

25 years of automation technology

→ This year, Beckhoff Industrie Elektronik can look back on 25 years of corporate history. Kai Binder, chief editor of "SPS-Magazin," spoke to Hans Beckhoff, company founder and managing director about this quarter century developing open automation systems and their benefits for machine manufacturers.



Managing director Hans Beckhoff

What did the Beckhoff world of automation look like in 1980?

| **Hans Beckhoff:** Over the years, particularly in the early years, the growth of our company was driven by the introduction of new technologies. Our first customer commissioned us to enhance a relay-based sequential control system for hydraulic machines, which we converted to a microprocessor control system that we developed ourselves. From these (initially application-specific) solutions, we developed a general, modular control system in double-height Eurocard format in 1982, which we optimized for motion applications. Our all-in-one controller board, which already offered full functionality for a 3-axis motion control system, was particularly successful. It enabled us to break away from our competitors, who usually still required complete racks with special hardware for the same functionality. We were able to replace all that with a single board, offering significantly more functionality at a reduced cost. This formed the basis for our growth in the early years.

The next significant step in the Beckhoff development history was the application of Industrial PCs as a control platform. What made Beckhoff use an Industrial PC as a machine controller?

| **Hans Beckhoff:** Our main product – our own microprocessor system – contained all the extension modules (graphics cards, controller cards, I/O cards, etc.) that were required. Even in the early days, we used it for controlling quite large machines and systems. In 1985, we were involved in a woodworking machine project that required our system to be extended with a hard disk for mass storage of processing programs. Because time was short, we decided to integrate an IBM XT PC into our control system as a data storage subsystem instead of developing our own hard disk controller – which at the time would

1986

PC Control technology from the beginning – the first PC-based machine controller integrated disk drive, large display and high-performance CPU



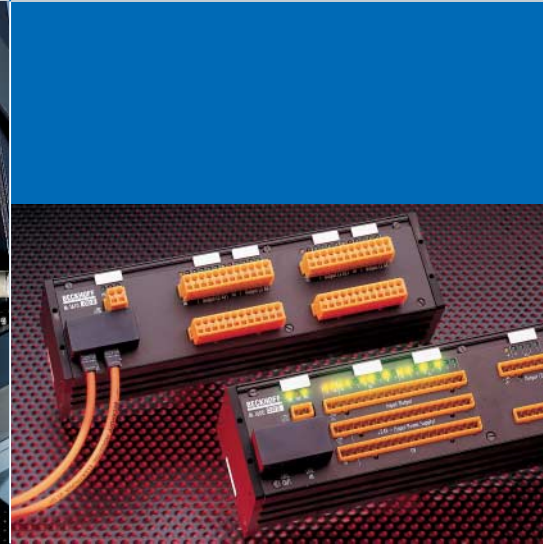
1988

S1000, Software PLC/NC on the PC (DOS)



1989

Lightbus, fast and failsafe communication



have been a very demanding task. Towards the end of the project, it became clear that the PC-based data storage subsystem with a 16-bit Intel 286 processor offered higher performance and was more generally applicable than our 8-bit microprocessor control system. For our personal pride as developers this was an unpleasant, almost bitter realization. However, one of the distinguishing features of our company is that we don't stand in the way of new technologies. On the contrary, we actively pursue them, even if it means changing or even abandoning previously successful products. 1985/86 saw a fundamental change of our product philosophy. We decided to apply the know-how we had acquired with microprocessor-based machine and positioning control systems to software suitable for PCs, which could then be used for machine control purposes. The operating system was MS-DOS, which we extended with our own real-time kernel. Our algorithms were implemented in C. This was by no means an obvious choice, because Pascal was the preferred language at the time, at least in Europe, but it was certainly the right decision.

When was the first Beckhoff PC control system commissioned?

Hans Beckhoff: After only a few months of development, in 1986 we delivered our first PC-based control system for a dual miter saw that was used for the production of windows. It was an immediate success. Suddenly, there was a machine control system with integrated disk drive, large display and high-performance CPU! Disks containing production data could be read directly, high-performance auxiliary programs, e.g. for cut optimization, were directly executable on the machine control system. The windows industry was enthusiastic. The timber industry followed, and today no industry blinds itself

to the benefits of PC-based control technology. I think it is fair to say – and our company is a little proud of it – that we are among the pioneers of software-based control technology and have written a piece of technology history.

Can software-based control technology therefore be regarded as a fundamental Beckhoff technology?

Hans Beckhoff: Absolutely! The philosophy of providing software solutions for automation applications associated with open hardware platforms has been a guiding principle for our company since 1985. Today it is a central component of our technological approach and our success. This is quite different from the approach adopted by many other suppliers who realize similar functions with embedded devices. In this context, "embedded" usually means that software and hardware are inextricably linked. While this is a feasible approach, from our point of view it lacks technological consistency. Function in the form of software should be available, independent of hardware and should be achievable on an open platform. Our users and customers value this approach since we don't force them into an enclosed, special hardware and software world.

How have your customers benefited from this openness? Have the machines become faster, safer and more powerful?

Hans Beckhoff: We offer openness at three levels, i.e. CPU, I/O and software. The CPU, i.e. the PC, is available in many different designs that are optimized for particular applications. The PC architecture is standardized and openness is provided (independent of Beckhoff) through Intel and Microsoft

1995

Bus Terminal, the modular I/O system



1998

Control cabinet PC with distributed Control Panel

1996

TwinCAT, Software PLC/NC on the PC (Windows NT)



with their specifications. Our TwinCAT software package and our fieldbus cards run on Beckhoff PCs, but also on third-party models. This is very different to the traditional PLC, where users are stuck with the hardware of the CPU manufacturer. Our customers are free to choose from the world market based on price and performance criteria and they naturally appreciate this. The second area is the I/O level. With our Bus Terminal, Fieldbus Box and drive systems, we offer an automation kit for more than 180 signal types for all main communication systems. Our control technology currently supports 17 different communication systems including PROFIBUS, CANopen, Lightbus, SERCOS, Modbus, different Ethernet versions, etc. Our users have a wide selection available, which they can obviously expand further at any time through combination with third-party products. Coupling of the I/O level with the CPU requires a high-performance abstraction layer between logical and physical I/O. This is ensured through our TwinCAT System Manager. In principle, our users can develop an automation application without precise knowledge of the physical I/O world. Our customers are, therefore, relatively free in terms of their choice of periphery. The third area is software. Our TwinCAT automation software acts as an integration platform for high-performance software modules for PLC, motion, CNC, control technology, measurement technology, communication and visualization. TwinCAT can be and is being extended through further software modules. Here too, openness is a significant aspect of our control system. What are the benefits for our users? Very simply: more powerful and less expensive machine control! Feedback from our customers suggests that PC Control technology can reduce cycle times by great orders of magnitude, enables the application of new, intelligent algorithms, and can be up to 50% cheaper than traditional control technology.

Another main benefit for users is greater independence – they are no longer dependent on a particular system supplier.

What factors shaped the development of your company during the second half of its 25-year existence?

Hans Beckhoff: On our route from a local one-man outfit to a company with 600 staff and 13 international branches, there were many milestones that were crucial for our continued development. The main technological steps resulted from the consistent pursuit of our PC Control philosophy. In 1989, we introduced Lightbus, our optical fiber-based, high-speed fieldbus; in 1990, we introduced the first all-in-one PC motherboard; in 1995, we introduced the Bus Terminals, which fundamentally influenced the design of fieldbus I/O modules in the market; in 1996, we introduced TwinCAT as the first highly integrated real-time software package under Windows with PLC and motion functions; in 1998, we introduced the Control Panel and in 2002, the CX1000, our modular DIN-rail IPC, and in 2003, we introduced EtherCAT (Ethernet for Control and Automation Technologies). We hope to continue this list in the future and we intend to continue expanding our distribution network and the consistent internationalization of our company.

The Beckhoff growth rate in 2004 was 31%. One of your company aims is a ten-fold increase in sales every ten years. What will this kind of growth be based on in the coming years?

Hans Beckhoff: I am aware that our aim is very ambitious and it is possible, and perhaps likely, that we may not quite reach it. But then again, one shouldn't aim too low! There are four factors that can make a significant con-

1999

Fieldbus Box, the I/O system in IP 67



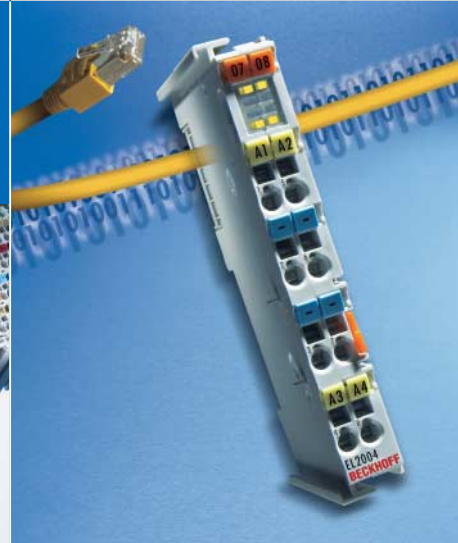
2002

CX1000, PLC and Motion Control on the top-hat rail



2003

EtherCAT, the real-time Ethernet fieldbus



tribution to our growth: First of all, we are lucky in the sense that the worldwide automation market is growing every year. The second aspect is that our approach to automation, i.e. PC-based control, decentralized I/O and Ethernet, is becoming more and more widespread in automation, thereby driving out outdated technologies. In the growing automation industry, the technologies we provide benefit from above-average growth. These are two basic growth factors that multiply with each other. Since Beckhoff provides basic technologies for a wide application layer, expansion of our distribution network automatically leads to an increase in turnover. This means that the expansion of our distribution network, both in Germany and naturally, abroad, is a significant component of our growth strategy. 40% of our sales volume is currently generated from export.

Are there any new product groups that will complement your automation system in the near future?

Hans Beckhoff: We are very pleased about the positive market response to EtherCAT, in Germany and internationally. The EtherCAT Technology Group (ETG) currently has more than 200 member companies, signifying real technological interest. EtherCAT-based developments are currently underway worldwide – even in unexpected areas. This will create new markets to explore. As inventors in EtherCAT, we hope to be able to corner a significant portion of this market with our products. We will continue to expand the EtherCAT range of products for control, I/O and drive applications. Furthermore, our PC Control philosophy has now become rather refined. PC controllers are increasingly being used in medium and small control applications. New IPC series will enable us to offer solutions for less than 1000 euros and

Windows CE controllers in Bus Coupler housings from as little as 400 euros. Additionally, components for our TwinSAFE solution will be certified and become available during the second half of 2005. TwinSAFE Bus Terminals enable connection of all common safety sensors and actuators. They can be operated with a PROFIsafe-compatible safety controller or in stand-alone mode with the KL6904 TwinSAFE logic Bus Terminal. The PROFIsafe or TwinSAFE protocol is used for safe communication. We also see further potential in special industry solutions. Our automation and control technology is inherently industry-universal. In the future, however, we will also introduce industry-specific products such as hardware and software designed for building automation.