CASE STUDY – A BEKA BOOK

Book Publisher Automates Manual DC with Industrial Automation Solution to Accelerate Shipping, Improve Accuracy and Accommodate Growth

Intelligent process-improvement software connects disparate data for increased productivity and reduced staffing.

A Beka Book was founded over four decades ago with the goal of providing high-quality, traditional educational materials for students at Pensacola Christian College in Pensacola, Florida, one of the largest Christian colleges in America. As a publisher and distributor, A Beka Book has grown from phonics-based readers and traditional arithmetic textbooks to comprise over 1,000 educational products for two-year-old preschool through twelfth-grade levels, supplying materials to both Christian schools and individual homeschooling families.

Shipping approximately 150,000-160,000 books per day and filling eight to ten UPS tractor-trailers daily, A Beka Book needed to fully convert their manual distribution center into an automated facility. While demand for their products was growing, their student workforce rotated at a rate of approximately 60% each semester and was decreasing in size. They also wished to gain previously unrealized shipping discounts from their primary carrier, United Parcel Service.

The Problem:

As one of the nation's largest homeschool curriculum publishers and distributors, A Beka Book was experiencing high growth and increasing annual demand. However, due to the majority of the company's workforce coming from a revolving labor program through Pensacola Christian College—with fewer students enrolling every year—A Beka Book's workforce continued to shrink. The increased demand and decreasing labor force made it increasingly difficult for A Beka Book to meet customer demand, particularly in the distribution center where materials were picked, packed and shipped.

In addition, because of the manual picking and shipping processes in place, A Beka Book was unable to earn shipping discounts that are typically available to high-volume shippers when their packages are grouped based on certain shipping criteria, such as destination, postal code, carrier code or destination country.

In order to reduce reliance on labor, increase speed and earn shipping discounts A Beka Book needed to automate their book distribution facility and remove the manual processes that existed there. The data automation system would work in conjunction with a new, seven-level material handling system was also being installed concurrently in the relatively small space, consisting of one conveyor line with packages inserted from four automatic box erectors supplying six different box sizes, plus two cold-seal feeds, sorted to two dock doors and two manual handling areas.

Why Inovity?

A Beka Book was one of BarCode ID Systems' (Inovity's) original customers, dating back to simple barcode media sales since 1994. With a long-term relationship and business-advisory approach, Inovity grew with A Beka Book, guiding them on various data automation solutions over the year—initially basic barcode scanning—to help ease their growth pains. When A Beka Book decided to fully automate their DC in 2004, they turned to its long-time business partners, Inovity, along with automated packaging equipment manufacturer, BestPack, to design and install a data- and material- handling solution that would handle higher volume more quickly and with fewer staff.

The Original Process:

A Beka Book had a manual system in place for picking and shipping orders that was driven by homegrown order management software. The software grouped items by size to fit in various boxes, and provided unique numbers for tracking multiple boxes within an order individually. Upon receipt of an order, workers would scan a pick sheet prompting a barcode label to print which contained both the stack ID and stack weight for the order. Workers would then take the materials to the packaging line and manually apply the barcode label to the bottom of a cardboard base sheet or "pad." The books and materials for the shipment were stacked on top of the cardboard pad, along with the pick list, and sent through a shrink-wrap machine, wrapping the order tightly to prevent movement during shipping and eliminating the need for wasteful filler in shipping boxes. Because the conveyor lines were accessible by many users from multiple points, rescanning of a job was typical when items were placed on the conveyor lines immediately before any additional processing took place.

After shrink-wrapping, workers would manually scan and weigh the package to confirm the correct total weight. After weighing, workers would manually select an appropriately-sized shipping carton, manually erect the box and place the materials into the carton. The carton would then be labeled manually with content and shipping labels, then sent through an automatic taping machine to seal it. After sealing, workers would manually group cartons and load them onto the trailers of various shipping carriers.

The Solution:

Inovity and BestPack designed data- and material-handling systems to allow the stacks of materials to travel along a new seven-level conveyor system, from loading point to shipping trailer, without further human touch or intervention. The system consisted of conveyors, fixed-mount scanners, in-line scales, diverters, box erectors, box inserters, inkjet printers, taping machines, automated print-and-apply machines, omni-directional imagers and intelligent server software from Inovity, knows as Automation IQ^{TM} or AIQ^{TM}, which processed and managed all of the data, sorting and validation logic. In total, the system consisted of 21 data input points and 17 data output points, with several transactions requiring sub-second processing from the time a barcode was read to the time a diverter must activate. The processing speeds were fast enough to make A Beka Book's operation the largest single-stop UPS pickup location in the country at that time, comprising of 150,000-160,000 books shipped daily, filling eight to ten UPS tractor-trailers.

To implement the final solution, several companies partnered and combined different areas of expertise:

- A Beka Book: Client and in-house programming
- Anser Coding: Inkjet printing system
- Inovity: Industrial automation software, data handling and data management system
- BestPack: Material handling systems, conveyors, sorters
- Fabricator: Local welding company for equipment mounts
- Metrologic: Omni-directional and linear fixed-mount barcode scanners
- Microscan: Linear fixed-mount barcode scanners
- Paragon Labeling: Automatic print-and-apply labeling systems
- Sunbelt Industrials: General contractor

Several conveyors and diverters were interconnected to provide continuous product flow through the tight space. Because of space limitations, the system consisted of seven different heights.

When pickers received a work order, A Beka Book's software would generate the Zebra Printer Language (ZPL) code to create barcode labels for the both the contents and the shipment(s). The ZPL code would be transmitted via AIQ software to the sortation system server, where it would be parsed and stored for future use, including label printing and case sortation. Workers would then place the materials on the conveyor to be shrink-wrapped and begin the automated journey from picking to shipment.

When the materials exited the shrink-wrap tunnel, a fixed-mount scanner would scan the original pad label on the bottom of the stack and send the data to the server for parsing to obtain the calculated weight originally encoded in the barcode. The stack then passed over an in-line scale and the actual weight would be sent to the server and compared with the expected weight, with user-defined tolerances of either actual- or percentage-variances allowed. If the weight was acceptable, the stack would be allowed to continue down the line; if not, the package would be diverted from the main line to a staffed, "off-weights" station for manual verification and correction. This dual weight-check system helped ensure workers had picked the correct books for the order based on weight, thus reducing pick errors.

The next step included automatic optical measurement of the stack by photo-eyes to determine which case inserter should be used to package the order. The stack would be diverted to the appropriate inserter based on size, scanned again and dropped into the correct-size shipping box. The scanned data would then be sent to an inkjet printer, which would recreate the original pad barcode on the side of the box, now called a case.

The case would then continue along the conveyor to an automatic taping machine to be sealed. After sealing, more fixed-mount scanners would scan the case and send the data to the AIQ server. The AIQ server would retrieve the previously-stored ZPL code for the shipping and contents labels and send it to print and apply machines. As their name suggests, the machines would automatically print the labels and apply them to each case.

Immediately after automatic label application, fixed-mount scanners would scan the inkjet and shipping barcodes and send their data to the server for comparison lookup to ensure they match. If the barcodes were unreadable or a mismatch occurred, AIQ would send a command to the fixed-mount scanner, triggering outputs to signal the PLC to stop the line.

Once orders were labeled and properly verified, fixed-mount scanners would scan the shipping label and send its data to the server. The server would apply user-defined sorting criteria and send a signal via AIQ to the high-speed sorting equipment to properly divert the case to one of three shipping lines. Cases that were diverted to dock doors for shipping in the USA had their shipment details sent via AIQ to UPS, and to A Beka Book's accounting system to build their manifest.

Cases not sent to dock doors would be scanned again by fixed-mount scanners and sorted between international and in-house orders. Due to additional paperwork requirements, international orders would still be processed manually, but all in-house orders and non-UPS domestic orders would have their shipment data sent directly to A Beka Book's accounting system.

Cold Seal:
In addition to the line handling stacked and shrink-wrapped materials, A Beka Book had two "cold seal" lines in operation to handle smaller shipments, typically consisting of slim workbooks, rather than large stacks of books.

In this area, pushcarts with 16 to 32 slots were in place for workers to pick items via A Beka Book's directed wave picking system. Workers would fill their carts then go to a cold-seal line where they and another operator would process the cold-seal shipments. One worker would place each order into the cold-seal machine while verbally calling out the order numbers, while another on the other side would receive the items and manually attach pre-printed shipping labels in the same order as placed into the cold-seal machine. While there were occasional errors in this process, the bigger issue for A Beka Book was the two-person workforce each cold-seal line required.

To eliminate these manual processes, Inovity installed fixed-mount scanners to scan the pick list barcode and send the shipment data to AIQ before the order was placed into a cold-seal machine. AIQ would retrieve the shipping label information and send it to an automatic print-and-apply labeling machine, which would label the box after the order left the cold-seal machine. A second fixed-mount scanner would then scan the shipping label and send the data to AIQ, which compared the expected values to actual. If incorrect, AIQ would send a command to the scanner to activate a control signal telling the PLC to stop the line. If correct, the package would continue down the conveyor and transfer to a weight-check line similar to that performed during the shrink- wrap process. Package weights were retrieved from the database via the shipping label scan and mis-matches would be diverted from the main line to a staffed, off-weights station for manual verification and correction. A new sub-server was added to handle this transactional volume. After the cold-seal off-weights process, the cold-seal packages would be merged into the main line and sorted with the other packages.

The Results:
The immense project at A Beka Book's distribution center was not without its difficulties. All components of the project—conveyor lines, fixed-mount scanners, scales, box erectors/inserters, printers, taping machines, print-and-apply machines, omni-directional scanners and the AIQ industrial automation software—were being implemented, installed, configured, tested and adjusted simultaneously, by all individual vendors, in a relatively small physical space. Teams of partners relied on other teams to

get each one's system components installed properly and on the same schedule for testing and troubleshooting, and there were inevitable delays. Ultimately, however, the system came together to drastically improve the DC's operation and provide measurable ROI for A Beka Book.

Primarily, the solution met A Beka Book's ultimate goal of reducing reliance on the rotating labor force required to fulfill and ship orders in its distribution center. In fact, the AIQ smart software solution provided a fully-automated packing, sorting and manifesting system that allowed A Beka Book to eliminate 12 positions in the DC and repurpose those workers to other areas of the facility to help the business keep up with demand.

Additionally, A Beka Book was also able to receive UPS shipping discounts by sorting and packing entire bypass trailers, along with the mixed trailers they had been shipping. Bypass trailers are direct shipments dedicated to a single, distant hub, preventing UPS drivers from taking the trailer to a local sorting hub, unloading it, processing the packages and reloading for shipment. Instead, when bypass trailers are ready, UPS drivers go immediately to their destination hub without any local sortation or downtime.

Because AIQ connects UPS shipment data with A Beka Book's accounting system, the company has improved service levels by being able to provide immediate tracking information to their customers. With the previous manual system, tracking information was difficult to provide in a timely fashion because it was never connected to the accounting system.

By integrating Automation IQ intelligent software with A Beka Book's in-house order management system, Inovity was able to automate a cumbersome and labor-intensive distribution center process into an automated, highly-productive solution that reduced the workforce, improved efficiency and throughput, and connected disparate data to create an automated, fast and efficient distribution line.

System Updates:

As a testament to the power and flexibility of AIQ, there has been little change to the underlying software in over 11 years of successful operation. Aging hardware has been upgraded as technologies have advanced, including the replacement of the original—and often-problematic—omni-directional scanners with laser scanners that could do the job more reliably. Today, those laser scanners are being replaced with intelligent Cognex imagers due to complex new requirements for advanced data parsing from new barcode labels.

The new label formats require barcodes of varying lengths, as determined by various carriers, to indicate the method of shipment (ground, priority, signature required, etc.). The advanced Cognex imagers must find and recognize the correct barcode to scan among several on the labels, then extract the right number of characters based on the length of the code. For example, if the imager sees a barcode of 22 characters, it has the intelligence to drop the first five characters and parse the remaining data needed by the system. Or if a code has 18 characters, it might drop the trailing two. Being advanced data-capture devices, the Cognex imagers can read multiple barcodes but parse only the needed pieces of data from the input stream.

Ultimately, the initial AIQ solution put in place is as viable today as it was when it was installed in 2004, despite dramatic advances in—and upgrades to—hardware, shipping software and labeling requirements. The AIQ code base has been updated to use current technologies and development languages, and additional functionality has been added as A Beka Book's requirements have changed. However, the solution continues to operate largely unchanged, handling the new requirements as well as three changes to A Beka Book's order and warehouse management software.

Automation IQ software from Inovity demonstrates significant flexibility and configurability in an application. As a solution that connects disparate data within an operation and gathers intelligence disconnected manufacturing processes, AIQ uses that data to improve production processes and deliver real-time information to the point of activity. Not only did AIQ improve A Beka Book's high-speed and complex distribution processes while making the package sorting and manifesting project an ongoing success, it is adaptable to future advancements—including RFID—should the need arise.