The manufacturing data revolution is coming

A combination of IIoT, MES and ML are extracting the value from data to increase efficiency, productivity and quality

There is a revolution in manufacturing and, at its center, is a huge asset: data. With the dawn of the Internet of Industrial Things (IIoT) and low cost, miniature electronics, there is more data than ever available about manufacturing processes, products, and equipment. This data alone, however, is not where the value lies. Indeed, it is estimated that 60% of data loses its value a mere millisecond after it is created and 65% of data is termed 'dark data', meaning it is collected, processed and stored, but never used to derive insights. The challenge is not to just collect data, but to maximize the benefits of that data and the intelligence it holds.

To make use of data, a data platform is required. This is not the IIoT Data Platform alone, as this does not meet every need of a manufacturing environment. The platform of the future is a combination of IIoT, Manufacturing Execution System (MES) and advanced analytical tools and comprises five main elements: Edge processing, ingestion, data brokering, data processing, and data serving and output.

Edge processing moves the software solution closer to where the data is generated. This removes the latency created in data transfer and enables faster system reactions. Processing at the edge also reduces the cost of ingestion and analysis and lowers cybersecurity risks and challenges with encryption of data over the network. Except for new, greenfield sites, however, factories will have lots of existing machinery and protocols that must co-exist with IIoT interfaces. A future ready MES can provide integration of legacy and IIoT devices to enable a practical upgrade path. It also provides central management with automatic deployment of drivers, controllers, and master data across dispersed shop floor intelligence.

Beyond edge processing, data ingestion is the start of the data platform. One of the most important aspects of this is the meta-data registry. The platform refers to a schema and attaches meta-data, so the system knows and understands what data is being sent.

Following ingestion of the data into the platform, data brokering takes data originally from equipment, processes, MES and ERP systems and delivers it to the relevant historian, SCADA, dashboard, alarm, analytical or reporting tool. Data warehouses have traditionally been used to manage this stage but, with rapidly increasing sources and volumes of data, these have become complicated to manage, expensive and difficult to scale. Modern data platforms need to include unstructured data such as photos, multimedia, and data maps, which do not have predefined data models. This has led to the creation of 'data lakes'. These provide clearer separation between data storage and processing. Using data lakes for data brokering is a cheap and scalable option, but they are still not particularly fast at writing and reading data for queries. New solutions use frameworks such as Apache Kafta, which provides a distributed, fault tolerant streaming platform that processes records as they are generated, adding the necessary speed and scalability required to deal with big data.

Once data has been brokered, it requires processing. Data processing comes in two forms. The first, batch processing, handles large groups of data in a single run. This is used to handle heavy data loads for reporting and offline data workflow. Stream processing, on the other hand, deals with data that needs to be handled quickly, with processing taking place as the data enters the platform. A manufacturing data platform needs to be able to handle both types of data processing.

When an event occurs, there are several steps before an action or counter measure can be actioned. The system must know the event has occurred, analyze the data, any counter measure needs to be approved, and the action must take effect. Between each of these steps there is latency. To get the best value from the data about the event and to optimize manufacturing efficiency, these latencies need to be as short as possible. The data processing framework Apache Spark offers an ideal solution with quick processing of large data sets using distributed data processing tasks across multiple computers.

For data to be analyzed, it requires context. This is provided by the MES. Once data has been enriched, Machine Learning (ML) and other Artificial Intelligence (AI) algorithms are used to detect anomalies to identify problems, safety issues or maintenance requirements. They can classify materials, products, operations, and failures and calculate probabilities of how changes will impact outcomes. These smart analytical tools can also optimize operations by calculating the probability of various outcomes and adjust processes accordingly.

Advanced analytics within a modern MES solution cover descriptive, diagnostic, predictive and prescriptive analysis to understand what has happened, why it happened, what will happen and what action should be taken. In a predictive maintenance scenario, for example, descriptive analysis uses data collected from condition monitoring sensors over a long period of time and merges this with previous maintenance activities. Diagnostic analysis then uses statistics to define the correlation between sensor data and failures. Using data driven models, predictive analysis tools can subsequently predict the probability of failure or remaining useful life. Prescriptive analytics then use decision support models to determine what action should be taken, thereby reducing maintenance costs.

ML analytical algorithms can be used to increase efficiencies and reduce costs throughout the manufacturing value chain. With enough data, learning algorithms can approximate any function. Another example is yield management. Here data analysis is used to identify patterns and visualize data. Correlation analysis can then identify core determinates of process performance and root causes of any drops in yield. These are then tested to ensure they are not spurious correlations and to identify which are significant. Finally, solutions like neural networks are used to model complex processes and quantify the impact and optimal ranges for the identified parameters to optimize yield.

The final element of the data platform is the serving and output layers. These expose results in variety of ways including file-based, OData and relational data sink outputs.

Ultimately, the data revolution is happening today. A combination of IIoT, MES and ML are extracting the value from data to increase efficiency, yield, productivity, and quality; drive continuous process improvements, and reduce costs. Nothing will stop this revolution. Manufacturers have a choice: Watch it happen or be part of it.

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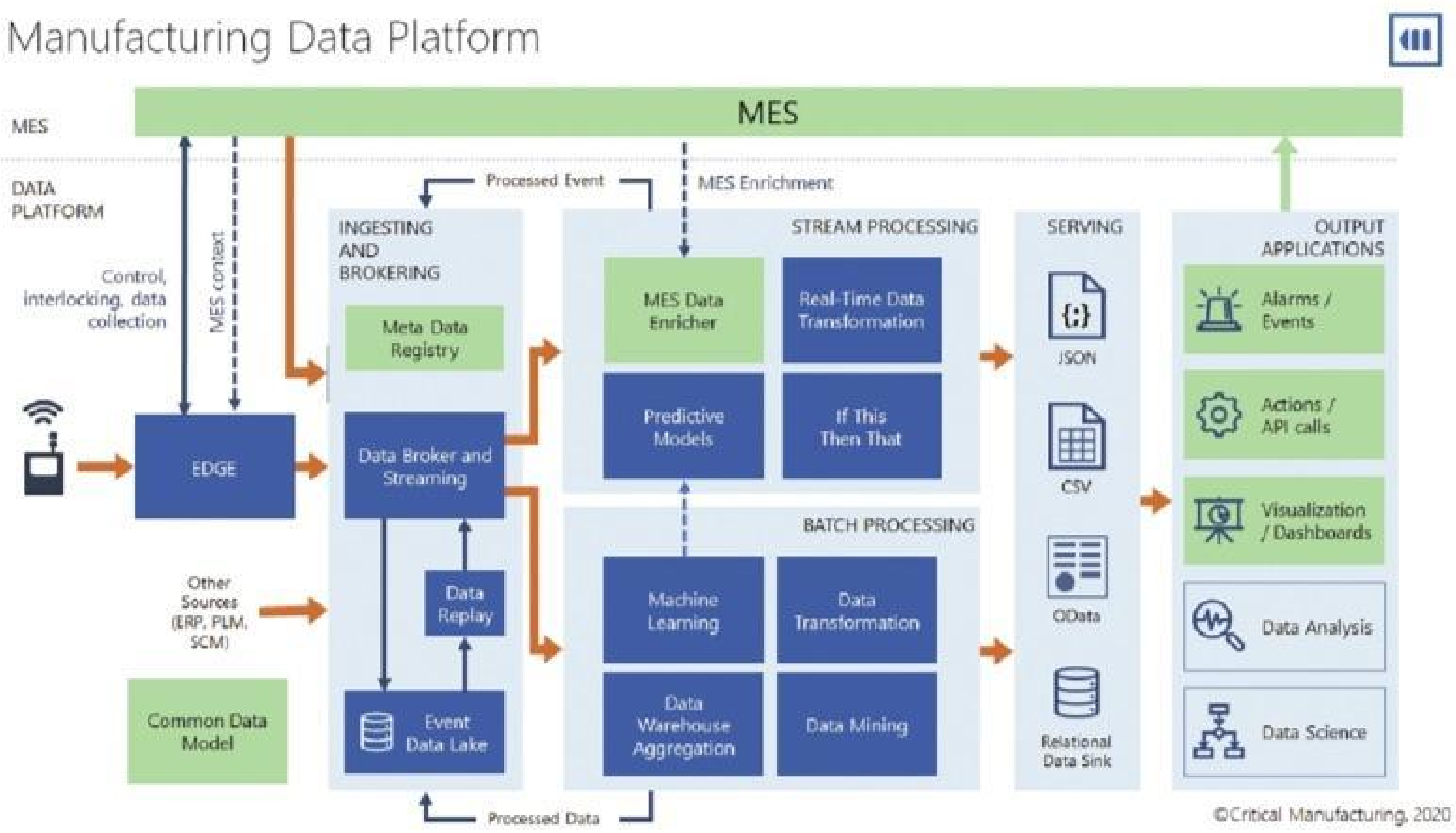
Benefits of ML in Manufacturing



Manufacturing data platform