The Russian company TMP successfully managed to increase the throughput of hot mills by increasing the degree of the production process automation. Programmed control systems and robotic handlers helped them to achieve this aim.

» The qualified professionals at Siemens helped us select and configure the control system and debug the real-time programs on time and within budget.«

Igor Valikov, Leading designer JSC TMP
TMP, based in the ancient city of Voronezh, Russia, is the largest developer and builder of equipment for the country’s metal forging industries. In terms of world presence, of the 17 hot forging presses with pressure greater than 10,000 t in current operation across the globe, 8 were built by TMP. Because of the tough market conditions that the world’s machine tool builders are faced with, companies try especially hard to secure business in their own domestic markets. This is particularly so in the BRICs (Brazil, Russia, India, and China). Against this difficult backdrop, the Russian machine builder TMP was awarded a contract to build an innovative new hot steel rolling project in Brazil. The main task of this project was building a hot rolling press system, called Rollers. The Rollers produce one of the suspension details of trucks and consist of the hot rolling press with special manipulator, the system of transport of hot billet and other technological equipment. For this mill, TMP developed an intelligent automated handling system, called Rollers, to manipulate the hot working material.

**Automating complex procedures**

The technological algorithm of rollers is divided into several parts. First, the general receiving manipulator transfers a red-hot billet to the feed conveyor by an exactly defined path calculated according to the safety standards. The feed conveyor transfers the billet to the roller manipulator, which grips the billet and begins the multiple rolling process. Each roll has four deep grooves. A billet is rolled through couple rolls which are formed in the shape of a billet. Usually after four forming cycles, the roll manipulator transfers the billet to the outfeed conveyor, which in turn transfers the billet on to the next manufacturing stage. The control system within rollers performs a variety of important tasks. In addition to the precision movement of the working material, it controls system temperatures, the hydroelectric equipment, and braking control. The PLC also coordinates the functioning of the rollers with other systems such as the furnace and other handlers, with communication passing via Profibus.

**Drive-based motion control platform**

The intelligent control driving the rollers is based on Simotion D435, a compact drive-based motion control platform combining motion control, logic control, and drive control within a single hardware environment. Simotion is the natural successor to earlier PLC approaches based on the S7-300 platform. Its greater power enables a larger volume of programs to be run simultaneously. For the main drive, Sinamics S120 was chosen. Sinamics S120 is a modular motion control drive system for complex tasks. It carries out the complex motion control of two axes of the roller manipulator, with each axis being equipped with 5 kW Simotics S-1FT6 motors. The distributed I/O system is an ET 200M station, connected to the Simotion D435 via Profinet. The control provides the operators with system information such as the drive operating hours, number of cycles, axis drive currents, and fault reports. For the Rollers project the programs are written using Simotion Scout, the network topology is performed in NetPro, and the HMI is provided via WinCC Flexible. These different systems all integrate seamlessly with the hardware platform. The open system integration enabled the TMP engineers to clearly specify and implement scalable solutions for complex technological tasks.

**Variable behavior**

The main challenge in developing the rollers was the two-axis motion control of the roller manipulator. When a hot billet is rolled, its shape changes dramatically, with each billet behaving in a slightly different manner. Because of this variance, the precise position of the billet as it exits from the rollers cannot be predicted by mathematical modeling. In order to achieve accurate control of the handling, a motion control system with on-the-fly switching of control algorithms for each axis was developed. The main principle of the algorithm is the capability to switch from master to slave mode on-the-fly. With the sophisticated control system implemented by TMP, the roller achieved a throughput of 130 billets per hour. This Rollers project was TMP’s first motion automation project using Simotion controls and Sinamics drives. Despite their relative lack of experience with this environment, the TMP engineers were successful in accomplishing an ambitious project that included the fast switching algorithms for the roller manipulator. The experience gained opens up opportunities for TMP in the development of further complex integrated machines.