New MES is the backbone of Industry 4.0

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The potential benefits of Industry 4.0 (I4.0) are so overwhelming it is an industrial revolution that will certainly happen.

This new manufacturing concept extends the boundaries of competitiveness and agility to companies that have to quickly innovate to respond to changing market demands, where mass customisation and personalisation of often complex products are becoming the norm – but price and margin pressure remains intense. Manufacturers stand to gain from lower costs, higher quality and faster processing, while designers gain from the ability to more quickly adapt products to customer demands and reduce innovation cycles.

The change to I4.0 may seem a large undertaking but ignoring it is not an option if businesses are to protect their future. Although the implementation of this game-changing technology may appear overwhelming, it does not need to happen overnight and companies can plot a strategic pathway for change that matches their business needs. But where do they start and how do they manage the mix of new and old technologies during the transition?

Bringing together I4.0 technologies

I4.0 combines real and virtual worlds. The technology required for this vision is here today and includes the Industrial Internet of Things (IIoT), mobile computing, cloud storage, big data, advanced analytics, machine learning, robotics and virtual and augmented reality (VR and AR). For a plant to run efficiently and to ensure new product introductions can happen smoothly, however, these technologies need connecting and coordinating – like a backbone connecting the body parts. A new generation of manufacturing execution system (MES) has been designed to provide this 'backbone' and give businesses a way to transition to the I4.0 model.

I4.0 uses intelligent products, materials and equipment to create a smart shop floor that is self-configuring and self-optimising. Artificial intelligence enables devices to complete complex tasks in the shortest time and at the lowest cost. Devices communicate with each other and generate masses of real-time data that can be used for real-time decision making and online correction of processes. Machine learning algorithms use historical data for fast decision making based on predictive analysis to prevent issues before they occur – enhancing quality to new levels and further driving efficiency.

A faster, dynamic production model

One of the fundamental changes the new smart factory brings is a dynamic, rather than linear, approach to manufacturing. This means that products, materials or carriers can select the most efficient route through the plant to meet their processing needs. Knowing the processes or recipes they require, customisation simply becomes part of the manufacturing process rather than special steps within it or after the

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production process. This means that design engineers are free to introduce many different product configurations without adding to the production overhead, enabling them to respond exactly to varied customer demands.

To manage the new production model the new MES needs to be service-oriented, modular and be able to handle the masses of IIoT data; giving it context to translate it into useful information. It has to integrate augmented reality to combine real and virtual worlds so operators have clear visibility of the operations throughout the plant. This technology also helps design engineers test and trial process steps for the introduction of new products and gives a clear path to product changes. The MES further needs to run on any mobile technologies, in any version of the cloud and provide logical decentralisation for the dynamic production model so that the state of smart products and tools can be managed and controlled through their IIoT.

As smart products and materials pass through the shop floor they request the processes they need from smart machines. This autonomous, shop floor marketplace ensures products take the most efficient route and both plant-wide operations and the wider supply chain are optimised for speed, cost and performance. The MES is needed to enforce business-wide rules and processes to ensure autonomous entities cannot bypass areas such as statistical process control or quality sampling. During transition to I4.0 the MES will broker connections between autonomous materials and machines to ensure that both smart and traditional product lines can move effectively through the plant.

To make use of the IIoT, the MES needs connectivity and mobility. Much of the logic of driving materials through the production process is no longer required, as the intelligence for this lies in the materials themselves and the machines with which they communicate. The next generation of MES, however, needs to add plant-wide context for production steps and vertical integration of autonomous entities to ensure operations are optimised across all business activities, including sales, logistics, quality assurance, maintenance, product design and process engineering. It also needs to provide horizontal integration to encompass wider services and functions from global facilities and trading partners through a smart supply chain. Through being truly modular and interoperable, the MES can alert the rest of the system to the information available so that smart materials and equipment can access the services they need both inside and outside of the factory walls. This can help drive down product costs and give design engineers more freedom to innovate and add features that will give real competitive edge.

By making use of the mobile technology available and the concept of ‘apps’, which are now so familiar in the consumer environment, the next generation of MES will provide user interfaces that are more agile and intuitive. Interfaces will be specific to the combination of operator’s location, processing step, equipment and product being made and so provide personnel with exactly the information they need. As the MES has live status of all equipment and batches being processed, it will be able to create a real-time 3D visualisation of the whole factory. Using location sensing, this can be extended to the support of 3D navigation where personnel can be directed to perform specific tasks, such as maintenance, quality or validation, using AR.

Another advantage of having an MES that has complete visibility of the shop floor is its ability to provide complete traceability of materials through to finished product, whatever the processing route. This can include the flexibility to split and merge batches and tracking beyond the factory walls to services provided by partners at remote sites. Such complete traceability is not only desirable but also essential in regulated environments such as the medical device industry.

The MES can further integrate advanced analytical capability of the masses of data from the smart factory. By using the massive amounts of computer power available in the cloud, enterprise-scale big data analytics can be handled efficiently. The new style of MES can create time-based data export to a big data structure to fully capture production context and add value to the data for efficient and effective enterprise-wide decision making, even in dynamically changing plant conditions. Processes can be continuously optimised based on the results of the previous output of a run. Design engineers can be provided with new depths of information to help them make decisions about new generations of products. Data from machines will enable predictive and prescriptive maintenance to maximise system availability.

Summary

The goal of I4.0 is to drive production costs down and optimise plant efficiencies, especially in high-mix, personalised product environments. By producing smaller batches, companies will add agility to their businesses and be able to respond rapidly and accurately to market demands without carrying large inventories. The data generated from the smart shop floor will, with advanced analytics, provide the information needed to make better operational decisions. This is made possible through the context provided by the MES. The information that will be made available will not only optimise plant operations but will also facilitate product development, process and plant engineering, quality, maintenance and supply chain optimisation. New products will be introduced more quickly and design engineers will have new depths of data and analysis to help them modify products to both meet market demands and further drive out costs. Management will have the information they need to understand what could be possible and where the most profitable choices lie.

MES have always supported both quality and functionality through a workflow engine. The next generation of MES is designed to handle the complexity of a dynamic, intelligent shop floor along with the constant change of the autonomous marketplace within it. It will provide clear, real-time visual information for real-time decision making through VR and AR. It will be a tool that will help designers create even better products and bring plants to new levels of production

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efficiency.

Ultimately I4.0 will change the expectations of manufacturing and remove the limits of linear production models. It will deliver faster response time to market demands, perfection of quality, rapid new product introduction and better decision making. The new generation of MES will be the backbone for making this vision a reality.

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