Automating the Unautomated: Inside Ethos Automation's Tier 1 Automotive Manufacturer Liftgate Assembly Cell

When a Tier 1 Automotive Manufacturer came to Ethos Automation with a challenge, the challenge was not simply to build a faster machine. It was to replace a process that had never been fully automated before, and to do it with robots flexible enough to outlast the program they were built for.

This Tier 1 manufacturer supplying structural and closure components to some of the world's most demanding automotive programs. For the companies liftgate assembly, they were running a labour-intensive manual process: up to twelve operators loading components into manual presses, managing left-hand and right-hand variants across two distinct vehicle models, assembling seven components by hand. Output was tied directly to headcount. Quality was tied directly to consistency, and consistency in a manual process has limits.

The brief Ethos received was precise: automate the entire process from component loading to finished part packaging. Achieve a cycle time below fourteen seconds. Handle both LH and RH variants for both models. Do it within a constrained footprint. And do it on a timeline that left little margin for the unexpected.

There was one additional requirement that shaped the entire engineering approach: The company wanted robots, not fixed hard automation. They were thinking beyond this program. In a business where vehicle models change and assembly requirements evolve, they wanted equipment that could be redeployed: assets that would continue to generate value long after the two models move through their production lifecycle.

That decision made the project significantly more complex. And it made the result significantly more valuable.

Building the Cell

The solution Ethos designed deploys twelve robots across the cell, each selected for the specific payload, reach, and precision demands of its station, and each with a clearly defined role in the assembly sequence.

Four FANUC 50iD robots handle the small, precision-critical components delivered from bowl feeders: bushings, conductivity rings, and pins. These are high-repeatability picks that demand consistent orientation and placement accuracy, work that suits the 50iD's compact form and fine motion control.

Five FANUC M20iD robots handle the heavier work: loading single forgings and stampings into stations, and rotating and orienting fully assembled parts out of the operator's loading zone and into the process-specific stations downstream. They are the workhorses of the cell, moving mass with speed.

Three FANUC R1000iA robots take on the most complex multi-part handling tasks. One manages finished part packaging, picking assembled parts and layering them into cardboard-lined shipping bins using a tool changer end-of-arm that allows it to also pick and place full sheets of cardboard between layers. A second transfers pairs of parts between press stations in a coordinated two-part handoff sequence. The third operates in the testing, marking, and inspection zone, managing three simultaneous parts through torque testing, OCR vision-verified part marking, and quality inspection before any part is cleared for packaging.

Finished parts are packed into bins with no fixed holders or locating features for the specific part geometry. The packaging robot determines placement dynamically.

Dave Brown, Ethos's Mechanical Engineering Manager, led the mechanical design team through what became one of the most technically layered projects in the company's history. Three designers: Erik Zurowski, Max Usik, and Zac Colton, each brought distinct expertise to the build. "Every component on this line had to work together precisely," Brown said. "The mechanical side wasn't just about structure and support, it was about enabling the controls and robotics teams to do what they needed to do."

One of the more demanding mechanical challenges involved the pick strategy for two of the robots. Both were required to pick from three separate feeder stations simultaneously, meaning all three stations had to be aligned with sub-millimetre precision to a single programmed pick position. The robots do not adjust their path between stations. There is one position for pick, one position for drop. If any station drifts, the pick fails. Engineering that consistency into the mechanical design, and holding it through the thermal and dynamic conditions of a production environment, required a level of rigor that went beyond standard machine building practice.

The Tolerance Stack-Up Problem

Manufacturing tolerances are unavoidable. Every component has a specification, and every specification has a band. A single component at the edge of its tolerance is acceptable. The challenge on the 240137 line was that the liftgate assembly involves four distinct components: a forging, a bushing, a formed part, and a conductivity ring, each with its own tolerance band.

When all four components arrive simultaneously at or near their respective limits, the cumulative dimensional stack-up can push the assembly outside the range that automated tooling is designed to accommodate. A robot gripper or press tool designed for nominal parts may not function correctly on a part stack built entirely from extremes. And in high-volume production, that scenario is not a theoretical edge case, it happens regularly.

Designing tooling that could absorb the full envelope of variation across all four components, while still maintaining the repeatability and cycle time the contract required, was one of the central mechanical engineering challenges of the project.

The Conductivity Ring

Not every challenge on a complex automation project originates in the machine. Some arrive in the parts bin.

The conductivity rings used in this assembly are exceptionally delicate: thin, lightweight components that can be deformed with almost no force. Compressed too easily. Stretched too easily. In a manual assembly process, a skilled operator compensates for that variability instinctively. An automated system cannot.

When rings arrived out of specification, too open to be gripped consistently, some still passed through the go/no-go nest in the bowl feeder and made their way down the inline. Because of their geometry, out-of-spec rings would also shingle together, stacking on top of one another rather than separating cleanly for individual presentation to the robot. The result was a pick station that could not be trusted.

"Before the EOAT was redesigned, picking was extremely difficult," said Scott Luke, Ethos's Assembly Manager. "The rings are so sensitive that how you handle them determines whether they stay in spec at all."

There were two distinct problems to solve, and they required two different solutions.

The first was the pick itself. Erik Zurowski redesigned the end-of-arm tooling with a shimable end-of-travel hard-stop: a precisely adjustable mechanical stop that set the exact compression depth of the gripper jaws on every cycle. By compressing the ring slightly and consistently during pick and place, the EOAT kept the ring circular enough to seat reliably on the press locating pin, regardless of minor dimensional variation in the incoming parts.

The second problem was subtler. The pick station, the "dead nest" where the robot retrieves the ring, turned out not to be dead at all. The inline conveyor was still active during the robot's pick cycle, which introduced vibration and movement at exactly the wrong moment, causing mis-picks and inconsistent placement. The controls team shut down the inline during the pick window to eliminate that interference.

But shutting off the inline created a new problem: when the conveyor stopped, the ring didn't always come to rest against the hard stop in the same position. The landing point was random, a function of where the ring happened to be when the inline cut out. To solve it, a magnet was added at the end of the inline. When the conveyor shuts down, the magnet draws the ring flush against the hard stop, giving the robot a consistent, repeatable pick position every cycle.

Each fix addressed one layer of the problem. Together, they turned an unreliable station into a stable one.

Controls: Integrating a Dozen Systems Into One

The controls architecture on this line is, by any measure, complex. Xavier Villanueva, the lead controls engineer on the project, was responsible for integrating a system that included twelve FANUC robots with vision-guided picking, servo presses, Baltec riveters, torque testing equipment, OCR vision cameras for part marking verification, tool changers, bowl feeders, and a custom packaging sequence, all coordinated through a single Omron PLC-based control system with a customer-specified HMI template.

Each of those systems has its own communication protocol, its own timing requirements, its own failure modes. Making them work independently is an engineering problem. Making them work together inside a sub-14-second cycle, with zero tolerance for sequence errors on a line running LH and RH variants simultaneously, is a different problem entirely.

"The number of systems on this line that had to communicate and sequence correctly was unlike most projects," Villanueva said. "The challenge wasn't any one system, it was making all of them trust each other."

Eight Weeks Early, On the Customer's Floor

Midway through the project, the customer informed Ethos that they needed the line earlier than originally contracted, eight weeks earlier, to meet a production readiness requirement on their floor. The machine was not complete. Integration and commissioning work that would normally happen inside Ethos's facility in Brantford would have to happen at the company’s plant instead.

Kevin Clarke, Ethos's lead builder on the project, was hands-on throughout: first on the shop floor in Brantford during the build, then at the customer’s facility during commissioning. When the ship date moved up eight weeks, Clarke was already deep in the machine. He moved with it.

Tolerance stack-up issues that would normally be resolved in a controlled shop environment had to be worked through in the field, alongside the customer, under production schedule pressure. Part quality problems that showed up for the first time in a live production context needed real-time engineering decisions.

"Working through the stack-up problems and part quality issues directly on the customer's floor, with their team watching, is a different kind of pressure," Clarke said. "But it also meant we were solving real problems with real parts in real conditions, and what we solved stayed solved."

Clarke remained at the customer's facility until the line was running reliably. The hands-on presence of the Ethos build team during that period, on the customer's floor, problem-solving in real time, was what ultimately got the line across the finish line.

The Result

The line is running at the Tier 1 Automotive Manufacturer today and is beating the contracted sub-14-second requirement. A process that once required up to twelve operators now requires one, whose sole responsibility is loading raw components at the start of the line. Everything else: assembly, forming, marking, verification, and packaging, happens automatically.

At full production capacity, the line produces 1.42 million liftgate assemblies per year.

The robots the customer insisted on are already delivering on their promise as reusable assets. The line's architecture was designed with flexibility in mind, and they are already in early discussions about what comes next: replacing the single human loading operator with a vision-guided robot, eliminating the last manual touchpoint and enabling the line to run fully lights-out. No operators. No shift constraints. Continuous production.

For Ethos Automation, the 240137 project was a demonstration of what it means to take on work that has not been done before. Fully robotic part assembly at this level of complexity and volume had no established playbook. The team built one.

"This was the kind of project where at multiple points you ask yourself whether it's going to work," said Peter Botros, co-founder of Ethos Automation. "It worked. And it worked better than we contracted to deliver. That's what this team is capable of."