

# Nothing runs like an AGV

**On its Iowa manufacturing campus, John Deere is using AGVs to move tractor cabs down the assembly line. The result has been savings in labor, a safer work environment and improved quality.**

By **Bob Trebilcock**, Executive Editor

**F**or years, manufacturers turned to automation to improve quality and take labor out of their processes. A robotic welding machine, overhead and floor-level conveyors, and automatic guided vehicles (AGVs) made workers more efficient and allowed companies to increase production without increasing their workforce.

In 2010, John Deere set out to bring a new level of automation to the assembly line for its CommandView II tractor cabs at Deere's historic Waterloo Works in Waterloo, Iowa, a huge manufacturing campus that includes six manufacturing facilities spread across 5.9 million square feet of floor space and 2,734 acres.

Deere was certainly looking for labor savings from automation, says Annie Olson, project manager for new cab assembly in Waterloo. But Deere was also in search of a solution that would bring a new level of safety and flexibility to its operations.

"The cabs that go on our 7R, 8R and 9R series of tractors are more complex as we add new levels of comfort and functionality for the operator," says Olson, citing heated seats and Bluetooth technology as just two of the options demanded today. "We needed an assembly line that could grow with the technology we are adding to our cabs now and might add in the future."

A final consideration was to add automation that would improve the quality and reliability of Deere's processes. As an adherent of lean manufacturing, Deere looks to drive higher, more consistent levels of quality with each new investment.

The solution was a fleet of 35 automatic guided vehicles (Toyota Material Handling USA, [toyotaforklift.com](http://toyotaforklift.com)) that went live in September 2010. The AGVs



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**Annie Olson,**  
project manager

Automatic guided vehicles engage specially-designed frames to transport cabs through the assembly process.



AGVs replaced a conventional elevated conveyORIZED assembly line. Now, Deere personnel can easily and safely access all four sides of a cab (top). The lower profile of the AGV allows workers to step up into the cab for interior work or to access the roof of the cab from a low platform (bottom).



serve as a flexible mobile assembly line, routing the cabs through as many as 12 assembly stations before a finished cab is delivered to the final tractor assembly line.

The result has been labor savings. With the new system, Deere has freed up the direct labor equivalent of one assembler, who used to move the cab from one station to the next, for more important value-added operations. More importantly, the AGVs have delivered a new level of flexibility and quality control to the cab assembly line. "Mistake proofing is very important to

our processes," says Olson. "The AGVs have allowed us to expand on our quality control systems and will allow us to add more technology in the future."

### Ensuring quality

John Deere has been producing tractors in Waterloo, Iowa, since it purchased the Waterloo Gasoline Engine Company, manufacturer of the Waterloo Boy Tractor, in 1918. The facilities include a foundry, an engine works plant, a product engineering center, and tractor assembly for some of Deere's most popular agricultural trac-

tors. Deere employs 5,000 workers in Waterloo and ships its tractors to more than 130 countries. With \$26 billion in total sales in 2010, John Deere is the largest manufacturer of agricultural equipment in the world.

In early 2010, the cab manufacturing team in Waterloo began discussions for a new line for the CommandView II cab, which would be common to the 7R, 8R and 9R series.

Some automation had already been introduced into the cab assembly area when a manual system was replaced with an elevated conveyor. In the past, cabs were placed on a dolly that an assembly worker manually pushed from station to station. "Tractors are getting heavier all the time, as are the cabs that go on them," says Olson. "If you're manually pushing a cab day in and day out, it takes a toll."

A manual line not only presented an ergonomic challenge, it created a challenge to Deere's quality control program. "We are a lean operation with a 'no fault forward policy,'" says Olson. "If we discover a quality issue, we stop work on that cab until we address the issue." When Deere was using a manual system of moving the cab along the line, it was difficult to ensure that all of the options were installed in the right cab and that all of the processes and quality checks were completed during the assembly process.

In part, that was addressed with the installation of a roller conveyor that sat about 2 feet off the floor. By automating the assembly line, Deere could also add technology to automatically cap-



**After the assembly process is complete, cabs are staged for delivery to the tractor manufacturing line.**

ture data about processes on the line. However, the conveyor had limitations if something did go wrong.

"With the conveyor, we could lock down the line to prevent a cab from moving forward," Olson says. "However, it was difficult to stop a cab on the conveyor mid line to make a repair. If we found a fault, we had to shut down the whole assembly process."

What's more, if the assembly line needed to change, say to add another assembly station for a new option, the whole conveyor line had to be moved. That was not easily accomplished.

Finally, with more available options than ever before, Deere needed a larger assembly line and extending the conveyor was not an option.

### **A better mouse trap**

Deere investigated several different solutions before choosing AGVs. These included an overhead handling system, an old-fashioned chain drive assembly line and even going back to a manual push line. At least with the old system, an operator could push a cab out of the way to fix a problem rather than shut down operations.

Then the Waterloo group learned about an AGV spec that had been designed for Deere's line of harvesters in East Moline, Ill. "There is a lot of commonality across our cabs and we like commonality across our factories," says Olson. "East Moline also had a no fault forward policy and their spec had the necessary line speed and weight specifications for our facility. We jumped on board."

The AGV design Deere chose is a

tugger vehicle known as "a mouse." The "mouse" is designed to go under the load, engage the dolly with a pin and then tug it along. Since there is no longer a conveyor on the floor, an operator can walk completely around the cab itself.

The mouse features a low profile base that rises just 8 inches off the floor and shares the same footprint as the dolly that carries the cab. The total load from the shop floor to the bottom of the cab is just 12 inches. At that height, the roof of the cab is accessible to an operator without a ladder. The step up from the ground into the cab was a normal height. These features both brought a level of ergonomics to the line. "There are certain stations that require additional height," Olson says, "but we address those with lift tables."

The vehicle navigates by following a magnetic tape on the floor: If the line needs to change in the future, Deere can simply move the tape.

Deere was also attracted to the mouse vehicle because it was a mass-produced product and not custom-made. If Deere needs another vehicle, it can simply place an order.

Finally, a systems integrator was available with the experience to integrate the AGVs into Deere's existing production line. "We needed a design for the dolly that carries the cab, we needed to modify the ergonomic lifts and the vehicles needed to communicate with the existing systems over the Ethernet," Olson says. "We did not have that expertise in-house. The fact that our supplier had an experienced integrator made this a full package."

### **Moving cabs**

The new system went live on Sept. 17, 2010. Prior to the implementation, Deere gathered a team of technicians, management and assemblers to take ownership of the project. Still, management and the skilled trades group at Waterloo saw a test run of the new system to allay any reservations. The supplier brought in an AGV that picked up a cab, ran a loop and then dropped it off at a staging area, just like the mouse would do once it went into production. Seeing was believing. "I'm sure that our skilled groups and management were skeptical," says Olson. "Once they saw the system do what it was designed to do, people were excited."

In the year since going live, there has been a reduction in labor associated with moving the cab from one station to the next. "Any time we can automatically deliver something to a station without manual labor or a lift truck, that delivers a reduction in labor," says Olson.

More importantly, Deere is now able to adhere to its mistake proofing policy without shutting down the line: If an error is discovered, the AGV carrying the cab with a fault will stop, while the cabs behind and in front of it continue to move forward.

And, the vehicles have brought a new level of flexibility to Deere. "Not that long ago, we did a project over a weekend that allowed a cab to go to five different testers instead of two," Olson says. "It was me, a couple of electricians, the integrator, someone from factory automation and some magnetic tape. We could not have done that with a conveyor."

Having worked with AGVs for the last year, she adds, "We are looking at where else we can use them and there are several other projects in the works," Olson says. "This has been a stepping stone for us." □

## Building cabs

Automatic guided vehicles move tractor cabs through the production line at John Deere's Waterloo plant.

By **Bob Trebilcock**, Executive Editor

The CommandView II cab production line is a good example of how a leading manufacturer has applied automation to an existing manufacturing line. Cart-style automatic guided vehicles (AGVs) are the primary materials handling technology that moves the carts from one assembly station to the next before delivering them to an electrical verification sta-

tion for quality control and finally to a queue where the completed cabs will be delivered to the next step in the tractor assembly process.

The system is simple and efficient. Here are the steps.

The process begins when a welded and painted cab frame enters the cab production area and is staged in an area known as the Mouse Trap (1). From

### John Deere Waterloo, Iowa

**Size:** 5.9 million square feet; more than 2,734 acres

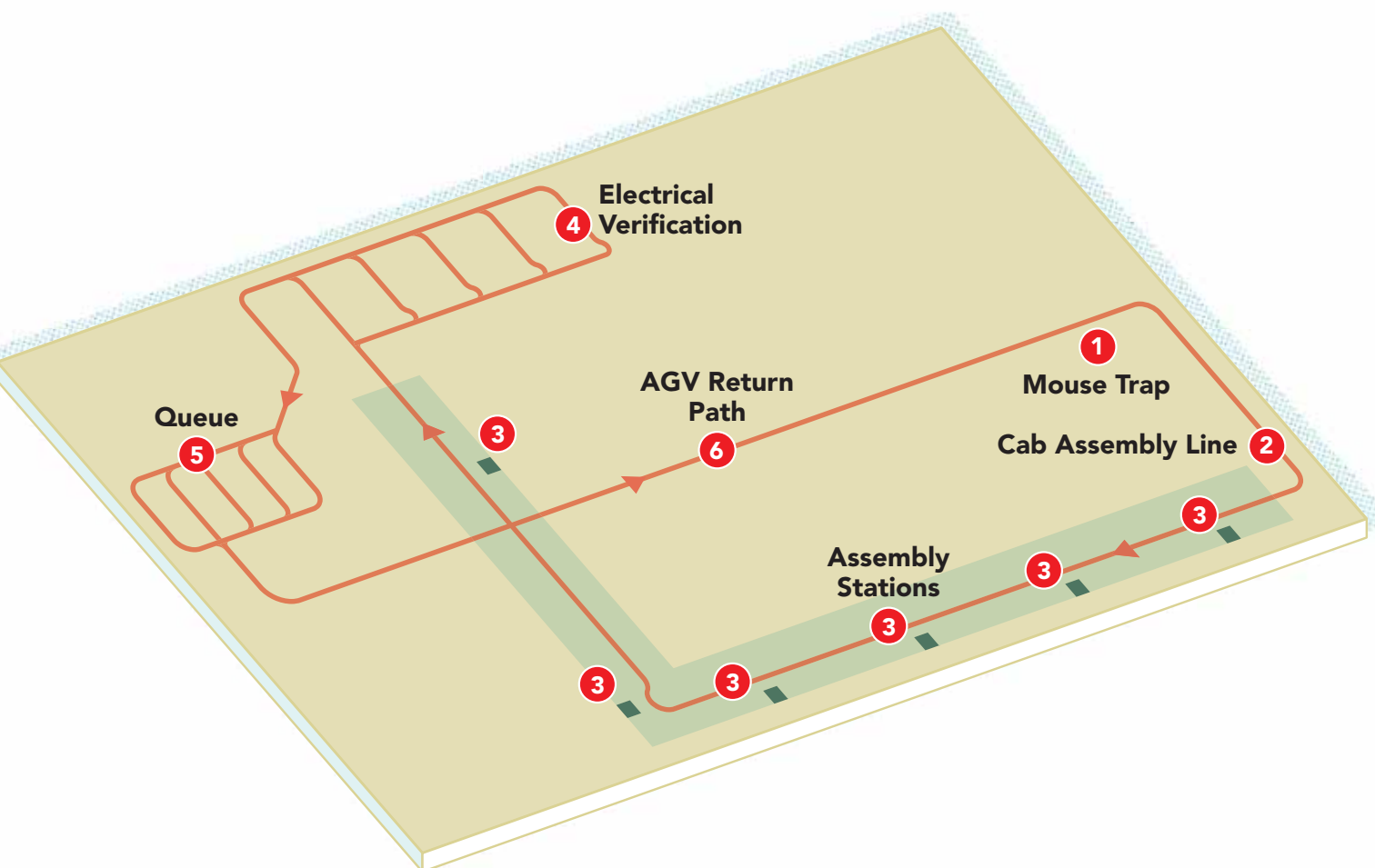
**Facilities:** Deere operates six manufacturing facilities on the Waterloo campus

**Products handled by AGV:** CommandView II cabs for 7R, 8R and 9R series tractors

**Employees:** 5,000

**Shifts/Days:** 2 shifts/5 days

here, the cab will enter the assembly line where large modular subassemblies will be installed. While every cab will go to certain stations along the line,



a cab may also be diverted off the main line to work stations where optional features and equipment will be installed to customize the cab for a customer.

At the Mouse Trap (1), the cab is on a specially designed skid. When the AGV moves under the skid, a pin connects the skid to the cart. That marries the cab frame to the AGV. During that process, an operator scans a serial number on the cart that will be transmitted to the manufacturing system and stored on the mouse to identify that cab during production.

From the Mouse Trap, the cab enters the assembly line (2). During its trip down the line, the cab can visit 12 assembly stations (3), such as the back panel, roof, seat, front control support, glass and fender stations. When an AGV pulls into one of the assembly stations, it communicates the serial number to a programmable logic controller (PLC) in the department. With that information, the system communicates the work to be done at that station to the operator. As the operator completes the steps associated with the process at that station, data is automatically collected and updated in the production system.

Overhead tooling has been outfitted with homing sensors. Before the AGV can move forward to the next station, the tooling has to be returned to a "home" location.

Once the work is complete and tools are safely out of the way, the AGV moves to its next stop. Once the final subassembly or option has been installed, the cab is delivered to an

electrical verification station (4) for a quality control check. From there, it will be delivered to a staging queue (5) where it will be picked up and delivered to one of two assembly lines.

The final assembly system notifies the cab line when it is ready for a spe-

cific cab. At that point, the operator releases the cab and its skid from the AGV. The cab moves on to the assembly line and the AGV travels along an AGV return path (6) back to the Mouse Trap (1) where it will pick up the next cab skid. □

## System suppliers

**AUTOMATIC GUIDED VEHICLES:** Toyota

Material Handling, USA, [toyotaforklift.com/products/toyotatowtractor/TugMouseAGV/TugMouseAGV.aspx](http://toyotaforklift.com/products/toyotatowtractor/TugMouseAGV/TugMouseAGV.aspx)

**INTEGRATION AND AUTOMATION**

**CONTROL SYSTEM SOFTWARE:** Industrial Concepts Incorporated, [ici-ky.com/agvagc.html](http://ici-ky.com/agvagc.html)

**SERVICE & SUPPORT:** HUPP Toyota Lift, [hupptoyotalift.com](http://hupptoyotalift.com)