Durrer: PC-based control and drive technology for fully automated paper and print processing

Integrated automation system optimizes wire binding

Durrer Spezialmaschinen AG, based in Küsnacht am Rigi, Switzerland, develops a wide range of specialized machines and has built up comprehensive expertise, in particular with regard to complex motion control systems. Based on integrated PC-based control and drive technology from Beckhoff, such a system was recently implemented in a line for the production of desktop calendars and notepads, which has an overall length of almost 20 m.
The complexity of the production process is evident from the size of the line alone, which is almost 20 m long, 1.4 m wide and 2 m high. A total of 69 servo axes, which feature AX5000 Servo Drives from Beckhoff and various One Cable Technology (OCT) servomotors from the AM8000 series, are used for the conveying and precise processing of calendar sheets. Patrick Suter, Head of Development at Durrer, explains: “The system consists of a SIX-CUT cutting machine with 18 servo axes, which is controlled by a CX2020 Embedded PC, and a WIRO4 punching and binding line, which is equipped with a C6640 control cabinet Industrial PC and 51 servo axes. It can produce print products with wire binding and in formats ranging from 140 x 90 mm to 380 x 240 mm. An innovative feature of the plant is the format- and thickness-independent processing capacity of around 2200 products per hour.”
In the SIX-CUT machine, the sheets are cut to the appropriate size and transferred to the WIRO4 main system for binding via a grip feeder. This system starts with two feed stations for optional advertising pages – on the front and back of a desktop calendar or notepad. The products, which are conveyed in a horizontal position, are raised into a vertical position and then divided into 1 to 2 mm thick subunits for punching. Patrick Suter explains: “The punching technology and the drive performance would allow the processing of larger paper bundles. However, the punching quality would be inferior. Therefore, the book blocks transported through the system are split into piles and distributed across two to eight lanes in a two-stage unit, depending on the thickness of the finished product. The subunits are then recombined and put down, so that the front and back covers and the binding wire can be added. In this way, the system operates with a high degree of flexibility, making format and product changes possible with minimal changeover times.”

**Connectivity for Industrie 4.0**
The hardware and software of the system was designed so that it is Industrie 4.0-ready and guarantees seamless integration with higher-level systems. The transfer of production data to an ERP system is also enabled. In addition, the system operates in a network of different machines from different manufacturers without communication problems.

A gathering machine from a renowned Swiss manufacturer is installed upstream from the WIRO4 and SIX-CUT machines from Durrer. An external label printer and a comb former are also integrated within the Durrer system, and a packaging system is installed downstream of the line. All of these machines are interconnected and coordinated in order to achieve the highest possible performance and productivity of the overall plant.

**Large number of moving mechanical components require high-performance control technology**
According to Patrick Suter, the large number of moving mechanical components places high demands on the control technology: “The system integrates a great deal of drive technology, including about 100 pneumatic and hydraulic functions. This requires highly-efficient control technology in combination with high-performance drive technology, ensuring that the system capably meets future demands. PC-based control from Beckhoff offers all of this, plus the benefits of an open, highly flexible and innovative system. An additional benefit is excellent support for the optimization of servo axes, for example, both from Beckhoff Switzerland and from the experts at the Beckhoff company headquarters in Verl, Germany.”

For Patrick Suter, the modularity of PC-based control is particularly important in several respects: “With the wide range of Beckhoff Industrial PCs available, the computing power is optimally scalable to suit each individual application. In addition, the I/O system can be conveniently realized via decentralized I/O “islands”, which can be expanded as required. This is especially true for the EtherCAT Box I/O modules, through which 80 percent of all I/O data is captured in our current system. On the control side, modularity is also well supported through simple engineering and convenient machine-to-machine communication via the EtherCAT Automation Protocol (EAP). EAP exchanges ready signals as well as speed and product data between the SIX-CUT and WIRO4 machines. The same applies to the software, which also constitutes...
an open, modular and easily expandable system. This means that we can adapt basic programmed functions without great effort and reuse them in new projects."

Due to the size of the line and the large number of drive technology components incorporated in the overall system, One Cable Technology (OCT) is another key benefit for Durrer. Patrick Suter explains: "Most drive technology cables have a length of 20 m or more. Accordingly, the OCT single-cable solution enables significant cost savings. In addition, cable routing and handling are simplified enormously, not to mention the fact that we can use smaller drag chains and the need for cable channels is reduced."

One software for all control tasks
TwinCAT control software ensures efficient implementation of the numerous motion tasks. The visualization based on TwinCAT PLC HMI provides a comprehensive overview of machine status information, while TwinCAT NC PTP enables highly accurate and dynamic positioning of the servo axes. Patrick Suter points out: "Our system makes extensive use of electronic and dynamic transmission units for reliable coupling of servo axes. In addition, the override function is used to vary speeds within the system for synchronization with the upstream gathering machine, which communicates with the SIX-CUT via OPC UA. All of this can be realized very conveniently via the corresponding PLCopen function blocks from the extensive motion control library provided by Beckhoff."

According to Patrick Suter, the implementation of safety functions within the machine, such as emergency stops, light curtains, protective doors and gates, also benefits from the universal system integration of PC-based control: "This high degree of integration enables the TwinSAFE logic EL6900 safety control to access the machine states stored in the PLC. This information can be transferred very conveniently to the AX5000 drives equipped with AXS805 TwinSAFE cards via the Safety-over-EtherCAT protocol. They can also be easily processed using the safety function blocks for the SOS, SS1, SS2 and SLS safety functions. The two EL6900 safety controllers in the SIX-CUT and WIRO4 machines also communicate via EAP in a multi-master network."

Innovative control technology for future-proof engineering
Consistent development of advanced control technology opens up high potential for innovation in engineering. According to Patrick Suter, the broad, scalable range of PC-based control components is already well proven in many ways: "So far, we have been able to meet all the diverse requirements of our special-purpose machines with the control and drive technology supplied by Beckhoff. Alternative options are available should the components in the standard range reach their limits. For example, eXtreme Fast Control (XFC) and oversampling were used in some machines to realize extremely fast signal processing, with seamless integration into the overall system. This optimum scalability applies to all areas, from small controllers to high-performance Industrial PCs, from compact drive technology in I/O terminal format to complex servo applications. PC-based control also helps us find the optimal solution for future requirements with innovative approaches, such as the XTS linear transport system."