Drive & Control profile

Technical Article

Lean production and automation: How to find the right mix

The intelligence, flexibility and efficiency of today's production platforms—from manual production cells to full automation solutions—offer new options for companies that want to use technology to become lean.

In this article, helpful tips regarding:

- Understanding "lean" manufacturing
- Identifying—and eliminating—waste
- Determining how and when to employ automation

Factors to consider that will help select the best production platform for lean operations

Today's competitive global markets challenge manufacturers in all industries to constantly seek efficiencies in order to stay competitive. Factors such as mass-customization, small lot sizes and demands for extremely rapid turnaround drive manufacturers to become much more flexible. The need to maximize manufacturing ROI has never been stronger; you need to get the most out of your processes, your systems, your equipment and your people.

Lean manufacturing has proven to be a powerful, fundamental way to achieve these goals. By providing a systematic way to identify waste and remove it, lean manufacturing is more than just an extra tool in your manufacturing toolbox. It's a way of life. To be good at lean, companies must commit to it and pursue lean techniques vigorously.

That includes making intelligent decisions about how and when to use automation technology to become—and to stay—lean. At its most elemental level, lean manufacturing is "pull" production, driven by customer or marketplace demand. Lean production optimizes all of your enterprise's flow in response to that demand: material flow, people flow and information flow.

Is it possible to use automation and still be "lean"? Newly emerging manufacturing platforms that utilize mechatronics concepts; powerful, intelligent, connected controls; and even wireless technologies are changing the equation by creating an entirely new range of capabilities.

These new capabilities add truly demand-driven flexibility to the traditional automation advantages of precision and speed, whether in semi-automated or fully automated production environments, and can even help to eliminate wasteful processes in assembly operations that are mostly manual. Finding the right level of automation can enhance your lean initiatives in previously unconsidered ways, giving you new ways to reduce wasted time, wasted energy and wasted effort when used in the right applications.

Identifying waste to optimize flow

It takes more than tying together a few U-shaped or L-shaped work cells to become lean. Lean is a philosophy that drives efforts to reduce waste throughout the manufacturing process. It's a guide for decision-making—and to make the right decisions about eliminating waste, it's crucial that you step back and consider how materials flow through the manufacturing process.

Optimizing the flow of material will guide the decisions you make about how best to eliminate waste. To get an idea of how much optimization might be needed, take a quick waste walk and think about addressing the classic seven types normally identified by lean practitioners:

- Overproduction
- Waiting
- Defects and errors
- Excess motion and movement
- Excess inventory
- Inefficient processes
- Excess transportation

These classic seven types of waste can be seen on a daily basis in many production environments—including those with a high degree of manual production. Further analysis has identified two other types of systemic waste that lean can address:

- Talent: As a consequence of inadequate training, or when an operator interface is poorly designed or implemented, operators can waste time or effort.
- Energy: Many production platforms are not designed to be as energy-efficient as they could be; Rexroth's 4EE for energy efficiency identifies four levers—optimization of energy system design, efficient components, energy on demand and energy recovery—that can be used to eliminate wasteful use of energy in manufacturing.

A very effective lean tool to help you get to the root of waste within your manufacturing systems is a Value Stream Map. Create a Value Stream Map and identify waste wherever it occurs in your system. (A simple Google search can help you find templates and resources for Value Stream Mapping.) And if you don't want to get this involved, ask your operators about wasteful processes. Because they're close to the process, they often know exactly where to start fixing things.

With this information, you can begin making effective, intelligent decisions about how to eliminate the waste you find, including determining the right level of automation to use to help accomplish that goal.

Lean Production System Matrix

Lean production provides a framework for efficient competitive production, based on a philosophy of comprehensive waste avoidance. To become lean, manufacturers need to attack waste everywhere by establishing processes—and utilizing the right kind of production systems—that enable you to:

- Reduce inventory
- Eliminate downtime
- Reduce space requirements
- Avoid errors and inefficient processes
- Intelligently monitor and track production
- Avoid overproduction
- Shorten transport routes

A helpful approach to choosing the right production systems is to think in terms of production volume and product mix, and to chart these factors in a matrix. One matrix that Bosch Rexroth has created plots the four broad types of production systems used most commonly: manual production systems, modular production systems with some automation, standalone automated production cells and fully automated production lines.

Depending on where your situation falls on the lean production matrix, the level of automation you need may range from no automation at all (manual production) to fully automated production.

In the most unpredictable assembly environment—low volumes, high product mix—manual assembly is usually the reasonable choice because you'd never recoup your investment in automated equipment. It's a dynamic set of considerations, with no one right answer.

In some assembly operations, manual production is augmented by automated intelligence: A new generation of cordless nutrunners for assembly operations has an integrated controller that temporarily stores the results of every nut tightened, and

then transmits that data via Wi-Fi to a receiving station and the production platform's quality-tracking system.

This ensures, through automated data capture, total tracking of the quality of manual production, through integrated intelligence, while at the same time eliminating the need for redundant, manual, post-operation checking.

The level of machine intelligence and sophistication now available has indeed begun to change the calculation for when automation makes sense. Automated production cells, which often combine skilled manual operator activities with automated conveyors and/or standalone handling solutions, enable relatively high volumes of production.

This useful decision matrix can help choose the right lean production technologies to select, by assessing your flow in terms of production volume and product mix, and to chart these factors against different types of production solutions.

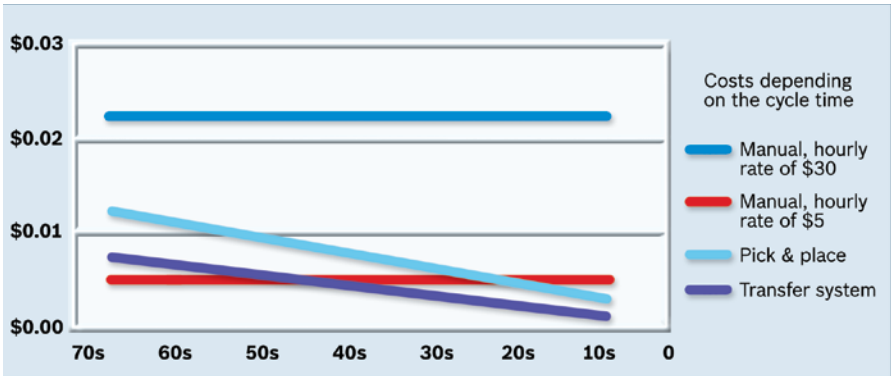
Mechatronics solutions with pre-integrated mechanical and electrical interfaces, such as Rexroth's EasyHandling platform, can not only support rapidly changing product mixes and production cycles; they also cut wasted time out of the engineering, procurement and implementation processes.

The use of conveyor systems in lean production environments is often disregarded too quickly, most likely because they are thought of as simply moving parts from place to place. Today's flexible conveyor systems go far beyond that, and are instrumental in minimizing waste in low-mix, medium-to-high-volume production. Yes, they quickly move products among operations. But with integrated parts tracking, precision workpiece holding and ergonomically correct work positioning, well-implemented conveyor systems are a key piece in the lean factory of tomorrow, especially when coupled with the latest mobile-enabled controls technologies.

Indeed, new ways of identifying, tracking and eliminating waste are becoming more and more apparent as the world of automation control meets the world of modern IT. Supervisory control systems play a part, of course, but also a movement toward more open engineering standards, which enable communication between traditional PLC platforms and higher level systems and languages.

As well as allowing the use of modern devices—such as tablets using standard operating systems like Android—this new level of communication allows manufacturers to take previously unconnected systems ... and connect them. This move toward "Connected Industry" allows "unlinked" automated cells—frequently used in packaging, inspection and other post-assembly operations—to be connected to overall production system diagnostics and other control and monitoring apps. Such smarter and leaner production systems will make lean practices even leaner, through faster, real-time communication. If there's a problem in your system that results in waiting or other forms of waste, you'll know instantly.

And as volumes increase, as the matrix shows, automation—especially if helped along by the latest automation controls and energy-saving technologies—can help to increase efficiency and quality even further; thus reducing waste to a bare minimum. When you have long product lifecycles and high production runs, a fully automated production system makes lean sense by allowing you to take full advantage of your investment



Costs per Transfer Cycle: As cycle time goes down and products are manufactured faster, automated transfer makes greater sense, even in low-wage scenarios.

in equipment and skilled personnel for the most efficient, and least wasteful, lean production solution.

Local production offers lean advantages

In the recent past, one of the choices many companies made to improve productivity and reduce costs was to outsource their assembly operations to countries with low-cost manual labor. The calculation underlying this approach is that it's easier and less costly to add workers to increase production as needed, instead of investing in potentially higher-cost local personnel and equipment.

There appears to be a significant change in this thinking: "Re-shoring" of production, moving it closer to where the end-user customers and markets are, is occurring with greater frequency in many industries. It's driven in part by realization that there are many costs that are initially difficult to quantify in outsourcing arrangements, including quality control and the ability to quickly respond to changing customer desires and requirements.

In addition, our Cost per Transfer Cycle chart compares the costs per transfer cycle of manual transfer, a "pick and place" solution, and an automated system. As cycle time goes down (i.e. speed of manufacture increases), automated transfer begins to make greater economic sense—even compared to manual assembly in low-wage countries.

When thinking about lean, it's worth remembering that travel distance is a kind of waste. That's why companies that practice lean as a culture try to manufacture as close to their customers as possible, and insist that their suppliers do the same.

The right automation mix is key to Lean

In today's economy, manufacturers must seize every opportunity to increase productivity and throughput, reduce costs, eliminate waste and improve product quality and reliability, while managing change on an almost daily basis.

Lean manufacturing principles, when effectively applied, can make all these benefits an ongoing reality. What's important to remember is that the technology you use to get lean depends very much on your production requirements. By looking at the best way to optimize material flow, people flow and information flow—including selecting the right level of automation that consistently, demonstrably removes waste from your manufacturing processes—it's possible to get and stay lean, and more importantly, to build a sustainable competitive advantage in your market.

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