JOEY Pouch Sorter moves 67,000 garment shuttles, boosts efficiency and communication through EtherCAT and PC-based control technologies

# SDI's transition to PC Control redefines intralogistics efficiency for distribution centers

The JOEY system from SDI maximizes footprint utilization in distribution centers by transporting product through unused space along the ceiling.

With the ever-increasing growth of e-commerce, today's distribution centers need to make every cubic foot count. Not only does material handling equipment need to be cost-effective, but it also has to efficiently utilize warehouse space. Since the majority of conveyors sit close to the ground, they take up significant space horizontally and waste space vertically. To address these and other relevant challenges, SDI launched the JOEY Pouch Sorter system, which raises unit sortation to the ceiling and promotes more efficient product transport.

"The JOEY system relies heavily on automatic switches and gravity accumulation to move pouches or garment hangers effectively," says Jim Suggs, Chief Technology Officer. "The first system we commissioned in 2016 used 5,000 pouches

to sort about 3,000 units per hour, which is actually relatively small. The second system used 67,000 shuttles to buffer and sort 7,000 units per hour."

Founded in 1970, California-based SDI provides turnkey material handling systems complete with controls and software for fast-paced distribution center environments. It often serves large retailers and clothing companies. What sets SDI apart is its robust portfolio of technologies. This includes the Distribution Center Management Solution (DCMS) software, tilt-tray, garment-on-hanger and bomb-bay (or split tray) sortation equipment and most recently the JOEY Pouch Sorter. In addition, SDI is a leading integrator of third-party conveyors, high-speed merges and other systems.
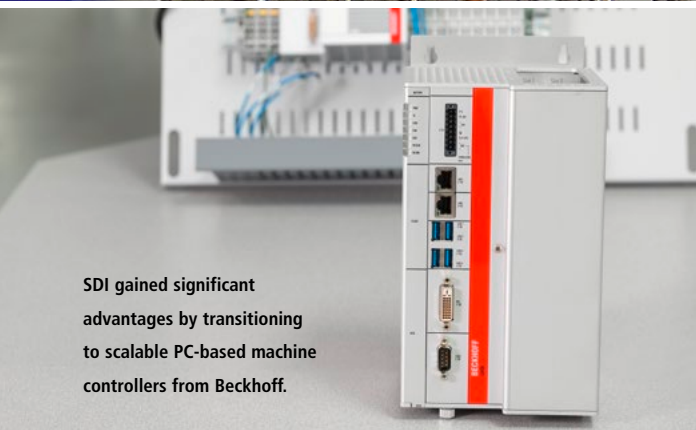
SDI gained significant advantages by transitioning to scalable PC-based machine controllers from Beckhoff.

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SDI boosted controls capabilities for the JOEY Pouch Sorter and other intralogistics solutions with PC-based automation from Beckhoff.

TwinCAT 3 automation software allowed SDI to preserve existing code and easily use modern programming standards.
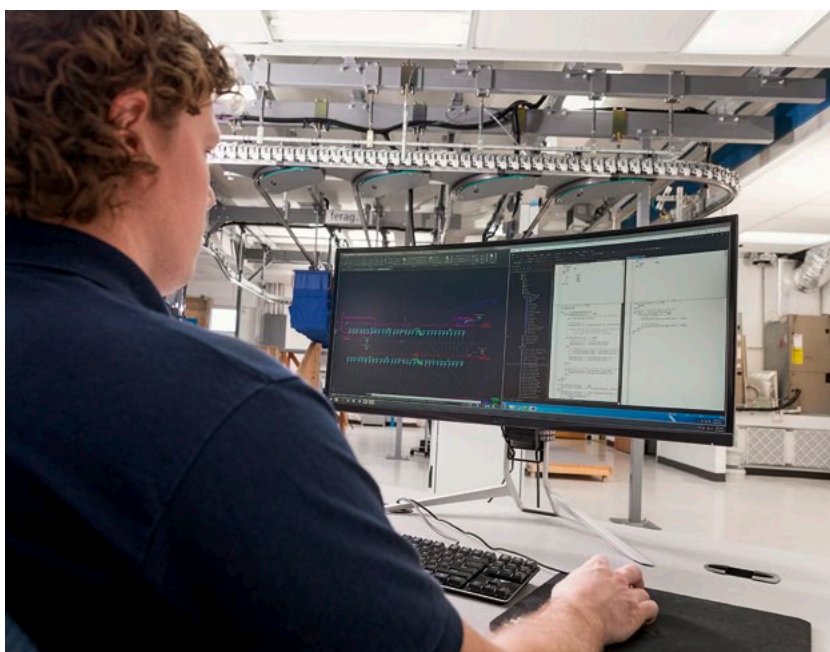
"We integrate numerous intralogistics solutions so that we can pick the best provider for the given application and combine the best technologies with our top-tier unit sortation equipment," Suggs says.

With the JOEY Pouch Sorter, engineering the product transport processes up instead of out offered serious potential to reduce equipment size and expense. However, coordinating thousands of pouches in a single system required a powerful, reliable control and networking platform, explains Senior Controls Engineer Kyle Upwood. "The JOEY Pouch Sorter is very demanding from a controls response point of view." For SDI, upgrading its standard automation platform would be crucial to the success of the JOEY Pouch Sorter.

Sorting out new automation technology

Around the time the first JOEY Pouch Sorter was implemented, SDI began to recognize limitations in its legacy automation platform then used on all of its unit sorter and conveying solutions. "For our auto-induct onto the unit sorters, for example, we do the motion control on the metering itself and automatically induct the products onto tilt-tray sorters," Suggs says. "We also use high-speed merges, which require high-speed motion control."

Engineers at SDI's Florida-based controls division had difficulty finding controllers and a fieldbus that could offer such rapid response times. At the time, their previous vendor's control software could not run on an OS above Windows 7, which

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All SDI solutions, from new intralogistics innovations to traditional conveying systems, now use EtherCAT and PC-based automation technology.

would soon become obsolete, and the software required outdated flowchart-style programming. In addition, their machine controllers offered extremely limited memory and depended on OPC DA to communicate with other devices, which was succeeded by the more effective and secure OPC UA standard long ago.

When exploring new control platforms, the SDI engineers focused on performance but also considered flexibility, scalability and cost to be key factors. The team wanted to maximize cost-effectiveness at the time of purchase and for the overall product lifecycle. "The technology most automation and controls vendors offered was simply not advanced enough, especially for the requirements of the JOEY Pouch Sorter," explains SDI Controls Director Mike McCanney. "These options were also significantly lacking in terms of both memory and storage. With any application, we always deliver our entire DCMS controls solution, even if it's not entirely used, to enable easier upgrades or customizations to meet client demands in the future. Therefore, the controller needs enough memory capacity to store that sizable project."

The new controls platform would also need to convert and repurpose existing code from SDI's broad portfolio with ease and help improve the company's build process when commissioning machines.

"As we started converting code, traditional PLC platforms simply couldn't support some of our fairly simple programming constructs," McCanney says. "Also, we wanted to preserve what we call 'the build,' which is our method for automatically mapping all I/O terminals and points. This software we developed

uses site-specific drawings and our library of preconfigured code for unit sorters, carton sorters, regular conveyors and other technologies in order to write the complete code project within hours. As a result, the commissioning engineer can essentially visit the site, load the code onto the machine and hit 'go.'" Preserving these efficiencies was very important as SDI explored new platforms.

PC Control carries new technological capabilities

The SDI controls team soon identified robust control solutions from Beckhoff Automation. "What first drew our attention to Beckhoff was the real-time communication speed of EtherCAT," Suggs says. The EtherCAT industrial Ethernet system enables a range of topologies – including line, tree and star – and can incorporate up to 65,535 nodes per network segment. This is particularly useful in widely distributed material handling applications. "The combination of these EtherCAT benefits helped SDI solve performance issues with its legacy fieldbus to enhance sorting and JOEY applications," says Mark Olton, Area Sales Engineer for Beckhoff. Olton adds that, at the same time, EtherCAT allowed SDI to continue incorporating third-party devices and networks, such as EtherNet/IP, AS-Interface and PROFIBUS: "The system openness inherent in EtherCAT proved very helpful, especially since most distribution center customers are unable to simply rip and replace their entire network infrastructure."

Because EtherCAT provided such advanced capabilities, the SDI engineers also began to explore PC Control technology from Beckhoff. After several successful in-house tests on SDI conveying systems, they specified the Beckhoff C6920 Control Cabinet Industrial PC (IPC) due to the power required by large and complex

architectures, including JOEY applications. The C6920-0050 variant SDI selected features a quad-core Intel® Core™ i7 processor with clock speeds of 2.4 GHz, and it offers 2 GB DDR3L RAM standard with the option to expand up to 16 GB. RAM in other variants in the C6920 series can even be expanded to 32 GB. "The C6920 is an extremely powerful PC, and it works well in the JOEY Pouch Sorter because of the high performance demands and large number of scanners," says Upwood.

For less demanding conveying and sortation systems, SDI was able to scale down to the Beckhoff CX5130 Embedded PC. This DIN rail-mounted controller offers a compact size of 142 mm x 100 mm x 92 mm, but still packs significant processing power via a dual-core Intel Atom® processor. "While the C6920 remains important in many situations, we standardized on the CX5130 as our main machine controller. It comfortably provides the necessary performance level for most applications and offers an optimal price point for us," Suggs explains. Through the inherent scalability of Beckhoff IPCs and TwinCAT 3 automation software, SDI can easily run the same code on either controller without requiring changes beyond the runtime license.

Automation software opens up new possibilities

As a universal engineering environment and runtime software, TwinCAT 3 allowed SDI to increase its capabilities while preserving existing code. Unlike the previous platform, TwinCAT offers programming in all IEC 61131-3 languages with object-oriented extensions as well as computer science languages through its integration into Microsoft Visual Studio®. "The ability to use more modern programming methods has completely changed how we create code," McCanney says. SDI also improved on its build process using TwinCAT Automation Interface, which enables the automatic creation and manipulation of TwinCAT eXtended Automation Engineering (XAE) configurations. The Automation Interface functionality is possible using all COM-capable and dynamic script programming languages, such as .NET, Windows PowerShell or IronPython.

The TwinCAT Automation Device Specification (ADS) interface offered additional benefits for commissioning and communication in distributed, multi-controller architectures. "TwinCAT treats individual software modules, such as the PLC, independently as a server or client, and ADS exchanges messages between these objects within the system and over the TCP/IP connections," Olton explains. As a device- and fieldbus-independent interface, ADS eliminated the requirement for outdated OPC DA in all new SDI applications. "With EtherCAT and ADS as a backbone for cross-controller communication, we can implement a more distributed controls environment with smaller controllers spread across fulfillment centers," McCanney says.

Intralogistics systems deliver significant improvements

The JOEY Pouch Sorter has allowed SDI to optimize the existing footprint in distribution centers while increasing throughput considerably. By transitioning its controls platform to Beckhoff, SDI has seen significant performance gains in all solutions. For the JOEY Pouch Sorter, in particular, this has enabled the installation of larger and more complex applications, according to Suggs. "A recent JOEY application for a large clothing manufacturer boasts 67,000 shuttles with numerous switches and 70 scanners where the shuttle makes logic decisions in real-time," he says. "This JOEY system uses garment hangers, rather than pouches, on the 67,000 shuttles. It tracks the items, typically suits, through various buffers to a matrix sortation system. This automatically produces the stack sequence – a small, medium and large suit, in that exact order – before delivering it to the packing station."

Collaboration at SDI's controls facility in Melbourne, Florida: (from left) Chief Technology Officer Jim Suggs, Senior Controls Engineer Kyle Upwood and Beckhoff Area Sales Engineer Mark Olton.

The upgraded controls platform has provided significant results, including increased messaging to the database, according to Upwood. "We increased the single point machine rate by 58% to now over 10,000 units per hour. This was achieved while also increasing the barcode cameras that are required to run at this new max rate by 40%. I/O points increased by 51%, and high-speed track switching devices increased by 182%," he says.

Less than two years after choosing Beckhoff, SDI migrated nearly all existing code to the new platform and enhanced its design and build processes. "There was a lot of concern when we first began shifting control platforms about how easy it would be to convert our libraries of code. Beckhoff made it much easier than we anticipated," McCanney says. Some SDI code is deprecated or for discontinued equipment, but the progress the company has made in programming is significant. "With the last major pieces that we had to finish, including the high-speed merge and the auto induct, we are likely 85% complete as of today," Suggs adds. "In addition, TwinCAT Automation Interface greatly improved our capability to create software that adapts well on every new application."

By implementing Beckhoff IPCs, SDI exceeded its memory and processing power requirements, but it also reduced cost compared to comparable offerings from other vendors. "To get that amount of memory from one particular competitor would have cost $20,000," McCanney says. "With Beckhoff, it just feels like we've roared into the 21st century. I didn't realize how much our previous controls platform was holding us back. For a company of our size to deliver large-scale automated systems to major retailers and apparel manufacturers, we benefitted greatly by implementing Beckhoff as our standard platform." With increased controller and networking capabilities, SDI can continue designing and implementing more innovative JOEY Pouch Sorters and other material handling innovations to further optimize floor space usage in today's distribution centers.

Further information:
www.sdi.systems
www.beckhoff.com