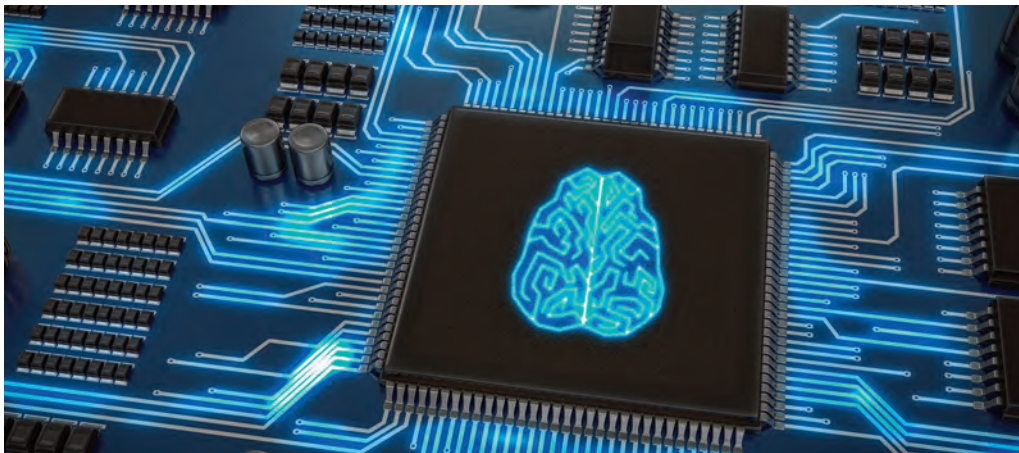


Semiconductor manufacturing and Industry 4.0: Connected production

Traditional semiconductor manufacturing models are leaving companies struggling to remain competitive due to the rising costs of bringing new chips to market, increasingly complex customer requirements and demands for higher quality, lower cost products. The new Industry 4.0 manufacturing vision for digital production enables businesses to meet these demands with the 'Smart Factory'. **Critical Manufacturing** looks across the digital landscape



The Industrial Internet of Things (IIoT); big data; low cost, miniature electronics, and advanced analytics are opening up new and exciting possibilities to manufacturing businesses. Whereas legacy manufacturing execution systems (MES) tend to silo information, leave sites disconnected and make quality procedures cumbersome; modern MES offer opportunities to accelerate processes across the entire front- end and back- end manufacturing process. Using the IIoT, this new, connected world further means that these systems go beyond plant boundaries and bring together whole enterprises and supply chains to best optimise manufacturing efficiency.

One of the fundamental differences in the new MES architecture is that it uses de-centralised logic. Having materials, products and machines with their own intelligence and communication capability means masses of data is being transferred throughout the production process in an inherently de- centralised manufacturing model. The Industry 4.0 concept merges real and virtual worlds where materials and products are cyber- physical systems (CPS) and machines cyber- physical production systems (CPPS). CPPS compete to provide services to the CPS, enhancing manufacturing efficiency and enabling rapid production of highly customised products.

This 'connected' production will speed up innovation, increase productivity and improve quality. The MES provides the necessary vertical integration of the

production model so that corporate processes cannot be bypassed. This ensures that necessary components of every process within the plant, and others that may reside outside are integrated into production. Areas such as compliance, quality, statistical process control (SPC), scheduling, engineering and maintenance systems are all managed and brought together to keep operations running smoothly.

CENTRALISED CONTROL

The fully integrated new MES brings all parts of the plant together where information is readily and easily exchanged to best optimise machine capacity, equipment availability and order scheduling. It also means that operators can have a single, intuitive view of the plant floor and concepts such as 3D modelling can be utilised to clearly see the status of all assets and batches across the shop floor.

The new MES will also be horizontally integrated to provide transparency throughout the whole supply chain. This will enable the decentralised production model to be extended to other factories, enabling them to compete to perform transformation steps on products to create a Manufacturing as a Service (MaaS) model.

Vast volumes of data are produced from the smart shop floor for which it is ultimately envisaged that the Cloud will provide 'anytime, anywhere' access and storage. The new MES has the necessary

expansion to accommodate the diversity and volume of data created. It will aggregate information from across the plant and add context to it to create useable intelligence that both real time and operational decisions can be based on. Advanced offline analytics and real-time analysis enable rapid triggering of plant responses to target manufacturing issues. For high value products, it may also make sense to use advanced techniques such as "in- memory" and complex event processing to further drive operational efficiency.

The limits of legacy MES systems are rapidly being reached. Although these systems are so embedded in production processes, a time will come where factories will need to change to survive. Lack of an IT architecture that can support new, highly competitive market places will ultimately result in cumbersome quality processes, poor intelligence on which to base strategic operational decisions and higher costs. The Industry 4.0 model offers manufacturers a way to increase efficiency, lower production costs and meet changing market demands that include increasingly sophisticated products and high mix, small batch solutions.

A shop floor that makes autonomous decisions with a modern MES based on de- centralised logic to keep ultimate control of quality and other corporate policies gives a platform to maximise production efficiency and quality. The tools that Industry 4.0 technologies provide will help manufacturers mine their vast stores of data and knowledge to create detailed and practical insights into production processes to further enhance plant performance.

Indeed, investment in a pathway to a smart shop floor will be the difference between a semiconductor manufacturer that is struggling to keep up to one that is sustaining and growing competitive edge with increasing agility, innovation and lower new product introduction costs.

Figure 1:
One of the fundamental differences in the new MES architecture is that it uses de-centralised logic

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