Golf Car Maker Scores with RFID

By integrating RFID with its new assembly line, Club Car has cut production time per golf car to 46 minutes from 88, improved its ability to customize cars—and saved millions of dollars.

By Jonathan Collins

March 22, 2004—Five years ago, while working on its next-generation golf car, Club Car decided to completely redesign its manufacturing process and incorporate RFID to help speed up production of its new model. The new production line went live in October 2003 with the launch of the company's Precedent Golf Car, and it is an overall investment that Club Car believes will deliver significant rewards.

Empty carriages, each equipped with an RFID tag, are lined up before they enter the assembly line.

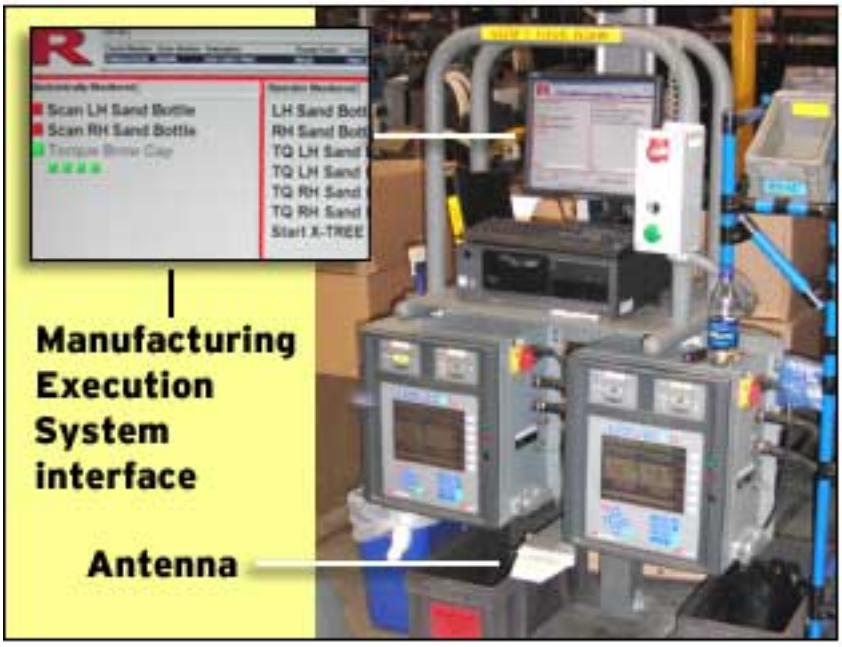
"We have invested millions of dollars in designing and deploying a new manufacturing process to support our new Precedent model vehicle, and we expect savings in the millions per year," says Alan Oester, vice president of information technologies for Club Car. The company is based in Augusta, Ga., where its manufacturing plant produces more than 100,000 golf and utility vehicles a year. It employs more than 1,000 people in both production and sales. Club Car, which is owned by Ingersoll-Rand, doesn't publicly disclose its precise revenues, but they are in the hundreds of millions of dollars a year.

By deploying RFID throughout its production line, Club Car completely restructured the way it produces its cars, introducing just-in-time materials delivery and improving the ability to customize vehicles on the fly. RFID technology has been one of the factors in cutting the time it takes to build each vehicle—from 88 minutes to about 46 minutes—and ensuring that each car is built to an exact specification. But deploying RFID was not without its difficulties, and the company says it has learned how it could have avoided problems if the technology had been deployed differently.

The new production line replaces separate production lines for Club Car's gas- and electric-powered vehicles. With the old system, a bar code label was attached to each car and workers used a handheld bar

code scanner to track the vehicle, which had to be manually pushed between workstations. The new system uses a single automated production line that moves both types of vehicles through the production process, using RFID to define and verify the manufacturing process at every stage. In addition, instead of building basic cars and then bringing them in from a storage yard to have specific customer-ordered accessories added, the company builds cars from scratch in a single trip through the production line. This customization entails fitting the vehicles with any combination of accessories from a list that exceeds 100 items.

The new production line is a loop of about 1,800 feet, but most of the vehicle construction takes place in one 500-foot-long stretch. The production line is controlled by a manufacturing execution system (MES) that was written by systems integrator ICE Automation Group, of Augusta. It controls a single chain conveyor that pulls upto 80 RFID-tagged carriages through the production process; each 5.5-foot-long, 4-foot-wide carriage transports a car as it's being built. The MES also controls the work carried out at each of 46 workstations.



The RFID antenna located at each station is connected to the RFID transceiver card installed in the PC.

It was essential for the design of the new production line to reduce the time that each carriage sits at each workstation. The design goal of the production line was to move each car under construction through each workstation every 45 seconds, allowing just 15 seconds for a carriage to pass between workstations.

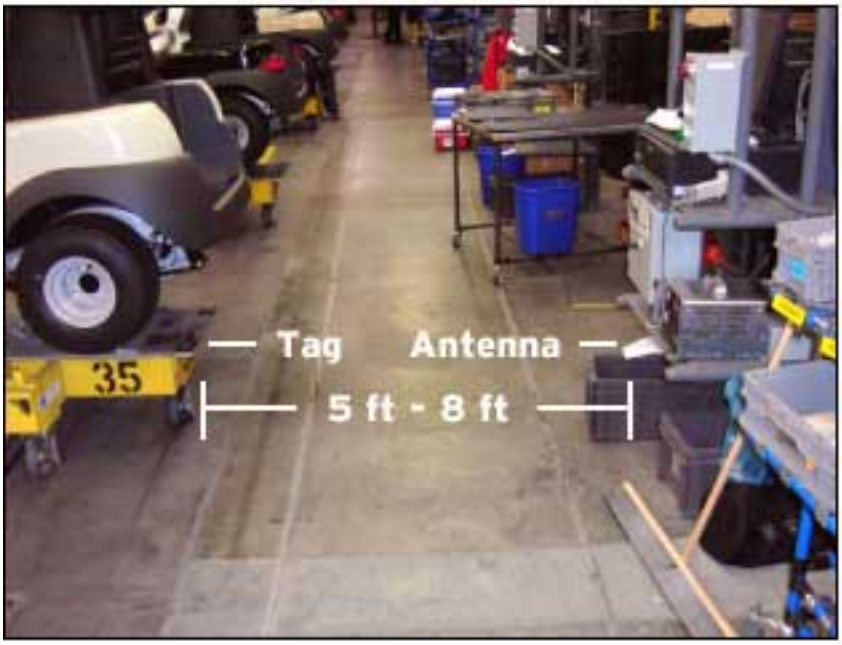
Each workstation was equipped with a reader that can detect an RFID tag attached to the carriage before it reaches the work area. The company says that choosing RFID instead of using bar codes on the carriage made sense. "Using RFID saves us around three seconds at every workstation," says Oester. "That doesn't sound like much, but when there are 46 workstations and you are producing around 100,000 vehicles a year, it probably gives us a 6.5 percent increase in capacity. It also probably saves us an additional workstation and operator."

Each carriage enters the central production line with a car's already-assembled drive train. The drive trains come from either of two feeder production lines: One feeder supplies gas-powered engines; the other, electrically powered drive trains. Each drive train is labeled with a bar code containing a unique ID number. When a carriage first enters the production line, an RFID reader automatically reads the ID number on the carriage's tag and a worker uses a handheld device to scan the bar code on the drive train. The car being built is automatically associated with those two numbers. The RFID tag helps ensure that all work and parts fitted to that vehicle at each workstation are exactly to the customer's specification.

As a carriage approaches a workstation, its RFID reader identifies the carriage by reading its tag. Each workstation has a PC that links to the manufacturing execution systems to control what tools can be used and what parts need to be fitted to each vehicle. Two screens at each workstation display the work that has to be carried out by the operator, and the carriage can't move out of the workstation until all the required work has been completed.

“This is electronically controlled work,” says Oester. “The system controls which tools, such as an electronically controlled torque wrench, can be used. When work at a station is complete, the operator pushes a button and the MES determines if everything was done before the carriage can proceed.”

Installing a PC at each workstation was always a central part of the new production line design. Club Car selected readers that could be plugged into those PCs, to tie its RFID deployment into its MES. “We knew we wanted an office-grade PC at every workstation,” says Oester, “so we wanted our RFID reader to fit into each PC on a PCI card.”



The antenna is located 5 to 8 feet from the tag in its station and 12 feet from tags in adjacent stations.

The company tested RFID PCI card readers and tags from several companies to make sure it was deploying technology that could match its requirements. “We brought in companies and tested a variety of tags and antennas,” says Oester. “That determined that we needed a directional antenna and active tags.”

Given the role of the tags and the confines of the production line, part of the testing included placing tags 6 feet apart and several feet from the antenna to make sure the system could pinpoint specific tags without interference from others. “We need to be able to read tags on carriages located anywhere from 4 to 10 feet from the antennas with a lot of steel around,” says Oester. “In addition, while some reads on the production line are10 feet from the reader antenna, another workstation and another carriage could be just 4 feet away.” To make sure that the reader for each workstation reads only the tag for the approaching carriage, each reader’s read range must be finely tuned.

The company is using iQ 8 active tags and iQ PCI card readers operating at 916.5 MHz from Identec Solutions, a Kelowna, British Columbia-based RFID solutions provider. According to ICE Automation Group, which was responsible for designing and implementing the MES system for the new production line, the decision to use active tags was a straightforward one, given the environment of the production line and the need for the ability to tune a reader’s antenna so it would read the correct tag. “We needed the tunability of the active tags, which allowed us to tune down the readers to get the read range we needed,” says Jim Smith, ICE’s director of information systems. “Passive tags bring a lot of mechanical constraints about where readers are, relative to tags.”

To ensure that each reader reads the tag on the correct carriage and not tags on carriages nearby or at other workstations, the company built a pilot line with a couple of workstations. Once Club Car tuned the system so tags could be read within a narrowly defined boundary, readers were set up on the final production line; it took time to individually set up each antenna.

For the reader PCI card inside the PC, the company attached a reader antenna under the shelf that holds the PC a few feet off the ground–something that the company now says it would change if it were to start over. “We get a 99 percent read rate with antennas where they are,” says Oester. “But if we were to do it