The Edge: A New Frontier for Manufacturing Analytics

One of the driving forces behind the paradigm shift in industrial processes is the need for increased efficiency. In the first industrial age, power-driven machines changed the use of manual labor forever. By the third industrial age, the introduction of lean manufacturing concepts enabled enterprises to be more efficient with available resources. In this outgoing decade, the annual productivity rate in manufacturing was an abysmal 0.5% according to Gartner. Thus, spearheading the need for another paradigm shift to increase efficiency levels and take manufacturing to newer frontiers.

Enter the digitization of manufacturing processes. The digital age which had brought many benefits to diverse industrial efforts was identified as a catalyst for kick-starting the manufacturing industry. The integration of digital transformation saw cloud computing enhance manufacturing by providing enterprises with single-sources of truth. These single sources of truth made it possible to analyze the large data sets shop floors produced within a centralized ecosystem to receive actionable intelligence and business insight. Thus, increasing operational efficiency and productivity levels by 10%.

Although cloud computing increased efficiency levels, the introduction of more data-producing sources such as Industrial Internet of Things (IIoT) devices and the need to analyze data closer to these sources led to edge computing. This is because for the manufacturing industry to truly take advantage of the large data sets its approximately 35billion IIoT connections produces, a decentralized process to data analytics is required. This is where edge computing comes into play.

The process of digitally transforming brownfield manufacturing facilities and legacy equipment to capture and analyze data also provides use cases for edge computing. Here, edge computing provides manufacturing enterprises with the opportunity to also receive business intelligence from the data produced by legacy operations. This highlights some of the different facets of edge computing, its application, and capacity to take manufacturing to new frontiers that will be explored in the next sections.

What is Edge Computing?

In the context of manufacturing, edge computing refers to computing infrastructure that exists close to the source of data producing assets and enables data-processing activities. Industrial controllers such as SCADA systems, scanners, IoT devices, and smart edge devices are examples of edge computing infrastructure or edge hardware that enable edge computing. In other cases, any generic laptop connected to a shop floor device or equipment which captures and manages data without having to access a central network is also an edge computing device.

The decentralized nature of edge computing brings versatility to manufacturing analytics in diverse ways which makes it one of the pillars of Industrie 4.0 and the digital transformation of shop floors. Here versatility refers to how edge computing enables real-time data analysis, automation, and ultimately delivers the 'lights out' factory that defines Industry 4.0.

The role of edge computing has been limited to capturing data, storing data, and organizing it before transferring the captured data to the cloud. This reduced role has been due to the limited computing resources integrated into the earlier edge computing hardware used manufacturing shop floors. However, in recent times edge devices are being integrated with more computing and analytical powers to deliver true computing capabilities. The MachineMetrics edge hardware is an example of these high-performing devices set to revolutionize manufacturing as we know it.

What is an Edge Platform?

To the analytical mind, the term 'edge platform' would be considered as an oxymoron when applied to the decentralized concept of edge computing. Because, why should a decentralized computing solution have a platform? But the edge does have and rely on edge platforms due to the following reasons:

- To support the development and implementation of edge applications
- To learn more about APIs that are interoperable across diverse edge hardware or IIoT devices
- To deliver enhanced computing powers or resources offline.
- To enable the transmission of shop floor data across IIoT devices and to and from the platform offline.

With these features in mind, an edge platform sometimes called an IIoT platform, refers to a platform that enables innovation in edge computing and supports deployed edge hardware. Edge platforms also enable low latency communication and high bandwidth transfer when an edge device is attached to equipment that produces large data sets.

Using the MachineMetrics Edge platform as a case study, interoperable applications deployed in a facility with a wide variety of IIoT devices are provided with a base to fall back on. The edge platform can receive the many varying data the app captures from the edge devices and use them to develop lite versions of the interoperable application for smaller edge hardware.

What is an Edge Device?

An edge device can be defined as the entry point into enterprise or service provider networks. Although this is an accurate description, a more manufacturing-friendly definition exists. Tech target defines edge devices as any piece of hardware that controls data flow and can manage data at the boundary between two networks. This definition highlights the abilities of the hardware or device to control and process data at its own boundary although other computing networks around it may exist. It also highlights its ability to manage the communications that may occur between its boundary and external networks like the cloud.

With this in mind, it is only right to define what an edge device's boundary or server is. An edge server refers to a computer used in running middleware or applications that are close to the edge of a network. While the network's edge refers to where an edge device's network connects to a third-party or centralized network. Alongside the examples of edge devices given earlier, other examples widely used on manufacturing facilities include; integrated access devices, multiplexers, robots and automated guided vehicles.

The Juxtaposition of the Cloud and the Edge

The non-scalable nature of edge computing devices means their computing resources are generally set aside for specific functions. Just like the Super Mario games of old which allowed only forward, back, and upward movements, edge applications are generally equipped with limited functions. Thus, an edge device may only capture the data relating to its functions while discarding other important shop floor data.

An area reflective sensor is an example of this limited capacity and its effect on data capture. Although the sensor is equipped to monitor the distance of a person from a designated area and send notifications or raise an alarm if trespassing occurs, it does not capture shop floor coordinates. In this scenario, capturing shop floor coordinates could help with understanding shop floor traffic and the cause of trespassing. But the sensor simply does its job and discards other non-relevant but important data.

Choosing to integrate cloud computing with the edge ensures that the above scenario does not occur. The scalable computing resources the cloud offers provides a support base or platform for edge computing in different ways. In a scenario where an industrial cloud platform such as the MachineMetrics Production platform is integrated into the manufacturing process, edge devices can transfer previously discarded data to the cloud. The IIoT cloud platform can then further analyze the captured data to receive actionable intelligence for enhancing digital transformation plans and the manufacturing process.

To ensure the symbiotic relationship between the cloud and the edge is beneficial, communication across both networks must be high-performing. This is because data transfer lags could lead to unplanned downtimes and cybersecurity challenges. Also, within Industry 4.0–compliant shop floors with multiple devices, interconnectivity is required for proper functioning. Here also, the quality of connection available is an important consideration for delivering automation. This is where concepts such as 5G technology come into play.

Solving the communication or data transfer issue involves developing more responsive networks for data transfer. In 2017, General Electric, Nokia, and QUALCOMM developed a custom network for IIoT. Similar initiatives alongside tech advances in 5G technology are set to enhance the collaboration between the cloud and edge computing. Also, to ensure some uniformity exists when integrating communication techniques between the edge and cloud networks, the OPC Foundation was created. The non-profit organization has developed multiple industrial interoperability standards such as the OPC Unified Architecture (UA) to define communication protocols within manufacturing shop floors.

For the cloud and edge computing, the bottom line is this; to increase productivity levels, the cloud and edge have important roles to play. The edge is expected to bring computing to individual sources, legacy assets, and in remote areas where low latency is required and bandwidth constraints exist. On the other hand, the cloud excels where significant computing resources are required for analyzing big data and managing research and development tasks. This makes both concepts similar to your two hands which can work autonomously, as well as, together to achieve a common goal.

The Business Case and Value-Added Proposition of Edge Computing

The integration of edge hardware and edge computing within manufacturing facilities is set to disrupt industrial effort in many ways. Disruptive technologies are defined as innovations that create new markets, value networks, and displaces established traditional markets and this highlights the new frontiers the edge intends to bring. And the Edge Computing Consortium, outline the following disruptive business cases:

Predictive Maintenance – The ability for machines to analyze the data they produce allows for the integration of preventive maintenance business models in manufacturing. Here, assets within the shop floor will continuously create alert tickets to notify enterprise systems about underperforming components. These assets also create preemptive maintenance schedules that drastically reduce the possibility of unplanned machine downtime. The value-added propositions that come with a data-driven predictive maintenance business model include:

- Reduced downtime
- Reduced maintenance cost
- Increased reliability and equipment efficiency

Energy Efficiency Management – In the United States, the industrial sector accounted for 32% of the energy consumption according to the US Energy Information Administration (EIA). This highlights the amount of energy that goes into manufacturing which affects the pricing of products. With edge computing, the consumption capacity of individual manufacturing equipment can be analyzed. Thus, providing a foundation for more efficient energy management policies. The benefits of this include:

- The ability to customize production modes and processes
- Lower energy consumption
- Reduced total manufacturing cost

Data-Driven Inventory Optimization – Edge computing makes access to data from individual components in a machine assembly possible. Analyzing the data from individual components introduces a preemptive approach to part replacement and provides guidance when stocking replacement part inventories. In more advanced scenarios, edge models can be developed to give manufacturing equipment the ability to request their own replacement parts before failure occurs. The benefits of this business model include:

- Reduced replacement costs

- Reduced unplanned downtime
- An automated spare part supply process

Developing New Business Models – Industry 4.0 business models all revolve around the use of data to enhance manufacturing processes. The model could either be a data-driven plant optimization model or a data-driven quality control model. These models will rely on the data edge hardware produce and provide a pathway for brownfield facilities to gradually implement smart manufacturing business models. The benefits of using edge computing to drive the development of business models include:

- A more efficient manufacturing process
- Enhanced quality control measure
- Increased product quality

Data as a Service – Data as a Service (DaaS) refers to the provision of data to users who require it to inform related processes. In terms of manufacturing, the data produced by edge computing can be sourced by manufacturers to develop new business models or fine-tune shop floor practices to increase revenue generation.

DaaS can be implemented in two different ways. They include owners of the data providing manufacturers with their curated data at no initial cost while collecting a percentage of the product or relational data its use produces. The other way DaaS functions involves manufacturers connecting equipment to centralized data sources or platforms to receive business insight. MachineMetrics offers the latter version of DaaS which allows manufacturers to analyze traditional manufacturing beliefs and concepts using accurate historical data. When applied to edge computing data, the benefits of DaaS include:

- Improved data quality
- Reduced production durations due to access to historical information
- Accurate insights into plants and equipment efficiency levels

The business cases highlighted here solidifies the reputation of the edge as a disruptive innovation to traditional manufacturing processes. They show that the edge creates new markets such as DaaS and the development of innovative edge hardware while displacing manual maintenance models by introducing predictive maintenance to manufacturing. This is why Mckinsey states that edge computing creates a new market for edge hardware which could be valued at $215billion in 2025.

Conclusion

The rise of smaller devices and innovative IIoT hardware, as well as, growth in edge software development is set to give manufacturers the ability to capture data at every level of the shop floor. The increasing compute, storage, and analytical abilities of these edge solutions, will make it possible for manufacturers to extract more value from shop floor data. Thus, opening a new frontier for manufacturing analytics as we know it.

MachineMetrics edge approach revolves around providing enterprises with solutions that move computing to the edge. These solutions include edge hardware and innovative software that support varying workloads and captures, as well as, analyses the data they produce. MachineMetrics also integrates with AWS cloud services to provide manufacturers with a scalable IIoT platform that delivers the combined benefits of the cloud and edge computing. This plug and play solution allows manufacturers to take advantage of the data from connected edge devices without having to manage or configure any IT infrastructure.