



MODULAR manufacturing

Caterpillar applies lean manufacturing principles to its paint process BY LAUREN DUENSING

Maximizing a company's lean manufacturing potential requires creativity and dedication to minimizing waste and creating value for customers. Lean manufacturing focuses on optimizing the flow of products and services throughout an operation, eliminating the seven points of waste: bad quality, overproduction, inventory, operator motion, transport, idle time and processing.

Caterpillar, a manufacturer of construction and mining equipment, diesel and natural gas engines, industrial gas turbines, and diesel-electric locomotives, wanted to create a lean paint line that addressed all seven points of waste—a tough task given that paint traditionally is a bottleneck in the manufacturing process. To tackle this difficult issue, the Peoria, Ill.-based company turned to a team led by John Spangler, senior development/research engineer at Caterpillar. Spangler's team developed an innovative paint system for the company, a system that so far has received seven patents.

Monument-style paint lines often are capital intensive, fixed capacity and require a large amount of floor space. Spangler and the Caterpillar team analyzed each step of the company's paint process and determined a lean line must have the ability to move in all directions—forward, backward, up and down. Caterpillar worked with a number of different suppliers on the project, drawing on each company's specific knowledge.

"We had a controls company, a conveyance company and a process equipment company," Spangler says. After developing the technology, Caterpillar li-

censed it to IntelliFinishing, Salina, Kan., and the company markets the equipment.

Achieving synergy

The team engineered a modular, highly customizable system with a chainless conveyor that "allows parts to move both forward and backward within the system to maximize efficiency and minimize floor space," according to IntelliFinishing's website. The conveyor is a "bolted-together, floor-supported system with friction-driven trolleys on a rotating tube instead of a chain," according to the company.

This type of conveyor system optimizes workflow through unique carrier and conveyor rail positioning, load accumulation and effective sequencing for highly variable processing in areas such as drying or curing.

Parts travel on the conveyor from initial fabrication to final assembly. The built-in control technology can change the destination of products, set up in-line speed changes or stop a carrier for processing without stopping production, eliminating slow zones and wasted time. The system's controls also recognize specific part recipes, tracking and adjusting for variations in components. This allows companies to sequence parts in the most efficient order for processing. Controls at each station link to the master control panel so the entire line is in sync.

In monument-style systems, parts are dependent upon each other, which can create line gaps if a part needs more time in the oven, washer or another process. These spaces cause reduced production throughput, quality issues, increased



Each part's recipe dictates the cure cycle time. Once the cycle is complete, the energy-saving doors open to allow the part to exit.



“YOU CAN MOVE THE WORK TO THE INDIVIDUAL AND NOT HAVE A LOT OF PEOPLE DOWN THE LINE WAITING FOR PARTS.”

JOHN SPANGLER, CATERPILLAR

labor costs from operators waiting for the delivery of parts and inventory problems.

Parts can be processed out of sequence, and the line is capable of handling increases and decreases in production. “I tried to address quality and cost, as well as make it ergonomic and safe,” Spangler says. “You can put the lift at any station, wherever you need it to be. You can move the work to the

individual and not have a lot of people down the line waiting for parts.

“It’s one of the few systems that can deliver parts in sequence or out of sequence,” he continues. “A high variation of parts can all be processed in the right time, and when they come off the line, they can be put back in sequence.”

Because of its flexibility, the line can

help companies allocate employees’ time more efficiently, using only the necessary people to produce the desired volume.

This flexible use of manpower especially comes in handy on a weekend, Spangler says. “If you want to work for four hours on a Saturday, [and] you have a monument paint system, you will have to bring everybody in. With this system, you



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Dry-off oven doors open as parts proceed from the blow-off deck through the oven on to the mask deck.

might be able to only bring in two people and manipulate the parts on the conveyor so they can handle the workload.”

A true Caterpillar yellow

“When you have synergy among the controls, the programming, the conveyance and the process equipment, you can develop a recipe-style process so you can have highly variable product going through a line and provide the ultimate quality for the end product,” Spangler says.

For Caterpillar, paint is part of the company's identity. The iconic Caterpillar yellow is more than a color, it represents the pride and heritage behind the brand. According to the company, there are multiple steps to ensure products are the correct shade of yellow, beginning with cleaning and pretreatment, which remove dirt and contaminants and roughen the surface to provide corrosion resistance and paint adhesion. Drying eliminates moisture and masking ensures parts that

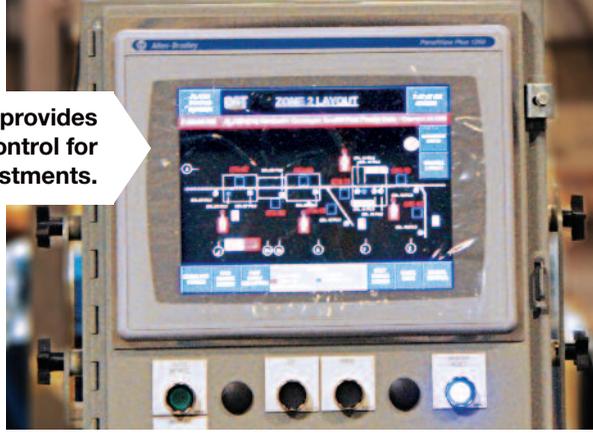
shouldn't be painted are covered.

After these steps are complete, the part is ready for painting. First a primer coat is applied. Primer consists of one or two applications of a liquid spray, a powder spray or a coating deposition dip. Then the part receives two coats of Caterpillar yellow paint for a saturated color and gloss, travels through a drying oven or final bake to cure the paint and moves to a cooling and demasking station.

Before developing the modular process, the Caterpillar paint lines included a conveyor rail moving at a constant speed and taking the product through each of the painting steps. The modular paint system has a unit for each individual step, which gives it the capability to process a variety of large and small components.

The company first installed the modular system at the Earthmoving Division's North Little Rock facility. Typically, this type of large installation takes a minimum of three months. “However, the

The operator station provides manual system control for workflow adjustments.



Spurs throughout the system allow for parts to be pulled offline and re-entered into the system.

North Little Rock paint system took only five weeks to install because the modules had already been built and tested before being shipped and assembled at the facility,” according to Caterpillar.

Beyond paint

Because the system is modular and there is no hard wiring, it can handle production increases or decreases easily. Companies can scale it to meet capacity, starting out with a small system and expanding with increases in business. In addition, its flexible concept can be applied to any type of processing, Spangler says. The technology is not hardwired, making it an adjustable system for any type of processing. “As long as you have power, you’re up and running,” he notes.

Companies also can customize the layout of the conveyor system with turnarounds, which can remove products from the flow for extra processing and then merge them back into the main line—sim-

ilar to a three-point turn in a vehicle. It also can be used with current equipment, new equipment or an integrated combination of new and old, which can amount to a large cost savings. When companies move or expand, the line is easily dismantled, relocated or stored for re-use. Spangler says the asset retention value for monorail systems is 10 percent to 30 percent, for power and free systems it’s less than 10 percent and for modular systems it’s 50 percent to 75 percent. He points out this easy relocation could lead to smaller shops requesting to lease the system.

“My whole goal was to have equipment that’s easily integrated. You can grow the system with your business; you don’t need to buy too much and you have flexibility,” Spangler says. ■

Caterpillar, Peoria, Ill., www.cat.com

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