

Manufacturing Execution Systems (MES)

Playing a vital role in digital manufacturing and the digital thread

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Thanks to the rapid growth of the Industrial Internet of Things (IIoT), Manufacturing Execution Systems (MES) are becoming a more important focus of enterprise system technology. Although MES has been available and the technology has continued to evolve and grow for decades, many companies still have no coherent MES strategy and only a few, disconnected MES-type applications in use in their plants. These companies are not only missing out on the benefits of MES today, they are ill prepared to take advantage of all that digital manufacturing has to offer.



Before going any further, it might help to define just what MES is, why it is important, and how it fits into a comprehensive technology strategy for digital manufacturing. MES collects, manages and communicates data and information on the plant floor and serves as the communication link to other enterprise systems including Product Lifecycle Management (PLM) and Enterprise Resource Planning (ERP). MES functions include:

- data collection, from bar-code scans, RFID readers, touch-screen terminals, voice response, machine controls (SCADA), etc.
- quality management, and
- scheduling to a more granular level than typically carried out in ERP – including work sequencing, intra-day scheduling and real-time dispatching.

The most important function of MES, however, is communication or what you might call data logistics. Logistics is all about warehousing and transportation. MES performs those functions in support of scheduling, reporting, quality, and keeping all plant resources “in the loop”.

Digital manufacturing and the digital thread

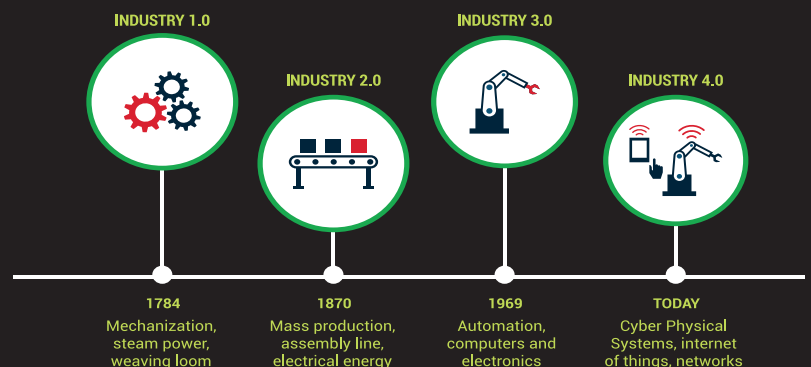
Digital Manufacturing is a blanket term that recognizes the computerization of nearly all aspects of design, production and distribution of manufactured products. Descriptions of digital manufacturing often refer to the digital thread as the concept of connecting digital information through the process from design to manufacturing and beyond. MES is a vital link in the digital thread.

Product design and engineering are largely if not completely digital these days. The product design starts out in a Computer-Assisted Design (CAD) system, is tested and refined digitally, and the machine instructions to make it are developed in Computer-Assisted Manufacturing (CAM). MES knows when those electronic documents and instructions are needed (through its ties to ERP schedules) and delivers them to the work centers and automated equipment at the right time. Activity reports (either automated or entered through scans or operator action) update the scheduling routines in MES and ERP. Quality management may occur in MES as well. Detailed records of the manufacturing activity that may include cost data, parametric measurements, regulatory-required documentation and sign-offs, material traceability data, and more are gathered by MES and passed on to ERP, Product Lifecycle Management (PLM), service management, back to engineering for analysis, and into archives for configuration control, audit, and analytics. MES plays a key role in digital manufacturing and the digital thread.

How MES fits in the world of computing

MES systems evolved in parallel with ERP and engineering systems (CAD/CAM) in a relatively isolated environment of their own. In those days, computer architectures, primitive by today's standards, were developed for specific environments and were generally difficult to interconnect. “Workstation” computers running the Unix operating system had the raw computing power that engineering applications demanded. Business systems (from mainframes to “minicomputers” and later Windows/Intel systems) handled large databases and reporting. Plant-level systems linked microcomputers and digital controls for real-time applications. In that environment, MES provided the data collection, quality and schedule-related functionality that kept the plant operating effectively but the data logistics were difficult to achieve because the platforms in engineering, the plant and the office operated on different time scales, used different operating systems and platforms, and even coded and stored the data differently.

Fast forward to the twenty-first century and those barriers to communication and data exchange have all but disappeared. Nearly all systems in all three business areas use the same computer architecture, programming environments, and data structures. In addition, service-oriented architecture, web services orientation, open data exchange and communications protocols and especially the emergence of the cloud as the environment of choice have all served to bring the Digital Thread into reality. The shop floor is no longer an isolated black hole to the business and engineering functions and all three business areas can work together to achieve company goals of delivering quality product to customers on time and within cost objectives.



MES and ERP systems today

Today's manufacturing environment faces unprecedented pressure to respond to product proliferation, smaller quantities of a wider variety of products and product variations with shorter life cycles and increasing demands for higher quality, lower cost and full traceability. In response to these demands, many companies are partnering with suppliers and contract manufacturers, and utilizing plants across the globe and today's efficient global logistics capabilities to build and assemble products in the locations best suited to each stage of the production process. Many products "travel" through numerous locations before coming together as final products. Keeping the Digital Thread intact across these many locations is a challenge that is addressed by the new breed of MES that is:

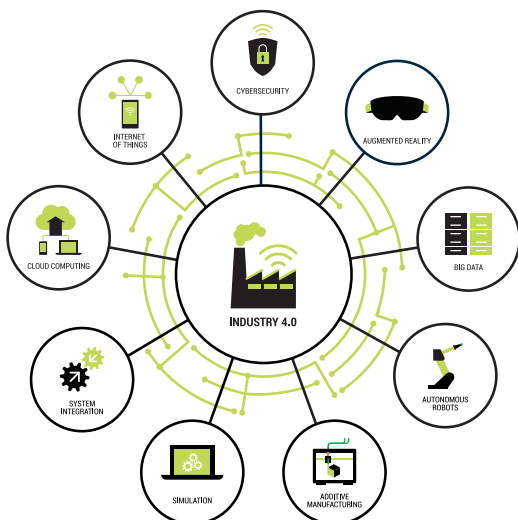
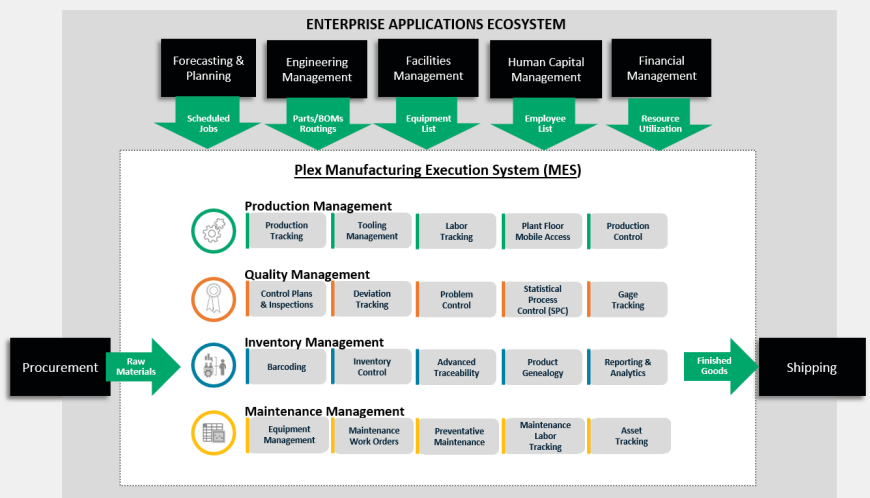
- built for real-time control and communications,
- tightly integrated with ERP and engineering, and
- cloud-based.

Don't discount the importance of the last item – being cloud-based is important. Whereas in earlier times, the MES environment was relatively isolated, today it is important to link the plant floor with the rest of the enterprise and that's what makes the cloud strategy so powerful. Cloud-based applications and systems are designed for interaction and data sharing with other systems, even with those that are not cloud-based themselves.

In addition, distributed production – having plants feeding other plants in a geographically spaced supply chain network – naturally fits with the cloud model that makes systems and their data available from anywhere at any time. Enterprise management can both monitor activities at remote manufacturing sites and closely coordinate and manage those remote activities and schedules through the linked cloud MES systems.

As ERP systems evolve, some are reaching further into the plant and some are reaching into what has traditionally been MES territory. In truth, the dividing line between ERP and MES has become somewhat ambiguous now that we no longer have the platform incompatibilities to worry about. Every ERP system, for example, has a scheduling function. MES also creates and manages schedules. The difference is quite straightforward, however, in that ERP will typically only plan and schedule to the day; start an order or operation on this day, complete it on that day. ERP does not address intra-day sequencing or scheduling hour-by-hour except through priorities and dispatching. MES, by contrast, only concerns itself with intra-day scheduling and dispatching and has no longer-term planning functionality. Some ERP systems have now added more detailed planning and scheduling that overlaps into traditional MES roles. Other ERP developers have added full MES-class intra-day scheduling.

Plex has its roots in manufacturing, having started out as a software developer for the automotive industry where plant operations are critically important and detailed tracking and traceability are key requirements. With deep functionality in plant operations, it was a relatively small step for Plex to adopt full MES functionality into the Plex Manufacturing Cloud. The MES part of the system is designed in such a way that it can be tightly integrated as part of the Plex ERP system, or it can be deployed as a stand-alone MES solution on the cloud that can be readily integrated into third party ERP systems. These third party ERP systems may reside either in the cloud, installed on premise at the plant location, or at a corporate headquarters anywhere in the world.



Just to finish the discussion of the MES – ERP overlap, most ERP systems have a quality module as do all MES systems. Once again, the main difference is in granularity and direct ties to production equipment and plant floor activities. ERP quality is usually somewhat at arms-length from the plant, managing historical data and statistics. MES quality is more likely to be tied into machine-level controls and sensors supporting operator feedback and automated monitoring and control systems. MES quality data is more detailed, more real-time. Both quality functions should work together, sharing data and completing the audit trail from overall quality reports and documentation tied directly to finely detailed plant-floor data gathered in real-time and stored and managed in MES. Obviously, ERP quality and MES quality must be tightly integrated.

Finally, most ERP systems are set up to utilize automated data collection for inventory transactions and shop activity reporting. When integrated to MES, separate ERP data collection should not be needed. MES can separate out the basic data that ERP needs and pass it along, since MES already collects and manages everything that ERP needs and more.

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Deliver better quality product to customers on time and improve bottom line profitability

About Baker Tilly

Baker Tilly is a premier global Plex partner with a specialized Plex Enterprise Solutions management and business technology consulting practice. We offer comprehensive implementation, business integration, tailored optimization and industrial analytics solutions in alignment with Industry 4.0 to manufacturing enterprises across various industries. We help new and legacy Plex clients resolve their business and technology challenges and improve their operational efficiencies through full solution or module-specific optimization, business integration, global compliance and material performance management implementations. From standardized industry solution sets for rapid rollouts to full transformational services, we apply best practice methodologies to organizational needs and enable enterprises to outperform their competition.

For further reference:

Manufacturing Execution Systems now Key in Digitized World, SearchManufacturingERP., TechTarget, <http://searchmanufacturingerp.techtarget.com/tip/Manufacturing-execution-systems-now-key-in-digitized-world>

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