Post-haste 100th robotic containerization system

installed in US mail sorting center

Bruce A. Meyer

Spot welding, machine tending, material handling, picking, packing, painting, palletizing, assembly... the list of tasks being performed by ABB robots keeps on growing.

Adding to this already impressive portfolio is a new Robot Containerization System (RCS) that ABB developed specifically for the United States Postal Service (USPS). The RCS has brought new levels of speed, accuracy, efficiency and productivity to the process of sorting and containerizing mail and packages. Recently, the 100th ABB RCS was installed at the USPS processing and distribution center in Columbus, Ohio.

ike all businesses today, the USPS must remain responsive and flexible to the changing business environment, ensuring along the way that it has all the capability it needs to satisfy a growing, increasingly demanding market. The USPS is satisfied that ABB's Robot Containerization System (RCS) will let them do just that.

First, though, a lengthy list of USPS requirements had to be met. For example, the RCS had to be easily replicable as 100 installations were planned. Customer site development was required for each installation because each site has its own unique characteristics, and provision had to be made for these during the installation phase. In addition, a system standard was required for the 100 installations. This had to cover:

- Software
- In-feed/recirculation conveyors

- Mechanical grippers for handling all types of intermixed mail trays
- Human-machine interface (HMI)
- Overhead gantry-mounted robots
- All equipment and hardware (barcode readers, docking stations, etc)
- Peripheral guarding
- Acceptance tests

- On-site system training/support for operators, maintenance staff, etc.
- Documentation, including manuals and videos, tailored to the exact needs of USPS personnel and processes
- Documented technical data

USPS processing and distribution center in Santa Ana, California





The 100 systems were delivered to 50 facilities and installed at the rate of two per week during the program.

Sorting and handling mail

The place to go to better understand the benefits of the RCS is the Chicago Metro Surface Hub (CMSH) in Elk Grove, Illinois, which covers some 465,000 square feet (43,200 square meters). The CMSH processes incoming and outgoing mail for postal delivery centers throughout the metropolitan Chicago area. 650 people work here in three eight-hour shifts, receiving and dispatching mail through 70 loading dock doors. With nearly 100% uptime, the ABB RCS works around the clock, providing better real-time collection of operating and performance data to help CMSH match staffing levels to expected volumes.

According to Surjit Grewal, CMSH Maintenance Manager, the RCS that sees

most work is the one used primarily for sorting incoming mail. This system handles an average of 80,000 to 100,000 mail trays per month. A unique, patented sorting system integrated in the RCS is easily able to cope with the varying input and maintain throughput at an optimum level. Designed for RCS installations with multiple locations, this dynamic sorting system allows the USPS to change sorting schemes very quickly based on incoming mail and volumes. Each of the locations may be assigned its own loading rate. The system can be preprogrammed with a simplified, base scheme of destinations. Grewal notes that the RCS's accuracy in sorting has been perfect.

The RCS sorts mail into 24 different containers, including general-purpose mail containers, eastern regional mail containers, and pallets. The robot automatically senses the container type and adapts the handling operation to it. Mail tub being picked up by the RCS gantry system

Another unique sorting feature of the RCS is its Off-Line Sort Scheme Capability. This allows the creation, modification and file transfer of sort schemes from an office PC to one of CMSH's several RCS installations.

The RCS also allows greater flexibility as there is no need to clear the cart/pallet location in the cell when a destination in the new scheme is assigned to the same location as in the old scheme. Partially full containers can therefore be safely left in the system when a new sort scheme is selected – the RCS ensures that the mail is sent to the correct facility.

These features together demonstrate the RCS's ability to meet the USPS's 100% sort accuracy requirement. By ensuring that mail is not misrouted to the wrong facility – something which happens in manual operations - it saves the CMSH costly re-work. Considering that 3000 to 4000 trays are typically handled per day, even a 1% mis-sort rate could result in 30 to 40 trays being misrouted each day at an average cost of approximately \$40 per tray. While actual data for mis-sort rates is difficult to obtain, ABB believes the figure for manual operations to be higher than the 1% mentioned – perhaps as high as 3-5%. Assuming just a 1% mis-sort rate, the estimated annual savings could be as high as \$390,000.

Other design features

The innovative double-gantry design of the RCS has been another big plus for the USPS. On each side of the RCS, an overhead, gantry-mounted robot retrieves trays from the in-feed conveyor and loads

RCS cell



them into containers. The two robots each have a telescopic arm equipped with a unique mechanical gripper designed to sense and handle all types of intermixed mail trays (sleeved or unsleeved, open or topped mail tubs). The trays and tubs are handled just once to maximize efficiency, while top loading eliminates the need to move the containers into a specific position. Metal fingers on each gripper support trays from beneath for secure handling, and a containment plate on top holds mail in place on open trays. With its robotic arm, the RCS can even determine the position of the shelf in a container, automatically lower the shelf once the container is half full, and then finish loading the container.

Each of these two robotic gantry sections is in turn divided into two zones. This allows one zone of the gantry to continue sorting operations while the other zone is undergoing cart exchange or maintenance. Any incoming trays destined for the zone the operator has entered continue to recirculate on a looping conveyor until the operator removes the filled container and closes the gate. This recirculation prevents trays from blocking robot operations during container exchanges, thereby minimizing downtime and maximizing throughput. "We like the fact that we can constantly work and continue to process mail even if one zone is disabled," Grewal says. "That helps us with our run times and our throughput."

For maximum packing efficiency, containers are filled with open trays to a specific height, rather than the trays being counted. This nesting allows greater packing efficiency. When a container is completely filled, the operator requests and obtains access to that zone of the RCS. All operations in the zone come to a halt, the gate is unlocked, and the operator enters the RCS. With a footprint of just 900 square feet (83.6 square meters), including guarding, the compact, rectangular shape of the RCS helps to conserve floor space. Its small size ensures there will be ample room around the sides and ends for operator access and container removal.

All RCS functions are controlled via a user-friendly graphic interface. This provides users with a clear visual representation of the system, showing the locations of the containers and pallets, the number of trays and their positions, and the status of each location. Sort schemes are easily created on the interface, and operators can obtain information about the system's overall status.

Improved ergonomics

One of the many important benefits robotic automation brings to mail sorting and containerizing is improved ergonomics. By eliminating the manual lifting of heavy mail trays and tubs, robotic systems help to reduce worker injuries and the associated costs. The RCS handles light to heavy loads with the same throughput, allowing for more predictable production times. With an RCS, productivity as measured by pieces per hour for dispatch operations is higher than with comparable manual methods. "Before, everything was done manually, so there were some problems," Grewal says. "Now, with the robots, we don't have as many people lifting so many heavy trays and tubs."

Through a variety of devices, every precaution has also been taken to ensure operator safety. The perimeter guarding enclosing the system provides a hard surface barrier, sliding gates and an

Gantry robot picking up a half-tray from a recirculating conveyor



100,000!

ABB has sold its 100,000th robot, becoming the first company in the world to do so.

"This is a big milestone for us as a company and sends a strong signal to our competitors," says Jouko Karvinen, executive vice president and head of ABB's Automation Technology Products division. "It shows that our customers – from carmakers to medication sorters – have tremendous confidence in our technology. It also means we have the largest installed base of robots globally."

ABB's robotics team, working in Sweden, Norway, the USA, Germany and Japan, among other countries, has in recent years broadened its range of robots. Among many other applications, ABB robots pick chocolates for companies like Lindt and Nestlé, and sort pills for pharmaceutical giants like Novartis and Bayer. American-based consumer goods companies like Harley-Davidson use ABB robots for building and painting motorcycles and, as this article shows, the US postal service uses ABB robots to sort mail and packages. For more information, visit www.abb.com/robotics.

electrical gate interlock that keeps each gate securely locked. These interlocks can be deactivated whenever an operator has to enter the RCS to remove a container or carry out maintenance.

Multiple buttons and safety pull-cords can be used to initiate an emergency stop, bringing all hazardous motion within the RCS to an immediate halt. Vertical light curtains further safeguard operators during container exchanges, and multiple floor-level sensing beams detect the presence of anyone inside the RCS during operation.

Satisfaction guaranteed

"Overall, we're very satisfied with the RCS," was Grewal's answer when asked how the USPS felt about the new system. The USPS is pleased that it has provided them with a flexible solution able to meet changing market demands. Improvements it has brought include: *Increased speed:* Trays/tubs are handled faster.

■ *Increased accuracy:* No mis-sorting of trays.

■ *Increased productivity:* Efficiency is higher than with manual methods.

Improved ergonomics: Manual lifting of heavy mail trays and tubs is eliminated, reducing work-related injuries.
More predictable production: Heavy loads are handled with the same throughput.

 On-time dispatch: Predictable, consistent production facilitates reliable dispatch planning. *High flexibility:* Fast changeover between tasks makes the system responsive to changing requirements.
Improved product tracking: Automatic identification increases ID accuracy for product routing, which reduces re-route mistakes and related costs.
Reduced product damage: Advanced

RCS software and a unique gripper design minimize damage to products. *Higher equipment utilization:* With uptime nearly 100%, the RCS works practically around the clock. *Better reporting:* Real-time collection of operating and performance data allows businesses to match staffing levels to expected volumes.

The number of moving parts in the RCS has been minimized and proven components and technology have been used wherever possible. The result is a remarkably reliable system with very high uptime. According to Grewal: "There were a few issues that had to be worked out just after the installation, but overall we've had no major problems with downtime. Right through the Christmas rush – when a small problem could have been a big headache – they worked great."

Author

Bruce A. Meyer ABB New Berlin, WI USA bruce.a.meyer@us.abb.com Fax: +01 262 785 2823