

Schuler's "Digital Suite" in operation at the "Smart Press Shop", a joint venture of Schuler and Porsche

Interconnection of sheet forming at Porsche

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In early February, more than 50 representatives from carmakers and automotive suppliers visited the Smart Press Shop of Schuler and Porsche in Halle, Germany, to get an impression of how digital assistant systems improve the production of carbody and structural parts. The plant operates on Schuler's "Digital Suite", a package of products for networking forming technology, including a system for tracking components, simulating part flow, monitoring dies and lubrication circuits.

Schuler has implemented numerous solutions from its "Digital Suite" for networking forming technology at the "Smart Press Shop" in Halle, Germany, making it the most modern press shop in the world. It was in spring 2019 that the joint venture between Schuler and Porsche, which operates the Smart Press Shop, announced the location for this: 32 acres in the "Star Park" industrial area directly at the A 14 motorway, which is located just outside the city. Despite the C-19 pandemic, the plant went into operation two years later.

Thanks to the proximity to its plant in Leipzig and the shorter logistics routes, Porsche is significantly reducing production-related CO2 emissions. This also brings the sports car

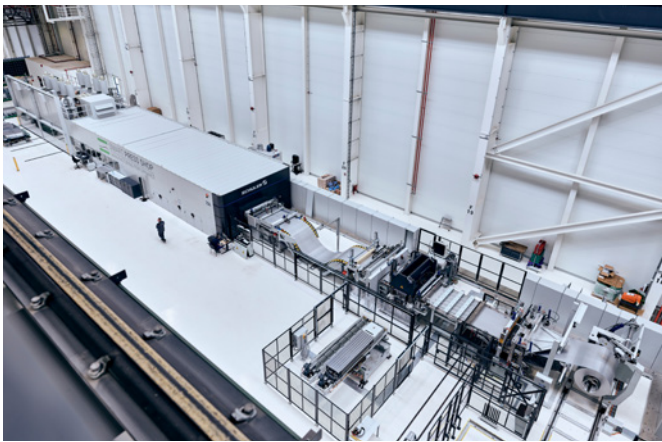
manufacturer closer to its goal of a "Zero Impact Factory", i.e. production without environmental impact. Above all, however, the Smart Press Shop is intended to raise production efficiency and digitisation of important process steps in automotive production to a new level for forming technology.

Production of high-quality body and structural parts

The machinery of the joint venture, in which Porsche and Schuler each hold half of the shares, includes a servo press line with an output of 20 strokes per minute, a try-out press and a laser blanking line. They produce high-quality body



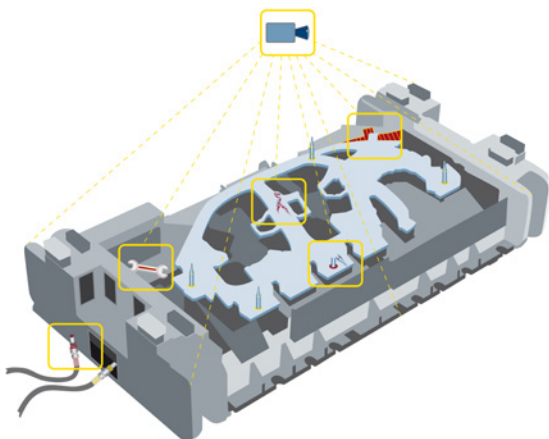
In the Smart Press Shop, Porsche and Schuler operate a servo press line with an output of 20 strokes per minute. (source: Schuler)



Schuler's laser blanking line does not require expensive and heavy cutting dies. (source: Schuler)



With the help of its digital twin, the processes within the press can be displayed virtually long before the start of production. (source: Schuler)



Cameras in the press line detect foreign objects and, if necessary, stop the system immediately. (source: Schuler)

and structural parts in small batch sizes, for example for the Porsche Macan.

Blanking lines with lasers do not require expensive and heavy dies, which is why they are particularly suitable for production of new parts or small batch sizes with frequent product changes. The coil material, which is continuously moving forward, is processed into blanks at high cutting

speeds. Thanks to a tooling-free shot separation, a high output can also be achieved. A material-friendly transport of sensitive materials such as aluminium is ensured, too.

The Laser Blanking Line 2.18 from Schuler is equipped with two cutting heads for processing strip material with a width of up to 1,880 mm. By recording various measured values of the system and the coil material, as well as by smart marking of the circuit board, the system that supplies the blanks for the servo press line is also the starting point for a “Track & Trace” system.

Tracking and tracing parts

Parallel to the development of machine, die and materials technology, the quality requirements for outer skin parts are constantly increasing. Due to the forming limits of lightweight materials and the design of sophisticated components, the process windows for production of good parts are often very small. Start-up effects up to continuous production, fluctuations in material quality or tolerances in the die often lead to problems and the production of rejected parts.

The continuous part tracking enables a complete proof of quality for ongoing production. The system marks each component with its own ID, which can be traced back at different times and product stages. For this ID, all important information is stored in a database, so that it is possible to trace afterwards from which coil the processed component originates, which parameters were present during the forming process, and which quality characteristics the component has.

Complete transparency in production

Track & Trace closes the gap to complete transparency in production. Each individual part receives a unique identifier and is tracked during the production process. All data and information are linked and put into context. The data collected by automatic or manual control devices includes the processed pre-material (coil), measurement and process values in the blanking and press line as well as quality features.

The resulting closed quality control loop enables an optimisation of production. Errors can be detected more quickly and eliminated in a targeted manner. Through open interfaces to MES systems or cloud platforms, the use of artificial intelligence from the field of machine learning is possible to monitor and control production in a supportive manner. Even if the developments here are still in their infancy, approaches are already being pursued to optimise the re-oiling of circuit boards and the adaptive control of the die cushion to reduce classic component defects such as cracks.

Cooperation with GEC

Schuler cooperates with the German Edge Cloud (GEC). The specialists supplied a central software module for the Track & Trace system. Schuler is also developing further modules according to the “User Centered Design” approach. The front-end runs on various mobile devices. This enables the two companies to optimally bundle their resources.

The German Edge Cloud brings its many years of expertise in the development and project planning of integration projects in manufacturing as well as forward-looking industrial solutions based on the Premise Edge ONCITE to the new

cooperation. A major advantage for users is full data sovereignty, so that know-how and critical production data remain in the right hands. The Track & Trace system is compatible with public clouds from major OEMs as well as with hybrids.

Simulation of the part flow

With the Smart Press Shop, the forming process and part flow are simulated on the computer in advance. The Schuler software “DigiSim” detects so-called interference contours and ensures the necessary safety distances by mimicking the actions of the slide and transfer as well as all other movements relevant for the application. In this way, collisions between all elements can be detected in advance and eliminated in an uncomplicated way. At the same time, real tests and setup processes are shortened while the risk of failure is minimised.

The other processes within the press can be displayed virtually with the help of their digital twin long before the start of production. Initial tests and software adjustments are possible, which noticeably accelerates commissioning. Training on the virtual image is also useful, because then the production on the real system does not have to be interrupted.

Die monitoring with cameras

Cameras in the press line use intelligent software to monitor the forming process. They detect foreign objects such as punch residues or wrenches in the die and check whether the parts have been correctly inserted, formed and removed. In the event of a registered deviation from the target state, the press stops immediately to avoid expensive consequential damage in the die.

Schuler calls the system “Visual Die Protection” or “VDP” for short, which can save die repairs, downtimes, or even complete production standstill. The cameras also detect whether the die is connected correctly and whether the blanks have been correctly inserted, formed and removed. They see cracks in the component as well as possible damage to the centering and ejection pins.

Artificial intelligence analyses images

To detect this, the cameras must first take reference images of the respective die before starting production. The operators mark sensitive areas such as the centering and ejection pins, which require particularly precise monitoring. The artificial intelligence on a separate computer then compares the current photos in real time with the original state of the die in the production process and immediately enables the initiation of countermeasures.

The “VDP Analyser” is a further development to find causes of errors. In the visualisation, fluctuations in the time curve can be used to quickly gain an overview of when exactly deviations from the normal state occurred. The user can now retrieve the images associated with these times in a targeted manner and recognise on them that, for example, parts are on a centering pin and are not threaded or that punching waste accumulates again and again in a certain scrap shaft.

Further development helps to investigate the past

In this way, appropriate changes can be made to avoid future production interruptions and thus increase process stability



With “Cloud Services”, operating status, pressing force, energy consumption, cooling and lubricating circuits can be monitored. (source: Schuler)



The prerequisite is the connection of the system to the Internet with appropriate hardware, which is also possible retrospectively. (source: Schuler)



The electronic assistant “Smart Assist” supports the start of production and accelerates the setup of presses. (source: Schuler)

and ultimately output. The system also enables the export of time series and image data for documentation and later comparisons.

Schuler’s customers had expressed the wish to be able to investigate the past with VDP in order to document errors and identify causes. With conventional cameras, press operators can monitor the die room, but then have to laboriously evaluate the videos themselves afterwards. This work is now carried out by the VDP Analyser.

Drawing edge may indicate deviations

In addition, cameras in the Smart Press Shop monitor the so-called drawing edge of the components. Under constant conditions in the forming process, the shape and size of this drawing edge remain largely identical. If there is a change

here, this indicates a deviation in the material properties, lubrication or pulling forces. In this case, process monitoring provides information to the plant operator so that he can make corrections at an early stage to largely avoid expensive reject or reworking parts.

In addition to the dies, the oil circulating in the plant is continuously monitored to determine the aging of the lubricant. The aim is to change the oil only when its condition really requires it. As a rule, this significantly increases the service life. In addition, the monitoring makes it possible to detect short-term changes in oil properties that indicate contamination with water or foreign particles, for example.

“Cloud Services” run on mobile devices

“Lubrication Analytics” is just one of several “cloud services” of the Digital Suite. The “Production Monitor” provides information, for example, on the number of strokes or the status of the current order. In addition, the pressing force, cooling circuit and the temperature of the drives can be monitored, too. The electrical power consumption of the motors is also one of the recorded parameters.

Both live and historical data can be called up at any time via mobile devices. This allows a comparison of productivity over time periods or depending on certain dies. Deviations can be detected at an early stage and optimisations can be carried out quickly. Based on the historical data, both order planning and component calculation can be carried out more precisely and realistically.

Secure connection to DataLoft

The prerequisite is the connection of the system to the Internet by appropriate hardware, which can also be attached retroactively. This enables communication with the Schuler DataLoft, the central data center for the administration, processing and visualisation of machine and process data via the mySchuler portal. Documents such as the operating or maintenance instructions can also be found there. The data remains the customers’ property. For maximum protection, they flow to the DataLoft via a one-way connection, completely separate from the remote maintenance connection.

In the Smart Press Shop, the documentation of the entire systems is also available in digital form, which can save employees from having to search for a long time. The files can be accessed from any control point with HMI and screen as well as from mobile devices with which all employees are equipped. For faster identification, electrical and fluid power components of the plant are provided with a DMC code.

Beginnings go back to 2016

Schuler had already presented the first digital applications at the EuroBLECH trade fair in Hanover in 2016. Since then, the press manufacturer has continuously developed the solutions and then bundled them in its Digital Suite at the beginning of 2021. Via the virtual product platform, interested parties have direct access to Schuler’s experts, with whom they can discuss specific use cases and request further detailed information. Each product is intended to help reduce unit costs on the customer side and increase the efficiency of machines and systems. Using open interfaces

and standard technologies, they can be easily integrated into existing IT networks.

One of the first solutions was the “Smart Assist” electronic assistant, which was also presented for the first time in 2016 and supports the start of production. Setting up presses is often a matter for absolute professionals: Bringing the machine, transfer, and conveyor system into harmony with maximum productivity requires a lot of know-how and tact. Smart Assist guides you step by step through the process with the help of videos and graphics, optimizes the movement curves of the slide and transfer fully automatically and transmits the data to the overall system.

Optimisation of motion curves

The safety of the parts transport is always guaranteed, and the fully automatic optimisation of the motion curves, including acceleration and adjustment angle, also increases the output performance. Smart Assist asks the operator to move the plunger and the transfer to certain positions one after the other. The “Teach” function stores these positions. In this way, Smart Assist records the minimum necessary transfer lifting stroke and all other relevant data.

Based on the collected information, the optimal movement curves of the plunger and transfer are then calculated, and the determined parameters are transmitted to the press control. The operator only has to press the start button. But the professionals remain in demand: In expert mode, Smart Assist allows the free programming of the motion curves of the slide and transfer – for example, for asymmetrical transfer movements to further minimise distances. This means that the last percent up to the maximum output of a transfer press can be tickled out.

INFO

Schuler and Swiss software forge AutoForm in February announced a collaboration combining AutoForm’s Digital Twin and Schuler’s Digital Suite technologies. The two companies will share their expertise and develop new digital press shop solutions. These new solutions will enable customers to eliminate the gap between the virtual and physical worlds, i.e. between simulation and the press shop, in order to further increase productivity. By combining AutoForm’s finite element based simulation technology with sensor data generated by the press, control parameters for each stamped part can be determined. These can then be transferred to Schuler’s software.

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