive maintenance, and centralized monitoring of the manufacturing infrastructure.

Verizon says that since 2017 the manufacturing industry saw an 84% boost in IIOT network connections, which was more than any other industry they surveyed from Transit to Healthcare.

IIOT Network Connections 2016 vs 2017 Growth²

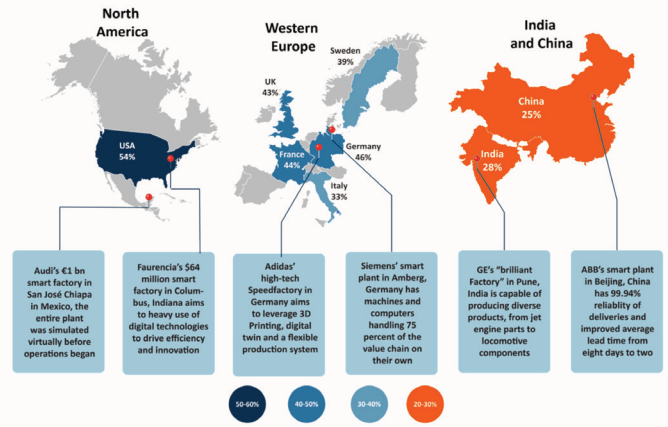


Projections from Market by Markets also show that North America is expected to have the largest market share in the IIOT in manufacturing market from 2017 to 2023.³ This dominance comes by way of its established economies allowing for significant investment in R&D resources, therefore contributing to the development of new technologies such as IIOT.

Manufacturers are keen to integrate IIOT and Big Data technologies into their processes in order to automate the manufacturing operations to enhance productivity and efficiency. The increasing digitization in manufacturing by larger enterprises drives the North American IIOT in manufacturing market.

According to Capgemini Smart Factories report the US and Western Europe in particular have made an early head start in adopting a smart factory business model. Nearly half of the manufacturers in the US, France, Germany, and UK have an ongoing smart factory initiative. These early adopters have collectively invested over a \$100M in these initiatives.⁴

Industries Across Countries Embracing Smart Factories⁵



Executives expect human-to-machine-centric environments to be a common norm by 2020. This transformation could potentially see \$500B in savings for manufacturers, and equipment makers from virtualization, co-bot technology and real-time communication.⁶

To push the envelope of the industry 4.0, the "Future Smart Manufacturer" means to transform the entire connected ecosystem beyond the walls of production across R&D, the plant, supply chain, product delivery, and customer service. To better understand the immense opportunities that IIOT brings to the manufacturing industry we will explore the following fundamental components:

- Connectivity
- Hardware
- Platforms & People
- Big Data and Artificial Intelligence

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www.momenta.partners



FUNDAMENTAL IoT COMPONENTS FOR MANUFACTURING

CONNECTIVITY OPTIONS

When it comes to connectivity for Industrial IoT (IIoT) it can be separated into two categories: massive and critical. Massive refers to the type of communication needed for connected tools, simple automatic machines and Automated Guided Vehicles (AGVs). All these examples are fundamental for a smart manufacturer.

Critical, on the other hand, requires very high, real-time connectivity in order to work. For example, intelligence being moved from the machines and up to the cloud. This is when mobile robots collaborate with each other, and humans, in real time.

Smart manufacturers will require a thoroughly connected, integrated infrastructure across the entire manufacturing ecosystem from engineering/R&D through to the supply chain and customer service. Depending upon the manufacturing process and desired output different types of connectivity can be required from hard wiring, Wi-Fi, Bluetooth, RFID, LTE-M and Low-Power, Wide-Area Networks including LoRa. Below we have explored the capabilities of the different options:

CELLULAR

For manufacturing is a smart, stable and secure connectivity option. As networks evolve from LTE to 5G, cellular becomes even more powerful, as does the value that it enables.

5G - Mobile Network Operators (MNO's) are looking at releasing 5G connectivity at the latter end of 2018 and nationwide by 2020 in the US.⁷ It is said to provide connectivity speeds up to 20 times faster than 4G LTE with a download peak of 20 Gb/s.⁸ This would give manufacturers the opportunity to utilize technologies such as automation, artificial intelligence and augmented reality.

4G LTE technology offers high bandwidth of up to 100 megabytes per second and has a range of more than ten kilometers. Reliability and availability are also good. Wireless carrier have now adopted new LTE categories specifically for IoT devices;

NB-IoT provides extreme optimization for low cost, low power, low throughput, delay-tolerant stationary IoT use cases. Download peak of 250 Kbps.

CAT-1 delivers scalable performance and seamless mobility for high performance IoT use cases. Download peak of 10 Mbp/s.

CAT-M1 optimizes for the broadest range of IoT applications with high-reliability and low latencies. Download peak of 1 Mbp/s.

LPWAN - LoRa, SIGFOX

Low Power, Wide Area Networks primary use case is for stationary assets with low data requirements. Each LPWAN technology has different advantages and implementation requirements; Sigfox manages its own network, while LoRa has over 500 partners. Sigfox has a download peak of 100 Bp/s and LoRa has a download peak of 290 Bp/s - 50 Kbp/s.

SATELLITE

Is split into 3 categories; Low Earth Orbit (LEO), Medium Earth Orbit (MEO), and Geostationary orbit. IoT stakeholders tend to use satellite when cellular and fiber options are not feasible, since it has the highest costs. So generally, you see it used in High Value Manufacturing services for; global transportation logistics and tracking. Manufactures can track their cargo containers all over the globe using GPS and Satellites. The global nature of satellite systems and their ability to broadcast to multiple points at the same time makes it the most efficient signal delivery on earth. Satellite transmissions can work seamlessly with terrestrial networks to attain global coverage.

UNLICENSED CONNECTIVITY

Unlicensed connectivity solutions Wi-Fi, Bluetooth and Zigbee are relatively inexpensive compared to the other connectivity options we have explored and allow manufacturers to manage their own networks, rather than relying on MNO's to do so. On the downside, unlicensed technologies can be vulnerable to interference and only function well in short-range.

Bluetooth communication is a global short-range wireless communication protocol typically used for device-to-device. BLE is a version of Bluetooth designed for lower-powered devices that use less data. To conserve power, BLE remains in sleep mode except when a connection is initiated. This makes it ideal for manufacturers wanting to use it for RFID readers to track inventory and assets ensuring distributors and manufactures can work together efficiently.

Wi-Fi and Wired Ethernet have a well-developed set of deployment capabilities and are the most well-known/utilized unlicensed connectivity option with a bandwidth of up to 1 Gbp/s. Wi-Fi with a wireless mesh topology allows for extended range and is great for monitoring large physical objects and tracking pallets with a highly reliable wireless connectivity network. Mesh networks can allow manufacturers to easily track key data across the factory floor, and across multiple locations to identify issues before they happen.



Zigbee protocol is secure, stable, and communicates on a 2.4GHz frequency. It has a data transfer rate of 250 kbp/s across 16 different channels up to 100 meters in range. This type of connectivity could be used in smart factory sensors to monitor movement and temperature.



HARDWARE & DEVICES

Robots are capable of mimicking more human traits such as dexterity and memory, which makes them more useful in industries like manufacturing. Highly trainable and collaborative, robots are also providing safer working environments for humans by switching places with them in dangerous or unsuitable situations.

3D Printing is shrinking supply chains, reducing development times and increasing manufacturers ability to adapt to customer's needs. This streamlined and efficient method makes it possible for manufactures to create parts at far lower costs and lead times. 3D printing will most likely take over the R&D and maintenance sectors for production but taking over the entire production facility will certainly take some time.

Sensors have replaced human hands, resulting in less wasted time and materials, as well as optimal accuracy and work-flow. Digitizing the factory means lower cost of production, quicker turnarounds, and more efficiently meeting customer demands. Sensors make it possible to monitor specific processes throughout the factory which increases awareness about what's happening on multiple levels.

Wearables & rugged mobile technology such as industrial smart tablets, phones, smart glasses, gloves or other clothing items can help boost worker productivity at a time of labor shortages.

Autonomous Vehicles & Drones can help to raise productivity by reducing the resources needed for rote tasks, like elevating a forklift to count top shelf inventory. Self-driving vehicles can be set to expedite pick-and-pack, inventory control or forklift operation.



ARTIFICIAL INTELLIGENCE, BIG DATA & PREDICTIVE ANALYTICS

Today, artificial intelligence (AI) and machine learning advanced algorithms are transforming the way the manufacturing industry collects information, performs skilled labor, and predicts consumer behavior.

Smart factories with integrated IT systems can provide relevant data to both sides of the supply chain more easily, increasing production capacity. Quality is no longer sacrificed for efficiency, as machine learning algorithms can determine which factors impact service and production quality.

Using the mass amounts of data gained from new technology to anticipate problems and improve forecasting manufacturers can take advantage of predictive analytics to know what shortages will occur at a future date and how downstream customers would be affected.



PLATFORMS

IIoT Platforms have become the glue, the hub for connecting devices, sensors, networks and services and kicking out the crucial data into useful business outcomes that manufacturers can easily make informed decisions with in real time. IIoT platforms are known as the 'middleware' because they bring together and handle everything in-between an end-device and the application. IIoT platforms are generally spilt into the following:

- **Application Enablement Platforms (AEPs)** are a combination of data management and device management
- **Data Management Platforms** process the data and analytics from connected devices
- **Device Management Platforms** focus on the lifecycle management of connected devices
- **Connected Device Platforms (CDP's)** manage the connectivity of a device

A manufacturer with a large number of machines connected to an IIoT platform can expect to save millions of dollars a year in energy costs alone. They can schedule downtime based on what the sensors are telling them about the condition of machines and supply demands.

The IIoT platform provider market in manufacturing is insanely competitive and fragmented, which can make it difficult to navigate. We are now starting to see more partnerships between providers in effort to create a one-stop shop. Below are some of the key players in the space who are making the smart factories of today possible.



PREDIX



deviceWISE





IoT USE CASES IN MANUFACTURING

MANUFACTURING PLANT

Connectivity: Cellular, 4G LTE/NB-IoT, /CAT-M Wi-Fi, Bluetooth, Zigbee

Hardware: Sensors, Robots, Industrial hand-held devices & Gate-ways

- 1 Production Line** flow in real time at the factory floor and at headquarters to eliminate waste and unnecessary work in progress inventory.
- 2 Remotely manage equipment** using temperature sensors and other settings to conserve energy and reduce costs.
- 3 Condition based maintenance** alerts via sensors to increase throughput and eliminate machine down-time.
- 4 Aggregated product data**, customer sentiment and other third party syndicated data to identify and correct quality issues.

CUSTOMER SITE

Connectivity: Cellular, LoRa/Sigfox, Satellite

Hardware: GPS Trackers, Sensors & Gateways

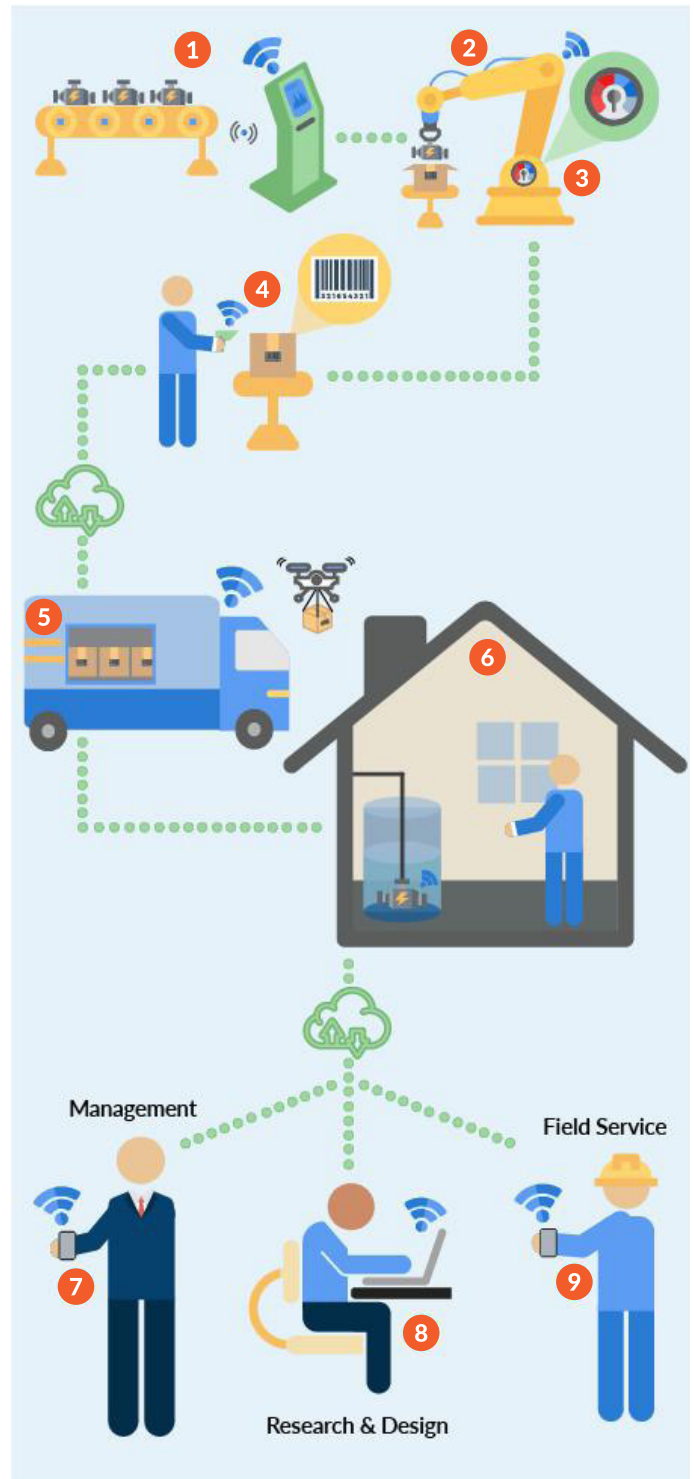
- 5 Visibility of inventories** across channels to optimize supply and a reduce shared costs in the value chain. Sensors placed on outgoing containers, pallets and packages can detect location, temperature, movement, and other data to ensure items reach their destination and meet the conditions that ensure quality.
- 6 Monitor products**, sensors transmit operational information to field service engineers for remote process, automation and optimization.

GLOBAL HEADQUARTERS

Connectivity: Cellular, Wi-Fi

Hardware: Industrial hand-held devices, Tablets & Computers

- 7 Management** obtains real-time data from the Manufacturing Plant via the cloud to monitor production line flow and status. Allowing for recommendations and adjustments to better manage operational costs.
- 8 Field Service** knows when to deploy resources for predictive maintenance to minimize equipment failures that will reduce service cost.
- 9 R&D** can track equipment deterioration and usage patterns of numerous customers, this allows engineers to re-engineer products for better performance.





WHY INVEST IN IoT FOR MANUFACTURING?

THE BENEFIT

By using all of the IoT components that we have explored in this White Paper to digitize all the most vital processes and assets manufacturer's can increase operational efficiency, deliver 'A Class' service experiences to customers and ultimately growth their business.

More devices and sensors means significantly more data. But is more data better? Yes, if understood and analyzed this influx of data can open up many doors of opportunity for the manufacturing industry.

By leveraging Big Data from connected devices, real-time analytics and sensors it will bring a new level of connectivity and cost saving efficiencies to manufacturing. Manufacturers can create service related revenue just by responding quickly to feedback in the value chain.

The use cases and data explored earlier confirm that the benefits of IoT adoption for manufacturing are undeniable. Working to incorporate IoT initiatives and have them embedded within the culture and operations of business allows for more than just cutting costs and increasing revenue. Below are some solid data points to reaffirm;

- **A slice of the pie is too big to ignore** - Smart factories are expected to boost the global economy by adding \$500B to \$1.5B annually to the global economy in next 5 years.⁹
- **15 Million** new jobs will be created in the U.S.¹⁰ across the next decade as a direct result of artificial intelligence and automation in smart factories.
- **17% - 20% productivity gains** have been seen by manufacturers that have implemented a smart factory.¹¹ Critical items such as capex and inventory are predicted to be rationalized at 12 times the rate of improvement since 1990.

HOW MOMENTA PARTNERS CAN HELP YOU SUCCEED

This year, IDC predicted that by 2021, spending on digital transformation in manufacturing and elsewhere will hit \$5.9 trillion, and that manufacturers investing in digital transformation and utilizing IoT would be able to maximize their outcomes, but that the rest would not progress due to outdated technology and business models.

Although the industry has made progress to counteract this prediction, there is still a lot more to be done for manufacturers to

realize the full potential of emerging IoT connectivity and technologies explored in this White Paper. According to Capgemini Smart Factories report 39% of manufacturers are struggling with their smart factory initiatives from strategy formulation to strategy implementation.¹¹

At Momenta Partners we know the realities and challenges that manufacturers face trying to adopt the Industrial Internet of Things (IIoT) and implement a successful strategy. We understand that it is critical for manufacturers to get up to speed and embrace the digital transformation.

Is your manufacturing enterprise ready for IoT?
Or is your smart factory project/initiative stuck in pilot purgatory?

Our team of IoT experts can help you navigate the IoT ecosystem successfully:

- **Do you want to know what adopting IoT means to your bottom line?**
- **How it will cut costs and by how much?**
- **Where will it help you create new revenue?**
- **How much business value can you expect to attribute to IoT-related initiatives?**

Let us help you get the answers and monetize with IoT in today. Contact Momenta Partners to learn more about our IoT experts and IoT Strategy and Execution program or visit www.momenta-partners/iiot-advisory



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As Digital Growth Partners, we help drive digital transformation within and assist with organic or inorganic growth. We place key talent and professional teams and invest in Connected Industry leaders and challengers to accelerate time-to-value, for companies in Energy, Manufacturing, Smart Spaces and Supply Chain/Logistics.

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This whitepaper was originally created by 151 Advisors, which is now a Momenta Partners company. We have updated most of the data from the original format.