

Dynamic shaping process opens the door to “single-piece” flow production

With its roll-forming system for manufacturing truck chassis rails, data M has achieved every production manager’s dream: the ability to manufacture a variety of different geometries and shapes without retooling! A CAD file from a library – in future perhaps even from the cloud – serves as the database for the servo-based shaping process. For the automation solution, data M is relying upon Schneider Electric and its PacDrive motion control technology.

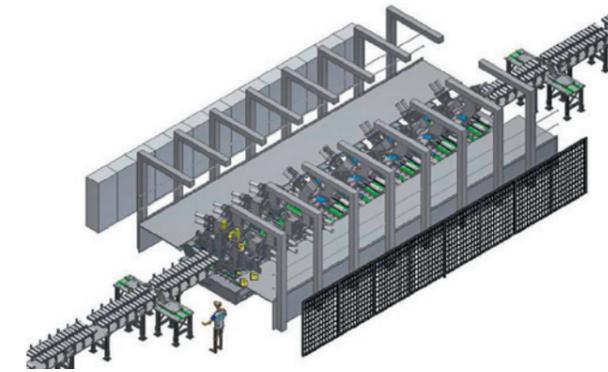


Figure 1: The CAD drawing shows the overall dimensions of the system, which is more than 30 m long.



forming rollers in each unit create the three-dimensional frame section from the sheet metal blank as it passes through the system.

Automation, engineering, and global technical support from Schneider Electric

The system combines sophisticated roll forming and high-end simulation know-how with an automation solution that is no less complex. To create its automation solution, data M brought Schneider Electric on board, both as a vendor of hardware and software solutions and for its engineering services. Based upon the specifications provided by data M, Schneider Electric’s European FlexCenter handled the engineering involved in creating the circuit diagram as well as the control cabinet layout and construction.

Sedlmaier emphasizes what he sees as the critical significance of the partnership with Schneider Electric: “The support we received from Schneider Electric was a decisive factor in our success. Our own development capabilities would not have been sufficient to develop the type of control technology required for this project. We are very happy with this partnership, even beyond the development phase, because it allows us to ensure spare parts availability and technical support for these systems around the world.”

Data M Sheet Metal Solutions GmbH specializes in software development and engineering services for the sheet metal processing industry. Founded in 1987 and headquartered in the Bavarian town of Valley, data M has created CAD solutions for developing tools to produce special profile sections, pipes, and even wire material. It also designs software to simulate shaping processes as well as upstream and downstream production processes. The company’s products include the well-known COPRA® RF software. Leading automotive suppliers worldwide use COPRA® RF to plan their roll-forming processes and conduct shaping simulations in their production processes.

data M recently introduced its own machine solution for the manufacture of three-dimensional rolled steel sections. The system, created for an Asian truck manufactur-



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er, is designed for manufacturing truck chassis rails. Beginning with sheet metal blanks up to 7 mm thickness, it produces three-dimensional sections in a single pass, with profile cross sections that vary along their longitudinal axis. This type of roll-forming system offers significant advantages over traditional pressing methods. The elimination of

mold construction is only one positive effect – the greatest advantage lies in a more flexible production. data M CEO Albert Sedlmaier describes the impressive possibilities: “Our system can use the same tool set to manufacture variable truck chassis rails in a variety of different geometries and shapes, without any retooling.”

The smooth and extremely energy-efficient shaping process is carried out by ten facing roll-forming units positioned along the length of the work area. Each of these units can be moved independently of the other units by means of multiple servo drives. Parallel kinematic elements in the bases of the units allow the shaping frames to be both rotated and translated, while two other drives enable individual adjustment of the rotational speeds in the upper and lower forming rollers. Through synchronous interaction of movements during the shaping process, the

All of the CAD data processing and simulation, which occurs upstream of the forming process itself, is performed on a PC: The installed data M software generates a DXF file, which is then used to calculate the curve data for the controller. Following a simulated collision test, the curve data are then transferred directly to the machine controller.

The system’s automation solution is based upon Schneider Electric’s PacDrive motion control technology. With a worldwide reputation as one of the leading automation

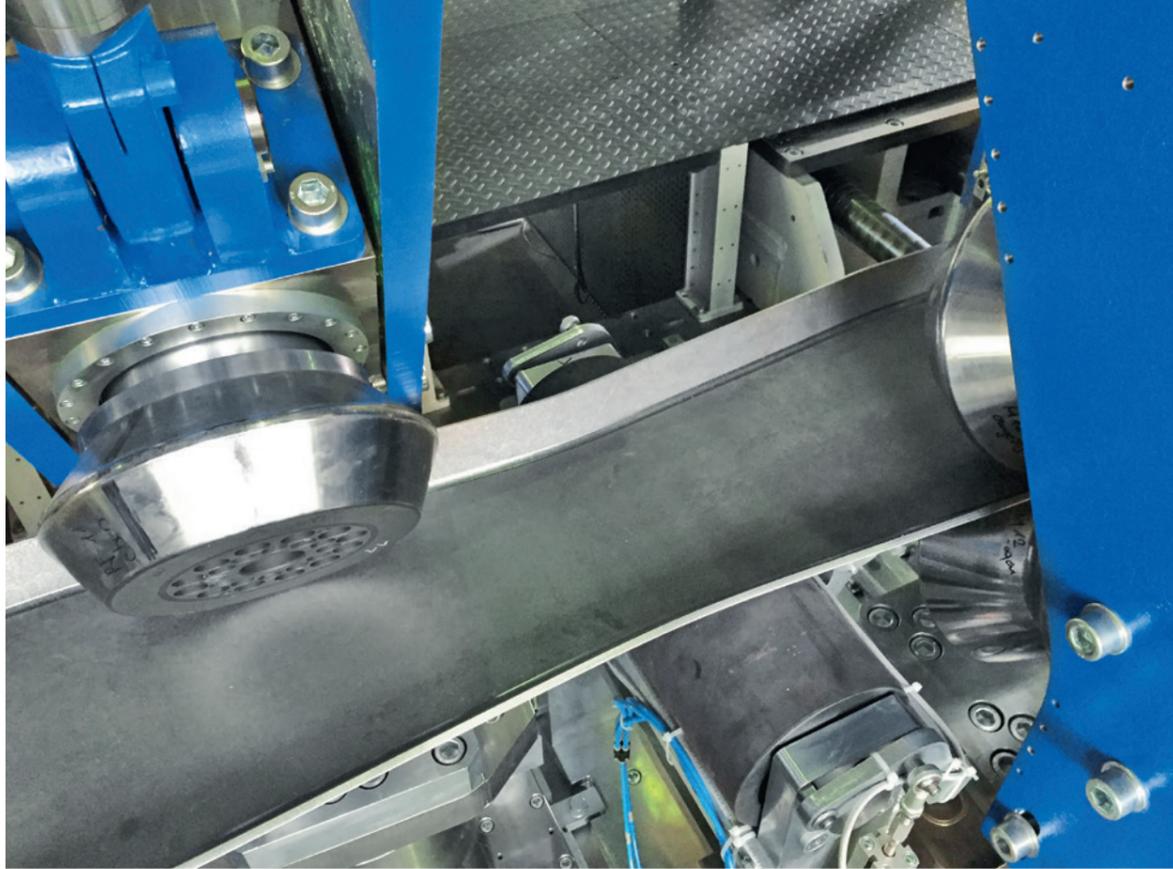


Figure 2: The section passes through the system during the forming process.

solutions in packaging machines for more than 15 years, PacDrive is building on the success of its servo technology and is now increasingly used in processing, production, and assembly processes as well.

100 servo axes receive information via Sercos in millisecond intervals

The solution created for data M is extremely impressive: The 100 servo axes that turn and move the roll-forming units or rotate the forming rollers are all connected via Sercos® with two PacDrive controllers, which share the control of the system.

For this function, data M developed a special machine program with a modular design to allow easy use in other types of roll-forming systems as well. Approximately 1,000 I/O points distributed across 50 I/O islands installed along the entire system can also be connected to the controller via Sercos.

The overall servo solution is based upon Lexium 62 series multi-axis servo drives. It was specially developed for PacDrive in order to reduce the space required in the control cabinet, as well as installation times, for high numbers of servo drives through serial assembly with shared power supply and electrical integration via front-side quick-connects. The electronic name plates on the variable frequency drives and the connected servo motors allow automatic

configuration and firmware comparison in interaction with the PacDrive controllers for easier commissioning, diagnostics, and maintenance.

During the shaping process, the PacDrive servo drives send a positional set point value to each axis every millisecond, and then read the resulting motor current data. The controller then uses special algorithms to independently optimize the speed of the forming rollers and thus the shaping process in terms of energy consumption and surface quality.

The required functionality for safety automation is provided by two Modicon TM5 SLC safety controllers. As part of an embedded safety solution, they use a parallel safety protocol to communicate with the two PacDrive controllers, the servo drives, and the safety I/Os via the standard Sercos bus. Some of the I/Os are “unmixed,” but some are also integrated into Sercos communication in I/O islands with mixed aggregates of safety and non-safety I/Os using standard bus couplers.

Implementation in Industry 4.0-supported processes

Seen as a whole, data M’s flexible roll-forming system is more than just a step towards maximal flexibility for production down to the level of single-piece flow: In principle, it is a CNC solution that can precisely replicate the production of any desired pieces from a prespecified repertoire without retooling operations or fine adjustments. Complex



Figure 3: The entire system is controlled with two PacDrive 3 LMC controllers operating in parallel, below are two safety controllers with a mixed I/O field.

processes have been consistently encapsulated in software, and system operation has been simplified. Advanced simulation as well as online monitoring and correction during the shaping process create sufficient process safety to allow production without specialists on site, using simple CAD files. The system’s motion control technology employs a sophisticated system-internal communi-

cation design with autoconfiguration mechanisms to simplify component exchange during maintenance activities. This creates all the conditions for a physical separation of parts design, production control, and materials management, as well as their linkage via Internet-based information technologies – for production à la Industry 4.0!

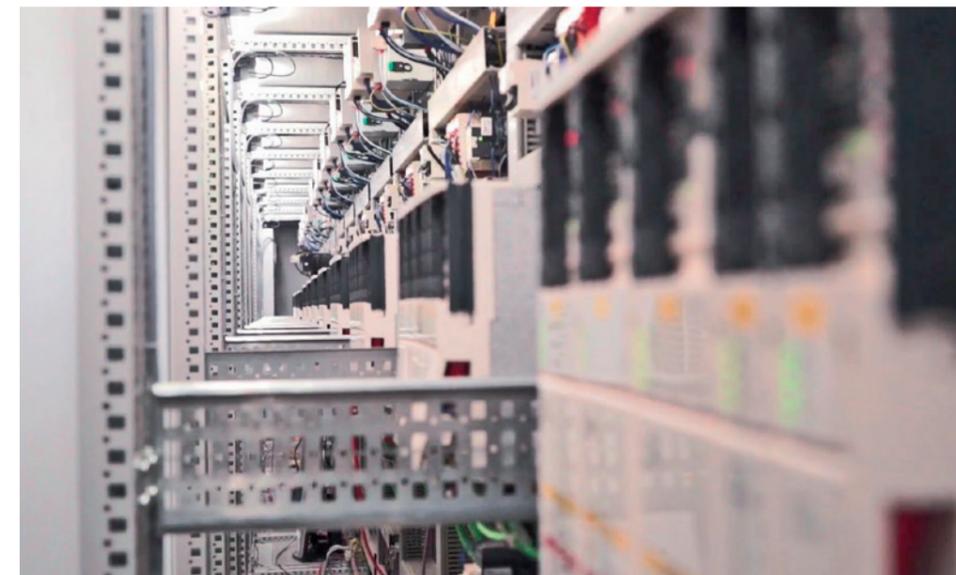


Figure 4: The consecutively arranged control cabinets extend for more than 16 m, here a view of one section of the serially mounted Lexium 62 servo drives.