

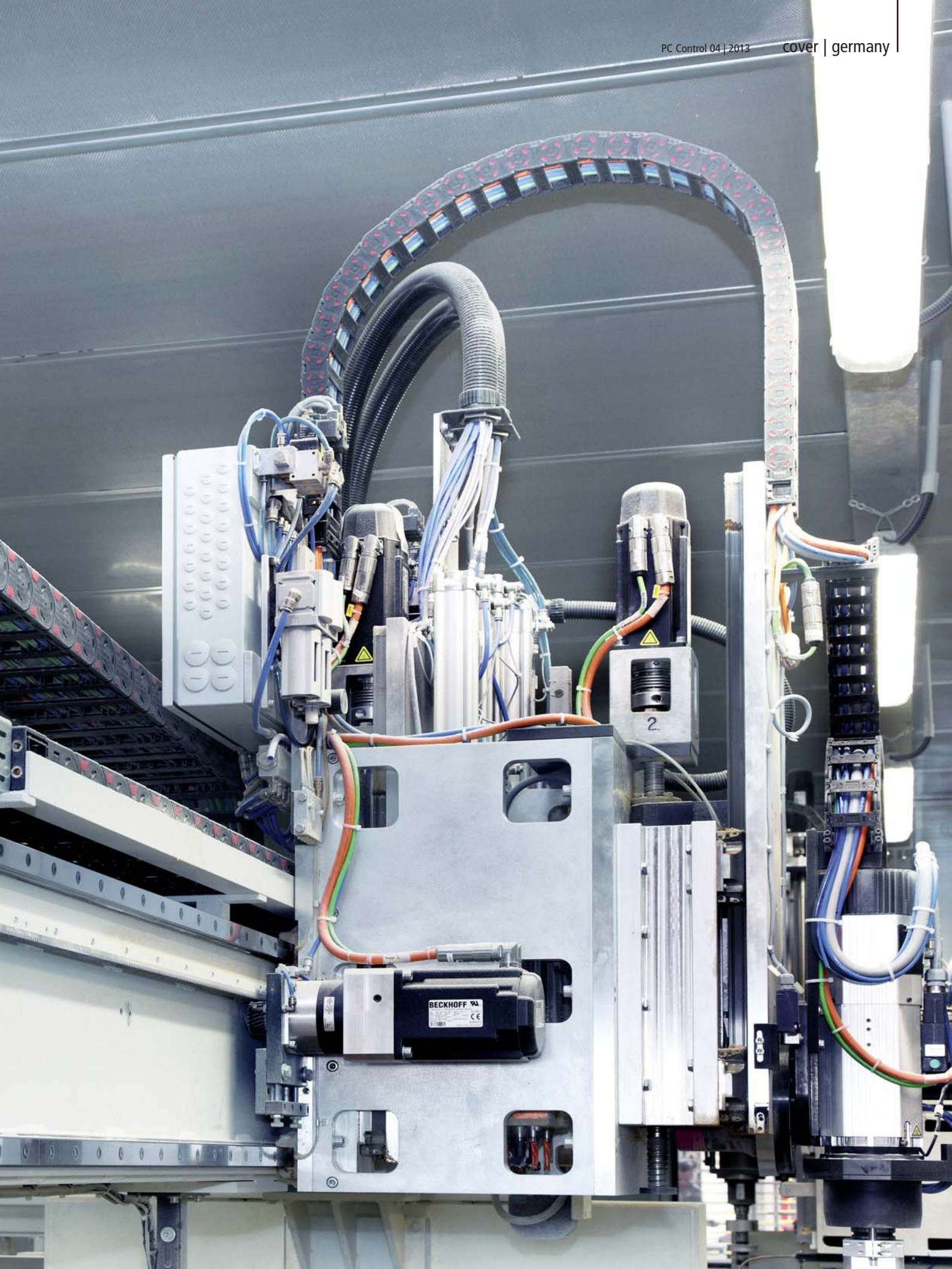
PC control in a production plant for wooden
and wood/metal windows

CNC machining center: with a single system to the individual finished product



More flexibility, speed and efficiency in production – this was the aim of French manufacturer Bieber who specializes in windows and doors. To this end they commissioned Koch Maschinenfabrik to build a new production plant that would set new standards in terms of sophistication and flexibility. Based on plenty of expertise and a strong investment commitment, the aim was achieved using PC- and EtherCAT-based control technology from Beckhoff. In addition the Bieber quality windows benefited from a genuine technical evolution.







With more than 50 years of experience, Gerhard Koch Maschinenfabrik GmbH & Co. KG, based in Leopoldshöhe, Germany, has become a leading supplier of top-quality machines for the production of furniture, doors and timber windows. The plant manufacturer specializes in machines for sawing, milling, drilling and, especially, for gluing and dowelling. This extensive know-how is what attracted the window and door specialist Bieber SA, based in the Alsatian town of Waldhambach, when the time came to modernize their production facilities with a new main production system.

Quality and flexibility as key requirements

Koch's main requirements for the new CNC machining center Winline-6 were safeguarding and possibly even increasing the high product quality and maximum flexibility right down to lot size 1. Both are key success factors in the market for wooden windows and doors. After all, the company even deals with private customers demanding custom products in small series or individual pieces.

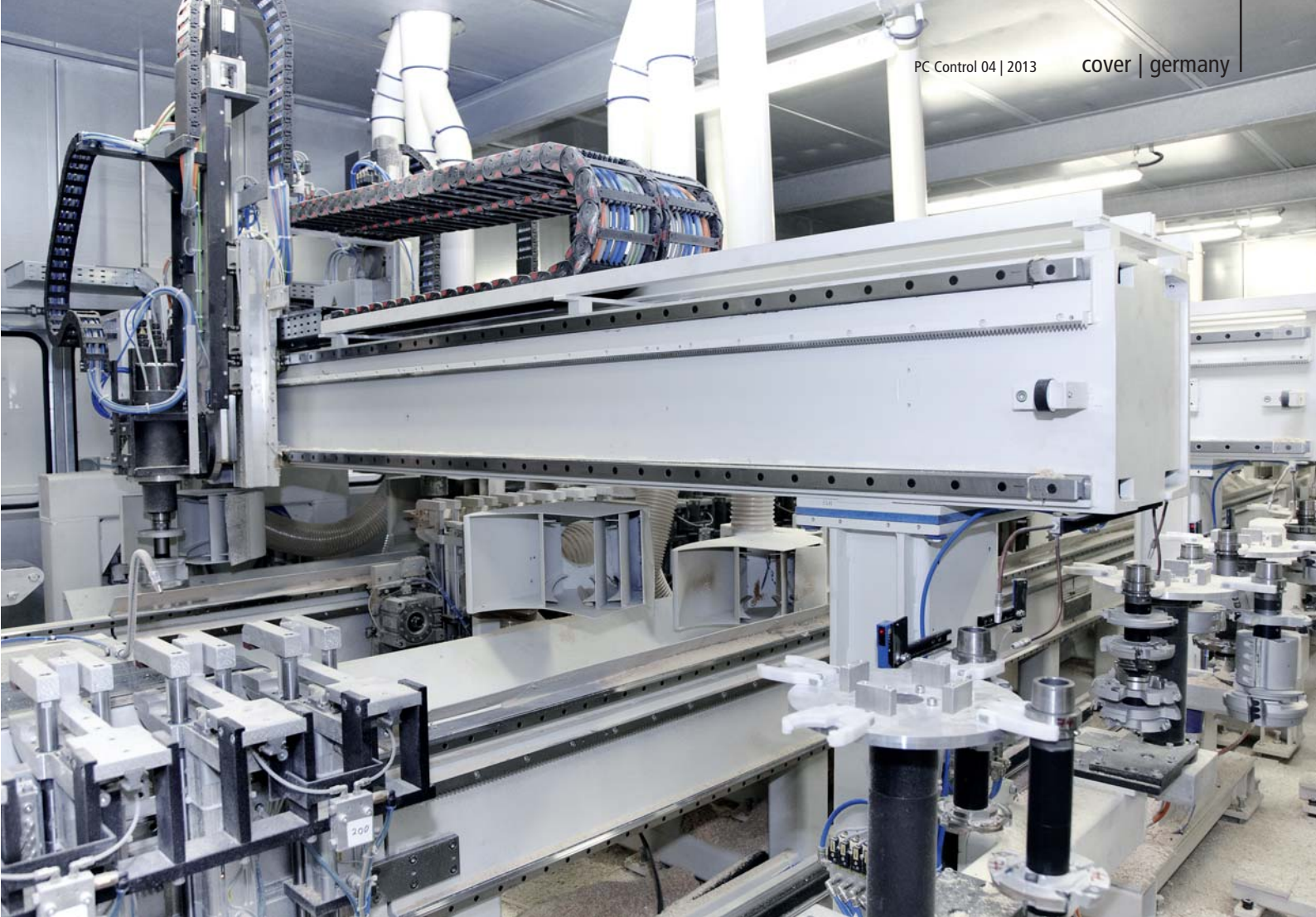
The result is a unique, modular woodworking machine, which, notwithstanding its size and complexity, only requires two operators. It handles all parts of a wooden window right up to the individual finished product – for wood/metal windows including the application of brackets for aluminum panels – so that the window is ready for coating. Although the new production plant for

Bieber is based on the tried and tested modular Koch system, it was tailored to meet the requirements of the window specialists, which included the in-house development of software for the PC Control master computer.

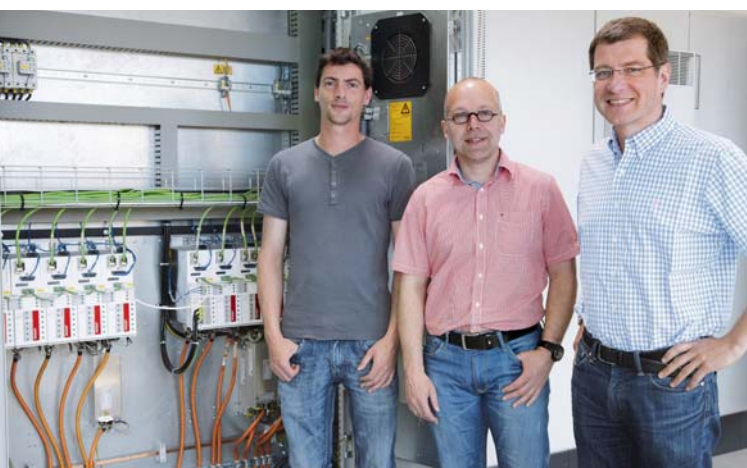
A complete machining center from one source

The machine manufacturer Koch developed the Bieber production plant completely in-house. Only the upstream planer, which was also automated with TwinCAT as requested by Koch, was sourced externally and then seamlessly integrated in the system. Koch's actual Winline-6 plant consists of five modules: the intermediate parts store, the three processing modules – Winline-600, Windoor-LU und Winline-6000 – arranged in a U-shaped configuration, and the tool changer with shuttle system located in between.

Koch uses EtherCAT and TwinCAT NC I software for transferring and processing control data within the individual machine modules. This was a prerequisite to meet the high requirements for axis synchronization of the servo-controlled and independently operating tension jacks in the Winline-600 processing module, for example. Oliver Bexte, software Development Manager at Koch, explains: "Each of the two Winline-600 processing sections may contain up to six individual components, i.e. twelve parts in total, at any one time. The high processing performance and short cycle times require very fast control technology. We therefore operate the NC with a task with 2 ms speed and precision, the



The tool change systems from Koch minimize processing times, since the plate changers are supplied with tools for subsequent processing steps via look-ahead functionality, thereby eliminating waiting times.



(from left) Yves Kuhl, Plant Designer at Bieber, Oliver Bexte, Software Expert from Koch, and Philippe Beyer, Managing Director from Bieber in front of the control cabinet for the Winline-600 processing unit.

cam-plate axes even at 1 ms." Based on the proven track record over many years, Koch uses Beckhoff automation technology for all its NC-controlled machines.

The different machine modules exchange higher-level data via real-time Ethernet. The communication with the master computer – which is used for the calculation and allocation of the production data, parts tracking and tool management – is based on TwinCAT ADS.

The high complexity of the plant is reflected in the key data of the automation system: C6140 control cabinet Industrial PCs with RAID system from Beckhoff are used as control computers in all modules and as master computer. They are operated via customized Beckhoff touch panels with push-button extension. Including the upstream planner, a total of 102 servo axes have to be controlled. In addition, the EtherCAT system has 1804 digital inputs and 1516 digital outputs, numerous analog I/Os and TwinSAFE terminals – for realization of a start-up lock and a global emergency stop – and several other terminals, such as the EL6001 for connecting RS232 devices.

Five modules for the production process

The first module of the Bieber production plant is the intermediate parts store with shelf trolleys from which the plant is automatically supplied with raw ma-

terial in the form of timber beams that are up to 6 m long. In order to minimize waste, the material supply is organized based on the overall order, rather than in relation to individual timber beams. An order can comprise of up to 196 individual components, which are allocated from the intermediate store on a frame-by-frame basis. The complex process is controlled via four AX51xx servo drives, four EK1100 EtherCAT couplers, 28 digital EL1004 input terminals and 37 digital EL2004 output terminals, plus a total of 30 I/Os in protection class IP 67, in the form of EP1008, EP2008 and EP2028 EtherCAT Box modules.

The subsequent Winline-600 module has three processing stations, so that up to six workpieces, which are transported through the plant on two conveyor sections, can be processed independently and simultaneously. The process steps include saw cutting with waste wood disposal, horizontal drilling for dowel joints, drilling for installation holes and corner hinges, strike plate installation and milling of face profiles. The module is controlled and monitored by 13 AX51xx and 11 AX52xx servo drives, 12 EK1100 EtherCAT couplers, 106 digital EL1004 input terminals and 127 digital EL2004 output terminals.

The third Window-LU module is the processing unit for length-independent drilling and dowelling. Two AX51xx and AX52xx servo drives, four EK1100 EtherCAT couplers, 39 EL1004 EtherCAT Terminals and 43 EL2004 EtherCAT Terminals ensure precise workpiece positioning and therefore exact drilling and dowelling. The maintenance-free monitoring system for correct glue application developed by Koch ensures high manufacturing quality when the dowels are applied.

The last processing module before the workpieces are queued or fed directly to the frame press is a Winline-6000 unit, where the workpieces are profiled longitudinally; first inside then outside. Up to four processing motors per side are used, depending on how the tools are allocated. A special feature is that all four motors can plunge and emerge on the fly, as required, thanks to TwinCAT cam plates, independently of each other and very dynamically, so that profile changes are smooth and fast, without the need to stop the main axis. The control system for the module comprises 20 AX51xx servo drives, 14 AX52xx servo drives, four EK1100 EtherCAT couplers, 238 EL1004 EtherCAT Terminals and 152 EL2004 EtherCAT Terminals.

The fifth module, the tool change system, sits between the Winline-600 and Winline-6000 processing units. Via a shuttle it supplies the ten plate changers for the processing units with the tools required for the next processing step, controlled via the master computer based on look-ahead functionality. In this way downtimes are eliminated, further reducing the processing times. The devices used in this module include 23 AX5xxx servo drives.

Customer requirements optimally implemented

The customer requirements in the market for high-quality wooden windows are the yardstick based on which the new production plant is measured. Bieber's Managing Director Philippe Beyer explains: "We cover the whole range from standard windows to individual products. We are renowned for high quality, particularly in the important and demanding US-American market, where Bill Gates is one of our customers, for example. Key aims were therefore increased flexibility, higher productivity and improved product quality, which is why we were looking for a new, innovative plant from Koch. In the meantime it has become evident that our products have experienced technical evolution thanks to the Koch plant." Yves Kuhl, Plant Designer at Bieber, said: "The high requi-



The modular woodworking machine from Koch covers all process steps required for window production.

rements resulting from short production times are optimally satisfied thanks to the high performance and positioning speed within the plant. On average we achieve a throughput of two workpieces per minute and therefore an output of around 800 window components per shift. Moreover, the Koch plant offers many innovative functions, such as profile changes, that were not possible with the previously used individual systems. Above all, the end product is a finished product with all the required holes and dowels that simply has to be pressed."

PC-based Control technology from Beckhoff has already been tried and tested in everyday practice at Bieber for a long time, as Ralf Steube, Chief Designer for window and door production machines at Koch, explains: "Two of our machines that are controlled with Beckhoff technology were installed at Bieber over ten years ago and are still operating extremely reliably. PLC-controlled machines therefore became a thing of the past quite some time ago. With the new plant, Bieber once again benefits from comprehensive PC Control expertise." Oliver Bexte, Software Expert at Koch, added: "With our new plant Bieber covers around 80 % of their production. A quick response in the event of a system shutdown is therefore crucial. This is one of the reasons why we use Beckhoff control technology throughout. The same PCs, EtherCAT couplers and I/Os are used anywhere in the system, so that in the event of a fault components can be replaced quickly and easily, quite often even without having to call in a service technician." Philippe Beyer sees another benefit: "The PC technology also sim-



Key requirements for the production of top-quality wooden windows at French specialist company Bieber are precision and flexibility.



The C6140 computers for the individual machine modules are operated via custom-made Beckhoff touch panels with push-button extension.

plifies interfacing with the ERP level. All production data are transferred from the ERP system directly to the Koch master computer, i.e. the plant is optimally integrated in our company network. This coming year we intend to rebuild our production EDP, which thanks to the process and material flow optimization offered by the new plant, will also become much simpler.”

Further Information:

www.kochtechnology.de

www.bieber-bois.com