



Integrated solution with PC-based control technology

→ Machine manufacturer IMA Klessmann GmbH Holzbearbeitungssysteme in Lübbecke Germany is putting his money on the Industrial PC. With its innovative and reliable machines and equipment, the company is one of the important added value partners for the furniture industry. The partner: Beckhoff from Verl. Together, they realized a concept for the PC-based control of edge processing machines.

Beckhoff has made a name for itself globally with PC-based control technology, while a large number of the woodworking machines installed worldwide carry the name IMA. Now both companies have built a fully PC-based control technology for the new "Combimat®" machine generation, thereby developing an optimized solution for the processing of furniture parts. The customers of the machine manufacturer will benefit from this new approach through higher performance and simpler machine operation.

Building on powerful standards

The crucial factor for the decision towards the PC was the incomparably high performance of the PC technology and continuous progress in this sector. The further development of worldwide standards, represented by companies such as Intel and Microsoft, forms a solid foundation of increasing acceptance of the PC technology. The opportunity to be able to meet nearly all functional requirements of a machine with one and the same medium, i.e. the "PC" and standard software products, is an advantage that leads to significant simplifications in control technology and thereby to cost reductions.

Beckhoff has been using this technology for many years and offers a comprehensive program consisting of Industrial PC, Control Panel, distributed I/Os and interface cards for all common fieldbus systems. Together with TwinCAT, the software PLC and software NC, they form an integrated control system." The idea of an integrated PC-based control technology occurred to us more than 10 years

ago, as soon as the first computers for process visualization and for design management appeared," describes Ralph Januschewski, software developer at IMA. In a new machine line for edge processing, installed for the first time at Rabe & Meyer Rotpunkt kitchens in Germany, a portal from IMA Meinert for feeding and separation of plate stacks, a double-end tenoner (FBA) for the format processing and two double-sided "Combimat®" edge processing machines from IMA Klessmann are used. The system also comprises a drilling and dowelling machine from IMA Nottmeyer and finally a further portal for stacking. Between the individual machines there are various transport and handling devices, bringing the workpieces into the exact starting positions for further processing.

"All machines within the production line, except for the drilling and dowelling machine, are controlled by Beckhoff Industrial PCs with integrated TwinCAT software PLC/NC. The control units are networked via Ethernet TCP/IP. A higher-level machine control computer is responsible for co-ordination and control tasks for the complete machine line such as parts tracking, setting up of the units, processing of machine messages. It also provides a central modem connection for all machines", explains Peter Klemme, who is responsible for continuous processing machine control at IMA Klessmann. "Until now, we used a variety of different control components, some of which we had developed ourselves. However, these components are beginning to reach their limits in terms of performance and also require increasing maintenance efforts."

IMA Klessmann GmbH
woodworking systems,
Lübbecke Germany
edge processing and
CNC processing centres

With now over 900 staff, the IMA-Klessmann machine factory, founded in 1951 by Erich Klessmann, has been a trend setter in terms of the latest woodworking technology for edge banding machines and CNC processing centers for many years. Many furniture manufacturing processes have been developed by IMA Klessmann.

A fact which is testified by a large number of patents: Innovative constructions and manufacturing technologies are set to continue this success story. The latest developments are continuous contour processing and very high throughput through high-speed processing.

A highlight of current developments is the Combimat series with its PC-based control concept. The consistent modularity and therefore upgradability of this product range makes machine modifications due to changing customer requirements very easy. Very early on, IMA Klessmann started to look into CNC technology for routing machines and processing centres. This also very powerful second product range perfectly complements their range of products.

The CNC processing centres of the BIMA series are also renowned for their performance and reliability. The integrated edge banding machine developed by IMA enables complete mechanical processing of machined parts for the first time.

Apart from individual machines, IMA Klessmann also supplies complete production lines. The high synergy effects of short communication routes, regular tuning and targeted planning based on advanced computer networks, ensure that the products from the other members of the IMA group are in tune with each other and can therefore be integrated seamlessly to complete systems.

The central control cabinet is redundant – modularity is trumps

The "Combimat" machine PC deals with particularly diverse and complex control tasks: for IMA, the product name Combimat® represents a new modular basic machine concept. Together with the existing component set, these modular basic machines allow nearly any machine constellation to be configured according to customer requirements.

This modular system enables IMA to offer its customers tailor-made solutions consisting of standard components that can be expanded later with ease. Optionally, the unit and associated software modules can be integrated in the machine. The logical solution was a fully distributed hardware design. All hardware components such as fieldbus devices, valves, drives, etc. are directly located at the unit. The required central control cabinet becomes redundant.

The control software is not developed on a machine-related basis, but unit-related. For each unit developed (e.g. molding, edge banding, crosscutting or finishing unit), a sealed software component exists. The software modules are combined to form the actual machine control according to the required physical equipment of the machine. Apart from the unit program there is also a unit data sheet describing the control-relevant functions such as limit values etc.

At Rabe & Meyer, a "Combimat" double-sided edge processing machine and a subsequent conveying unit (turning station) are controlled from a single C6140 Control Cabinet PC with installed TwinCAT NC PTP. The operating system is Windows 2000. The system involves the co-ordination of approx. 1100 digital input and output signals and the control of 25 positioning axes. Depending on individual requirements, these are simple stepper motor and high/low speed axes, or servo drives for more dynamic or higher precision requirements.

Communication between the controller and the distributed I/Os assigned to the units is via two Lightbus branches (one branch for each machine side), originat-

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At the machine manufacturer IMA from Germany, the hardware PLCs have become redundant, since the company is now fitting PC-based controller equipment to all their woodworking machines. The first step has been taken with the Combimat edge processing machine.

ing from a dual Lightbus PCI master card, type FC2002. The choice of Lightbus system was imperative in order to meet the communication speed requirements and, directly related, the workpiece processing precision requirements. The input/output data arising in the machine are collected via the Beckhoff Bus Terminals.

Software modules have replaced hardware

Under TwinCAT, 2 of the 4 possible PLC runtime systems, one for controlling the "Combimat®", one for controlling the turning station, are used. The runtime system for controlling the "Combimat®" contains 3 PLC tasks, enabling functional and performance optimization of the machine. The PLC is programmed in the IEC 61131-3 languages, which are an integral component of TwinCAT. The NC controller integrated in TwinCAT controls the 25 axes.

A special feature of the system is the so-called linear path control, TwinCAT LC (Line Control). The linear path control enables sensorless tracking of all workpieces through the machine. A workpiece transmitter at the machine inlet causes the linear path control to read the current incremental encoder value as soon as a part arrives. This value is directly allocated to the workpiece that has just entered the machine. The information thus derived is used to calculate the positions (or encoder values), at which the tools along the machine have to be activated. Subsequently, the current encoder information is read cyclically and compared with the values calculated by the linear path control. If two values correspond to each other, the appropriate tools are activated.

The scanning speed of the encoder value and also of the digital outputs for the tools directly depend both on the speed of the fieldbus and on the processing speed of the controller. Ultimately, it determines the possible processing speed and the achievable contour accuracy.

Nothing can substitute speed, except higher speed

A basic prerequisite for the highly complex controller is therefore that all control components involved (PLC, NC, LC) operated in real time – jitter above a minimum value of approx. 25 µs is not acceptable.

In the case described here, the "Combimat®" developers chose scan frequencies of 2 ms for TwinCAT LC and 4 ms for the NC axes, in order to achieve the required precision. The logic controllers in the PLC tasks run at between 5 and 25 ms.

The Industrial PC C6140, which was embedded accessibly directly into the machine construction, deals with a number of further tasks in combination with an external Beckhoff Control Panel, e.g. machine visualization, operating state monitoring, the so-called segment or setup control and the network and modem connection for remote diagnostics.

The Control Panel can be located up to 65 m away from the Industrial PC, e.g. mounted on a swivelling support arm system. As a result, the installation of the PC controller and of the operator interface in the shape of the Control Panel can be optimally adapted to local conditions. The 15 inch TFT color display of the Control Panel enables clear and comprehensible layout and operation of all relevant functions such as program selection, machine diagnostics, unit selection, etc. The functions can be activated either via the standard keyboard or via a mouse.

Project manager Peter Klemme is very satisfied with the conversion to PC-based control technology. He is convinced "that the new machines have increased the processing speed and have generally led to better product quality. The decision was the right one, we now have a high-performance, future-proof system."