



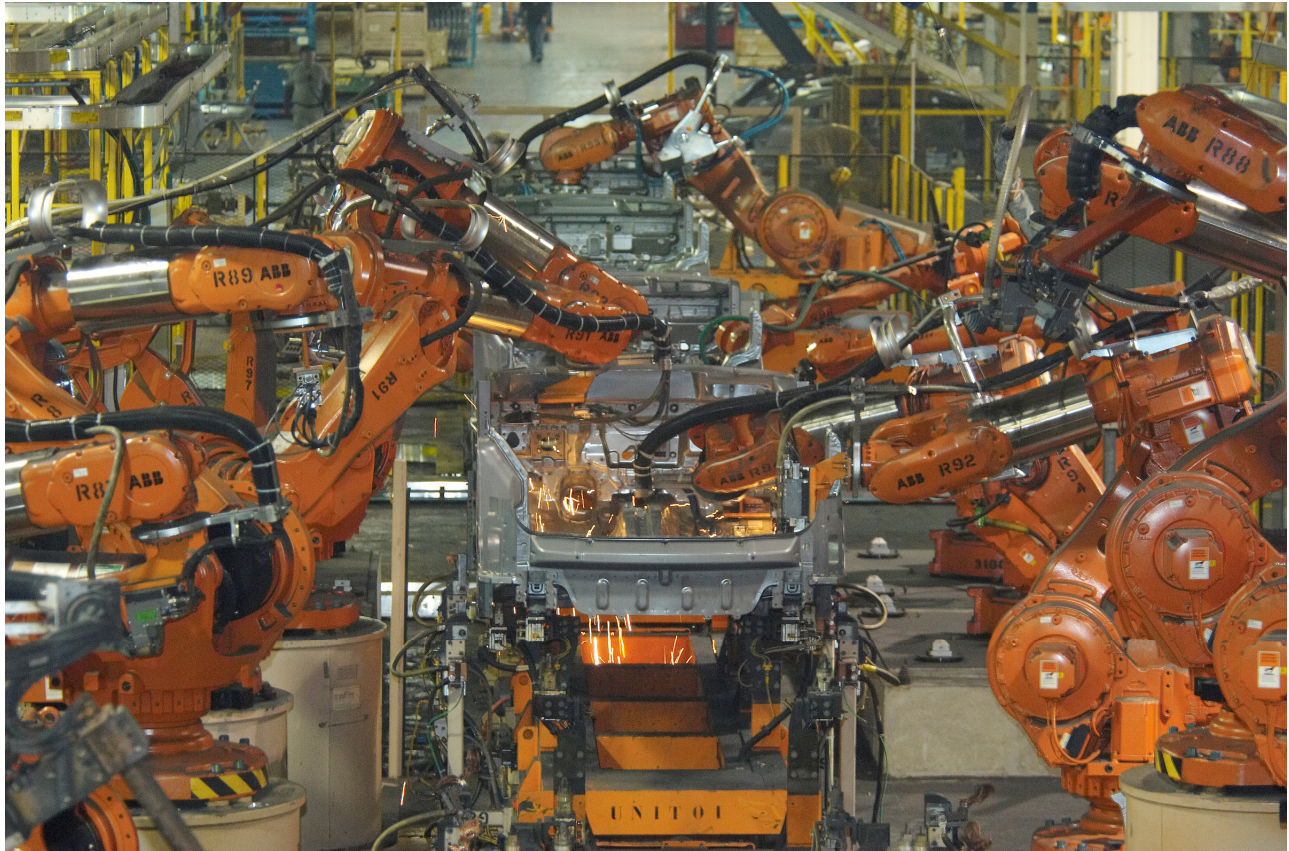
One-line, Three-model Facility Helps Car Maker Continue to Roll Out New Models

Applications

- Automotive
- Metal Fabrication
- Assembly

Products

- FlexFramer
- Roller Hemming
- TrueView™ Vision Guidance
- 7th Axis



Imagine a manufacturing facility that is automated so that approximately 800 robots work together in harmony to roll out some of the hottest new vehicles on the market. Then, look no further than Belvidere, Ill.

Set around 70 miles outside of Chicago, Chrysler's Belvidere assembly facility is one of the world's most automated and flexible automotive factories, capable of producing three vehicle models on the same line – the Dodge

Caliber, launched in December 2005; the Jeep® Compass, unveiled in May 2006; and the Jeep® Patriot, introduced in December 2006.

The 3.7-million-square-foot facility houses around 3,000 employees who support all facets of production. Originally a one-shift operation, a second shift was added to the facility in March 2006, with the third shift starting in July 2006.

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With three models to manufacture and market demands to keep up with, Chrysler needed an automation solution that would keep them ahead of the competition, without expensive model changeovers or the need for separate lines for each vehicle.

Teaming Up

The solution needed to be flexible, with the ability to switch between the assembly of cars and small SUVs with minimal interference to production. Chrysler awarded the body shop project to ABB based on a manufacturing process developed by ABB globally in 2003, and was the result of a vision match between Chrysler and ABB on flexible and robotic manufacturing.

Through collaboration, Chrysler and ABB designed the facility to automatically change between production of the Caliber, Compass and Patriot, combining old and new technologies with approximately 800 robots.

“Belvidere is a true one-line, three-model, high-volume, flexible facility,” said Frank Ewasyszyn, Executive Vice President – Manufacturing for Chrysler. “The assembly line is designed to quickly change between manufacturing the three vehicles, meaning the line can automatically switch between car and small SUVs in the vehicle assembly on the same assembly line without stopping the line for tooling changes – allowing Chrysler to keep up with market demands for each of the models without expensive model changeovers or separate lines for each vehicle.”

The robots, which work in the body shop with Chrysler employees, perform a number of tasks, both with employees and independently.

With employees, the robots are loaded directly by production workers. The robots then geometrically position parts to be assembled, insert parts to realign the sequence as necessary, extract parts to validate quality levels and build additional parts for service needs.

When working independently, the robots hold, weld, seal, form, position, transfer and assemble all sheet metal portions of the vehicles.

Some of the facility’s robotic features include:

- Automatic lift gate load – although traditionally manually applied, the Belvidere facility’s process allows the task to be completed with a robot. Because of the improved efficiency, the process is being shared and implemented by other Chrysler facilities.
- FlexFramer – the only framer that requires no fixed tooling, the FlexFramer runs with two main



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two main robots, where in the past, a large hydraulic structure was required. The FlexFramer makes maintenance of current models and introduction of new models simple and cost-effective, while also providing superior tolerance characteristics and rapid model mix changeover.

- Flexible measuring systems – cameras mounted to the robot provide better dimensional tolerances and vehicle dimensions measured during actual production, allowing real-time statistical process control.
- Roller hemming cells – robotic roller hemming cells, which replaced hydraulic presses and resulted in a 40-second cycle time, maintain high-quality production of all closure panels. The systems are more flexible and cost-effective versus previous production equipment utilized in the past, and allow the closure systems to switch from model to model with the flexible assembly line, producing closures just-in-time.
- Standard components – about 80 percent of the components used in all of the different style robots are common, resulting in less service, maintenance and components.
- TrueView™ – using cameras and intelligent software, robots are able to find and deliver a part with accuracy. Parts can be brought in on a rack and placed into the system precisely by the robot without the expense and added complexity of the precision dunnage and fixturing normally used with automated systems.
- 7th Axis – robots are given full motion and are able to transfer parts forward and backward. With 7th Axis, an additional external axis is integrated into the robot

and can maintain the orientation of the part, following an optimal natural path along with the production flow.

One of the most unique attributes of the assembly line is the sequencing. For the first time, all systems are coordinated, with the sequence carrying throughout the facility – for example, part A must align with part B on the opposite side of the facility. And, when Belvidere changes the sequence, the systems automatically adjust to the change.

“This is one of the most elegant assembly lines to watch run,” said Sal Lucido, Program Manager for ABB Robotics on the Belvidere project. “It’s as if the equipment is dancing in choreographed motion, not just performing an operation.”

Obstacles to Overcome

To shorten installation time, Chrysler and ABB utilized FlexiCells – modules that were assembled at ABB’s facility in Auburn Hills, Mich., and delivered complete to the Belvidere facility. Rather than the typical 16- to 18-week installation, Belvidere took just eight weeks to install more than 300 pre-fabricated modules.

However, as with any launch, production in the facility faced several obstacles.

The program required a tight turnaround, with Belvidere trying to launch three models in a nine-month period. In addition, the facility was really a one-shift operation that needed to be changed to a three-shift environment.

With regards to personnel, those not familiar with the Belvidere facility or its methods of operation were required to support production. Plus, the learning curve was further lengthened by the level of automation incorporated, which was never before seen at previous production facilities.



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Finally, the complexity of sequencing an entire body shop was an additional factor in reducing the initial output.

To overcome these obstacles and get the facility in working order, Chrysler and ABB worked together to establish core production teams, which mutually guided and managed all aspects of production. This included training initiatives to elevate the skilled trades' knowledge of the new equipment, simplification and reduction of redundant features and focused maintenance initiatives to limit downtime.

Rolling Off the Line

As the first facility to implement a low headcount, flexible manufacturing solution with sequential build capability, Belvidere has changed how American automobile makers produce vehicles.

Chrysler and ABB launched this groundbreaking program in less time than traditional vehicle launches, even though the program required not only a change in specifications, but also a willingness by the customer to accept non-traditional methods. Ground-level acceptance required persistence and validation at every stage of production.

As the facility is robotic-based, it requires no fixed tooling as traditional in a body-in-white shop, increasing line utilization from eight to 12 years, versus the typical three to four years. When implementing a new model, which typically necessitates retooling the entire line, the Belvidere facility just requires a change to end-effectors and grippers.

When the line was up and running in December 2005, it resulted in the highest quality level launch of a vehicle through Chrysler, from pilot to production.

In addition, Chrysler has used the baseline process and concepts from Belvidere to incorporate technology into a number of its facilities, including the recent release of the Chrysler Sebring, Dodge Avenger, Chrysler Town & Country and Dodge Grand Caravan. The success has even changed Chrysler's global manufacturing strategy, with this flexible concept being implemented at other Chrysler body shops and additional robot commitments going to ABB.

> HIGHLIGHTS

- Assembly line is designed for quick changeovers without the need for tooling changes
- Robots work independently and with employees
- All systems are coordinated, with the sequence carrying throughout the facility
- When the sequence is changed, the system automatically adjusts itself
- Installation time was shortened through FlexiCells – modules that were assembled at ABB's facility and delivered complete