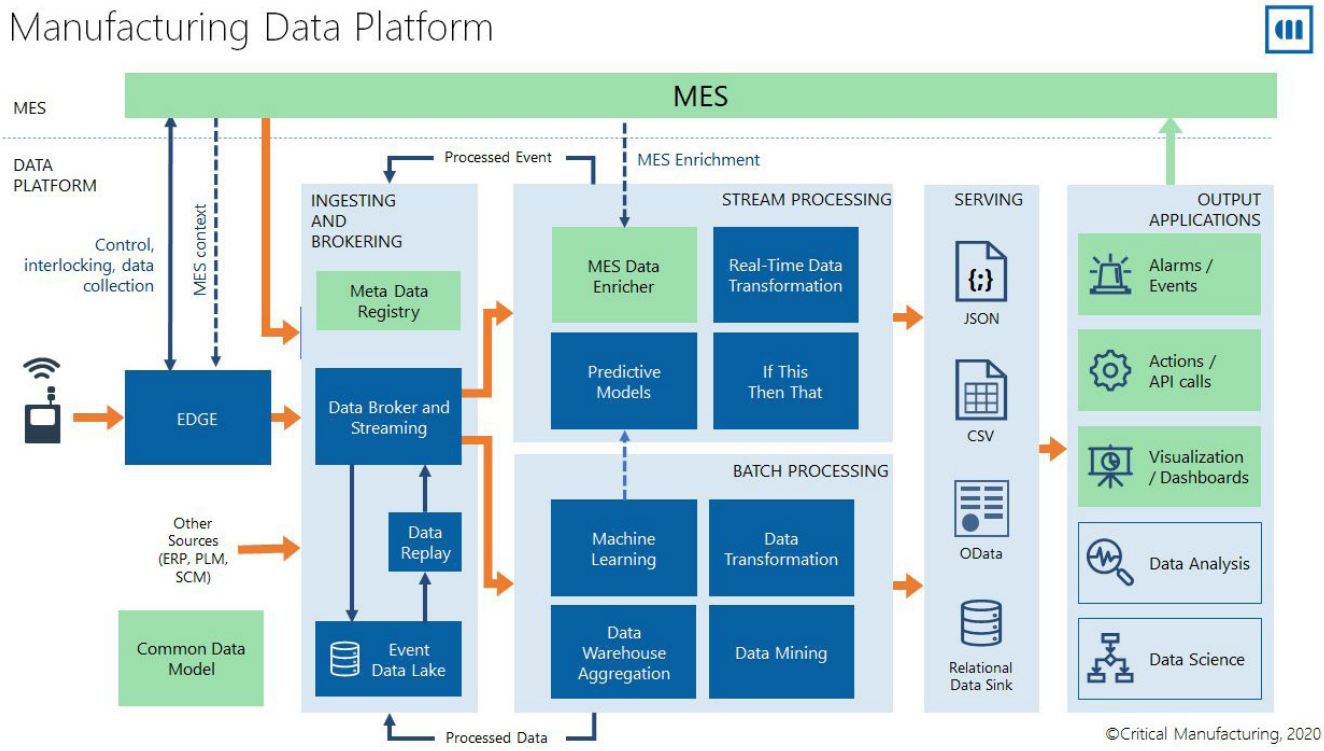
The manufacturing data revolution



It is estimated that 60 % of data loses its value a mere millisecond after it is created, an MES system can help minimize this. Source: Critical Manufacturing

A revolution is taking place in manufacturing and at its center is a huge *asset*: data. With the dawn of the Industrial Internet of Things (IIoT) and low cost, miniature electronics, more data than ever about manufacturing processes, products, and equipment has become available.

However, this data alone 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 alone, as this does not meet all the needs of the manufacturing environment. The data platform of the future will be a combination of IIoT, Manufacturing Execution System (MES) and advanced analytical tools and comprises five main elements:

- Edge processing,
- Ingestion,
- Data brokering,
- Data processing,
- Data serving and output.

Edge processing

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 retain much 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.

> "Without data, you're just another person with an opinion."
>
> *W. Edwards Deming: engineer, statistician, professor, author, lecturer, and consultant*

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 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 and expensive and difficult to scale. Modern data platforms need to include and structure data including 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.

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 within the MES are used to detect anomalies to identify problems, safety issues or maintenance requirements. 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 next 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. 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, neural networks are used to model complex processes and quantify the impact and optimal ranges for the identified parameters to optimize yield.

The data revolution has already begun. A combination of IIoT, MES and ML are already extracting 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. ■

About Critical Manufacturing/ ASM Pacific Technology:

Critical Manufacturing, headquartered in Porto (Maia), Portugal, helps electronics manufacturers to improve process capability and manage capacity and quality. The company provides modern, flexible and configurable manufacturing execution systems (MES). Critical Manufacturing is a subsidiary of ASM Pacific Technology, who provide materials for the semiconductor assembly and packaging industries.
For more information visit: www.criticalmanufacturing.com

asset	Aktivposten, Gewinn, Vermögenswert
batch	Stapel, Bündel, Ladung
data brokering	Informationsvermittlung, Informationshandel
deployment	Einsatz
derive, to	ableiten, etw. erlangen
disperse, to	(zer)streuen, verbreiten, verteilen
ingestion	Einnahme, Aufnahme, Zufuhr
pattern	Muster
query	Abfrage, Anfrage, Frage
spurious	unberechtigt, falsch, fadenscheinig
yield	Ertrag

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