FOUR PRINCIPLES
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How Manufacturing Execution Systems (MES) help manufacturers meet demand, despite disruptions across the supply chain

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THERE'S NO QUESTION THAT WE'VE ENTERED THE ERA OF INDUSTRY 4.0, DESCRIBED BY PWC AS ENCOMPASSING "END-TO-END DIGITIZATION AND DATA INTEGRATION OF THE VALUE CHAIN." INDUSTRY 4.0 COMPANIES OPTIMIZE PRODUCTION TO THE FULLEST EXTENT BY CONNECTING PHYSICAL, VIRTUAL, AND HUMAN ASSETS, AND INTEGRATING ALL OPERATIONS AND INTERNAL ACTIVITIES.

Lean manufacturers are best positioned to elevate to Industry 4.0 because they are customer-driven, evaluating and optimizing production to produce only the goods consumers want and need. Manufacturing Execution Systems (MES) are a key component of this digitization, and the perfect partner in Lean's quest to eliminate waste.

What is a Manufacturing Execution System (MES)?

Put in simple terms, a Manufacturing Execution System (MES) is a technology package that enables a manufacturer to incrementally track and control inputs and outputs with great accuracy. Introduced in simple form almost two decades ago, MES technologies digitize data collection and control a production process through a single platform, boosting efficiency and productivity. Essentially, an MES supports the common goal of making more with less, by connecting and monitoring machines and work centers on the factory floor and thus optimizing manufacturing operations. Once optional, MES tools have now become must-haves as a foundation for digital manufacturing and smart factories of the future.

The top functions of an MES include:

- Product track and trace
- Formula/recipe management
- Machine process control
- Supply chain visibility
- Logistics scheduling & planning
- Labor management
- Regulatory compliance
- Performance analysis

Implementing an MES allows manufacturers to link production to actual costs. Like a continuous real-time audit, an MES supplies robust real-time data across all aspects of production, allowing manufacturers to recognize defects, variations and inefficiencies at each stage of production and analyze the impact on costs. An MES consolidates data and conducts performance analysis, calculating KPIs (key performance indicators) like rework, scrap, process capability, OEE and more.

Lean manufacturers use this data to see behind old-fashioned metrics such as production quotas. Quotas may have been met, but an MES allows the manufacturer to assess the factors that went into delivering products on time, such as material shortages that required higher-priced sourcing, breakdowns that necessitated repairs, or the need for excessive overtime. One common scenario: Operating machinery and systems at greater speeds or for longer intervals than recommended or lengthening equipment service intervals, risk future breakdowns and shortening equipment life, problems that will incur costs down the line.

As manufacturing has become more sophisticated and automated, the ability to error-proof processes has become critical in increasing productivity. A key component is the ability to automatically adjust for variations of parameters such as weight, dimension, machine settings, and inspection criteria. By building this functionality with an MES, manufacturers have standards to measure against, thus increasing their ability to detect when a process has drifted outside expected and ideal operating parameters.

The Challenges of a manufacturing environment in flux

The global economy, subjected to the start-stop-start rhythm of repeated COVID-19 surges and the resulting rules and restrictions, is more unpredictable than any time in recent history. Regardless of industry, consumer demand is in a constant state of flux, making long-term prediction extremely difficult, if not impossible. Slowdown and recovery are affecting different sectors and product classes at different times, with some manufacturers experiencing sudden spikes in demand just as others see orders canceled and contracts shelved. It's essential for manufacturers who wish to succeed in this erratic environment to have systems in place that allow for flexibility, adaptation, and the ability to initiate rapid changes in direction.

The current landscape could be likened to the American Wild West, and those who can ride a bucking horse will win the rodeo. In the Middle East, as in the rest of the world, a host of external factors will cause customer and market demand to remain unpredictable. Meanwhile, supply chains are disrupted across the globe, with manufacturers experiencing shortages of raw materials, parts, tools, technologies.

Labor shortages, and shipping and trucking interruptions, are not only affecting the supply chain, but are preventing manufacturers from getting products to market in a timely manner. The industrial companies rising above the competition are those that are capable of pivoting to source materials differently, produce components in-house, adapt production and identify new ways to get products. "This continual improvement mindset is ingrained in Lean and Agile manufacturers, giving them an advantage over old-style companies incapable of rapid innovation," says Seif Shieshakly, Co-founder and Managing Partner at Four Principles.

This means that manufacturers will have to become more Agile. But what does Agile really mean? In a manufacturing context, it is using a highly organized cross-functional approach to regularly re-assess demand and react to that as quickly as possible, continually adapting each time to a moving market target. Those manufacturers who learn to adapt systematically will not only master the crisis but put themselves in an optimal position to succeed years, or even decades, into the future.

Four Principles has developed a simple, systematic approach to helping manufacturers leverage Lean tools to navigate their way out of the current crisis and position themselves to be industry leaders.

Applying an MES in a Lean environment

Presented simply, Lean manufacturing is all about less; eliminating waste across all aspects of an industrial process. Lean helps manufacturers produce products in less time with fewer materials, requiring less human effort, less capital and often less physical space as well. To do this, the Lean system seeks to eliminate waste at every step. The types of waste can include:

- Overprocessing or unnecessary processing steps
- Overstocking of parts, materials, and components
- Errors, defects or wasted scrap material
- Overproduction
- Unnecessary or over-expensive shipping and transport
- Unnecessary human activity
- Delays and downtimes

An MES tool supports this quest to eliminate waste by helping manufacturers generate reliable and effective indicators to assess whether they're on track. Functioning both as a quality management and scheduling system, an MES can become a key instrument in achieving a data-driven culture of iterative improvement.

An MES tool supports Lean's quest to eliminate waste and strengthen performance by improving analysis and enabling a systemic approach to creating and maintaining best practices. "To cope with today's supply and demand challenges, manufacturers need to find ways to optimize operations and reduce material and operating costs throughout the production process," says Patrick Wiebusch, Co-Founder and Managing Partner at Four Principles. "A Lean performance improvement mindset assisted by the tracking capabilities of an MES can achieve dramatic performance enhancements and outpace competitors."

Regulatory functions are also aided by an MES, which improves materials traceability, essential for manufacturers in fields such as aeronautics, medical technology, and food and beverage, that are governed by strict regulations.

The introduction of an MES often works synergistically with an enterprise resource planning system (ERP.) Today's modern ERPs integrate all facets of an enterprise into one comprehensive information system enabled by embedded AI and automation, to provide an immersive user experience. The MES connects shop floor systems with the ERP, which handles business and logistics. When integrated, the two systems provide a single source of real-time data to all employees, from those in production to those in management. As a result, production managers are much better informed and can make decisions faster and more flexibly.

By helping industrial companies operate more efficiently, an effective MES makes it possible to devote some resources to other priorities, such as diversifying offerings. There's more time to accommodate scheduled maintenance, deal with staffing issues, and handle rush orders or other sudden changes in demand.

Lean systems are key transformational tools in this process, enabling manufacturers to map value streams and identify areas of waste and inefficiency while making personnel decisions that match roles and skills to the betterment of all.

How an MES enables a continuous improvement mindset

For Lean to achieve success, manufacturers need knowledge and data to analyze and control production and make iterative improvements. IoT sensors on the manufacturing floor can collect data and link machines with the MES, allowing a manufacturer to obtain frequent measurements, track processes step by step, identify issues and solve problems as they arise. Building quality checks throughout the process avoids an enormous amount of re-work at the end of the line.

Numerous examples exist throughout the industrial sector of companies achieving proven results from implementation of Lean MES.

Case Study: Lean MES improves traceability

Sar Teknik, based in Bursa, Turkey, designs and produces interior components for buses and train coaches such as rails, lighting systems, ceiling panels, pillar coverings and luggage racks. Global operations consist of five subsidiaries with factories in Europe, the Middle East, Asia and America.

As Sar Teknik makes such a wide variety of products, the company utilizes numerous types of materials including fiberglass, a variety of plastics, textiles, aluminum and other metals. Sar Teknik factories employ numerous manufacturing processes including milling, cutting, welding, bending, shaping, punching, assembly, painting, and surface coating.

Starting with a pilot project, Sar Teknik implemented an MES to solve quality and cost problems resulting from non-standardized data collection and the inability to consistently evaluate performance indicators, such as machines utilization and overall process efficiency.

The project was an instant success, enabling operators and managers to extract data on utilization of resources and the impact of defects and failures at any time, and take snapshots of the shop-floor state at different time scales.

Sar Teknik saw significant benefit from the creation of a product "passport," a document containing the entire chronology of the manufacturing steps that went into producing each part. This traceability produced significant results, including the ability to average values for utilization of equipment and evaluate the cost of processing a part.

Case Study: Integration of 50 legacy systems

Through its acquisitions, Vishay Intertechnology has become one of the world's largest manufacturers of semiconductors and electronic components. In 2018, the company embarked on a program to standardize systems across more than 30 plants through the implementation of a single Manufacturing Execution System (MES). Working with consultants, Vishay determined that MES functionality could replace more than 50 legacy systems. While ROI data are not yet available, Vishay has already seen transformational benefits, which are best summarized in before-and-after terms.

Before: Monthly manual inventory counts were done at the end of every month, including counting both raw and work-in-progress (WIP) materials.
After: Managers can see online how much of each material is available in each location.

Before: Preparation for each new production order required listing materials needed and hoping they were available.
After: managers have real-time visibility of inventory to determine of materials and personnel area available for order.

Before: There was no system for raw material quality inspection.
After: Quality control has access to site data for inspection.

In sum, thanks to the new MES, Vishay's managers and controllers have access to materials, products, and equipment operations at each step and can easily determine the production status of each running order. As a result, operational workflows have been radically streamlined.

At the leadership level, visibility into the production process has vastly improved organizational decision-making. Thorough reporting of materials and personnel hours utilized supports accurate product costing while tighter quality control has led to a spike in customer satisfaction.

As Industry 4.0 technologies like AI, augmented reality (AR) and smart machines evolve and become even more integrated, the role of the MES will become even more pivotal in managing production operations. When we envision the factory of the future, smart enough to run itself, it is the MES that will lead the way.

Challenges require expert advice

While the benefits of both Lean and MES are clear, there are challenges to successful implementation and adoption, both operational and cultural. The solution and provider must be the correct ones for the company and industry. For example, industrial companies with a long history need the ability to incorporate historical records. And smaller manufacturers may feel their production capacities and profit margins aren't large enough to justify purchase of an MES. There are people issues as well – leaders and managers must be prepared for the change and coached to understand the benefits and possibly re-think their roles in the face of more data-driven operations. For some, the newer, more detailed visibility and depth of data may come as a threat, since it may reveal organizational weaknesses.

"Lean manufacturing experts take a holistic approach to the entire organization and know how to embed Lean philosophy and digitization tools such as MES throughout the operation," says Manuel Silva, Senior Manager & Director Digital Kaizen Lab at Four Principles. "With the right introduction, companies can undergo dramatic changes with the full support and enthusiasm of leaders and managers."

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