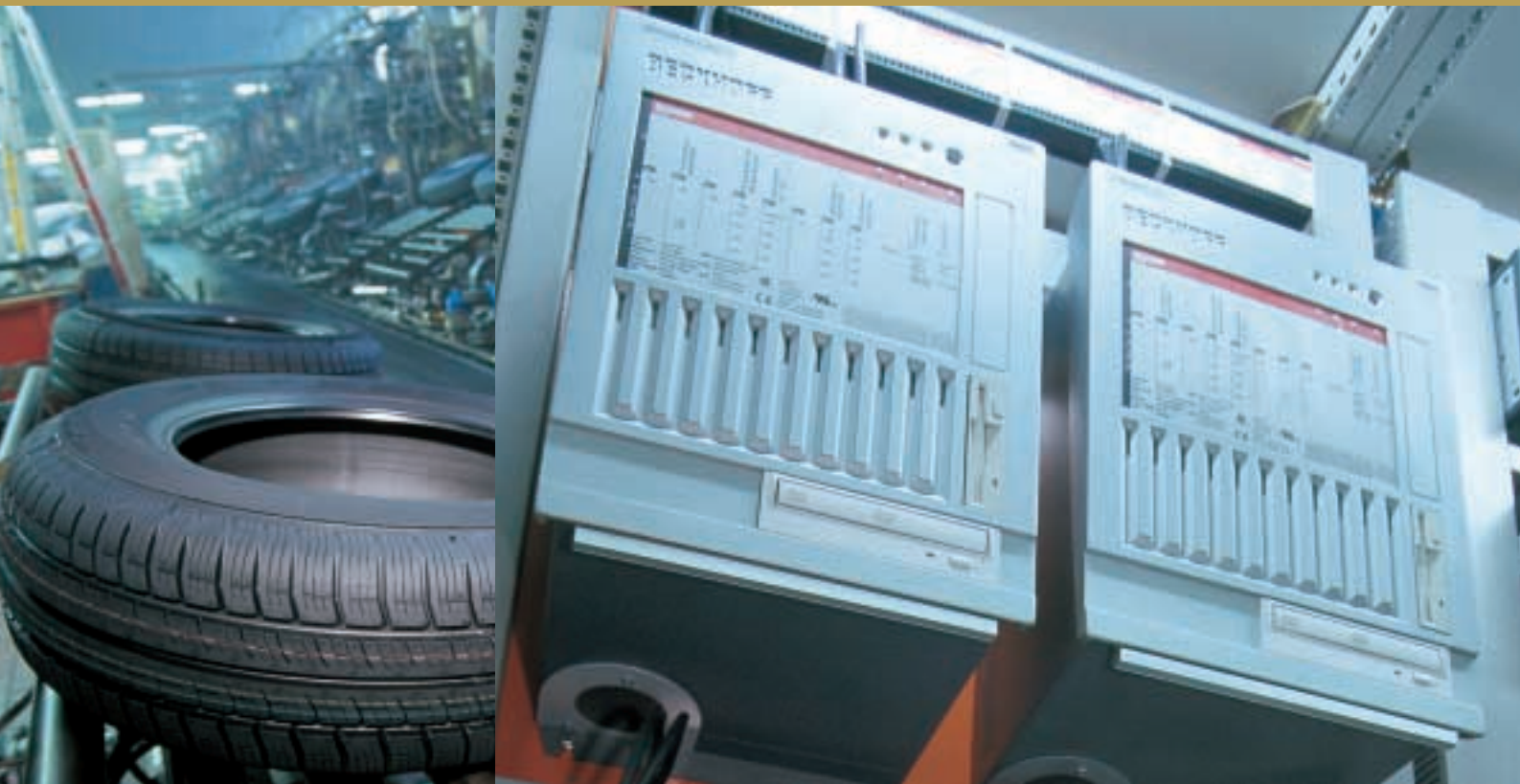


**Continental Timisoara:
The first fully PC-controlled factory
in the world**



All-round control

→ The tire manufacturer Continental AG successfully uses Beckhoff PC-based automation in its production facilities around the globe. Europe's most advanced mass-production tire factory was recently built in record time in the Rumanian town of Timisoara. The new manufacturing facility cut installation and commissioning costs in half using PC control compared with traditional PLC-based technology. All production machines and systems at the Timisoara tire plant are equipped with Beckhoff control technology.



Continental AG with head office in Hanover (Germany) is a worldwide leader for brake systems, chassis components, vehicle electronics, tires and technological elastomers, with sales of 11.4 billion euros in 2002. The company currently employs around 65,500 people worldwide, of which approximately 27,000 are based in Germany.

Traditionally, tire production is one of the core competencies of the Continental Group. However, this classic market segment in particular is faced with a constant stream of entrepreneurial challenges. Fluctuating demand for car tires from the automotive industry (due to economic cycles), strong competitive and price pressure, and a degree of market saturation observed over recent years require the development of special strengths. These include concentration on the quality of the products and on the cost-effectiveness and profitability of the global produc-

tion facilities. In order to achieve these aims, all aspects of tire business were "licked into shape" with measures that included the successful implementation of state of the art production techniques in each case.

Investments safeguard the future

Tire production in the Continental plants is highly automated, but not without manpower. This is one of the reasons for the increasing trend to relocate tire production plants in low-wage regions. On the other hand, it means that very powerful and intelligent human-machine interfaces (HMI) have to be implemented in the production machines. Additional factors are cost and system benefits, for example due to the visualization running on the same IPC that also deals with the machine control.



The Continental plant in the Rumanian town of Timisoara is one of the most advanced factories for mass-produced car tires in Europe.

Interview with Martin Kleinbrod, Plant Manager for Continental AG at Timisoara

PC-Control: The actual "life cycle" of manufacturing facilities only starts once a new production site commences production, i. e. the start-up of the production equipment often reveals the need for further optimization. In hindsight, how would you judge the flexibility offered by PC control technology?

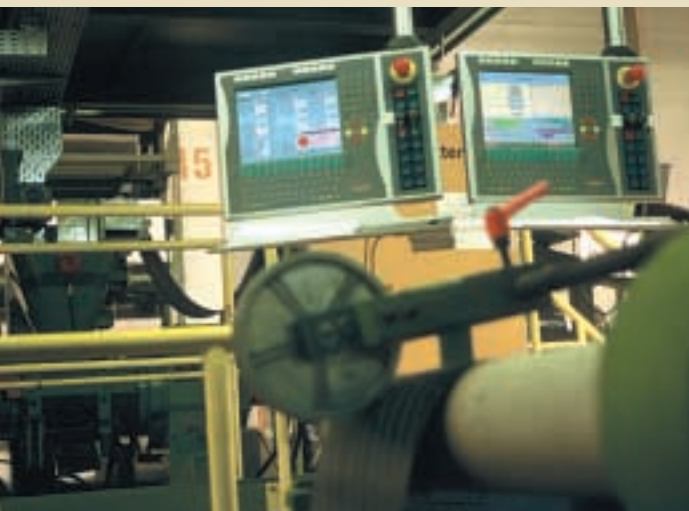
Martin Kleinbrod: Today, the PC is a familiar tool at many levels. Even in a new factory, broad basic PC technology know-how is therefore available, unlike with previous control systems that required specialized knowledge.

PC-Control: PCs come with communications capability. To what extent are the manufacturing facilities at Timisoara networked, and what networking functions are provided by the control technology?

Martin Kleinbrod: Our big advantage is the continuity of the control system. Due to the fact that the same technology is used throughout it was relatively simple and cost-efficient to link all PC controls at the shop floor levels using conventional Ethernet components. Today we can archive data and manage recipes centrally, and acquire production data directly from the production plant control system.

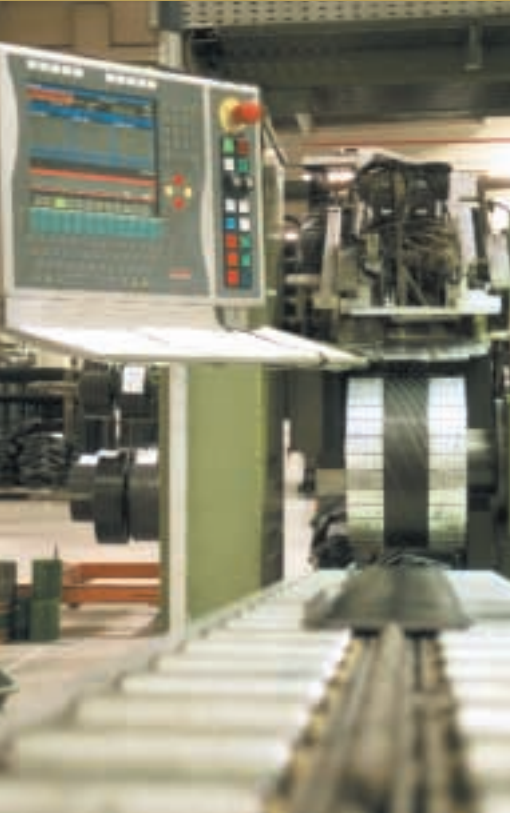
PC-Control: For plants on "greenfield sites", in addition to the actual plant equipment, employee training is also an issue. What kind of training did you provide for the staff at the most advanced car-tire plant in the world?

Martin Kleinbrod: Staff know-how is characterized more by previous knowledge and training than by the technology used. We have had few problems with technological skills, but our main efforts currently focus on management requirements: Independent decision-making and action, analytical approach and open communication, even (or in particular) in case of problems, are the main training issues. In terms of the control technology we have the advantage of being able to deal with familiar structures. Or to put it more simply: Once you have mastered boolean logic, PC-based implementation is not rocket science.



The supplier relationship between Beckhoff and Continental AG goes back to 1996 and has developed into a global success story (see text page 8). The highlight of this successful cooperation so far was the opening of the car tire plant in the Rumanian town of Timisoara in October 2000, which is still regarded as Europe's most advanced factory for the mass-production of car tires.

The new tire factory in Timisoara was built to different standards than those used for many traditional production plants. To date, approximately 100 million euros have been invested. The plant was designed for an initial annual capacity of 6.5 million tires and built in record time: The location was chosen in mid-1998, design and engineering work started at the end of that year. The foundation stone was laid in February 1999, and the first machines were installed at the end of 1999. Production officially started on 20 October 2000, and the plant was certi-



fied according to ISO 14001 and EMAS in mid-April 2001. To date, the following production stages and systems have been realized at Timisoara:

- | Preparation with extrusion lines and cutting machines,
- | Assembly of green tires with individual machines using highly dynamic and automated processes,
- | Vulcanization for shaping under high pressure and temperature in heating presses,
- | Fully automatic test machines and visual inspection benches,
- | Complex conveyor systems.

The factory is currently being expanded for a much larger production capacity. The plans include the construction of a mixing room and a calender facility for producing crude rubber blends and steel or fabric plies for tire production.

Standardized machinery

The production plant is equipped with state of the art machines and systems and designed for maximum productivity. The main aim for the design of the control system was the use of standardized machinery to ensure continuity and uniformity. For the whole Timisoara plant, Industrial PCs, fieldbus components and servo controllers from Beckhoff were chosen as the control technology for all production facilities.

The requirements for the PC-based control technology were clearly defined, including high speed and availability, and simple handling of the control components. Accordingly, the first applications were developed and programmed jointly by specialists from Continental AG and Beckhoff staff. "Once the hardware and platform issues had been clarified, the Continental AG staff responsible for the project prepared guidelines for writing the application software that were bind-



ing for all suppliers, in close cooperation with the Beckhoff specialists," said Klaus Büttner, responsible for tire technology sector marketing at Beckhoff, Germany. "These guidelines were so successful that they were subsequently also used at other plants."

Specialists from the Beckhoff branch in Hanover provided advice and support for all suppliers of manufacturing facilities.

Uniform PC Control

All production machines and systems at the Timisoara tire plant are equipped with Beckhoff control technology. Over 230 IPC controllers are used, plus more than 250 Beckhoff servo axes. Networking is via various Bus Terminals and Bus Couplers for the Beckhoff Lightbus and Profibus DP. The operating system for the PC controls is Windows NT with the Beckhoff real-time kernel and different levels of the TwinCAT automation software (PLC, NC PTP).

Compared with traditional PLC-based automation of the manufacturing facilities, the PC control technology saved a total of approximately 50 percent of investment, installation and commissioning costs. In addition, the PC technology enables globally accepted standards for hardware and operator interface design to find their way onto the production floor. Furthermore, the complete diagnostics concept was realized using state of the art technology: The extrusion and cutting equipment features camera systems that store the results of continuous width measurements in order-related databases. These data are analyzed in networked quality management workstations.

Spare parts management also benefits from PC-based control technology: Only two types of Industrial PC are used at the Timisoara plant, so that the hardware is always compatible and the software can be ported at any time. In the harsh vulcanization environment, the compact C7130 Panel PC controls the tire heating presses. The C6140 control cabinet PC is used wherever high performance for complex machines, systems and NC controls is required.

In addition, all safety aspects that are relevant for the PC control technology have been considered, so that even unforeseeable sources of malfunction such as power failures do not cause problems. The motivated Continental team with the ability to think unconventionally and the determination to use state of the art machine technology has contributed significantly to the success of the project.

This strategy obviously also involves modern IT and associated flexibility, including, for example, the retrieval of machine data via web-based technology and

standard web browsers through a hierarchic structure with access rights. Another option is access via intranet from the production machine to recipes that are stored in the recipe server for certain products. Ralf Eulig from the Beckhoff branch at Hanover, who has been dealing with customer support for Continental AG as Key Account Manager since early 2003, commented on this aspect: "Since our controllers are basically PCs, they can be networked and integrated in IT concepts without problem." IT coupling is very important, since tire production is documented throughout.

Beckhoff supplied approximately 150 Industrial PCs for the company-wide tire information and control system, so that each individual production step can be recorded and documented, irrespective of the degree of automation and the control technology of a production machine, which for older machines may well still be based on electromechanical or relay technology.

Value enhancement is the yardstick

One characteristic of the tire business is a high degree of sensitivity. This does not only apply to motor racing, where the current contest between the large teams is more like a tire war rather than a question of engine or chassis superiority. Sensitivity is also the basis of the business relationship between Continental and Beckhoff and the successful cooperation of the two companies. More than 1,000 Beckhoff Industrial PCs with additional communication, drive and Bus Terminal systems and HMI equipment are currently used in Continental tire plants worldwide.

One of the main success factors for the cooperation is the Beckhoff commitment to open system architecture and internationally recognized standards. This applies to all aspects such as the hardware, e.g. the Intel-based processor technology, the operating system (Windows), the programming according to IEC 61131-3 or the open communication technology.

> Continental AG
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Around 1,000 Beckhoff Industrial PCs are currently in use worldwide for the control of tire production machines in Continental facilities.

Successful step into the new control world

The first contact between the Hanover-based tire manufacturer Continental and Beckhoff, the specialists for PC-based automation from Eastern Westphalia, came about in 1996. Initial efforts centered on the tire construction machines produced by the (also Hanover-based) molds and machine factory (FMF) of Continental AG, which represent important and know-how-intense manufacturing facilities.

Until early 1996, all production machines manufactured by FMF were equipped with hardware PLC control technology. In those days, a tire construction machine required a Simatic S5-155U-type PLC in a three-tier configuration, i. e. in addition to the CPU rack two further racks for I/O and various periphery cards were required. They contained, for example, the drive modules for 15 to 20 servo axes. Addi-

tional items were special technological function groups such as tracking control, coil drive and winding functions, etc. Special tasks that the PLC itself could not handle had to be dealt with by so-called black box units. These managed winding functions with positioning control and actual value acquisition. In terms of the process technology, the auxiliary equipment was used alternately with the PLC and operator terminals. The previous control system concept used by FMF for the tire construction machines therefore was an "evolved", complex control structure.

In response to the cost pressures resulting from these complex machines with their costly control technology, the company started looking for alternatives. During this re-orientation process, one of the FMF managers paid a momentous visit to Beckhoff in Verl. During the

presentation, in which the Beckhoff IPC control concept was discussed, including evolutionary aspects of PC technology and IPC-based solution options that differ from and go beyond PLC concepts, a constructive process developed, which shortly afterwards was followed by a concrete project discussion and an offer for the automation of a tire construction machine with Beckhoff systems. Ultimately, the significant cost advantage proved convincing and led to the order, following a feasibility study. While originally only a single machine had been envisaged as a "test project", FMF decided to build five machines with Beckhoff control technology. Joachim Bieber, sales manager at Beckhoff Hanover, who looked after Continental from the first contacts to global key account management, remembers this phase well: "A snowball effect developed, which led to the implementation of IPC-

based production technology throughout the Continental tire production and is still undiminished today."

As a consequence of the successful completion of the "test projects", more than 1,000 Beckhoff Industrial PCs have been installed for the control of tire production machines at Continental AG plants worldwide. Additional Beckhoff products used by Continental include the TwinCAT software for PLC and motion control applications, drive systems for servo axes, fieldbus cards, Bus Terminals and Control Panels, and various other components, including complete control cabinets.

A further step towards closer cooperation was the formation of a special Continental project team based at Beckhoff in Hanover, which is involved in commissioning and service tasks worldwide.