

Elevating manufacturing quality

Four best practices for high-tech industries

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Smart factories, cyber-physical systems, augmented reality—it seems like every passing day brings new tech that promises to improve manufacturing efficiency and quality. In other words, Industry 4.0 is here, and with it, revolutionary opportunities.

Ironically, these very same advancements place unprecedented demand on manufacturers. As the world grows increasingly reliant on electronic equipment, systems, and components, high-tech businesses must expand their focus beyond product innovation. They must redefine the manufacturing process itself.

This article aims to provide decision-makers with real-world insights into the introduction and implementation of modern manufacturing techniques. By bolstering proven methods with the latest technology, manufacturers can develop and sustainably maintain operations that unlock new levels of precision and productivity.

#1. Adopting lean manufacturing principles

The twofold approach of eliminating waste while increasing efficiency underpins lean manufacturing ideology. As simple as this sounds in theory, the reality is that modern industry almost encourages the opposite. New innovations, software, tools, and systems ever seek to “improve” upon the manufacturing process—often simply bogging it down along the way.

But lean manufacturing does not mean simply adopting every new innovation that promises to reduce production times and costs. These principles begin at a more fundamental level:

- **Define value** – Identify what value means—both from the customer’s perspective and your own. What

aspects of the product are customers willing to pay for? Which KPIs do you prioritize in your operations?

- **Map workflows** – Once value is defined, the next step is to map out all workflows and processes involved in creating the product, from raw materials to final delivery. Aim to visualize your current state of operations, identifying any non-value activities or bottlenecks that can be eliminated or improved.
- **Align systems** – With a clear understanding of value and detailed workflow maps, you are now positioned to implement systems and processes that add genuine value. Integrate new technologies, tools, and innovations in a way that supports lean objectives rather than complicating them.
- **Continuously improve** – This step embodies ongoing “Kaizen” initiatives, instilling a work culture where all employees actively suggest and implement improvements. Operating as both a philosophy and concrete action plan, Kaizen aims to incrementally refine wasteful or inefficient manufacturing processes.

Amidst revolutionary advances in AI and automation, sometimes the biggest advantage lies in going back to basics. By returning to these fundamental principles, manufacturers can navigate the complexities of modern industry and emerge more competitive, resilient, and aligned with market demand.

#2. Optimizing line layouts and facility design

The physical layout of a manufacturing facility also plays a crucial role in determining the efficiency and quality of production. Strategic decisions surrounding these factors can significantly impact the flow of materials, the movement of workers,



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and the overall productivity of the manufacturing process.

When designing (or revamping) a manufacturing facility, it is essential to consider the specific requirements of the final products. This includes factors such as:

- Component size and weight
- Assembly operation sequence
- Necessary equipment and workstations

With these considerations in mind, decision-makers can work backward to develop a layout that optimizes the use of space while minimizing the distance traveled by materials and workers.

4.0

Industry 4.0 is driving new technology designed to deliver higher levels of precision and productivity

A classic example of such effective facility design is cellular manufacturing. This involves arranging equipment and workstations in a way that allows for the production of similar products or components in a dedicated area, or ‘cell’. Grouping related operations together enables manufacturers to reduce the need for material handling and transportation, resulting in faster production times and fewer errors.

Standardizing equipment used across production lines and cells also plays a pivotal role. A standardized approach minimizes production setup variables and simplifies the knowledge needed for operation and maintenance. This enables a more flexible production system, capable of adapting to new products or changes with greater agility while reducing the waste associated with equipment diversity.



#3. Leveraging automation for safety, speed and precision

Another key strategy in modern manufacturing is the automation of menial, repetitive, or dangerous tasks. This reduces the need for manual operators while driving higher quality and cost-efficiency. Consider just a few examples:

- Robot soldering and auto-screwing machines revolutionize assembly processes, allowing for faster and more reliable connections.
- Conveyor belts equipped with barcode scanners for moving sub-assemblies ensure that each component is accurately tracked and placed, further streamlining the production process.
- Automated processes for delicate or potentially messy applications (such as handling glues and liquids) enable manufacturers to achieve clean and consistent results.

Such automated applications offer a multitude of benefits. Precision robotics can often improve both aesthetic quality and overall reliability of the final product. Operators no longer need to put themselves at risk—either for injury or simple human error—across the production line. And these benefits compound by freeing up operators to handle projects that are less menial and more meaningful.

#4. Engineering efficiency with manufacturing execution systems

Manufacturing Execution Systems (MES) are comprehensive software

solutions that provide real-time visibility and control over the entire manufacturing process. By leveraging an MES, high-tech manufacturers can significantly enhance both productivity and visibility in their operations.

An MES collects and analyzes vast amounts of data from machines, sensors, and operators to:

- Monitor equipment performance
- Track order progress
- Identify potential quality issues in real-time

These functions enable more informed decision-making and proactive problem prevention. In the high-tech industry, an MES is particularly valuable for ensuring the reliability of complex electronic components. It does so by integrating with automated testing and inspection systems, catching and flagging defects early in the production process.

Beyond real-time monitoring and control, MES facilitates a critical feedback loop for continuous improvement. Manufacturers can leverage lessons learned directly from the production floor by incorporating regular reviews based on three key design principles:

- **Design for Manufacturability (DFM)** focuses on products that are easy to manufacture at the lowest possible cost without compromising quality. This includes simplifying parts, reducing components, and using common materials or processes to streamline production and assembly.

- **Design for Quality (DFQ)** involves incorporating features and design choices that ensure products meet high-quality standards, perform reliably under expected conditions, and are durable over their intended lifespan.
- **Design for Cost (DFC)** inverts the traditional approach of determining prices in later production cycle stages based on the costs already accrued. Instead, DFC incorporates final target pricing at the initial design stages to ensure market competitiveness. Then, OEMs assess cost reduction strategies like parts standardization or streamlined supply chain logistics to reach that target.

Data gathered from MES software thus enables lean manufacturing from the very start. This ensures product designs are consistently optimized, undergo fewer revisions, and are manufactured with maximum efficiency.

Navigating the future of manufacturing

Even with the most cutting-edge tech, the pursuit of manufacturing excellence remains a continuous journey. By focusing on lean principles, strategic line layouts, automation, and rigorous quality control, manufacturers can redefine their production processes to deliver genuine value at every level.

The transformation won't happen overnight; it will require investing in operator training and a culture of continuous improvement. But these investments will pay dividends—laying the groundwork for operations that remain agile and responsive amidst the market's ever-changing demands.

In the age of Industry 4.0, where quality and efficiency emerge as prime differentiators, these best practices offer a blueprint for manufacturers to achieve operational excellence and a strong competitive advantage in the global marketplace. **EP&T**

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MES

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