



Integrated control and drive technology in a versatile door frame production line

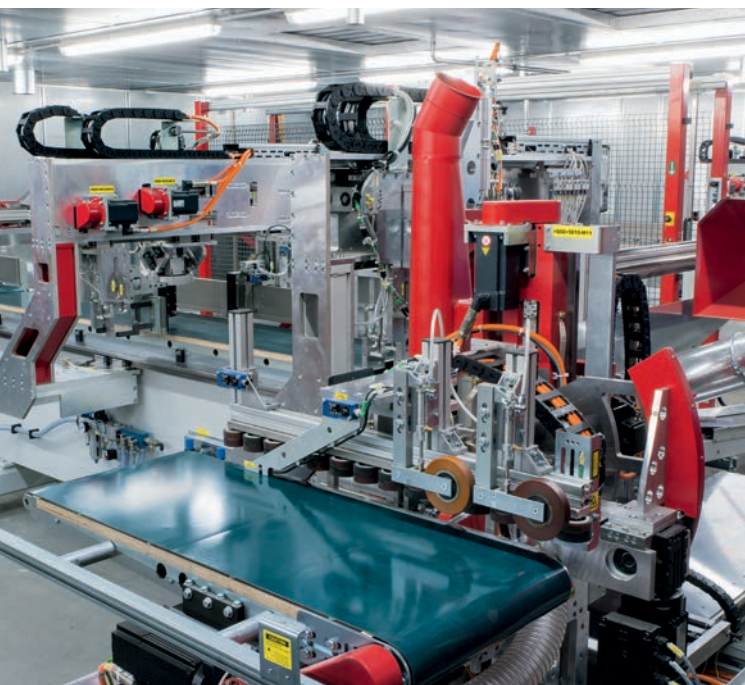
Scalable PC Control solution combines high-end PLC performance with CNC functionality

Specialist machine manufacturing company, Kraft Maschinenbau was tasked by a major door manufacturer to develop a system for producing high-quality door frames as quickly and flexibly as possible, with production runs down to batch size 1. These requirements were successfully implemented in a complex production line based on PC Control from Beckhoff for all PLC and CNC requirements.



The company, G. Kraft Maschinenbau GmbH, based in Rietberg Mastholte, Germany, manufactures specialized machines for a wide range of industries. Its product and service portfolio includes design, construction, programming and commissioning of individual machines, automation systems, and complete, fully-automated production lines. The company has established particularly extensive expertise in door and frame manufacturing, as Tobias Walkenfort, Head of Automation Technology at Kraft, explains: "Our customers benefit from the fact that they receive mechanical systems and automation technology from a single source, combined with many years of experience. The finely scalable and integrated control and drive technology from Beckhoff ideally supports the implementation of individual requirements."

A current example is the company's new door frame production line, created for a major Westphalia-based manufacturer of doors with real wood veneers. The complex line is 46 meters wide and 110 meters long. Compared with compact machining centers, it offers an optimum balance of capacity and product flexibility. Tobias Walkenfort: "The cycle time is an impressive 20 seconds, which means the system is capable of producing three complete door frames per minute, consisting of two longitudinal members and a cross member." Andreas Wapelhorst, Technical Director at Kraft, adds: "The considerable capacity of the production line becomes clear if one considers that we do not just produce standard doors. The system enables very flexible, mixed production of a large variety of components and products, right down to batch size 1. This does not merely relate to the frame size, but also to different materials, décors, seal types, and fittings."



PC-based control technology not only deals with the typical PLC tasks in the production line, it also controls frame processing in CNC machines.



At a glance:

Solutions for woodworking

Door frame production with PC-based control and drive technology

Customer benefits

Flexible, user-friendly production line for high performance down to batch size 1

Applied PC Control

- C6930, CP3921: powerful, scalable control cabinet PC and state-of-the-art multi-touch panel
- EtherCAT: high-performance, integrated communication architecture
- OCT drive technology: reduced costs and installation efforts
- TwinCAT 3: Visual Studio® integration, multi-core support, PLC and CNC functionality



The CP3921 multi-touch Control Panel of the master computer with additional electromechanical buttons features a durable glass front along with a high-quality and attractive design.



(f.l.t.r.) Carsten Seidenberg, Project Manager at Kraft, Stefan Sieber, Business Management Woodworking at Beckhoff, Andreas Wapelhorst, Technical Director, and Tobias Walkenfort, Head of Automation Technology at Kraft, inspect the layout of the new door frame production line.

System layout aimed at flexibility and high production runs

Typical machining centers, where a single machine deals with the entire production process, are particularly suitable for producing special doors in small quantities. A decentralized system – such as the new frames production line – distributes the various processing steps to several machines, making it better suited for high-volume series production. At the same time, the Kraft system is flexible enough to handle batch size 1 production, achieved through individually-designed line layout as well as integrated control and drive technology.

The process begins with feeding and separating the stacked lining boards. A bar code reader identifies each part, so that it can be combined with the matching rebate and decorative trim. The raw parts produced on two parallel processing lines then have to be divided onto three lines – one for the cross member, and two for the longitudinal parts – in order to ensure high throughput despite the more time-consuming end, hinge, and strike plate processing and the subsequent automatic hinge and strike plate assembly. Insertion and cutting of the seals is followed by dismantling of the individual frame components for final packaging at manual work stations.

PC-based control, the integrated and scalable system

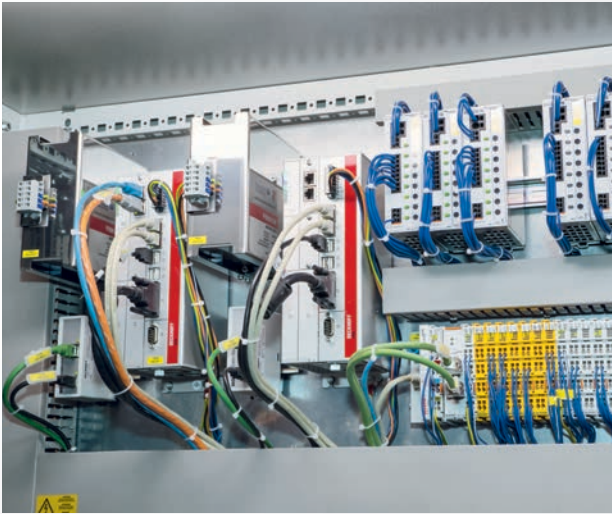
The production line relies on PC-based control throughout. Tobias Walkenfort explains one of the main reasons: "The high performance of PC Control was one of the key advantages for us. The PLC technology we had used previously was increasingly reaching its limits, meaning that additional, higher-level controllers would have been required, for example in coordinating the various parts transport steps. Another factor was the good scalability of the Beckhoff control system, not least with respect to the software. Our production line requires very high PLC functionality, but also includes a certain amount of CNC tasks. This could be optimally implemented, thanks to the high scalability of PC-based control and the TwinCAT software."

For Tobias Walkenfort, another advantage is the powerful and integrated communication technology offered by PC Control: "As the I/O and drive bus, EtherCAT offers very high performance, simple commissioning, and is used widely, including by numerous third-party suppliers. Communication via TwinCAT ADS between the control and production management level offers the additional advantage of automatic reporting of changes in control data. This eliminates the need for data polling, which is required with conventional PLC technology, considerably reducing the network capacity and response times. Other benefits include real-time Ethernet communication between individual controllers, including transfer of safety-relevant data. It enables convenient realization of process enabling between the individual production areas."

According to Tobias Walkenfort, Kraft benefits from the openness of the Beckhoff system overall, as evidenced in the realization of a unified operating concept for PLC, CNC, and the production master computer. After all, it is important that a system with such a high degree of complexity is easy to operate in practice. The openness of the system is also a key factor when it comes to integration into the company network, to ensure convenient remote maintenance and individual coupling of the production master computer to the customer's central data infrastructure. For the latter, Kraft implemented the corresponding data exchange as an additional service.

Dynamic servo drive technology that is efficient to install

The complexity of the system necessitates extensive drive technology. In some of the production line sections, more than 30 Beckhoff servo axes per control computer ensure very precise and dynamic processes, which can be easily controlled via TwinCAT, as Tobias Walkenfort explained: "The PLC technology we used in the past would have reached its performance limits in this respect, especially since the systems demanded by customers are becoming increasingly complex. PC Control offers far more options and flexibility."



A total of eleven CP6930 control cabinet IPCs, i.e. one master computer and ten control computers, ensure precise and flawless production processes, in conjunction with numerous EtherCAT Terminals (below) for almost 3,800 digital inputs and more than 2,100 digital outputs.

The line includes 126 Beckhoff servomotors of the AM8000 series. Along with around 90 servomotors from third-party suppliers, they are controlled by a total of 213 servo drives of the AX5000 series. Andreas Wapelhorst adds an important aspect: "Due to the large number of drives, One Cable Technology (OCT) has been particularly beneficial for us. This single-cable connection technology saves time during installation and permits smaller drag chains, resulting in significant cost savings in view of the large cable lengths required in our systems. In addition, the smaller number of cables makes the system tidier."

Architecture with one master computer and ten control computers

In addition to the numerous servomotors, the complexity of the system is illustrated by the large number of digital inputs and outputs: more than 3,700 inputs and 2,100 outputs are implemented via EtherCAT Terminals. This includes more than 400 fail-safe TwinSAFE inputs and 100 TwinSAFE outputs. All safety functions were implemented in conjunction with the safe servo drives. Examples include emergency stops and the monitoring of protective doors, light curtains, and rotary scanners for the trolleys that move around the system.

The system is centrally controlled by a C6930 control cabinet IPC that acts as production master computer. It features an Intel® Core™ i7 processor, a CP3921 multi-touch Control Panel with 21.5-inch widescreen display, and push-button extension. Tobias Walkenfort explains the importance of the Control Panel: "The look is an important aspect for us. The Control Panel gives a high-quality and design-oriented impression. An additional advantage is the durable glass front and the capabilities offered by multi-touch functionality, enabling future functionality." The high computing power of the C6930 is necessary because it manages 10 distributed control computers. These are also C6930 control cabinet PCs, equipped with Intel® Core™ i3 or i5 processors, or indeed i7 in the CNC environment.

Integrated automation software for PLC and CNC tasks

Kraft uses TwinCAT 3 automation software, which offers numerous advantages, as Tobias Walkenfort explained: "First, we benefit from the integration with Visual Studio®, because we already use this standard IT tool to create our own visualization and production master computer applications. Thanks to the integration of TwinCAT 3 in Visual Studio®, we now also benefit from IEC 61131-3 programming options, so that all the programming languages required for the automation of machines and systems are available in one flexible tool. The option to use powerful yet user-friendly source code management tools is an added advantage. In our case, this is the Microsoft Team Foundation Server (TFS), which is fully supported by TwinCAT 3."

Further advantages arise from the integration of the different functional areas in the control software. For example, in all CNC processing machines, Kraft uses the comprehensive multi-core support of TwinCAT 3 in order to run PLC, NC, CNC, and visualization separately on dedicated processor cores. Tobias Walkenfort explains: "This results in much improved access times to the drive controllers. To start, we had integrated all the functions on one core, which was problematic in terms of the drive technology and CNC due to the position control cycle times. These are now much shorter, so that such problems no longer occur." The performance capability of the software meets the stringent requirements of the application: "For our multi-channel CNC machines, we use the TwinCAT 3 CNC Channel Packs. This enables us to equip our machines with up to 12 CNC channels."

Further information:

www.kraft-maschinenbau.de

www.beckhoff.com/EtherCAT

www.beckhoff.com/TwinCAT3

PC Control as the standard

Kraft consistently uses PC-based control and drive technology from Beckhoff. At the end of 2014, two further systems which were almost as complex were created for major door suppliers:

- One system contained more than 1,300 digital inputs and almost 1,000 digital outputs, more than 200 TwinSAFE inputs and more than 40 TwinSAFE outputs, as well as 86 Beckhoff servo axes
- Another system was equipped with more than 1,000 digital inputs and almost 800 digital outputs, almost 200 TwinSAFE inputs and more than 30 TwinSAFE outputs, plus 84 Beckhoff servo axes