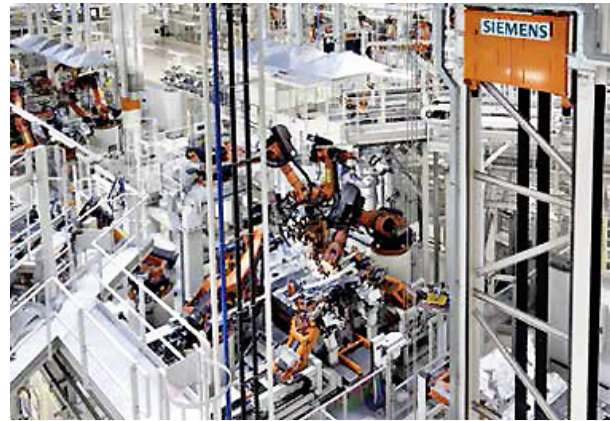


Perfectly organized

Process control for simultaneous production of different car models

IEN Europe 10/2013, Author Dana Deutscher

Robotized welding of a car body is a demanding job in and of itself. But building different models of a particular car in a single plant is a challenge that requires sophisticated logistics and a highly complex process control system. A large automotive company from Spain has mastered this challenge, relying on a comprehensive solution not only for building the plant itself, but also for ensuring smooth control and communication throughout the entire process.



The small town of Martorell, some 30 kilometers from Barcelona, is the headquarters of car manufacturer Seat. Not only are several hundred thousand cars (approximately 377,000 in 2012) built and distributed here annually, it is also the site where future models of the brand are designed, developed, and built.

Seat was founded in 1950 and is closely linked to the development of individual mobility in the country. Seat, a reference brand in Spain, designs its cars under the motto “Enjoyneering” – which means the unique fusion of enjoyment and engineering. In 1986, Seat became part of the Volkswagen Group. As the largest industrial investor in Spain for research and development and as an employer of more than 14,000 employees, the company contributes significantly to the economy of Spain.

Production according to Volkswagen standards

In order to achieve a higher level of efficiency and reduce costs in production, the Volkswagen Group introduced the new MQB (Modular Transverse Matrix) production concept, which also includes the VASS (Volkswagen Audi Seat Skoda) standard (please see text box). The new concept enables various models to be manufactured on the same production line – regardless of vehicle size, model, or drive train – with a higher degree of flexibility. At the Martorell plant, the new Leon is the first Seat model to be produced under this concept.

The automation and drive concept for the conveyor systems of the body shop, where the cars’ body shell is manufactured, will also conform to the VASS standards. Seat wanted a solution from a single source, and as a long-standing technology partner, Siemens was able to provide just that. The result was a turnkey solution that includes everything, from mechanical construction all the way to the production control system. Visitors to this section of the plant are impressed by the clean environment, dominated by robots handling large body pieces and joining them with numerous welding points until the complete mechanical structure of the car, including hood, doors, and hatchback, is complete. What looks like a smooth and easy operation is actually a highly complex process, using the most sophisticated technologies and the highest degree of automation.

After all, the production control system not only needs to ensure that the right parts are available for pickup at every welding section precisely when they are needed. It also needs to differentiate between the different models since it makes a difference whether the car needs to be equipped with two or four doors or whether it’s a sports model.

Highest level of availability

For the brand new Leon body shop at the Seat Martorell plant, Siemens installed its top-of-the line Simatic CPU 319F-3 PN/DP safety controllers, which communicate via Profinet and support a safe signal transmission via Profisafe. Because the Simatic S7-300 controllers are very fast and efficient, even complex automation tasks can be carried out in real time. At the field level, Simatic ET 200S I/O units are

used to communicate with the numerous actors and sensors and link them to the CPUs. Sitop switched-mode power supply units provide 24 V DC power to all interface components.

Throughout the body shop, a ring-type network topology with redundancy manager provides the basis for redundancy, which increases plant availability and reduces the wiring needs. Scalance X-200 managed switches handle uninterrupted data transfer. The managed switches have a proven track record in the automotive industry and make the ring-type network cost-effective and easy to manage. Particularly in demanding environments such as a body shop, they stand out due to their extreme robustness and reliability. The devices are characterized by comprehensive diagnostic functionality, for example access via SNMP, web diagnostics, and Profinet. Simatic S7-300 extended diagnostics functions can be used in conjunction with the controllers.

New freedom thanks to Profinet

One major step toward a modern production control system for the Seat body shop was the change to Profinet. As an Ethernet-based communication protocol, Profinet not only provides the basis for extended diagnostics for the communication infrastructure, but also eliminates the need for a separate protocol for all process control functions involving time-critical process data or safety signals. "With Profinet, we can communicate process information and real-time data over the same bus," says Mario Alegre, technical manager of the Martorell body shop. "We can even monitor the system down to each field device and diagnose problems right from the control room. This is clearly an advance over anything we had before," he adds. A further major advantage of Profinet is its ability to communicate information over long distances without the need for repeaters. This aspect is highly welcome, considering the expansiveness of the body shop. Profinet, an open industrial Ethernet standard, enables fast and reliable data transmission.

Safety without extra wiring

A constant flow of heavy car body parts and fast-moving robots characterize the work at the Seat body shop. This calls for extra efforts to prevent injuries and ensure the safe operation of the equipment. Previously, the components of the safety system were connected to the control system via a vast number of safety relays. In the new body shop, however, this challenge is solved with Profisafe, an integrated safety technology based on Profinet or Profibus. The Profisafe technology enables process control information and safety signals to be transmitted via the same bus system. This itself results in a huge cost reduction itself, and there are additional cost savings through the elimination of wires from each individual safety device to the central cabinet. The safety system can be monitored directly via Profinet in order to ensure its proper operation in case a safety-critical situation arises.

Putting the puzzle together

An integrated manufacturing process like the one at the Martorell body shop will only work smoothly if the production control system can ensure that the correct parts are joined at the correct time. For this, RFID systems ensure the traceability of different pieces within the logistics process. A high-frequency (HF) solution (here Moby E) is implemented at the main transport system. In order to carry the basic floor of the car body through the individual processing steps, from one welding position to the next, a skid is used (a platform similar to roller beds). Short-distance HF readers are located close to the transport path. They read the RFID labels on the skid and thus identify the type of body that the respective skid carries. The HF readers are connected to a connection module RF180C, which communicates via Profinet to the respective PLC. The RFID system is designed for the lower performance spectrum but it identifies pieces contactlessly, quickly, and automatically with very high reliability. Compact read/write devices and antennas make it especially suitable for applications in conveyor systems where space is tight.

A similar solution is being realized with RF620R. Along the main transport system, containers are used to manually provide further components of the car body, for example the lateral side pieces. The containers carry an RFID tag that clearly identifies the parts contained. Through this, the individual pieces can be reliably and easily allocated to the corresponding car body. The RF620R readers can read and write the

information of an RFID label over a distance of up to several meters. RF180C interfaces are used for the connection to Profinet. In addition to the flexible integration with Profinet, the RF620R system is characterized by the high reading speed. Furthermore, fast-moving tags are reliably detected, even in difficult radio environments or in correlation with another RFID system.

In addition, specific pieces have a visual bar code tag. At several points of the production process, the partly assembled body needs to be separated from the skid, which means that clear identification via the RFID label on the skid gets lost. In such situations, one of the bar code labels must be read when returning the body to a skid, thereby informing the production control system about the type of car. When the body is returned to the skid, the information from its bar code label is transmitted to the RFID tag of the skid.

Keeping things moving

For the new Leon body shop, Siemens not only provided the automation and drive solution for the conveyor system but also the complete vertical and horizontal conveyor system itself. This skid-based system follows a strictly modular design made up of individual sections that can easily be joined and rearranged. Each of the sections features not only a Siemens drive, but also its own Sirius M200D soft motor starter and Sinamics G120/G120D frequency converter, connected directly to Profinet. "What is beautiful about the Siemens system is the dramatic reduction of wire harnesses," says Julián Carrasco of Seat conveyor technology planning about the solution. "Thanks to the regeneration functionality, Sinamics G120 saves energy and thus minimizes production costs. The soft motor starters convinced the customer through its modular concept, which allows the fast device exchange and their automatic reparameterization. The included media redundancy protocol (MRP) enables configuration of a redundant Profinet ring without any switches and thus saves costs due to fewer additional hardware devices. Each section is simply linked to the Profinet and can be controlled centrally."

The conveyor system is not only used throughout the body shop. It also connects the body shop with the paint shop via the warehouse. To ensure a cost-effective painting process, the warehouse provides the paint shop with bodies in the right sequence. This ensures minimum color changes, a process which results in time-consuming flushing processes.

IWLAN delivers reliable communication to the warehouse

Vertical and horizontal transport of the skid in the warehouse is accomplished with two elevators that communicate with the control system via a wireless solution, which is also provided by Siemens. Scalance W784-1RR access points are used, together with special antennas. These so-called RCoax radiating cables provide a reliable and secure radio connection throughout the complete transport route. In addition, safety signals will be wirelessly transmitted via Profinet. Because the need for slip rings is eliminated, the wireless solution is maintenance-free and helps to minimize production costs.

Selecting a field-proven technology

The demand for improved quality in manufacturing usually goes hand-in-hand with the cost-conscious use of technologies and resources. Identical standards along the entire manufacturing process lead to highly efficient production. Profinet makes this real for Seat's comprehensive network concept. This single communication system handles all the communication tasks – such as transfer of the individual job data, as well as the safety and control signals – in real-time. Several thousand Ethernet nodes must communicate smoothly with each other and exchange data. With its support of data transmission rates up to 100 Mbit/s and short response times, Profinet is particularly well-suited in the automotive industry for direct control of all intelligent field devices, such as drives, motor starters, process controllers, or panels. And finally, one additional reason that Seat selected Profinet is because the communication system makes the production and diagnostics of the entire network more transparent. It avoids interfaces and reduces the need for specialist knowledge for the tools, for instance commissioning and engineering tools. Profinet and Profisafe have not only helped Seat conform to the VASS standard. Siemens' turnkey solution has also raised the efficiency, reliability, and availability of the body shop to higher levels. All

these advantages allow Seat to speed up commissioning time and get their products to market more quickly.

Standardized processes within Seat

In order to achieve a higher level of efficiency and reduce costs, the Volkswagen Group introduced the new MQB production concept (Modular Transverse Matrix). At the Martorell plant, the new Leon will be the first Seat model to be produced based on MQB. This modular construction concept for front-transverse mounted engines and front-wheel drive automobiles allows manufacturing of various brands on the same production line and at the same time – regardless of vehicle size, model, or drive train. One element of the MQB concept is the new Volkswagen Audi Seat Skoda (VASS) standard. With VASS, Volkswagen is standardizing its production system across all of its facilities worldwide. The entire manufacturing process becomes even more flexible and efficient, enabling the company to respond better to the wide product diversity and personalization of incoming orders.

The body shop for the new Seat Leon is the first production line working under a new production concept