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PCcontrol

The New Automation Technology Magazine

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Eventlogger

11:03 | Sawing station ready

11:03 | PLC start

11:03 | TwinCAT start

11:02 | User login

TWINCAT_HMI
11:05 am

Microsoft Visual Studio

Search

Solution 'Beckhoff_1'
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**Ramon Barth, Manager
Software Development
(System, HMI and Real-Time),
Beckhoff**

The evolution of the Human Machine Interface

Technological developments tend to be evolutionary, with innovations influencing the development in one direction or another. Looking back on nearly 30 years of PC-based control technology, one realizes that technological innovations eventually find their way from the IT marketplace into automation technology, where they are more persistent.

As early as the company's S1000 automation system using MS-DOS, Beckhoff developed user interface technology which was characterized by the separation of design and logic. An instruction language controlled the image formation much in the way that HTML operates today, except that it was proprietary and used text-based "block graphics".

With the spread of Windows operating systems (OS), graphical user interfaces found their way into automation technology. Visual Basic was the tool of choice for Beckhoff software developers and our customers. Developers found it easy to implement, enabling them to quickly achieve presentable results. The first demo application demonstrating TwinCAT automation software at the 1998 Hannover trade show already featured service videos, animations of a machine process and a circuit diagram showing a simulated fault. However, for some automation specialists, a disadvantage was that a certain amount of program code had to be written to create a functioning user interface (HMI).

Configuring instead of programming provides developers with exceptional advantages. This has always been the basis to justify the use of a specialized visualization tool in automation technology. However, these specialized tools were not always as flexible as most programmers would have liked. The options remained limited. If the task went beyond displaying color images, the use of a script language was unavoidable. Ideally, script language should also offer access to general IT technologies such as databases and network protocols, which brings us back to Visual Basic.

Ultimately, Visual Basic as a so-called RAD tool (Rapid Application Development) was replaced by .NET-based programming languages. Object orientation and type certainty – in conjunction with more sophisticated software tools –

made software development easier and improved product quality. Libraries with automation-specific control elements were used to connect to the machine controller. The development would probably still continue in this vein, if not for the rise of the Internet.

In an internal memo with the title "The Internet Tidal Wave", Bill Gates suggested that, as early as 1995, Microsoft's main competition would come from "the Internet". The crest of this wave has taken some time, but today it is clear that web-based technologies have become firmly established and perhaps even dominate by leveraging the Internet and the widespread use of mobile devices. In fact, the majority of Internet access no longer takes place via Windows PCs. Multi-touch displays, which have become second nature through the pervasiveness of smartphones and tablets, can now also serve as state-of-the-art industrial control units. The ubiquitous web browser, ready to use on an immense range of devices, can become the operating and monitoring platform. Platform-independence is a much-requested feature of technology users today. With this in mind, the task is now to make all remaining Internet technologies usable for automation technology.

The newly announced TwinCAT HMI is the Beckhoff response to the evolving user interface requirements of the automation industry. It masters the delicate balancing act between simplicity in development and flexibility in expansion. Full utilization of web technologies based on international standards is a given. TwinCAT HMI enables the efficient development of feature-rich user interfaces without any programming. On the other hand, it also offers extensive support for experienced web programmers, without limiting them. Execution speed and protection of customers' intellectual property embedded in algorithms were further goals in the development of TwinCAT HMI. Efficient engineering using all advanced IT infrastructure is supported via integration into the TwinCAT toolbox. At SPS IPC Drives 2015 in Nuremberg, Germany, and in this issue of PC Control magazine, we will provide further insights into our new HMI platform.

Third Asia-Pacific
Sales Meeting in South Korea

The third Beckhoff Asia-Pacific Sales Meeting (APSM) took place from September 2–5, 2015. Following biennial sales meetings held in Shanghai (2011) and Singapore (2013), this year delegates from 15 countries converged in South Korea. Kai Ristau, Head of International Sales and Business Development at Beckhoff, and Key Yoo, Managing Partner of host company and official Beckhoff distributor, Tri-TEK, stressed that the collaboration goes far beyond a business relationship. The choice of South Korea as the meeting venue underlined the importance of all global Beckhoff distributors.

Delegates at this year's meeting included representatives from Beckhoff subsidiaries in China, India, Japan, Australia, New Zealand, Singapore, Malaysia, the United Arab Emirates and Turkey. A country manager also represented Beckhoff Indonesia for the first time. Distributor representatives based locally in South Korea, as well as attendees from Taiwan and Iran were also present. Speakers from the German headquarters of Beckhoff and colleagues from Beckhoff Finland complemented the meeting.

As in previous years, the meeting motto of "One Team – One Vision: Cooperation" was used to intensify international cooperation. Representatives from all countries presented information and success stories from their work, leading to lively exchanges. Kai Ristau stressed the business importance of the Asia-Pacific region: "Since the region is the focus for so many industries, we expect further increases in the high demand for automation technology over the coming years. Therefore, the Asia-Pacific Sales Meeting takes place every two years in order to facilitate exchanges on evolving market conditions, to keep colleagues up-to-date with the newest information and to foster the ongoing spirit of cooperation. Ultimately, this will also benefit Beckhoff customers, because with a strong international network and close cooperation across the region, we ensure the best possible support for our customers." The next Beckhoff APSM will take place in 2017 in Malaysia.

Production data for even more productivity

From the Internet of Things to the Internet of Services – Beckhoff will present solutions at the SPS IPC Drives trade show in Nuremberg, Germany, that underline the increasing convergence of Internet, IT and automation technologies, representing an important foundation for IoT and Industry 4.0 projects. Ronald Heinze, Chief Editor of Open Automation magazine, interviewed Managing Director, Hans Beckhoff in the run-up to the major international trade show.

"Without automation, further improvement in living standards around the world becomes hard to imagine and even more difficult to actually achieve," states Hans Beckhoff. Automation technology deals with automated production, process control in power generation, and with water supply, among other important infrastructure for civilization. "Automation technology affects many areas of human life," he further explains. "Any increase in well-being in societies is closely related to industrial productivity gains." This dynamic provides compelling reasons to undertake constructive technology assessments – from both positive and negative standpoints. "Particularly due to the fact that automation technology stimulates progress, it requires serious self-analysis," emphasizes the entrepreneur.

As an example from the field, he mentions Nobilia, the world's largest kitchen manufacturer, where Beckhoff technology plays a key role in advanced production methodologies. The number of production stages per custom kitchen was reduced significantly, despite the fact that manufacturing in batch size 1 has been around for years through the integration of Industry 4.0 concepts. However, increased productivity highlights only one benefit of automation. Many modern products could not be produced at all without the aid of advanced control technology, due to their nearly endless variety of dimensions and formats, or due to stringent precision and quality requirements.

Through the open, fully-integrated product range based on PC-based control technology, Beckhoff benefits tremendously from this development. For 2015, Hans Beckhoff once again expects a revenue growth percentage well into the double-digit range. This should enable the leading automation company from Germany's Eastern Westphalia region to approach the turnover threshold of 600 million euros or even exceed it – another milestone achieved after a highly successful financial year in 2014. "The Asian region is a significant factor in this dramatic growth," notes Beckhoff. "Southern Europe and North America are also developing at an impressive rate."

For next year, the Company Director expects these positive growth trends to continue based on a healthy influx of orders. Even though the overall global economic situation can be volatile, the company will continue major strategic investments into technology research and development. Beckhoff is very optimistic about the market for automation technology overall, asserting that any temporary decline due to any unforeseen crises will be overcome quickly, and the positive overall development will resume. "Growth will, and indeed has to, return," says Hans Beckhoff reassuringly. In order to prepare the company for future growth and development, the central Beckhoff headquarters building in Verl, Germany will be expanded by a further 27,000 m² in 2016 to accommodate additional warehouse and production space. "On the production side, this will prepare us with the infrastructure needed for two further years of growth," the Managing Director states decisively.

Data-based applications for even greater progress

Data-based applications create new opportunities for society to progress. In the B2C sector, this can go as far as transforming lives. "Whole professions can change for the better and new ones can rise up," says Hans Beckhoff. "Cloud databases make this possible, and many new applications will emerge as a result. One example outside the realm of automation is cloud-based diagnostics in the medical industry."

Further significant growth is also expected in the manufacturing sector. "Automation has always been the driver for productivity improvements," says the Managing Director. "With Industry 4.0, this trend is accelerating further." Batch size 1 manufacturing is becoming increasingly common in many applications, both in mass production and in smaller, decentralized production facilities. "PC-based control has been established as the ideal platform for both production models," says Hans Beckhoff. The use of highly-connected systems and devices will continue to grow and on the production side, new business models will emerge to better access and capitalize on the additional production data.

"Automation has always been the driver for productivity improvements, with Industry 4.0, this trend is accelerating further."

Today's major industry trends such as batch size 1 manufacturing and 3D printing, as well as new business models for Industry 4.0, require data-intensive automation. The question is: How will the large volume of data be managed? At the upcoming SPS IPC Drives 2015 trade show, Beckhoff will present its new TwinCAT Analytics technology as the answer. "This exciting new technology enables TwinCAT 3 automation software to store process data in a cycle-synchronous manner and record it in a standardized data model. This is a true Industry 4.0 technology that is beneficial for all industries," the Managing Director underlines. The data can be stored locally, such as on a server or externally in a secure cloud database. "The result is a full 'transcript' of the process image and the production data," Hans Beckhoff explains enthusiastically. "This is similar to a data recorder, where all data is logged and serves as the basis for a wide range of useful analytical functions."

Analyses can be performed easily for service tasks. For the purpose of optimization, the cycle times and/or the energy consumption of each individual module can be analyzed, as one example. The duty cycle of pump motors or the number of switching cycles of solenoid valves provide a means to perform diagnostics for predictive maintenance. "Operating hour counters provide important information for condition monitoring," confirms Hans Beckhoff, the physicist. "In conjunction with TwinCAT Analytics, we will present new functionalities in TwinCAT Scope, initially for cycle time analysis."

The machine "transcript" can, for example, be used to analyze malfunctions that may have occurred during the night, without the need for new measurements. "The recorded production data with corresponding context data is ideally suited to such analysis," he says, reassuringly. Error messages are stored and process variations can be precisely traced. In the context of batch size 1, TwinCAT Analytics enables complete documentation for each individual workpiece. TwinCAT Analytics also enables the compacting of cyclically logged data.

"After gathering detailed feedback in consultation with our customers, we in-

tend to open up our data stores for other software manufacturers, with the intent to implement new business models," continues Hans Beckhoff. OPC UA lends itself well as a vertical data transport route, as the data can be transferred easily into the cloud in just a few steps. "In this way, an online CMS can be realized as a cloud service and as a part of TwinCAT Analytics."

Controllers and services directly communicate with each other

Another new highlight from Beckhoff at SPS IPC Drives also relates to provisions for data in IoT and Industry 4.0 applications. "With new TwinCAT IoT Communication, we present an easy-to-use software library for IoT applications," reports Hans Beckhoff. The library supports widely-used protocols for cloud communication, including AMQP and MQTT for push messages to smart devices. "By fully-leveraging these standard protocols, each industrial controller can communicate with cloud-based services," says Hans Beckhoff. One service may deliver alarm and status messages to smartwatches, for example. The software is quick and easy to configure and, together with an Embedded PC as the IoT controller, TwinCAT IoT enables seamless connection between the Internet of Things and the Internet of Services.

Both software products are new examples of the convergence of information and automation technology. "Our convergence effort started as early as 1985 with the beginnings of PC Control," says the Managing Director. "This has continued consistently, right up to the introduction of TwinCAT 3 with Visual Studio® integrated and the newest products to use production data for IoT and Industry 4.0, which will be presented at this year's SPS IPC Drives." At Beckhoff, new product innovations quite often emerge from technological observations of IT trends, in some cases even from studying consumer products such as data glasses for use as a wearable HMI. "After all, Google has even announced an industrial version of the data glasses," Beckhoff continues.

From a historical perspective on IT trends, first there was the Internet, followed by all the innovative ideas about what to do with it. Similarly, for data mining,

"Our convergence effort started as early as 1985 with the beginnings of PC Control. This has continued consistently, right up to the introduction of TwinCAT 3 with Visual Studio® integrated and the newest products to use production data for IoT and Industry 4.0."

Hans Beckhoff expects the emergence of many other good ideas that answer how to utilize stored production data, noting that machine controllers will provide the corresponding information.

Despite this increasing convergence, the future marketplace will still offer enough added value for suppliers of automation technology, according to Hans Beckhoff, because they have significant expertise in the underlying technologies. These include control of sensor and actuator signals, production of intelligent CPUs in compact, industry-compliant designs, the creation of software for controlling motion sequences, measurement technology and much more.

High-performance web-based user interfaces

An important prerequisite for highly flexible manufacturing is a high-performance process visualization that provides users with an overview of production, anywhere and at any time. In order to save engineering time and avoid multiple data entries, control and visualization are "cast into one piece" today.

With the new TwinCAT HMI solution, Beckhoff now presents its own HMI software system, based on pure web development technology via HTML5 and JavaScript – yet another example of the increasing convergence of automation technology with IT. "TwinCAT HMI has a high-performance, yet basic structure that utilizes state-of-the-art technologies. It is completely modular and is quick and easy to configure," emphasizes Hans Beckhoff. "The platform-independent system offers multi-client, multi-runtime and server capability." Any device with an integrated web browser can be used as a display for the HMI system, which offers many exciting new possibilities. "The application framework makes it easy to map the machine logic," he further adds. "Source code management is included as a standard feature."

Based on the "What-You-See-Is-What-You-Get" (WYSIWYG) programming philosophy, users can assemble pages intuitively. In other words, a document is displayed on the monitor during editing exactly as it appears when it is output on another device. It is also possible to incorporate cameras and related devices. Additionally, software specialists can write their own programs in high-level languages and integrate them in TwinCAT HMI. Seamless connectivity is ensured through a wide range of common or industry-specific protocols, including OPC UA, TwinCAT ADS or BACnet. As the software is further expanded, TwinCAT HMI is certain to become one of the main product lines from Beckhoff.

Many new products for SPS IPC Drives

In addition, Beckhoff will present a wide range of new products at SPS IPC Drives that further expand the already extensive automation technology portfolio. One of the new products is a motherboard for a new, entry-level compact IPC class. The new board will become the centerpiece of control cabinet PCs and 7-inch "built-in" Control Panels. In the area of drive technology, a new Beckhoff Motion Designer engineering tool will be presented as a technology demonstration, which now also maps part of the mechanical design process. "Our new Motion Designer significantly simplifies drive technology system design," adds the Managing Director.

"For the XTS linear transport system, we will present a quadruple kinematic system, which enables three-axis motion in Cartesian space," continues the business owner. Integrated in TwinCAT NC with G code, it is possible to realize three-dimensional movements. As an example he mentions the "flying" three-dimensional material handling robot, which offers many benefits compared with the likes of stationary pick & place applications.

"This year, we will present an exceptionally large number of new products," Hans Beckhoff concludes. "We therefore look forward to a trade show with many thought-provoking discussions with our customers." As a result, further productivity advances and innovations for all involved are guaranteed.

Faster and simpler with platform independence: TwinCAT HMI
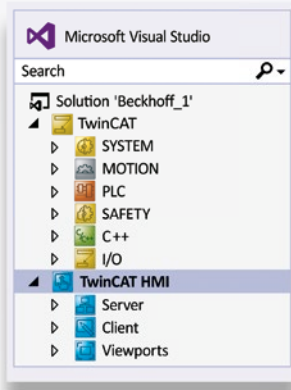
The development environment of the TwinCAT HMI is fully integrated in Visual Studio® and TwinCAT
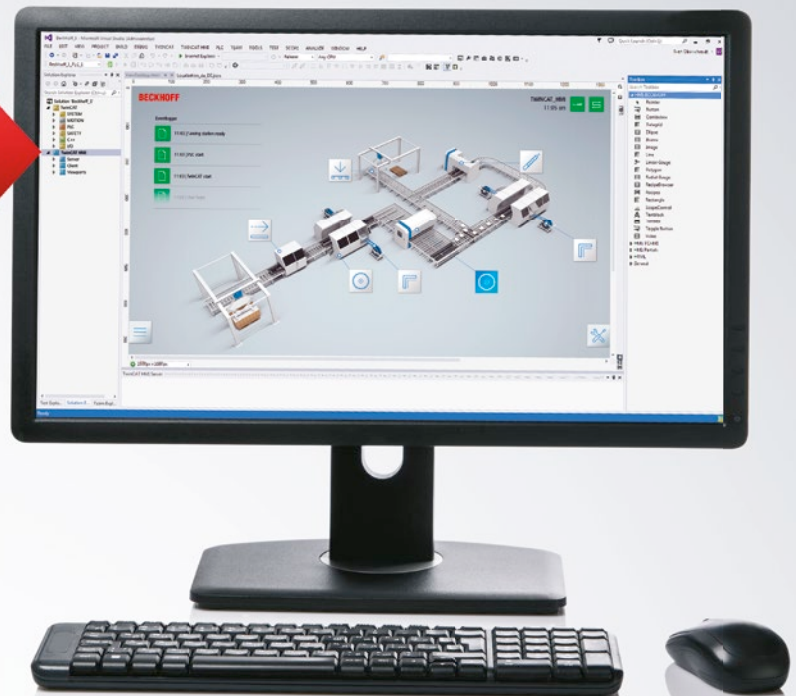
What will the HMI solution of the future look like? Can the all-important user interface be given industry-spanning design in the future to ensure optimum efficiency with maximum user comfort? Beckhoff has paved the way to the next generation HMI with the new TwinCAT HMI solution which integrates the Human Machine Interface (HMI) directly into the familiar Microsoft Visual Studio® integrated development environment (IDE). Programming is not required, as simple configuration is handled via the user-friendly graphical editor. The simplicity of the configuration is mirrored by the adaptability of the handling: the web-based solution, based on HTML5 and JavaScript, acts "responsively", regardless of the operating system, browser or device. A powerful, standard HMI architecture enables numerous application scenarios: from the local panel display solution to multi-client, multi-server and multi-runtime concepts. Defined interfaces offer simple implementation of individual extensions, plus the mix of standard graphic controls and custom design elements facilitates individualized concepts.

Simplicity

A good HMI must be simple, and achieving this simplicity begins with the engineering process. Through the integration of the TwinCAT HMI in Visual Studio®, the graphical "What-You-See-Is-What-You-Get" (WYSIWYG) editor enables you to use simple controls from a toolbox, arrange them on the interface and link them to real-time variables. In addition, it is possible to assemble and parameterize user controls from the variety of simple controls, making the HMI design kit easy to expand. Ready-made HTML5 templates – like the kind that normally require design specialists – can be integrated with little effort in order to generate complex, yet ergonomic pages.

Depending on experience and the application type, the HMI logic can be implemented either on the client side in JavaScript or as a server extension that offers the option to write extensions in C++ or .NET, achieving maximum intellectual property (IP) protection.

TwinCAT HMI automatically adjusts according to the respective resolution and orientation of the display hardware. This permits use with various display sizes, aspect ratios and screen orientations. Since the browsers are available on different hardware platforms and operating systems, TwinCAT HMI can be executed on all processor platforms – from the ARM and Core™-i series to many-core computers – without recompiling or adaptation.

Integration

Visual Studio® facilitates efficient design of the HMI and its various pages and a graphical editor offers the possibility to place controls on the interface, as well as to parameterize them. In addition to the visual parameters such as size and color, it is also necessary to create the link to the variables, e. g. from the PLC or from a C++ module. Various software wizards provide assistance to handle this with ease.
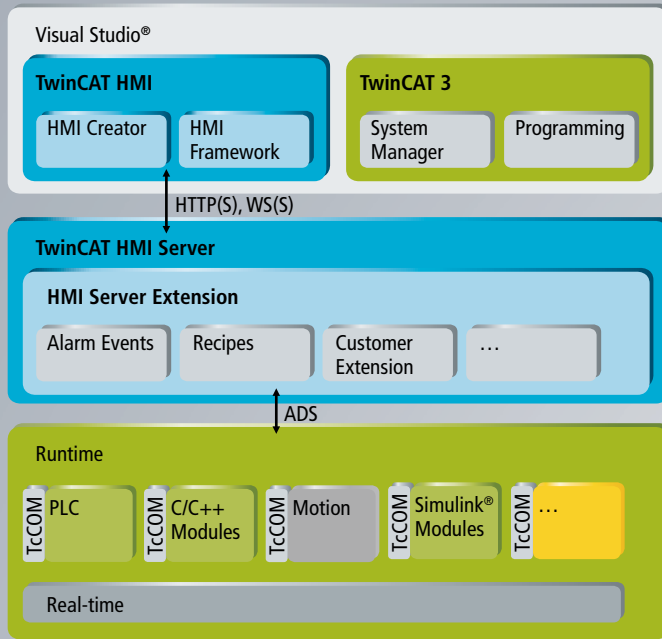
Engineering architecture of
the TwinCAT HMI
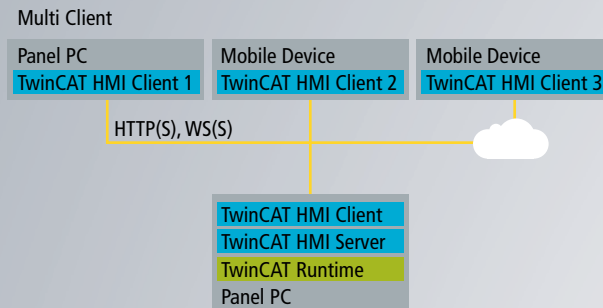
The TwinCAT HMI can be observed and operated from
several clients in parallel.
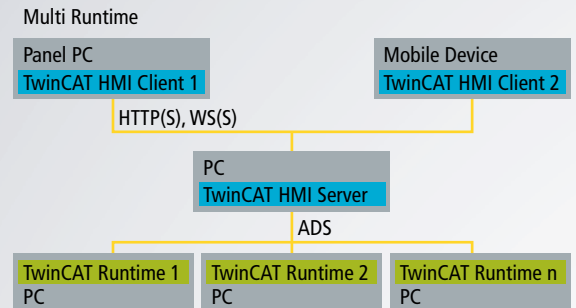
The TwinCAT HMI server supports access
to several runtime systems.

To allow the display of online values so that they can be seen even during the development of an HMI, the designed HMI page can be directly animated with the variables. Of course, modifications are also possible in live mode. The use of a source code database, such as Team Foundation Server or Subversion, enables the connection of all data, making team-based software development work simpler and easier to manage.

Design in HTML5

As the rising global standard in modern web programming, HTML5 provides simple, high-performance and globally-available technology for webpage design. Successfully used and driven forward by all major webpage developers and more influential tech companies every day, HTML5 has been integral in mitigating many of the previous issues with "living" webpages. TwinCAT HMI utilizes HTML5, helping many thousands of designers create modern and ergonomic HMI pages, and enabling numerous browser types to quickly and easily display these webpages.

Connectivity and security

One might ask, "How can TwinCAT HMI exchange data with a PLC?" Simply put, the client, i. e. the browser, communicates directly with the HMI server.

Long-familiar, tried-and-tested standards, such as HTTPS and Websocket Secure, guarantee security from the client to the server. The HMI server, on the other hand, connects to the respective controller(s) via the appropriate protocols. OPC UA, for example, provides this type of functionality, along with the Automation Device Specification (ADS) within TwinCAT software. Further protocols, such as industry-specific protocols, including BACnet and IEC 61850, are simple to implement using the server extensions.

Various controllers can exchange their data with one or more clients in a local network. These clients can run on local PCs or Panel PCs, or on mobile devices such as tablets and smartphones. A secure connection to cloud-based services is also integrated, allowing the display of HMI pages on smartphones connected to the machine via internet, for example.

Flexibility and openness

The use of HTML5 can serve as the simple extension of the TwinCAT HMI via individual HTML pages. For example, complex user controls can be assembled from the individual controls. In this way, a thoroughly modular and simply extendable system exists on the viewer side. JavaScript can be used for the client logic, but this is not the only option. Those who are unfamiliar with JavaScript

Dr. Josef Papenfort,
TwinCAT Product Manager, Beckhoff

Sven Oberschmidt,
TwinCAT Product Manager, Beckhoff

Multi Protocol
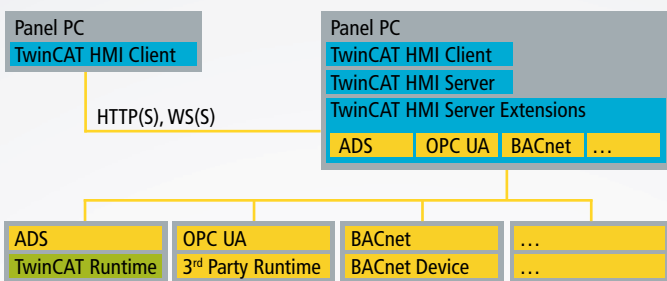
The TwinCAT HMI server can be modularly
expanded for further protocols.

can simply configure certain conditions using a graphical editor instead of programming them.

On the server side, extensions can be programmed very simply, with functionalities modularly extended or retrofitted using the previously mentioned extensions. These could be logic functions programmed in C++ or .NET, or even an extension for a certain protocol. TwinCAT HMI offers the ideal solution for industry-specific controls; however, controls of a completely different design can be integrated just as easily.

Paradigm shift for modern HMI solutions
The new TwinCAT HMI ushers in a significant paradigm shift in the field of HMI software: Instead of proprietary systems for engineering and communication and their use only on certain operating systems, TwinCAT HMI makes use of standard development technologies for design, especially Visual Studio® and HTML5, as well as standards for the communication, namely Websockets and HTTPS. There is also no dependence on the operating system – TwinCAT HMI runs on any browser compliant with HTML5 and with any operating system. In this way, Beckhoff has created a future-proof, open and high-performance solution for a highly-connected world moving toward Industry 4.0 concepts.

The highlights at a glance:

– Efficient engineering, integration into Visual Studio®
– Platform-independence
– Web-based (HTML5, JavaScript)
– Powerful architecture
– Modular expandability
– High-level language integration
– Standard graphic tool chains

Product announcement
estimated market release: 3rd quarter 2016

Further information:
www.beckhoff.com/TwinCAT-HMI

Integrated energy data management enhances PC-based control

Comprehensive and transparent energy data saves money from the building to the machine

| Current | Heat, Gas | Water | Air pressure consumption | Temperature | Condition Monitoring |

An energy data management system that is integrated into the PC-based control system enables monitoring and analysis of all energy consumers – consistently and linked to the higher-level energy data management system.

Energy Data Management System

Company
Current
Heat | Gas
Water

Production   Administration   Logistics

Ethernet, OPC UA, IoT Communication

OPC UA

Wearable Devices

Production
Current
Heat | Gas
Water
Air pressure consumption

Production 1   Production 2   Production n

Ethernet, OPC UA, IoT Communication, Database Server

Visualization of the production data

Machines and Plants
Current
Air pressure consumption
Temperature
Condition Monitoring

Machine 1 Sensor/Actuator   Machine 2 Sensor/Actuator   Machine n Sensor/Actuator

EtherCAT, EAP, OPC UA, IoT Communication, ADS, Database Server

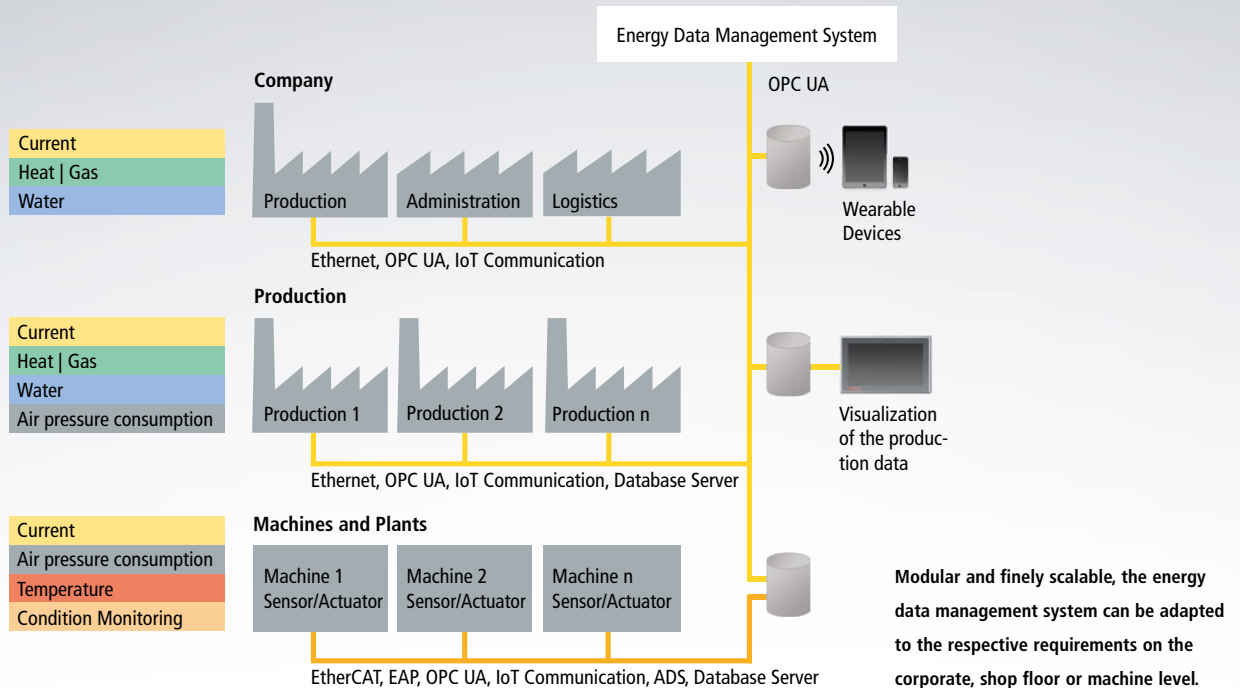**Modular and finely scalable, the energy data management system can be adapted to the respective requirements on the corporate, shop floor or machine level.**

More than ever, managing energy consumption in buildings, production facilities and machines is critical to the success of a company. Making correct cost reduction decisions requires the ability to collect and process all energy-related data. Scalable energy data management systems integrated into PC-based control equipment cover everything from the building to the machine and even each individual motor.

The only way to uncover all potential energy savings is by taking a comprehensive view of the entire business – the administrative level with its offices, conference rooms, and cafeterias; the production facility level; and the individual machine and equipment levels. To secure meaningful results, one must be able to identify all "energy hogs" and make appropriate improvements in some cases, while coordinating the operation of all energy consumers, based on comprehensive and reliable energy data.

Energy-efficient Smart Factory saves costs
With such an energy measurement system, the forward-thinking company supports the creation of a "Smart Factory", from the aspects that it meets the requirements of the DIN EN ISO 50001 standards as well as from an energy perspective, all with minimal effort. In addition, the integrated and, therefore, low-cost energy data management system does not require large investments. Since the necessary sensors and meters can be integrated into existing buildings and machine automation systems and expanded when necessary, developing a comprehensive energy data management system step-by-step becomes relatively easy, and any investment costs quickly pay for themselves. The end user can analyze and potentially smooth out peak loads based on collected data. In addition, companies can reap clear and long-term cost benefits by consistently optimizing energy usage, which is particularly important against the backdrop of almost certain future price increases.

Also, being "green" is becoming more important to society in general, with businesses facing increasing governmental and political pressure to reduce energy consumption and CO_2 emissions. For example, the repayment of the so-called "renewable energy surcharge" in certain countries depends on the introduction of an energy management system (EnMS) or EMAS certification. The EnMS model of the DIN EN ISO 50001 standard, for example, defines detailed energy monitoring, metering and analysis requirements which can be easily implemented with a Beckhoff solution consisting of modular I/O terminals, TwinCAT and open communication standards such as EtherCAT and OPC UA. In addition, continuous improvement of an energy data management system is just as important as its initial implementation because receiving a refund of the renewable energy surcharge as well as the power and pollution tax requires continuously improved compliance with the DIN EN ISO 50001 standard or EMAS certification. Beyond that, the new Energy Services Act (EDL-G) in several countries requires that all companies not falling under the definition of "small enterprises" implement an energy audit as well as an energy or environmental management system. Such improvements are only possible with a continuous stream of accurate energy consumption data.

Comprehensive and integrated energy data collection
Beckhoff PC-based control technology makes the programming of advanced measurement systems more efficient. The modular and highly scalable PC

| Current | Heat, Gas | Water | Air pressure consumption | Temperature | Condition Monitoring |
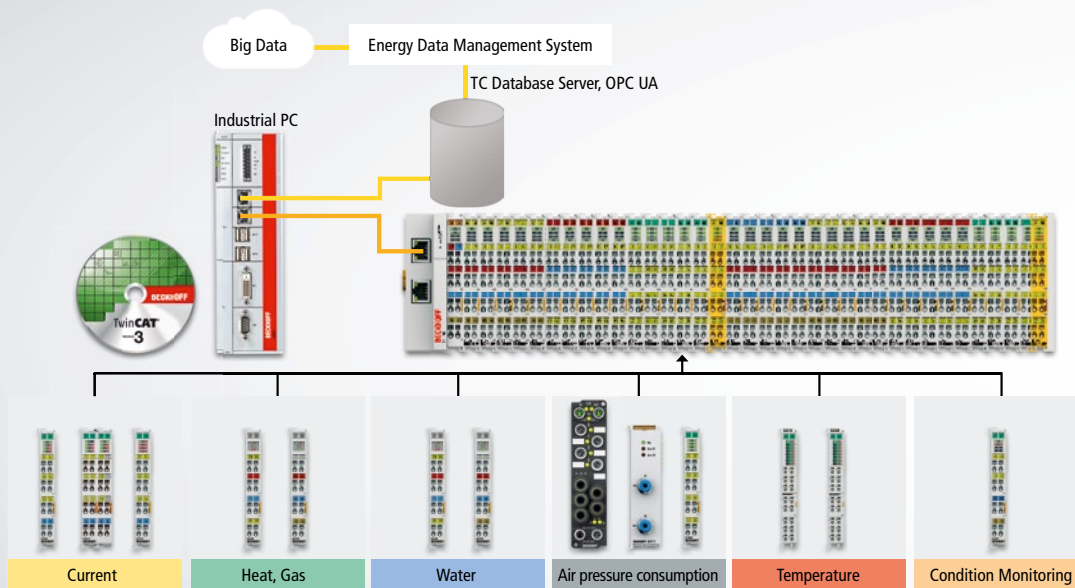
The Beckhoff concept of Scientific Automation combines control and measurement technology in a single system with the help of powerful measurement and condition monitoring terminals.

Control technology works not only for machines, but also for building automation applications with a single, universal software system that can handle all control and energy data. This makes it easy to process, combine, and correlate all relevant data, forwarding it to the energy management software. The user also benefits greatly from the flexibility and openness of PC-based control. On the one hand, all signals can be easily integrated into the control system via the modular and extremely broad I/O spectrum. On the other hand, all popular fieldbus systems and transmission standards, such as OPC UA as well as telecontrol protocols, and the EtherCAT protocol are all supported and seamlessly integrated into the PC-based control system.

To maintain a highly efficient energy data management system, end users require a generalized view that can still show every detail. Controlling the company's overall energy consumption is just as important as having precise usage data for every consumer. To accomplish this, energy usage is measured locally and with minimal wiring wherever it occurs – in each department, on each machine and on each actuator. The raw data is transmitted to the controller and TwinCAT via the fast, broadband EtherCAT network for pre-processing, scope or HMI functions. Thus, all power, heat, water, gas and compressed air consumption data is available to the energy management system via standard interfaces like OPC UA.

The benefits of a fully integrated energy data management system become especially apparent in highly complex solutions. The metering components can be added to the existing automation technology easily – even to what is already in place – without having to set up a separate metering and control system. Additionally, the seamless integration enables much faster responses to important energy-related events.

Detailed data analysis with standard control software

With the open PC-based control system, energy data is available for analysis and further processing on all software levels, not just in a higher-level energy management system. Since the TwinCAT automation software operates directly on the control level, the consumption data can be analyzed directly in the control algorithms to improve plant energy efficiency. TwinCAT also supplies a wide range of advanced monitoring and analysis tools. The TwinCAT Condition Monitoring Library, as an example, features a modular toolbox of mathematical algorithms for analyzing the energy status of machines and systems, with functions that cover the areas of analysis, statistics and classification.

The energy data can also be monitored with the TwinCAT software oscilloscope, which combines fast data logging with a powerful visualization tool. The logger can process long series in addition to very fast cycles in the millisecond range, for example, from EtherCAT monitoring I/O terminals such as the EL3773 with oversampling functionality. The results are displayed via the Scope View component, which provides an almost unlimited number of curves in high resolution over time. This enables the viewer to see, for example, whether sinusoidal voltage profiles or harmonics are present. Because of the high resolution, even short peaks become visible, which are very hard to analyze with conventional systems.

Application scenarios for better management of energy costs

Realizing all potential improvements requires a comprehensive energy data management system. This enables users to integrate the collection and analysis of energy consumption data into the building automation system on the administrative level in order to optimize the consumption of power, water, gas and heat with an Embedded PC, TwinCAT and I/O terminals. In industrial envi-

Power/kWh

[Chart showing power load curve over time from 00:00 to 23:45, with y-axis Power/kWh marked 0 to 50. Labels: Peak Load (red region near 7:30), Mid Load, Basic Load. X-axis labeled t with markers 00:00, 7:30, 23:45]

PC-based control provides detailed energy consumption data that lets users map load curves to identify peaks and balance the overall load.
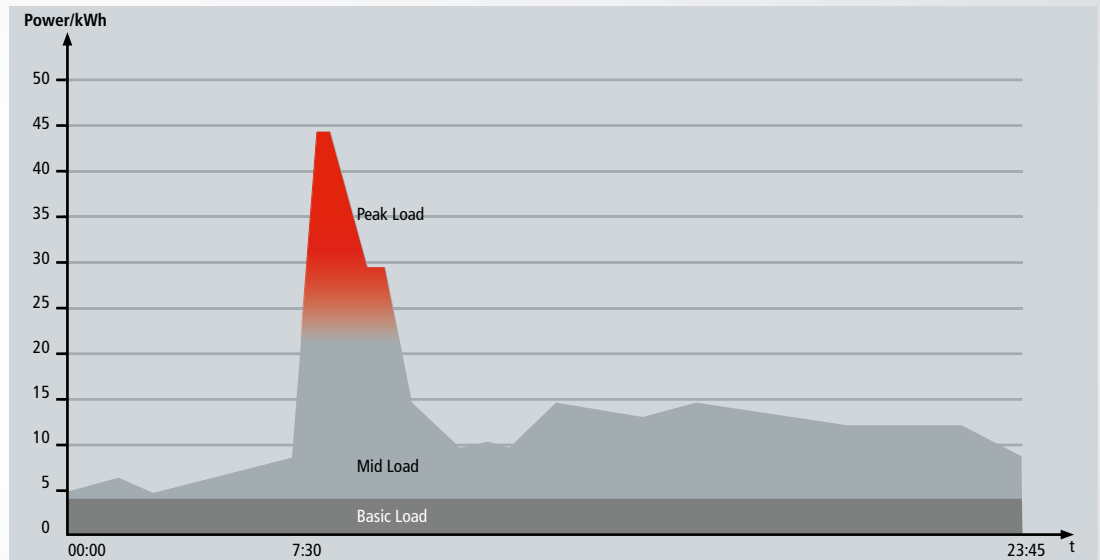
ronments, an Industrial PC with TwinCAT in connection with EtherCAT Terminals provides the ideal data management solution for evaluating cost centers such as the usage of power and compressed air. Installed within the machine, PC-based control produces and manages accurate data down to the sensor and actuator. It also provides comprehensive condition monitoring as the basis for cost-optimized preventive maintenance. This helps users generate load curves and identify peak usage periods for future load balancing. PC-based control also enables determination of each single load share, as well as the basic and average loads. Companies can also use the information to analyze the machines' power requirements relative to each other and use the results as the basis for further improvements. Identifying "energy hogs" can reduce electricity costs and make it easier to accurately allocate them to the appropriate cost center. Detailed energy data can also be used for control purposes, for example, to make the entire production process more stable and to prevent failures.

Module-based integration of all energy data types

The PC-based control technology with its scalability and modularity provides the ideal basis for integrated and detailed energy management solutions. It also features a broad I/O system that enables data collection for all forms of energy usage within the enterprise. For example, one can collect data directly via the KL/EL3403 power measurement terminals. In addition, the EL3413 and EL3433 power measurement terminals and the EL3773 power monitoring oversampling terminal provide extended analytical functions. Consumption data for gas, water and heat, on the other hand, can be integrated indirectly into the energy data management system. The KL6781 and KL6401 Bus Terminals with M-bus and LON interface, respectively, make it easy to link popular gas, water and heat meters to the system. The typical counter pulse output can be integrated with digital input terminals.

Temperatures can be controlled directly via thermocouples or RTD resistance sensors via KL3xxx Bus Terminals and EL3xxx EtherCAT Terminals. The compressed air usage can be measured with KM37xx differential pressure measuring terminals and the locally installed EP3744 IP 67 differential pressure metering EtherCAT Box, making it easy to identify energy-wasting leaks. Compressed air sensors can be indirectly integrated into the system via KL/EL3xxx analog input terminals. Sensors with IO-Link interface can also be used. Further, the EL3632 analog input terminal is suitable for condition monitoring applications in which fluctuations are recorded by means of acceleration sensors or microphones. With condition monitoring, impending failures can be recognized early on so that countermeasures can be taken before developing problems bring the application to a halt.

Further information:
www.beckhoff.com/energy-data-management
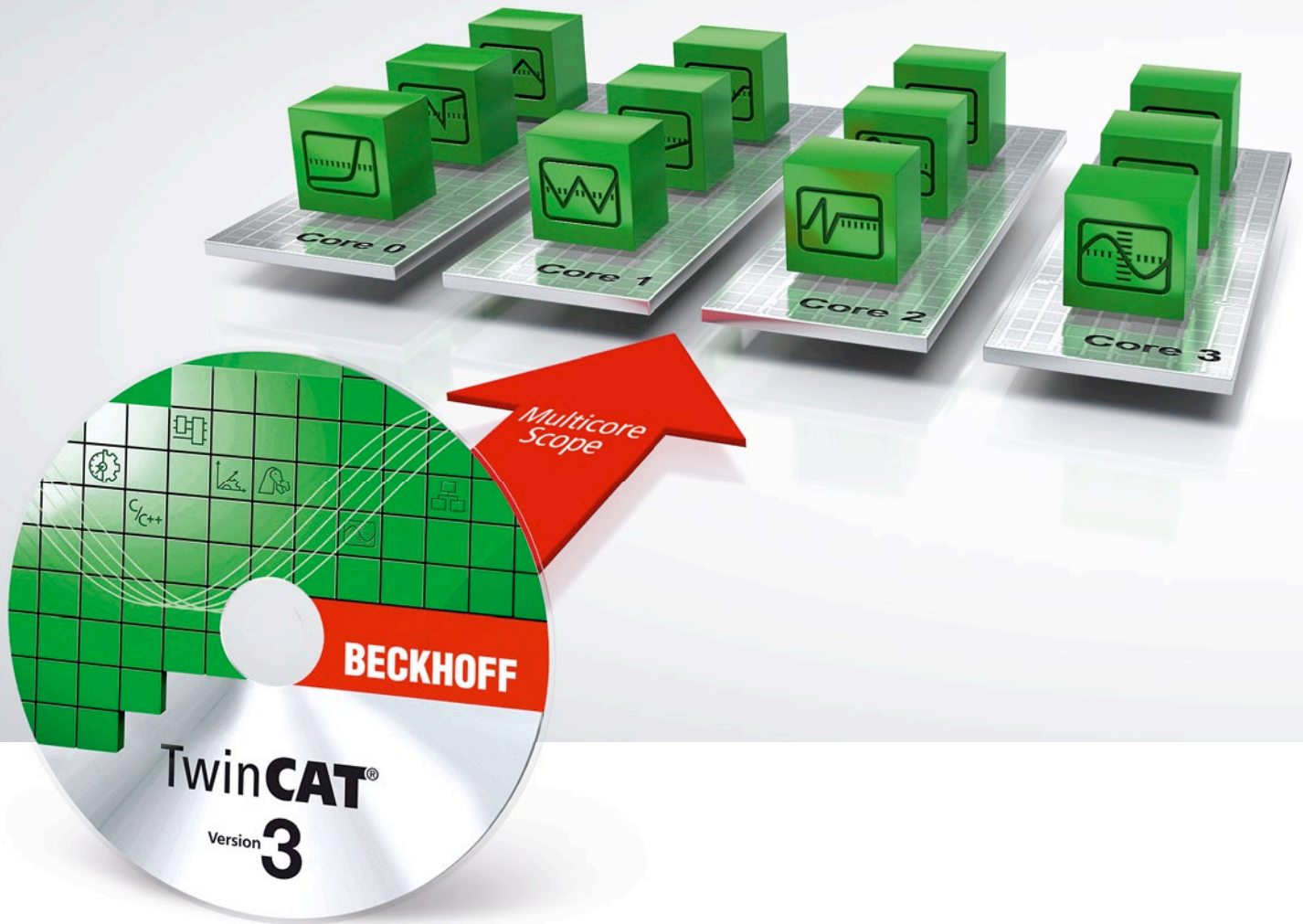
TwinCAT Scope: Increased performance via multi-core technology

Especially against the background of Industry 4.0 and "Big Data", advanced data acquisition for machines is no longer an issue just for test bench operators. More and more production machines require reliable data acquisition over the entire lifecycle of the machine: data is collected during commissioning for setting and optimizing the machine, during production in the plant, and for condition monitoring systems in order to increase machine availability.

In terms of requirements, there are virtually no differences between the engineering phase and service operation. As a basic rule, data must be presented in the right sequence, with maximum performance, and in a clear and transparent manner. The integration of a charting tool into the development environment for machine software is therefore essential to achieve maximum engineering performance. The TwinCAT Scope meets all these requirements, and has been further optimized with regard to the representation of multiple channels.
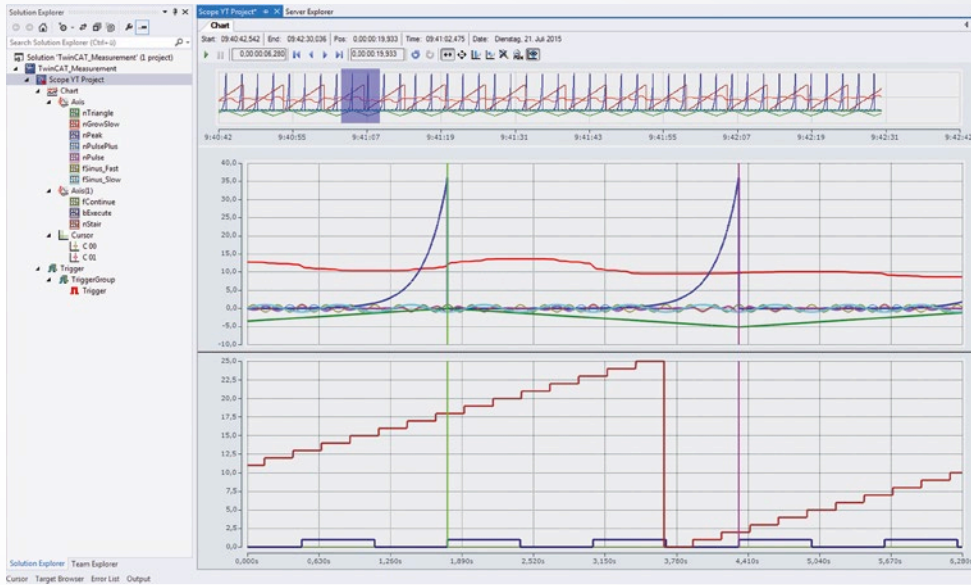
Fig. 1: Scope configuration in Visual Studio®,
with overview chart also shown

Pascal Dresselhaus,
TwinCAT Product Manager, Beckhoff

Architecture

TwinCAT 3 Scope is a software oscilloscope for the graphical display and analysis of variables from the automation system. The TwinCAT 3 Scope consists of two main components: Scope View for the graphic display of the signal curves, and the Scope Server for the actual data logging. For logging purposes, the Scope Server can be installed on the target device without the View component. In this case, it is controlled via a PLC function block, which can handle the loading of configurations, starting and stopping of recordings, and data storage. If Scope View is used for control purposes, the Scope Server can be installed on the remote device or locally on the engineering device. In view of the fact that the local server is sufficient for recording data, Scope is ideal for service technicians, because no additional software has to be installed on the target device in order to perform a highly accurate and graphically enhanced analysis of the machine. The service technician can connect directly and start a trigger-controlled configuration, for example. A "stop-record trigger", in which a pre- and post-trigger time can be set, often lends itself in service situations. Here, logging takes place in the ring buffer, with the period prior to the trigger event and the effects of the event being logged in one recording.

Like the engineering of TwinCAT 3 itself, the configuration and display part of the Scope is integrated into Microsoft Visual Studio®. Particularly during machine commissioning, it is very advantageous if the Scope View hosted in the measurement project can exist in parallel with the TwinCAT project within the same solution in Visual Studio®. The Windows docking feature can be used to display the Scope View and the program code or the hardware configuration directly side by side. In this way, the effects of executed program sections or newly set hardware parameters are always directly processed graphically, which can be very useful for user analyses. At the same time, Scope View can exist on its own in a solution, i. e. independent of a TwinCAT project, due to the fact that it has its own project. If Visual Studio® is not available on a runtime system,

Scope View automatically installs the Visual Studio® shell and integrates itself into it. An additional Microsoft installation is therefore not required.

Applications

The original development objective for the TwinCAT Scope was a tool that supports engineers, technicians and programmers during machine commissioning and troubleshooting. Therefore, it is very important that this tool collects data in a manner that is exactly synchronous with the cycle – even at cycle times of 50 µs. With oversampling technology, it is possible to scan signals even faster than the actual PLC cycle time. Naturally, it should also be possible to display these values. The chart display therefore enables zooming right into the µs range. Cycle-matched analysis is assisted by the cursors available in Scope View, which can be used to display differences on x- and y-axes, for example. The data picker, which appears as a tooltip when data points are selected and shows the values for the x- and y-axis, is also very helpful. Furthermore, the TwinCAT Scope is often used for the commissioning of drive axes, since signals can be viewed and compared side by side in charts or y-axes, even during recording. The XY plot feature can be used to graphically display travel paths of drives – particularly for CNC applications. Just five mouse clicks are sufficient to record the first drive axis in a TwinCAT configuration with all key parameters: select an appropriate NC template in the Project Wizard, then press the Start Record button, and the recording starts with the main axis data (position, velocity, etc.). The Copy and MultiSelect functions can be used to extend the template to any number of axes within the controller configuration.

A TwinCAT 3 Engineering installation always includes a Scope View and a local Scope Server. Both components are included in the basic version, with the described functionalities and many more – all without additional license costs. Many TwinCAT Scope functions are also ideal for process monitoring. The main
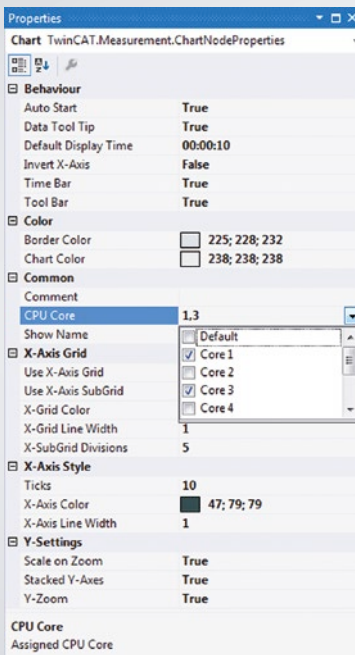
Fig. 2: Property window for the chart settings under the new multi-core support
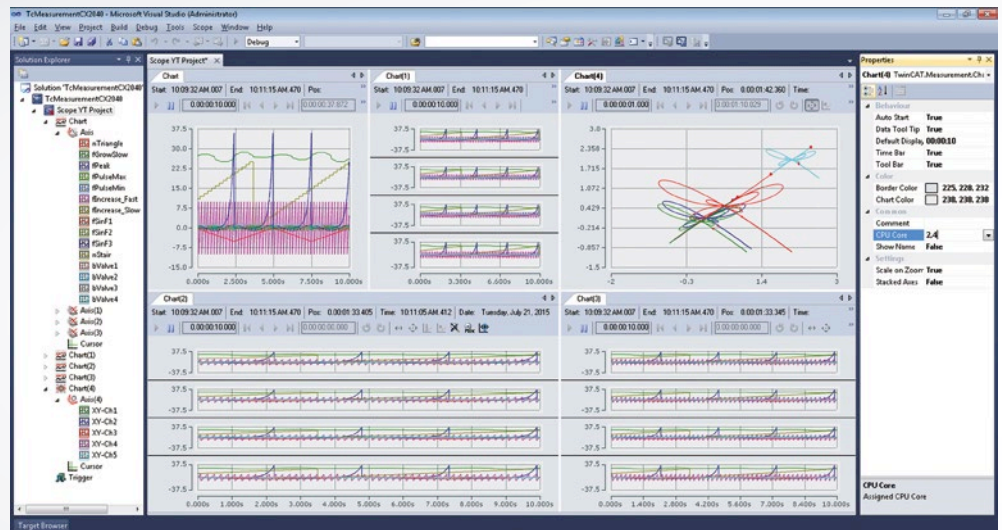
Fig. 3: Visual Studio® shell on a CX2040 with more than 230 signals in Scope View

feature in this case is the ability to carry out long-term recordings over several days. Trigger-controlled intermediate results can be stored consistently on the hard drive in parallel with long-term recordings. The Scope-specific data files can be exported to various other data formats, either manually or automatically via command line calls. Even during a long-term recording, the user can stop the online display for closer examination of the results with different zoom functionalities. An overview chart is available to keep track of complex diagrams with many curves. This "chart in chart" shows the data arriving in the background on an absolute time axis. The blue window in the overview chart in Figure 1 indicates the current position in the main chart. This marker is variable and makes it easy to jump from event to event, without having to scroll and zoom in the main chart.

Long-term recordings naturally generate very large data volumes. These data quantities are a result of sampling rates of 20 kHz or more per channel, and are fittingly described by the keyword "Big Data". They have to be managed and stored appropriately, to ensure that they are available for subsequent analysis and evaluation.

Example
The fieldbus cycle time of 1 ms corresponds to a sampling rate of 1 kHz.

Number of measuring channels	Data type	Comment
5	REAL	10-times oversampling
40	INT	
20	BOOL	

In the example with 65 channels, even a recording duration of just one hour generates a data volume of more than 3.8 GB, including timestamp. Sometimes it is not necessary to record each process record with the control cycle time as a

sampling rate. Cycle-matched sampling may be required for drive axis or acceleration sensor data, but not necessarily for temperature sensors which are also present in the system. In Scope View, it is therefore possible to set an individual sampling rate for each channel. For example, if the sampling rate for the 40 integer variables is reduced from 1000 values per second to just 1 value per second, the memory usage reduces by more than 1.5 GB per hour.

Performance
The bottleneck for complex Scope configurations is rarely data logging, per se. Apart from high data traffic volumes, it is the display of multiple channels with a high sampling rate that present the main challenges. The key parameters are system resources, such as CPU performance, the graphics card, and RAM. However, even if the system itself offers high performance, the software must be able to utilize the available resources efficiently. TwinCAT 3 is just such a software: in the TwinCAT 3 runtime, it is possible to execute real-time PLC, NC, C++ or MATLAB®/Simulink® tasks at different cycle times on different CPU cores. In this way, the automation software can benefit directly from advancements in PC technology, which provides processors with more and more cores, increasing performance. Scope View is now also able to make full use of multi-core systems, by using one or several CPU cores for displaying the signals. For each chart within the Scope configuration, the user can select the cores the processing power to be used for signal displays. For complex charts, e. g. with several channels and axes in XY plots, several CPU cores can be used for one chart. The user can make the selection in the Property window (see Figure 2) of Visual Studio® for the selected chart.

If CPU cores on the target device were reserved for exclusive use by the TwinCAT configuration, so that they are no longer available for Windows, they are automatically no longer available for selection in the Scope configuration. In this way, the TwinCAT real-time retains the reserved cores for exclusive use.

Fig. 4: CPU load; top: graphics load on one core, bottom:
graphics load distributed across all four cores

Fig. 5: Two Scope controls integrated
in a .NET application

In order to further improve the display performance and adapt it to the existing device, Scope View also supports two graphics libraries: GDI+ and DirectX. For DirectX-capable devices, this library significantly increases the graphics performance, as DirectX outsources the diagram calculations to the graphics card, thus considerably reducing the CPU load. The graphics chipset is designed for graphics rendering and can display significantly more data points than the GDI+ variant of the CPU. Multi-core support, in combination with DirectX graphics, enables a considerable performance boost for the display of signals.

Example
On a CX2040 Embedded PC from Beckhoff, which features an Intel® Core™ i7 2715QE 2.1 GHz quad-core processor, it is possible to display around 60 signals simultaneously within five charts. By switching from GDI+ to DirectX, and by allocating each chart to one or several dedicated CPU cores, it is possible to record and display more than 230 signals live. Figure 3 shows Scope View during such a recording, in which all signals are sampled with a cycle time of one millisecond.

Both features, i. e. multi-core support and the graphics libraries, are also available for the so-called Scope Control integration. Scope Control integration refers to the option of integrating Scope View charting into a custom, .NET-based visualization as a ready-made control element, as shown in Figure 5 with an XY and a YT chart. This includes not only data handling during the recording, but also control functions such as zoom, panning, and overview of the chart, among others. Therefore, neither a custom charting tool nor a third-party tool is necessary for customer-specific visualizations, significantly reducing engineering effort. Ultimately, the user has the benefit of using a standard product, which is maintained by Beckhoff, to create a software oscilloscope with fully customizable configuration and appearance.

Conclusions
TwinCAT 3 Scope is a core product within the TwinCAT system and is continuously evolving. This product benefits from more than seven years of development experience. It simplifies the engineering during application development, but also troubleshooting and parameter optimization at the machine. Its modularity enables integration into customer-specific visualizations. The new functionalities, particularly multi-core CPU support, underline the status of TwinCAT Scope as an high-performance charting tool for the TwinCAT software world.

Further information:
www.beckhoff.com/tc3-scope

Scientific Automation and compact drive technology in end-of-line tester for the automotive industry

Highly-integrated automatic haptic testing devices for in-vehicle control elements

Engineering consultants Borrmann GmbH, based in Ingelheim, Germany and Schuhriemen Maschinenbau GmbH, based in Sommerloch, Germany manufacture extremely compact and high-performance automatic test devices for driver control features in vehicles, using PC-based control technology from Beckhoff. The concept of Scientific Automation, which combines control technology with very fast, high-precision measurement technology, offers significant advantages and results in cost savings of up to 70 percent when compared with existing solutions. An additional benefit is significant space savings through the use of compact servo drives in Bus Terminal I/O format.

Thanks to the high-performance PC-based control technology with integrated high-end measurement technology, the end-of-line tester is very compact.

The AM81xx OCT servomotors ensure high-precision movements in no less than seven axes.

The automatic test devices are end-of-line testers for the comprehensive testing of control elements for drivers in vehicles. Drivers use these features to operate the lighting, radio, air-conditioning, navigation system and much more. A wide range of vehicle functions are selected by pressing, pushing, tilting, turning or touching. Andreas Borrmann, Managing Director of an engineering consultant company under the same name, explains: "The main task of the test system is automatic haptic testing. Numerous sensors measure the forces and torques involved in actuating the different switching functions. Rotary plate applications are implemented with up to eight independently operating stations." These automatic units are among the most integrated haptic testers in the market, offering very compact control and drive technology. Coupled with the particularly powerful measurement technology, these features play a key role in providing a robust, powerful solution. Borrmann continues: "Whereas in the past special measurement technology was required for synchronous acquisition of force/path or torque/angle data, we can now use standard components from Beckhoff. The standard I/O terminals even enable additional synchronous acquisition of bus telegrams such as CAN or LIN from the devices under test." A single Industrial PC (IPC) handles all the control and measuring tasks for the eight stations. It is not uncommon to have up to 450 test parameters for each operator control element. Typical cycle times for a rotary plate cycle are 20 seconds, which corresponds to an annual production of more than 300,000 driver control elements.

Simplifying complex test procedures

At the start of a test cycle, the operator subjectively examines the component to be tested in station 1 for obvious mechanical flaws and cosmetic deficiencies such as scratches. Once the device under test has been inserted, it is automatically clamped and contacted. After manual through-switching of the device and confirmation of the subjective inspection by the operator, the lift door closes and the rotary plate cycle starts.

The brightness of the LED symbol illumination can vary by more than 30 percent. In station 2, the brightness is calibrated by measuring light levels with a video camera. Correction values for the brightness control are written into the EEPROM of the device under test via a CAN telegram. In station 3, lift-off tests using suction grippers ensure that the decorative lids and covers are glued on correctly. Inductive analog initiators verify the presence of the bolts, and several sensors ensure the correct color combination of all buttons. The first haptic test in the form of a torque measurement follows in station 4. A torque sensor, which operates based on the piezo-electrical effect, provides torque data with a resolution down to 0.1 Nm at a rotational speed of up to 180 degrees per second. The goal of this measurement is to determine the notching as well as the minimum and maximum cogging torques. Cogging torques outside the permitted limits indicate a malfunction in the assembly process for the device under test. Andreas Borrmann explains: "We use the oversampling functionality with a factor of 20 to enable 20,000 measurements per second at a task cycle time of 1 ms. Therefore, each angle degree is resolved with more than 25 torque data sets."

Station 5 is uniquely configured for testing vertical pressure forces. Here too, a high-precision piezoelectric force sensor is used. Thanks to the oversampling functionality, a force resolution of 0.02 N can be achieved at an actuation speed of 10 mm/s, with a path resolution of 0.002 mm. At the same time, CAN and LIN telegrams are recorded during actuation and are exactly assigned to the actuation position, thanks to a task cycle time of 1 ms. Stations 6 and 7 are optimized for measuring horizontal tilting forces, utilizing the same measurement technology as in station 5. Because strictly horizontal actuation of tilting movements gives rise to lateral forces, these forces must be compensated through elaborate mechanical balancing components. The final writing of data, such as part number, serial number, production date and further product-specific information into the EEPROM takes place in station 8, which is the last station. If the results of all test parameters (up to 450) are within the specified limits, laser labelling of the device under test is approved. The labels contain information in plain text and in Data Matrix code (DMC). A DMC reader scans the code and checks the content and quality. In the subsequent rotary plate step, the fully checked module is transported to station 1, where the operator removes and packs it.

Communication with the test device according to the ISO 15765 standard is
realized via seven EL6751 CANopen master terminals. This has reduced the costs
by more than 80 percent when compared with existing solutions.

EL7211-0010 servomotor terminals with One Cable Technology (OCT)
are key components to enable compact design and precise motion control.

Speed and precision require PC Control solution

Without PC-based control technology from Beckhoff, the development of this
end-of-line tester would have been virtually impossible, according to Andreas
Borrmann: "Only PC-based control enabled us to meet the very stringent re-
quirements in terms of speed and accuracy for the measurement and drive
technology. The performance of existing solutions was limited by the lack of
expandability of the PCs with measuring and control cards, which were used in
the past. The modular, decentralized Beckhoff technology removes this limita-
tion, facilitating a reduction in hardware costs by up to 70 percent, compared
with existing solutions that have separate measurement technology."

Andreas Borrmann sees further benefits in the fact that the entire measuring
and control system can be controlled centrally and conveniently from a single
IPC. The additional PLC required in existing systems can be omitted, and the
effort involved in numerous driver installations for the measurement technolo-
gy from different manufacturers is a thing of the past: "The integrated system
solution offers significant benefits in this respect, not least in view of the fact
that PC-based control also includes high-performance, high-precision and very
fast measurement technology. Moreover, it is easily possible to integrate the
CAN protocol used in the vehicle for communication between operating ele-
ments and the control unit according to the ISO 15765 standard. The protocol is
modelled in the TwinCAT PLC and processed via seven EL6751 CANopen master
terminals. Compared with the technology used in the past, this results in cost
savings of more than 80 percent. What's more, the CAN protocols can now be
read and evaluated in real-time, synchronized with automatic actuation of the
device under test. Previously, this was only possible with highly specialized and
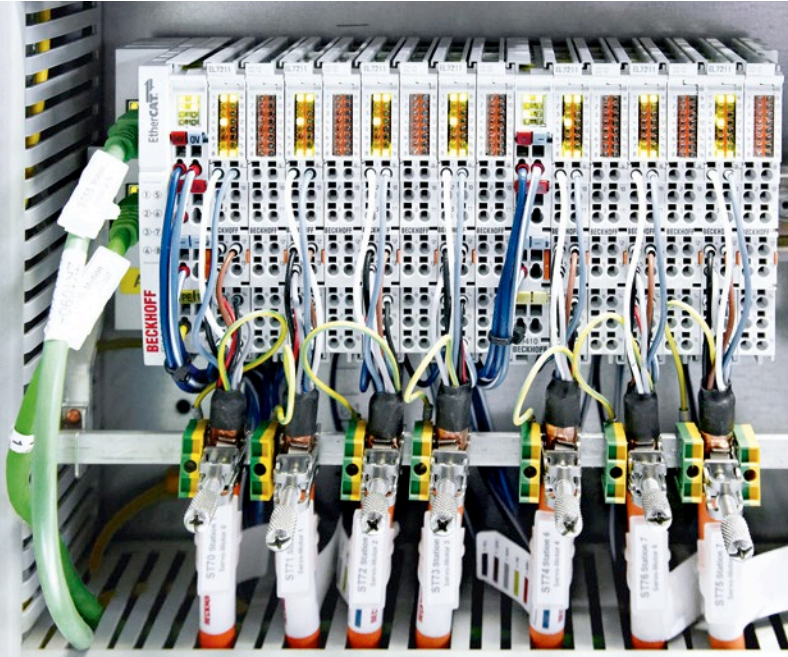
complex electronic measuring systems. The haptic data consists of three ele-
ments – the force sampled by analog means, the path determined directly via
the motor and the contact determined via a CANopen master terminal – which
can now be determined easily."

I/O system integrates advanced measurement technology

In addition to servomotor and CANopen master terminals, the
I/O system that complements the control technology leverages
16 EL1008 digital input terminals and twelve EL2008 digital out-
put terminals, each with eight channels. Measurement technology
integrates directly via the corresponding EtherCAT Terminals. Four
2-channel EL3202 analog input terminals with an oversampling
factor of 20 ensure time-synchronous, high-precision acquisition
of force, path, torque and angle data. Seven 4-channel EL3104
analog input terminal process current, temperature and signal
measurements. An EL3681 digital multimeter terminal also mea-
sures currents, while a high-precision, 2-channel EL3692 resis-
tance measurement terminal provides contact resistance value
determination.
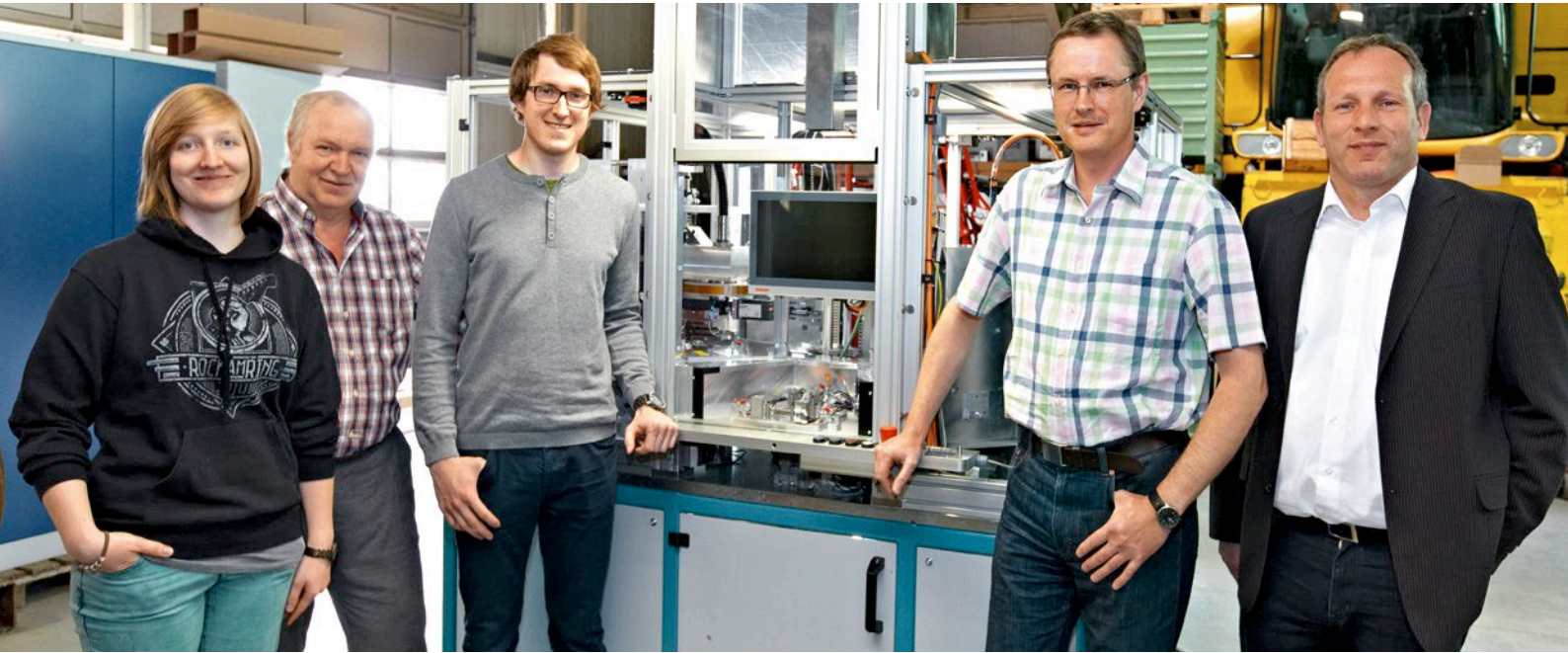
Jasmin Schuhriemen, Managing Director Hans-Julius Schuhriemen and Stefan Schuhriemen, all from Schuhriemen Maschinenbau;
Andreas Borrmann, Managing Director of Borrmann engineering consultants; and Jörg-Michael Vetter from the Beckhoff regional office
in Frankfurt (left to right)

Servo drive technology with minimal space requirements

Servo drive technology is also integrated directly into the I/O system. The high-precision movements in the individual testing stations are realized via seven servo axes, consisting of EL7211-0010 servomotor terminals with a width of only 24 mm. These terminals also feature integrated One Cable Technology (OCT) and up to 4.5 ARMS output current, in addition to AM812x OCT servomotors with rated torques of 0.5 Nm and 0.8 Nm respectively. Andreas Borrmann continues: "Without the servo drives in the very compact Bus Terminal format, it would not have been possible to achieve such a small footprint for the machine. These products enabled us to minimize the size of the installation and do away with additional control cabinets. OCT was also very helpful, since it significantly simplifies the otherwise complex cable layout, based on linear and rotary bushings. Big advantages also arise from the absolute feedback system, which makes the previously required reference switches unnecessary, thereby significantly reducing the drive technology complexity."

Further information:
www.borrmann-gmbh.com
www.beckhoff.com/Scientific-Automation
www.beckhoff.com/Compact-Drive-Technology

i   At a glance:

Solutions for the automotive industry
End-of-line test facility for control elements in cars

Customer benefits
Minimum machine footprint and integration of cost-effective measurement technology

Applied PC Control
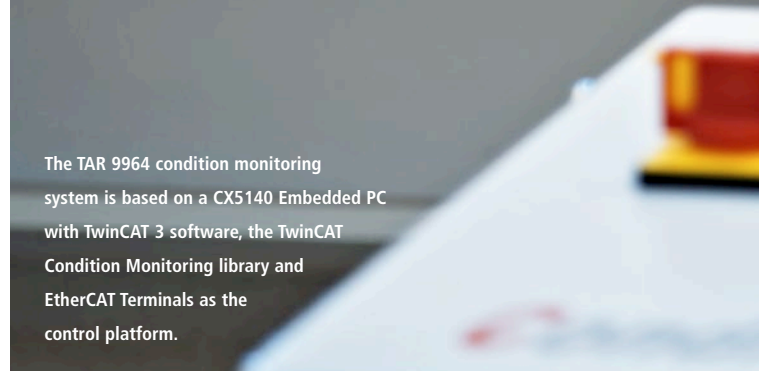– Decentralized and integrated measurement and control solution reduces costs by up to 70 percent.
– EL6751 CANopen master terminals reduce the costs for communication according to ISO 15765 by more than 80 percent.
– EL3702 EtherCAT analog input terminals ensure high-precision force and torque measurement via oversampling.
– EL7211 servomotor terminals and AM81xx servomotors with OCT minimize space requirements.

Advanced measurement data processing with TwinCAT 3

Process optimization through integrated condition monitoring

TAR Automation specializes in high-quality automation technology, supporting manufacturing companies through the integration of innovative control solutions. In addition to the design and implementation of new systems, as well as modernization of existing production machines, TAR develops system solutions in the areas of motion control and condition monitoring. The company, which is based in Dinslaken, Germany, recently developed an efficient condition monitoring system (CMS) for production equipment, based on integrated automation solutions from Beckhoff.

The TAR 9964 condition monitoring system is based on a CX5140 Embedded PC with TwinCAT 3 software, the TwinCAT Condition Monitoring library and EtherCAT Terminals as the control platform.

"In the early days of our enterprise, we used conventional PLC and SCADA products almost exclusively. Today, we increasingly employ PC-based automation solutions from Beckhoff," Alfred Rachner, Managing Director of TAR Automation, explains. "The multi-functional TwinCAT 3 automation platform provides an efficient development environment for our engineers to create software components. It is modularly structured, but nevertheless integrated. The finely scaled series of Embedded PCs provides the ideal hardware platform for the performance requirements of any task at hand."

Highly precise and customizable: Seamlessly integrated condition monitoring system

"The PC-based control solution enables us to integrate numerous new functions in automation technology, which in the past could only be realized using dedicated 'black-box devices'. Condition monitoring for production equipment is a good example," says Alfred Rachner. A conventional CMS is usually installed as a separate subsystem within the overall system. It consists of special hardware for data sampling and evaluation, has a fixed number of channels and a defined functionality. This makes such stand-alone solutions very inflexi-

ble: the user is unable to respond to changing needs, and condition monitoring functions become difficult to integrate, as well as very expensive.

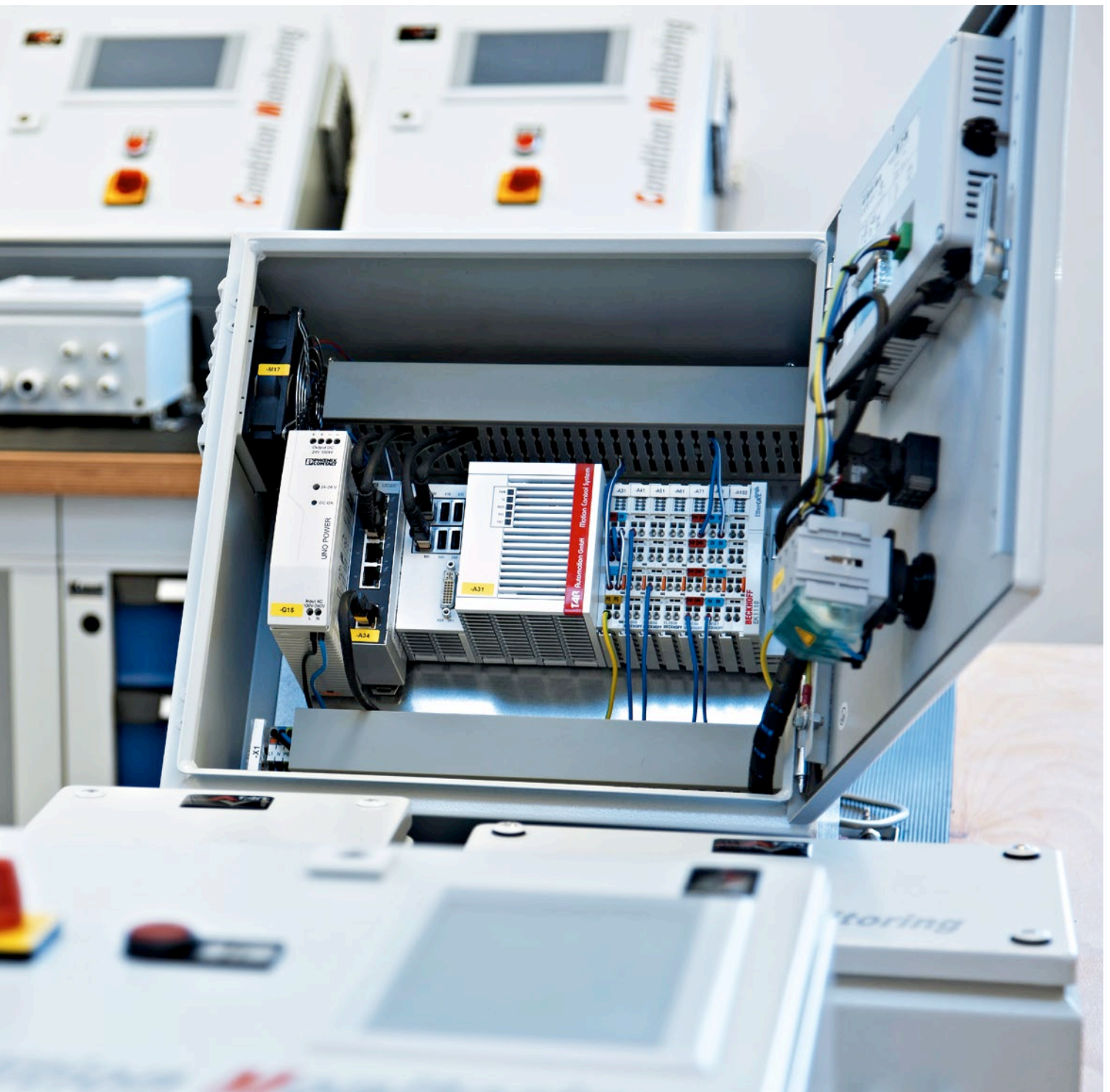Enhanced flexibility and reduced costs drove the TAR engineering team to develop the TAR 9964 condition monitoring system, which is based on a CX5140 Embedded PC with TwinCAT 3 software, the TwinCAT Condition Monitoring library and EtherCAT Terminals as the control platform. EL3632 Condition Monitoring terminals are used to connect IEPE acceleration sensors. The integrated configuration provides numerous benefits:

– The system is freely programmable, enabling the addition of new functions at any time.
– Vibration and analog channels, in addition to temperature measurement or digital I/Os, can be retrofitted at any time using the range of modular EtherCAT Terminal I/O.
– EtherCAT, as a broadband real-time network with high-precision clocks for synchronization, as well as oversampling technology, facilitates sampling rates of up to 100 kHz for analog signals and 50 kHz for acceleration values.

**Ralf Stachelhaus, Manager
Beckhoff Sales Office
Rhein/Ruhr, and Alfred Rachner,
Managing Director TAR
Automation (left to right)**

– The EL3632 condition monitoring terminal provides connection of IEPE sensors (acceleration, microphones, etc.) and features oversampling technology, parameterizable hardware-based antialiasing filters, digital filters and offset compensation.
– Basic analysis algorithms can be integrated as a PLC library, permitting the modification or expansion of functionality at any time.
– Integration into the customer's system is straightforward – a function of the availability of all common interfaces, including PROFIBUS, PROFINET, EtherNet/IP, CANopen, and Ethernet, among others.

More than condition monitoring: Process optimization of a granulator

The TAR 9964 condition monitoring system provides, as a real-world example, monitoring and process optimization of a shredding machine for recyclable material such as components used in PCBs, cooling units, washing machines, various plastics or tires. The granulator has a 400 kW drive for the cutter shaft and a 12 kW hydraulic unit for the pushing unit and stator adjustment. The cutter shaft features acceleration sensors, whose data are logged via the EL3632. First, software function blocks from the TwinCAT Condition Monitoring library acquire and bundle data in a very fast task. In one or several subsequent tasks, various analysis function blocks are used for additional operations, such as Fourier analysis, limit value monitoring, averaging and classification. The condition monitoring library also ensures correct time correlation of the acquisition and analysis tasks.

The integrated condition monitoring system results in tangible benefits for the operator of the shredding system:
– Bearing monitoring: In the past, bearings were monitored via temperature measurement, so that impending bearing damage was usually detected too late.
– Vibration, limit value and trend analysis: Detect potential bearing damage before costly damage actually occurs.
– Over-lubrication detection: Minimize lubrication waste Optimized system operation: If the working area is not closed properly, the material

"dances" on the cutter shaft and does not shred correctly. The resulting increased vibrations can now be measured, and the feed corrected by applying pressure.
– Automatic V-belt tension detection: Automatic detection and adjustment of loose V-belts Detection of blunt cutters: In the past, the plant was inspected "by ear", requiring personnel to actually listen for changes in equipment and the cutters were sharpened manually when needed. The condition monitoring system supplies reliable measurement readings for detecting blunt cutters and sharpening is carried out automatically.
– Integration into the machine control system: The material feed was historically controlled manually. Previous attempts to control the infeed with optical measuring systems were unsuccessful, because the materials to be shredded differ greatly in size and form. Now, the vibration analysis function of the condition monitoring system enables reliable detection when the granulator is empty, supplying new material automatically. Continuous utilization of the machine increases productivity by up to 50 percent.

New potential for system integrators

"For TAR, integrating condition monitoring into the automation and control system also opens up new opportunities and sales potential," points out Alfred Rachner. "TwinCAT is ideal for us as an integration platform: From simple control tasks to motion control, CNC applications, condition monitoring and safety technology – we can solve any task with a single system. This eliminates costs for training programmers on different platforms, and we only have to install and maintain a single engineering system in our departments. The same savings apply to maintenance procedures at our customers' sites."

"In addition, TwinCAT supports all common fieldbus interfaces such as PROFIBUS, PROFINET, EtherNet/IP, and CANopen, so that we can easily integrate our solutions into the control environments our customers use – for example, when it comes to modernizing an existing system. The most effective way forward is a fully integrated PLC/NC/CMS solution based on TwinCAT, although this is obviously only possible for new systems."

Condition monitoring with TwinCAT and EtherCAT

EtherCAT eliminates the need for subsystems

In the past, sampling rates of 100 kHz were not possible with fieldbus systems. With EtherCAT, this has changed – its functional principle enables usable data rates far in excess of 90 percent with full-duplex, fast Ethernet and bus cycle times of a few microseconds. Oversampling technology, providing buffering of measured data directly in the EtherCAT slave, enables the increase of sampling rates far beyond the actual bus cycle. Distributed Clocks in the EtherCAT slaves ensure time-synchronized data sampling across the network. The jitter is significantly less than 1 microsecond, usually even less than 100 nanoseconds. This enables the integration of a variety of functions into the control system, which in the past were realized with decentralized, intelligent subsystems to address speed concerns. Now, EtherCAT offers ample speed for the measured data to reach the control system with time to spare.

High-precision measurement technology via EtherCAT Terminals

Beckhoff utilizes EtherCAT functionality for ongoing development of new measurement technology I/Os. Terminals are already available for temperature measurement, load cell analysis, current and voltage logging, vibration monitoring and various analog signals, such as +/-10 V or 0…20 mA.

Condition monitoring integrated seamlessly into the control system

In addition to EtherCAT and high-precision measurement terminals, the continuous performance improvements from PC-based control technology represents a key factor in the ability to operate condition monitoring systems directly, rather than via subsystems. Intel® Core™ i7 quad-core CPUs with 2.1 GHz are used in high-performance devices such as the CX2040 Embedded PC. Even for complex control tasks, this means that ample performance reserves are available for the analysis of measured data.

## TwinCAT 3 optimizes data processing

TwinCAT 3 automation software gives users the power to distribute individual program tasks to separate CPU cores. To use computationally intensive algorithms for analyzing measured data, for example, a dedicated analysis task can be defined and executed on a separate CPU core. In addition, TwinCAT 3 offers PLC programmers a Condition Monitoring Library for measurement data processing. It is designed as a software kit, which enables users to choose between basic mathematical algorithms or user-specific modules, depending on the application and level of knowledge: Examples for basic algorithms from the fields of analysis, statistics and classification include blocks for Fast Fourier transformations, Envelope, Kurtosis, Crest Factor, RMS and limit value monitoring. Users have a full range of basic algorithms available for developing their own analysis routines.

User modules serve as another step towards application. These modules comprise basic algorithms and encapsulate the algorithms as required for monitoring roller bearings, for example. In this way, a user can configure the module with individual bearing geometry data and teach-in limit values, without the need for detailed knowledge of the calculations that are carried out internally.

Piezoelectric sensors from IMI Sensors

The vibration sensors used by TAR Automation are based on ICP® technology and have the significant advantage that the measuring signal is transferred as a voltage value with low source impedance, which is immune to interference. This minimizes disturbances through electrical and magnetic fields from adjacent devices. The different versions and types of available sensors facilitate use in virtually any situation, including high-temperature applications or Ex zones.
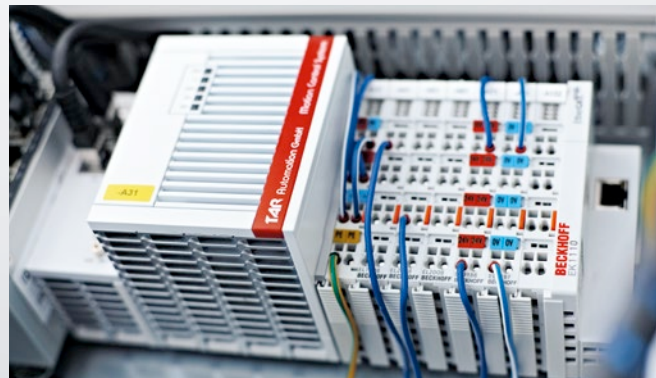
The condition monitoring system is supplied ready for operation, installed in a compact terminal box.

Industry 4.0: Communication standards for vertical and horizontal networking

The wide range of Embedded PCs are scalable in terms of performance and I/O configuration while offering diverse networking options. This offers many degrees of freedom when implementing control architectures and, as a result, optimum solutions for the tasks at hand. "Whether we are dealing with a small, stand-alone solution, networking of decentralized, intelligent controllers or a high-performance central solution – anything is possible," concludes TAR's Managing Director. "In combination with support for OPC UA as the universal standard for vertical networking, it is also possible to integrate ERP systems, both within a site and across sites."

Further information:
www.tar-automation.de
www.beckhoff.com/Condition-Monitoring

Beckhoff Switzerland: Gerhard Meier hands over management duties to René Zuberbühler

During a customer event held by Beckhoff Automation AG Switzerland on September 4, 2015 at the historic Dolder Grand hotel in Zurich, Gerhard Meier officially handed over the management of the company to his successor, René Zuberbühler. Around 100 guests were in attendance for the occasion, among them representatives from 50 large Swiss customers.

Gerhard Meier established Beckhoff Switzerland more than 15 years ago, successfully serving as Managing Director during this time. Recently, Meier handed over the reins to his successor, René Zuberbühler at the Dolder Grand hotel, which the company helped revamp and modernize 10 years ago. At the time, Beckhoff Switzerland implemented a very advanced control system with the help of another solutions provider; the project involved more than 280 Embedded PCs and 25,000 Bus Terminals. "It was a very interesting, but also challenging project, as it was highly demanding for all parties involved," said Gerhard Meier. "The baton handover event was probably my most relaxed visit to the Dolder Grand to-date."

In 1995, Gerhard Meier made his first contacts with the German Beckhoff headquarters office at an industrial trade show, from which the opportunity arose for him to establish Beckhoff representation in Switzerland. Even though today it is hard to imagine life without PC-based control technology, at the time it was rather "exotic" and required pioneering effort. "In the early days, it wasn't always easy to convey the benefits of PC-based control technology to traditional users," noted Meier. "However, a significant advantage was the fact that Swiss machine manufacturers tend to use very sophisticated automation technology. Even back in 1995, PC-based control was clearly superior to conventional technologies, thanks to the high-performance Lightbus fiber optic communication and TwinCAT software with motion control. The ability to make equipment and machine positioning faster and more accurate was the decisive factor for many early Swiss customers."

Based on rapid positive sales development, Beckhoff Automation AG Switzerland was established in 1999 as the first business subsidiary outside Germany. The opening of the Yverdon office and the entry into the marketplace in western Switzerland followed two years later. This was an important milestone, because it enabled the company to optimally serve customers in their own local language. Further branch and sales offices followed in Zurich, Lyssach and Losone.

Since 1999, Beckhoff has attracted many new customers across Switzerland, resulting in sustained growth. Between 1999 and 2015, annual sales rose from 2 million euros to 23 million, and the number of employees increased from 3 to the current number of 30.

After his retirement as Managing Director, Gerhard Meier will continue to act as chairman of the board of Beckhoff Switzerland and will support key customer projects for a period of two years. In addition, he will continue to be involved in the further expansion of the CNC center of excellence for machine tools in Switzerland. "Understanding a CNC machine requires knowledge in electronics, mechanics, drive technology, software and NC programming," said Meier. "I was able to make very good use of this expertise I acquired in general automation technology during my time at Beckhoff."

René Zuberbühler,
Managing Director, Beckhoff Switzerland

Let us take a look at the future of the company. What can customers expect?

René Zuberbühler: Beckhoff has a major presence at five different locations in Switzerland. Thanks to our decentralized structure, we have established a strong market position. To me, it is important that we continue to expand and strengthen local support for our customers in Switzerland. In addition to more customer visits, we can achieve this through customer events such as Automation UpDate seminars. Local support means close proximity and, therefore, short response times to answer requests from customers. Our offices have sufficient reserve capacity and potential for growth and further expansion. We want to continue exploiting this potential to provide comprehensive support for our customers. In 2016, we will focus particularly on motion and CNC business opportunities.

What are the special demands arising from Switzerland as a marketplace from your perspective?

René Zuberbühler: Swiss companies need the latest technologies in order to succeed in the global marketplace. Machines made in Switzerland will be competitive if they can offer shorter cycle times, better control quality, higher precision and top-quality, premium design. For Swiss companies, the priority is not to buy the cheapest product, but to optimize the complete development and production process and the whole life cycle of a machine.

The high availability of machinery is critical, which is the primary reason why the global presence of Beckhoff international support is so strong. The high costs associated with the maintenance of legacy con-trol systems continue to move Swiss customers to open, PC-based solutions. This same PC-based control philosophy also happens to serve as the optimal foundation to implement highly-connected Industry 4.0 concepts. There is high demand for industrial solutions that can be easily serviced remotely. Customers are also seeking scalable solutions with as few required interfaces as possible in order to promote seamless control systems – all in a complete package presented at an attractive price point.

What is your «recipe for success» for the next 20 years of Beckhoff Switzerland?

René Zuberbühler: We must be available to support our customers whenever and wherever needed while finding new ways to differentiate ourselves. Our goal is to inspire customers and position ourselves as an expert automation team. Our products are unique, as is our staff. Ultimately, it is the people who make the difference. By harnessing this "people power", I expect Beckhoff Switzerland to maintain sales increase percentages in the double digit range for the foreseeable future." says René Zuberbühler. Mutually-beneficial business relationships and cooperation based on reliable partnerships are essential for the success of our customers and for us. Productivity gains are needed in all areas, and we will always support our customers in the most demanding and challenging projects.

Further information:
www.beckhoff.ch
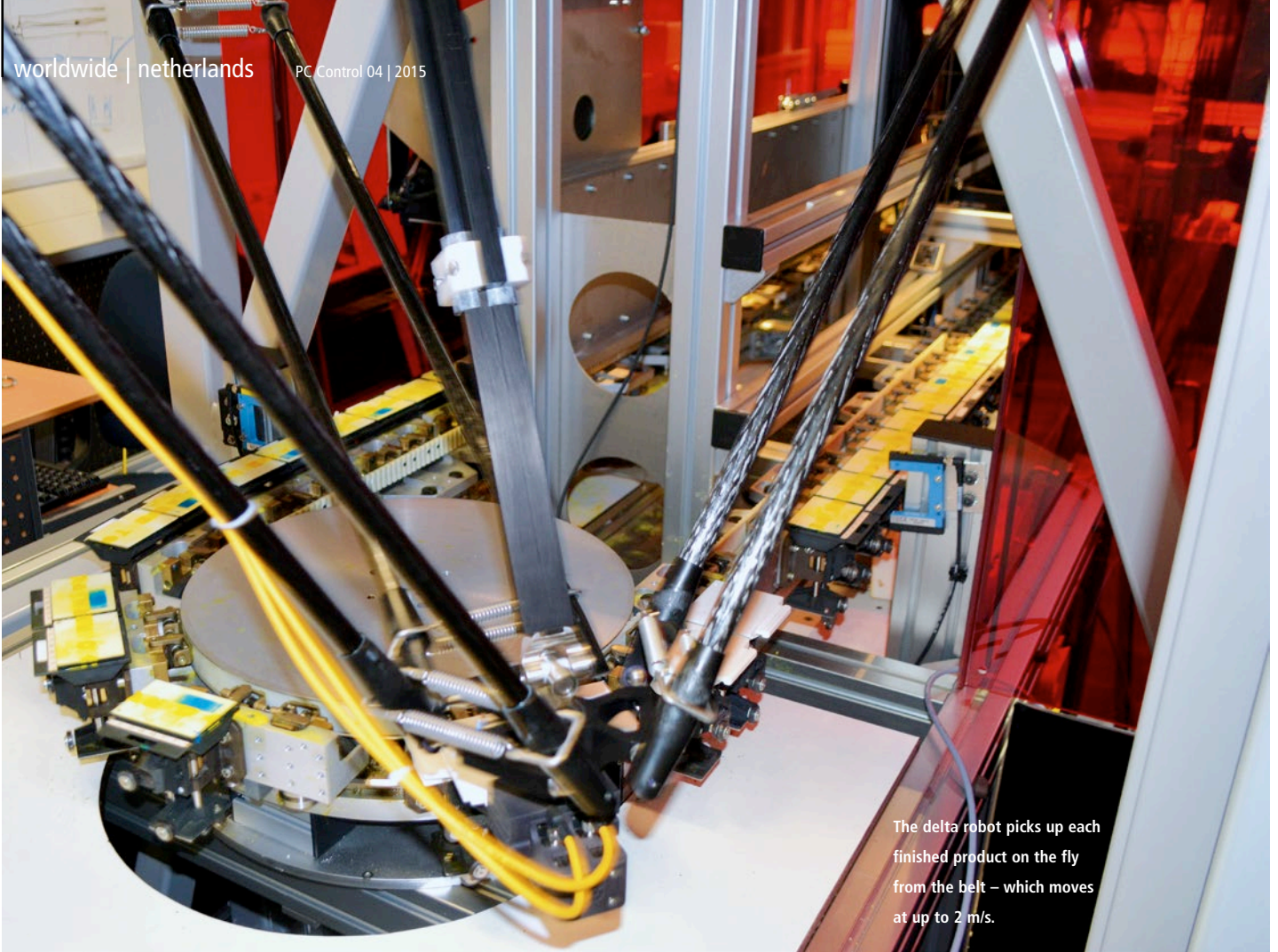
The delta robot picks up each finished product on the fly from the belt – which moves at up to 2 m/s.

Customized mass production in the factory of the future

High-speed production line combines 3D printing with precision machining

The development of additive manufacturing is progressing rapidly. One of the main advances in the progression of this technology is 3D printing of metals. To enhance this trend, TNO's additive manufacturing department in Eindhoven, The Netherlands, is developing "Hyproline", a "High Performance Production Line for Small Series Metal Parts" which consists of an integrated production line that incorporates printers and modules for finishing small metal products in various designs.

Up to now, the 3D printing process was limited to stand-alone machines that delivered products in small quantities, such as prostheses or non-standard machine parts. The ability to produce "batch size 1" quantities is one of the great benefits of 3D printing, and is often mentioned in discussions on Smart Industry or Industry 4.0.

To meet the demand for mass customization, i. e. the desire of modern consumers for a singular product at an affordable price, it is necessary to combine a large variety of products with high production figures. For this reason TNO, the Netherlands Organization for Applied Scientific Research, has developed "Hyproline". This high-speed production line makes 3D printing an integral part of the overall process, thus increasing the production output along with

product variety and quality at the same time. "Hybrid manufacturing", which is based on the PrintValley concept, enables a combination of 3D printing and precision machining of 100 different product variants at high speed.

Hyproline begins as a European research project
Arguments in favor of the Hyproline were endorsed by the European Union, which supports the Hyproline research project to the tune of 4 million euros. (Hyproline was financially supported by the European Union's Seventh Framework Program under Grant Agreement no 314685) The "Equipment for Additive Manufacturing" division of TNO in Eindhoven is one of the key partners in this project. Other partners include the University of Birmingham (United Kingdom), the Swerea research center (Sweden), as well as the

companies CCM (Centre for Concepts in Mechatronics, The Netherlands), Höganäs (Sweden), and ITI TranscenData (United Kingdom). Frits Feenstra, Senior Project Manager, Frits Verhoeven, Research Engineer, and Herbert Fiedler, Control and Automation Developer at TNO, have been working on Hyproline for four years and plan to complete the project in 2015. Frits Feenstra comments: "With Hyproline, we address two key points: First, we want to considerably speed up the production of complete, individualized metal products, and second, we want to make 3D printing an integral part of a complete production line." Although the metal products are currently not yet produced on the Hyproline platform itself, the process of finishing 100 different metal components is an important step towards fast, high-quality production of 3D-printed parts.

A continuous conveyor is the solution

"We have to say goodbye to the idea that 3D printing always takes place in batches," Frits Feenstra explains. "At present, we still work in successive steps, as is customary with 3D printing. Our goal, however, is to produce several, perhaps completely different, products at the same time, and, to that end, we developed Hyproline." Bearing a striking resemblance to a toy train that keeps going round and round, the Hyproline implements an endless belt system with an overall length of 8 m, on which 100 carriers/pallets are mounted. The belt can move at a speed of up to 2 m/s, passing various processing stations. The individual machining steps are executed by modules mounted above the belt. Installed modules include measurement of the height (of the pallet and the printed layers), 3D scanning of metal products, laser processing (ablation, grinding and polishing), the printing itself, and flash curing as a final step. In each round, the pallet is set to the correct height for the next processing steps. "Due to the length of the belt, we can mount a large number of printers and other modules above the belt. The supplied parts are made by printing on metal powder (titanium, stainless steel 316L, or copper) followed by a sintering step," according to Frits Verhoeven. A 3D scanner determines the roughness of the applied metal. If the surface is too rough, it is polished by a laser beam. The processing steps are then repeated until the product is complete and ready to be removed from the belt.

TNO values control system openness

An integrated delta robot picks the pallet with the finished product from the belt "on the fly". "Our goal is a top speed of 2 m/s, although the currently realized speed of 1.3 m/s is already a remarkable achievement," Herbert Fiedler points out. A Beckhoff CX2020 Embedded PC controls the robot, and two further controllers provide instruction for the conveyor belt and the cleaning and filling mechanism of the print heads. "TwinCAT 3 is used as the integrated automation software," says the Control Developer. "We have been using hardware and software solutions from Beckhoff for five years. The main reason is the openness of the system, which gives us free choice of controllers and protocols. Also, when compared with control systems we used in the past, the Beckhoff system is much more maintenance-friendly. Openness and maintenance are important aspects for us, not least because we want to continue using machine control systems we developed in the past in the new lines. For programming the functionality we use TwinCAT and for motion control hardware, the Beckhoff AX5000 Servo Drives. The EL6692 EtherCAT bridge terminal is used for synchronizing the robot with the filling mechanism of the printer."
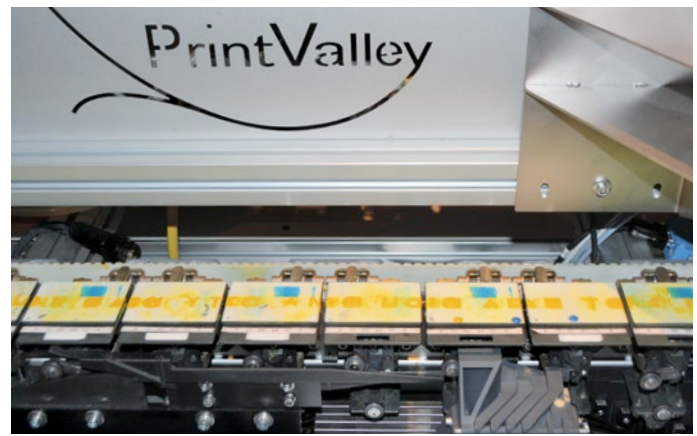
Conveyor belt with lift for quick height adjustment of the pallets

The TNO team with Hyproline in the background: Frits Feenstra, Senior Project Manager, Frits Verhoeven, Research Engineer, and Herbert Fiedler, Control and Automation Developer (left to right)

Integrated safety

Machine safety for the Hyproline system is ensured using TwinSAFE I/O modules from Beckhoff, providing IP 20 and IP 67 rated protection. "TwinSAFE enables machine safety and machine control to communicate via the same fieldbus and the same cable," states Herbert Fiedler. "This eliminates the need for external wiring." Safety functions of the AX5000 Servo Drives are integrated through AX5805 safety option cards. The two CX2020 Embedded PCs are directly linked with the EL6900 TwinSAFE Logic Terminals for controlling these safety functions. The sensors for the monitoring screens and the emergency stop buttons communicate directly with the machine control via eight EP1908 TwinSAFE IP 67 modules mounted directly on the machine.

A new maximum speed

"Today, Hyproline is able to simultaneously print and process 100 products with totally different shapes," notes Senior Project Manager Frits Feenstra. "The speed of Hyproline is crucial for its high productivity." With this in mind, the TNO developer team aims to increase the production capacity to about 10,000 parts per day.

Further information:
www.tno.nl/en
www.beckhoff.nl

Test of a manufacturing line that consists of one standard production platform and six different modules. IMS machines are used for the assembly of small parts in the areas of consumer electronics, automotive parts, and medical technology.

Ready for future trends: Individual customer needs determine production systems

Flexible machine lay-out will be key in the Smart Factory

The intelligent factory of the future will require modular machine concepts that allow users to adapt machines to changing production processes with minimal effort. Dutch company, Integrated Mechanization Solutions (IMS) decided to face this challenge head-on by developing its new METIS 4.0 machine concept. It consists of a standard machine module and individual units that can be flexibly interchanged in order to build a production line based on the steps to be executed. With PC-based control, IMS selected a control system that meets all requirements in terms of modularity, scalability, universal communication, and connectivity.

Industry 4.0 is not a passing trend for IMS, rather it embodies the production system of the future which will have to accommodate end user demands for highly customized products. The machines from IMS are mainly used to assemble small parts for consumer electronics, medical devices, or in the automobile industry. "We are currently building and installing production lines for the assembly of camera lenses and speakers for smartphones," explains Henri Paus, Technical Director at IMS. "While these products are very different, what they all have in common is the precision of the processing steps our machines have to execute."

Modular machine concept

IMS electrical engineer, Bart Deen explains the METIS 4.0 machine concept: METIS 4.0 is a production line with three important characteristics: It is scalable in production capacity; flexible in process sequences and re-configurable in lay-out. The machine's most important feature is that the production volume can

be expanded in order to match the needs for automation. Customers can start by investing a small amount in low volume automation, and this investment increases with the need for extra automation. "At the core we have the principal of modularity. This means that our machine can be exchanged and combined with each other as needed." For the actual application, this means that any IMS production line consists of two types of components: the standard production module as the underlying framework and application-specific process units.

The process units are installed on the standard platform and carry out specific steps in the production process. These may include: pick-and-place units for positioning parts, or units for applying liquids or connecting materials, treating a product with UV light, or laser-welding. IMS offers a broad range of standard units that can be easily added to and removed from the METIS 4.0 platform. Owing to their plug-in design, the units can be tested offline and installed according to the plug-and-play principle.

Bart Deen, Electrical Engineer;
Henri Paus, Technical Director;
and Ilse Buter, Marketing Manager at IMS
in Almelo, Netherlands (left to right)

The plug-in production modules can
be tested offline and installed according
to the plug-and-play principle.

Control cabinet of the METIS 4.0
with Embedded PC CX2040,
EtherCAT and TwinSAFE terminals
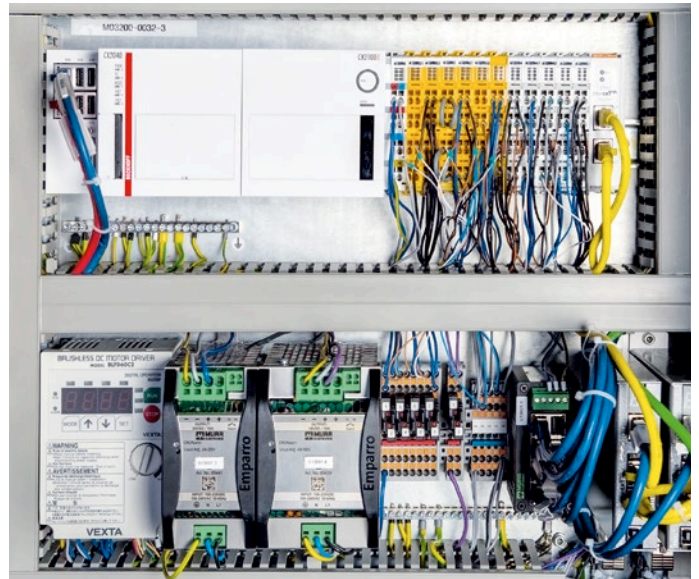
High flexibility enables quick changeovers

"Our machine development is focused on flexibility," says IMS Marketing Manager, Ilse Buter. "We face the challenge of ever shorter product lifecycles today, especially in the field of consumer electronics. In addition, products are being offered in many more versions, which means that different production lot sizes continue to shrink. That's why the manufacturing industry needs machines that can be adapted quickly and easily to handle new products, variants and lot sizes. When we already recognized this development some time ago, we promptly shifted our focus to extremely short setup changeover times. For example, we recently built a line for a customer that enables the manufacturing of products in 60 different variants."

PC-based control:
Fast, highly accurate, and exceptionally scalable

Having easily exchangeable units places high demands on the control system," says Bart Deen. "For three years IMS has used PC- and EtherCAT-based control systems from Beckhoff as their standard, depending on the size of project we choose from the CX50x0, CX51x0 or the CX20x0 Embedded PC series. Because of its fast response times, EtherCAT is very important for the types of machines built. The machine uses the EK1101 EtherCAT Couplers to connect the different modules. Each module has its own ID range, which identifies the type of module and its hardware revision. Based on this ID the controlling software loads the correct functions blocks. This enables the easily interchangeability of our modules. "Beckhoff also meets our needs as far as scalability is concerned," says Bart Deen "Since all control components are highly scalable, we can design control solutions that perfectly meet the needs of our customers."

IMS

IMS (Integrated Mechanization Solutions) is headquartered in Almelo, Netherlands. After a management buyout from Texas Instruments in 1999, the company became part of the WWINN Holding. With over 50 years of experience in developing high-end production lines, IMS specializes in customized solutions for complex assembly and manufacturing of small products. Customers include global companies in the automobile and smart-device industries as well as medical device manufacturers.

Further information:
www.ims-nl.com
www.beckhoff.nl

TwinCAT enables efficient mechanical engineering and high-performance glass processing

Compact and high-precision glass cutting machine

The main objective of global machine builder, LiSEC is polyvalent, i. e. very versatile machines, which can be easily adapted and parameterized to the respective application as a stand-alone system or system module. This requires PC-based control for highly scalable control and flexible technology, which – as the glass cutting machine, "base Cut" clearly illustrates – is extremely compact and facilitates precise machining procedures.

"base Cut", the compact flat glass cutting system from LiSEC enables high precision and low cutting tolerances in straight and shaped cuts.

With base CUT, glass plates from 2.3 to 19 mm thickness as well as 3.7 x 2.6 m, and in the future, also 6.0 x 3.3 m glass plates can be processed depending on the application.

The Austrian company, LiSEC Maschinenbau GmbH, with its headquarters in Seitenstetten, has specialized in flat glass processing for over 50 years. Their portfolio ranges from glass cutting systems to glass processing, such as technology for smoothing and grinding glass edges, to production lines for insulating glass. In recent years, LiSEC has increasingly reinforced its leading position as a supplier of automated complete systems, with complementary operator expertise through a separate glass processing division. Other features include a separate software program connected to Beckhoff software, TwinCAT, via ADS communication for production planning and optimization or for order entry and inventory management as well as "transparent production" developed in the framework of Industry 4.0.

### Scalable control technology simplifies machine building

The PC-based control technology from Beckhoff results in numerous advantages for LiSEC, as Dr. Markus Schoisswohl, Head of Automation at LiSEC, explains: "Since system visualization requires one anyway, also using a PC as the controller was a no-brainer for us. In addition, there is the exceptional scalability and high flexibility of PC Control. This is very important to us, because it enables us to implement machine automation as economically as possible. Finally, our systems offer a huge number of configuration options that go hand-in-hand with the best possible support from a control technology standpoint. Also, TwinCAT makes it easy to keep new systems updated to the latest software version without reprogramming."

Andreas Rohrweck, head of L1 (PLC) & L2 (Visualization) at LiSEC lists another advantage, scalability: "The fact that the processes are quite similar in different machines means that we can be more efficient with uniform control programs. For example, the new glass cutting machine, base CUT – as a stand-alone machine with basic functionality – uses the same control program as a high-end system in the system network. With the Beckhoff solution this can be scaled brilliantly, both in terms of software as well as with regard to the drive technology available from Beckhoff. The TwinCAT System Manager provides ideal support for this by adding a layer of abstraction for the programming and hardware levels."

According to Dr. Markus Schoisswohl, speed and openness are also central properties of PC Control: "Due to the increasing modernization of our division, the demand for advanced automation systems is rising. That is why a flexible solution for system-wide communication that accommodates different networks is so important to us. The EtherCAT industrial Ethernet system handles the communication tasks and forwarding of the real-time data transfers among the machines. Non-time critical data are transferred by client-server technology via TCP/IP, for example, to a higher level line coordinator." Andreas Rohrweck adds: "The speed of EtherCAT also benefits us in the area of motion control. The servo-axes are operated in 1 ms clocks, for example, to meet the especially high requirements in the CNC machining of glass edges. This is supported by TwinCAT NC I software, which also facilitates highly dynamic controls."

Powerful control and drive technology provides the necessary high precision in each movement. Andreas Rohrweck explains: "There is a broad distribution here with respect to the processing steps and the range of machinery, beginning with relatively less critical single-axis positioning tasks (simple point-to-
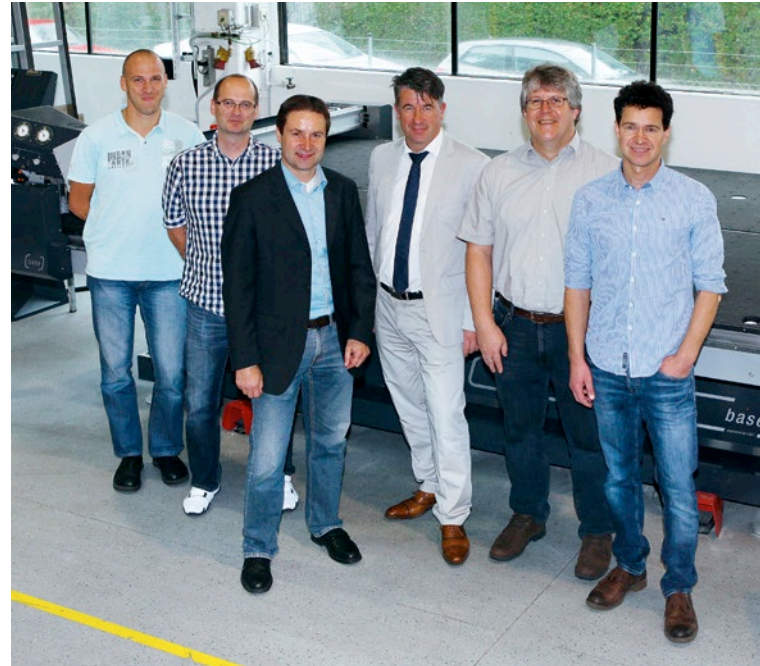
Due to its compact design, it was possible to mount the Beckhoff C6930 control cabinet IPC (bottom right) directly in the operator terminal and the AM8000 servomotors (top left) were placed in the cutting table under restricted space conditions, saving an enormous amount of space.

point movements), to complex machine tools operated in the CNC environment. In the process, e. g. the grinding, the boring of holes or milling require much greater precision than glass cutting. For example, a cutting tolerance of 0.2 mm is sufficient for base CUT; for machines that polish edges on the other hand, this value lies in the hundredth of a millimeter range. TwinCAT NC I can handle all of this, supported by ready-made function blocks for smooth starting after an S-shaped ramp and much more."

Compact machine design through space-saving control components

Tasks accomplished with PC Control using base CUT and a 2-axis NC with auxiliary axis include: automatic search for workpiece zero point, automatic detection of workpiece position with corresponding correction in the NC program, automatic measurement of unknown glass plates as well as standard PLC tasks such as tilting the table up. The heart of the control system is a Beckhoff C6930 control cabinet Industrial PC (IPC), which according to Andreas Rohrweck, excels due to its very compact and robust design: "Due to its low space requirements we could integrate this IPC directly into the operator terminal in the base CUT. In addition, the C6930 has all the necessary interfaces for our machines as well as the option of to use high availability SLC flash memory. Also, high scalability through numerous options is a decisive factor for us, since the C6930 is employed in our entire range of machinery."

Since the operator terminal for base CUT is placed directly on the machine, LiSEC also stresses the importance of space saving components here. In Andreas Rohrweck's view, the compact drive technology is also a major contributor in this: "The X- and Y-axes are jointly controlled via the AX5206 2-channel EtherCAT Servo Drive. In addition to this, there is the EL7201 servomotor terminal for the Z-axis, integrated directly in the EtherCAT I/O system. Both of these save a tremendous amount of space in control cabinets. Furthermore, One Cable

With the TwinSAFE terminals (left) and the EL7201 servomotor EtherCAT Terminal (right), extremely compact safety and drive technology can be integrated seamlessly into the control system.

The AX5206 2-channel Servo Drive also contributes to the compact machine design.
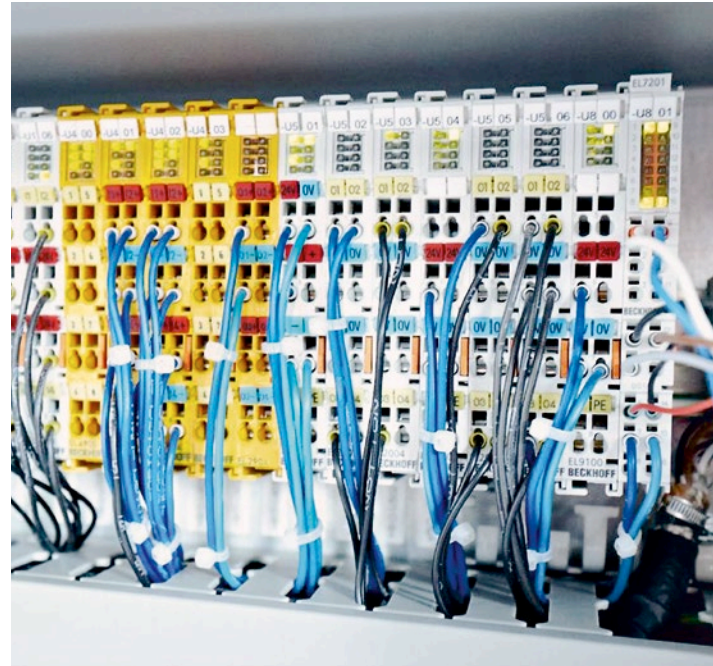
Technology (OCT) to connect the AM8000 servomotors ensures compact design and reduced installation efforts. The same goes for the safety engineering directly integrated in the PC Control architecture via the TwinSAFE terminals, the AX5801 TwinSAFE drive option card and the Safety over EtherCAT protocol, with which the functions 'Control On', 'Emergency Stop' and 'Safe Stop of Axes' are implemented in base CUT."

Advantages through high computing power and online change

Due to its high computing power, the C6930 IPC can process several runtimes simultaneously. Andreas Rohrweck explains: "Like all LiSEC machines, the basic system of the base CUT can be upgraded and networked. For example, the cutting table can be augmented by downstream glass crushing systems. To this end, up to two additional runtimes are available on the C6930 from base CUT, so that additional systems requiring only a few user interventions do not need a separate IPC. This reduces costs and engineering time while eliminating a cross-controller and expensive axis synchronization."

For Dr. Markus Schoisswohl, the Online Change feature first implemented through TwinCAT, is indispensable: "The ability to load a new program on the controller on the fly is tremendously important to us, in particular with very large processing systems. This makes machine prototyping and adjustments as well as remote maintenance of systems much easier. This is a huge advantage, in particular for end customers, since they can benefit from program updates without stopping production."

Universal control philosophy from basic machines to complete systems

Since 1999 LiSEC has consistently relied on the PC-based control and drive technology from Beckhoff, both in series machines and systems as well as in its own glass processing division. In the Hausmening, Austria plant, for example, all machines and peripherals are thoroughly validated through in-house production before these production lines or machines are used at the customer's site.

One example is base CUT, the glass cutting table designed as a basic, stand-alone system for straight cuts and shaped cuts of flat glass. The machine, the smaller of two models is only about 4.6 m long, 3.2 m wide and 1.4 m high, has a massive steel frame with a cutting bridge that can be tilted or used in a stationary position. Glass plates from 2.3 to 19 mm in thickness can be processed as well as 3.7 x 2.6 m glass plates; in the future, it will also be possible to process 6.0 x 3.3 m glass plates. The position of the manually inserted glass plate in X and Y directions are automatically recorded and, if necessary, the bearing plate is rotated accordingly.

Further information:
www.lisec.com
www.beckhoff.at

The Hedgehog: a universal holding fixture for the aircraft industry

NC-controlled vacuum suction devices reduce set-up time by 70 percent

Austrian company, MICADO specializes in fixtures and machines for the production of composite fiber aircraft components. For finishing carbon fiber components for the A350, the new Airbus flagship, the company developed a versatile vacuum suction system called the Hedgehog. The system uses vacuum suction units to secure aircraft components flexibly, without the need for time-consuming changeovers. All control and drive tasks are handled by PC-based control from Beckhoff.

Aircraft panels are made from ever lighter and more resource-friendly materials, based on glass or carbon-fiber-reinforced plastic. The aerodynamically shaped components must be fixed in special devices for further processing. In the past, an exact aluminum negative mound was milled from a block, and the hard tool weighing several tons was transported to a CNC machine with a crane, in order to safely process so-called flap track fairings, for example. There, the aircraft components were inserted, calibrated, and lifted with vacuum suction heads. Only then was it possible to drill the mounting holes and cut and deburr the contours. However, this method is very time-consuming and costly; especially in view of the fact that lot size 1 manufacturing is quite common in the aircraft industry.

Austrian company, MICADO therefore developed a versatile holding system, called the Hedgehog, which can handle more than 20 different components. The device is able to extend its individual vacuum suction units in all directions – similar to how a hedgehog can move its spines – and optimally adjust itself to the contour of respective component. Each vacuum suction head is controlled via a specific NC axis. The different flap track fairing shapes are entered point-by-point only once, and the information is then stored for future operations.

The advantage of this method is that the holding device only has to be mounted and measured once on the machine table. Afterwards, all component types can be mounted and processed in a few minutes. In this way, set-up times are

Mounting an aircraft component on the Hedgehog

Andreas Dorians, Technical Director of MICADO AUTOMATION, at the operating panel

reduced by as much as 70 percent. Not surprisingly, demand is high, so further Hedgehog systems have been built for other aircraft, including the Airbus models A330, A340 and A380, as well as the Brazilian Embraer 190.

PC-based control replaces conventional NC controllers

The clamping device has 18 vacuum suction heads, each of which is controlled as an NC axis. Once a component has been placed manually and aligned at the mechanical stops, the Hedgehog positions the required actuators. The system automatically moves to the required position and secures the component. The part is then measured by the processing machine and precisely adjusted via the axes. This sequence is preset and configurable. After milling, the operator releases the component, all actuators move to their idle positions, and the machined part is removed.

The Hedgehog control system is based on an integrated PC-based control solution from Beckhoff. It includes a built-in CP2219 Panel PC, EtherCAT Terminals, as well as drive and safety technology. The axes are controlled via EL7201-0010 servomotor terminals and TwinCAT NC PTP software running on the Panel PC. Point-to-point axis positioning replaces conventional positioning modules and NC controllers, since the high-performance Panel PC can position all NC axes of the vacuum suction units simultaneously and in parallel with the PLC function. All the information is transferred to a database via an XML server.

For implementing the NC axes, MICADO uses compact Beckhoff AM8121 servomotors with One Cable Technology (OCT). Differing from conventional motor cabling systems by combining the power and feedback systems into a single cable, OCT saves valuable installation space. The motors are connected to the EL7201-0010 servomotor terminals, which integrate a complete servo drive into a compact, standard terminal housing. "This system exceeds our expectations for speed and space-saving requirements. With a width of only 12 mm, the devices house a standard EtherCAT slave with a servo drive including servo control, supporting highly dynamic axis positioning with a current control cycle of up to 62.5 µs. When we were planning the first Hedgehog, Beckhoff was

the only supplier who could meet our requirements for the drive system with regard to space, speed, and performance," explains Andreas Dorer, Technical Director of MICADO AUTOMATION GmbH.

"Another important aspect when choosing the system was its openness, which allows us to use existing software components from other projects. The controller communicates with the visualization via TwinCAT ADS. The set-up and teach-in procedures, and the range of individual processing parts are stored directly in TwinCAT. Moreover, TwinSAFE safety technology is also an integrated part of the control solution," Dorer continues.

Quick re-fastening and positioning with maximum control quality

"A special challenge was getting a grip on the multitude of axes with drive technology that, at the same time, had to be as compact as possible. Although the holding system is more than 6 m long, the available width was only 50 to 70 cm and the height only 1.50 m. Within this space, we also had to accommodate the control components for 18 NC axes. Additional components included the system technology with operating panel and control units, as well as distributed peripherals and pneumatic components," Andreas Dorer points out. "Our aim was to solve all this with standard products, and in this way, the benefits offered by EtherCAT came in very handy. When it comes to fast, reliable communication, including drive technology, there is no better bus system as far as we are concerned. For fast position sensing, we need a high-performance communication system, and EtherCAT enables significantly enhanced control quality."

Further information:
www.micado.at
www.beckhoff.at

PC-based labeling and marking solutions from
C³ can be operated from web-capable devices
such as smartphones and tablets.

Turnkey labeling and marking solution raises efficiency and saves money

Smart Identity System connects ERP and shop floor

The development of innovative labeling and marking solutions is one of the main undertakings of C³ Corporation. Based in Appleton, Wisconsin, C³ recognized at an early stage that intelligent track-and-trace is the key to intelligent manufacturing. Equipped with PC-based control technology, the Smart Identity System developed by C³ provides comprehensive remote connectivity, enabling users to access applications via web-capable devices like smartphones and tablets.

C³ track-and-trace systems are used in many industries like foam and urethane production, the paper and packaging industry, the food and beverage industry, as well as in the finished metal products industry. "We work very closely with our customers. We want to understand the entire operation from the shop floor to the top management level and everything in-between. This enables us eliminate bottlenecks and make the whole operation more efficient," explains Joe Van De Hey, the CEO of C³.

With the company's Smart Identity System for marking products with data-intensive labels, C³ has managed to introduce a new development in the field of integration services. "Our system gives customers an accurate overview of their operation's throughput rates and effectiveness. Via remote access they can use any web-capable device to issue commands, change templates and labels, run diagnostics and access data," explains C³ application and database engineer, Drew Demerath. "The openness of the PC Control platform also allows us to adapt our labeling and marking solution to the customer's specific requirements."

PC-based control: Integrated, highly-connected control platform

The control platform of the Smart Identity System consists of a Beckhoff CX2020 Embedded PC with a 1.4 GHz Intel® Celeron® CPU, TwinCAT 3 automation software, and EtherCAT as the real-time communication system. "The Embedded PC, with its directly connected EtherCAT I/O terminals, allows us to design the system with great flexibility. This is a huge benefit, because all our applications and installations are customer-specific. The PC-based control solution also enables optimal vertical and horizontal integration. For example, linking to an ERP system is just as easy to implement as it is cost-effective," adds Joe Van De Hey. "The controller's connectivity allows you to link it to the

The Smart Identity System from C³ features extensive connectivity. Users can issue commands, run diagnostics, change templates and labels, and access data from any web-capable device.

Cloud and access it via mobile devices from anywhere as long as the customer's network is VPN-capable." C³ has also begun to implement OPC UA so that users of Smart Identity Systems can see the same data at the same time with built-in security and data encryption.

"Based on PC-based control technology we implemented a web server, a comprehensive database and a controller in a single device," says Drew Demerath. "Conventional systems can't compete with this solution because they require multiple hardware layers or separate devices. With PC Control we simply add more software layers, combine everything in a single hardware device, and sell the solution as an all-in-one, turnkey package."

Automation technology and IT convergence via TwinCAT 3

TwinCAT 3 plays an important role in the labeling and marking solutions from C³. In addition to the standard programming languages for automation applications, TwinCAT 3 offers a wide range of IT engineering tools. "The development software, the easy installation of web servers and a series of new software tools give us many options to further advance the functionality of our Smart Identity Systems," explains Joe Van De Hey. "As a result, we can embed many functions at no additional cost into the PC-based software platform, which makes the work of our developers considerably easier."

The TwinCAT 3 software libraries make it possible to implement one or more TCP/IP servers and/or TCP/IP clients within the TwinCAT 3 controller. The controller variables and/or the direct values from the EtherCAT I/O system can be recorded and saved in databases cyclically or in an event-driven manner. "With the TwinCAT 3 Database Server, C³ was able to significantly expand the history tracking and trend analysis functionalities," says Demerath. "We can see all the labels and the markings throughout a line, and it is rather easy to view what a facility has produced by the day, month or year."

C³ uses a variety of digital EtherCAT I/O terminals to connect sensors, scales, scanners and other field devices. EP6652-0010 EtherNet/IP slave terminals handle the communication with other industrial Ethernet systems. They provide a direct link to EtherNet/IP devices in C³ applications and return their data via EtherCAT.

Power through intellectual property

C³ recently installed the new PC-based Smart Identity System for a highly automated national dairy processor client. "This company can now gather data about its recipes and improve their traceability," says Drew Demerath. In the previous system, the main PLC sent requests to a computer, which then sent the print commands to the label printer. The issue was time: Since a single computer controlled all the labelers, a boxed product would frequently be missing a label because it was not printed on time. Consequently, the product had to be sent back through the system to be properly labeled. "EtherCAT allowed us to increase the labeling speed significantly," says Joe Van De Hey. "The real-time communication system makes sure that all labels are correctly printed by the time each package arrives for final processing." It also gives the company access to its entire production history. Another advantage of the PC-based solution is the system's source code protection, says the CEO: "This solution allows the customer to protect valuable intellectual property."

The hot-connect capability of EtherCAT also made it much easier to switch out print engines and consumables. "These processes could take four hours or more on the plant floor if you include the IT department's involvement with the ERP systems. With PC-based control and EtherCAT, it takes one person just about half an hour now," reports Joe Van De Hey.

Further information:
www.c3ingenuity.com
www.beckhoffautomation.com

The Smart Identity System uses a CX2020 Embedded PC running TwinCAT 3 automation software as its control platform and Windows 7 as the operating system.
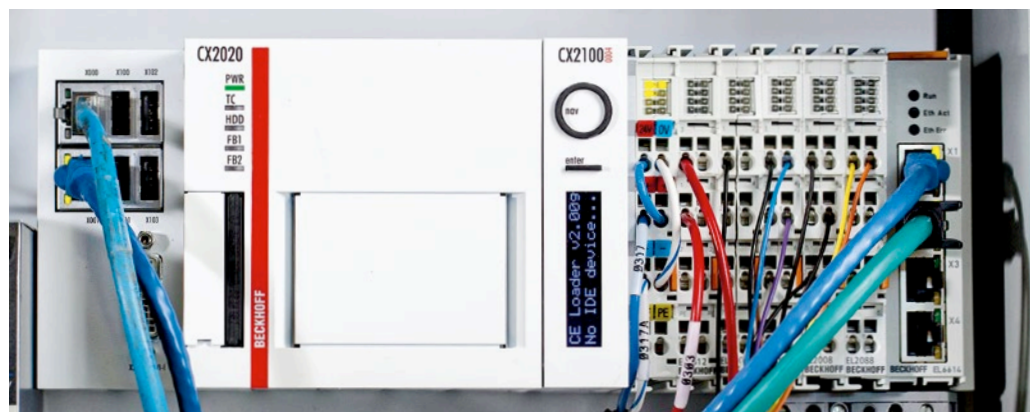
US machine manufacturer KVAL reduces engineering costs with TwinCAT

Flexible and efficient door production even in small lot sizes

KVAL, Inc., based in Petaluma, California, is well-known for its high-quality door manufacturing machines. In order to offer its customers the most competitive solutions, KVAL began using state-of-the-art automation technology very early on; PC-based control from Beckhoff has been in use since 2010. The company values, among other features, the high level of reusability in the software modules and the wide variety of usable fieldbus and protocol standards.

With a broad range of machines, KVAL meets every conceivable customer requirement in the door manufacturing industry. "Whether the customer builds interior or exterior doors, we can customize our machines to precisely match their respective needs," says David Schneider, KVAL Software Developer.

Universal hardware and software platform for all machine types
The search for a control platform that integrates PLC, motion control, and HMI on a single control platform, as well as enabling the flexible adaptation of the machine to customer-specific applications, led KVAL to implement PC-based control technology from Beckhoff. "Our goal was to simplify the machine control architecture and enhance system communication. PC-based control technology does just that: as a universal hardware and software platform, it enables us to automate all our machines with the same control system, from the smallest to the largest and most complex machines," says David Schneider, in summary.

In the software developer's view, the use of TwinCAT as a uniform programming and runtime environment as well as the great flexibility in the choice of programming languages is a huge advantage. David Schneider continues: "TwinCAT offers high reusability of software code. Once programmed, a module can be reused on any applicable machine. That means we can build up a library of function blocks and essentially 'drop in' the code specific to a feeder system, a hinge router, or a door lock router in new projects. In this way, we are able to save significant engineering time."

"In addition, a major advantage of PC-based control technology is openness with regard to fieldbus and communication standards," David Schneider stresses. "Many of our implementations consist of a series of machines or extensive plants. Effective communication between the individual machines is paramount, regardless of the signal type inherent to each machine. EtherCAT provides a fast fieldbus system with a flexible topology, as well as various options

to connect our machines with other protocols via gateways and couplers. The software tools in TwinCAT add flexibility, abstracting the application from the network/protocol layer."

Flexible solution for small lot sizes

With the Commander™ 3, KVAL has introduced the next generation of its successful machine series to the market. Equipped with PC-based control technology, the CNC machine is designed to provide versatile door and jamb hinge routing functionality. Geometries stored in the software for different hinges and the possibility of quick retooling when changing production lots make the Commander™ 3 particularly well-suited for small lot sizes. "Using the PC-based control platform, we can route any hinge radius, hinge depth, square corner chisel, piloted pre-drilled holes, beveled door edges and more, with a negligibly longer cycle time than for more limited routines. The winner in terms of performance, quality, and time savings is the customer," according to David Schneider.

### Scalable control platform: the price and performance are right

"The scalability of the Beckhoff control solution has allowed us, in the Commander™ 3, to create a machine tailored to smaller shops that need automation, but are unable to budget for larger machines," David Schneider emphasizes. A Beckhoff CX2020 Embedded PC with TwinCAT NC I software for motion control and CNC serves as the integrated control platform for PLC and motion control. "In addition, the Windows OS provides us with the possibility of remote diagnostics and troubleshooting using standard tools and programs," David Schneider explains.

Through the use of the high-performance AX5000 Servo Drives, KVAL requires only a standard Ethernet cable for the connection to the EtherCAT fieldbus. David Schneider also regards the wide voltage range of the EtherCAT drives as an advantage: "Since we sell machines designed for both 230 and 480 V AC, we previously had to include a bulky and expensive transformer into the bill of materials, or stock two different power level drives for each particular size. With the Beckhoff AX5000, we only need to stock a single drive type, drastically simplifying our designs and parts management, creating savings we then pass on to the customer." Cost benefits also arise as a result of using servomotors from the AM8000 series equipped with One Cable Technology (OCT). Valuable commissioning time is saved, since the motor wiring and number of plug connectors are both reduced by 50 percent.

KVAL opted to use the EtherCAT I/O Terminals from the ES line, which feature a pluggable wiring level option for easy installation. "The fact that we send these machines all over the world restricts our ability to do on-site commissioning and maintenance ourselves. Due to the pluggable wiring feature, our customers are able to carry out routine maintenance themselves, with no special wiring knowledge required," explains David Schneider.

Simplified development and commissioning

Building on the success of the Commander™ 3, KVAL has also converted its 990H – a high-performance 10-axis CNC routing machine – to PC-based control technology. "We were able to completely program, test, and ship the machines, including G-code routines, in just two months. The first machines were shipped to Australia, so simple commissioning and troubleshooting were all
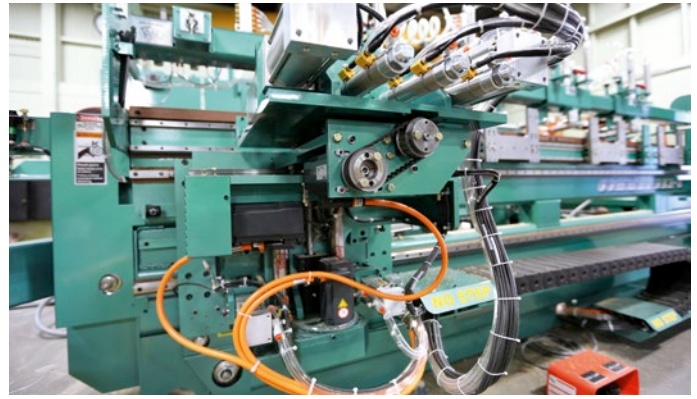
With the Commander™ 3, KVAL has introduced the next generation of its successful machine series to the market which, providing versatile door and jamb hinge routing functionality and enabling quick retooling, is particularly well-suited for small lot sizes.

A CX2020 Embedded PC with TwinCAT NC I software serves as integrated control platform for PLC and motion control.

the more important," David Schneider emphasizes. Not only that, KVAL was able to save a great deal of time due to the more flexible automated processes and simplified wiring. "In the past we needed two to four days to get the machine from wired to running – but still not fully tested. With the PC- and EtherCAT-based control, the entire process takes less than a day," says the software expert. "Through the creation of automated test routines, we were able to dispense with the tedious manual processes that used to be necessary for this. Previous troubleshooting often required checking each axis and all the limit switches to find the issue. This takes place automatically via TwinCAT and is far more efficient."

Further information:
www.kvalinc.com
www.beckhoffautomation.com

Control cabinet IPC ensures reliable operation under rough environmental conditions

Fail-safe marine communication system on schooner "Thor Heyerdahl" leverages PC-based control

The schooner "Thor Heyerdahl" uses Industrial PC technology from Beckhoff for reliable on-board communication systems, always maintaining contact with other ships and the mainland.

Even after six years of daily use in salty sea air, the C6320 IPC continues to operate failure-free, despite some heavily corroded USB ports.

Having functioning marine communication and navigation systems is critical on the high seas. The fact that these systems must withstand extreme environmental conditions such as aggressive saltwater, high humidity, and massive temperature fluctuations, to name just a few, poses an especially difficult challenge. Nevertheless, for many years now a Beckhoff control cabinet Industrial PC (IPC) on the schooner "Thor Heyerdahl" has performed reliably, putting an end to the dangerous threat of a communication failure.

Six-and-a-half months, 12,000 nautical miles, and 34 students are some of the key numbers to note when the 50-meter-long motor-powered sailing vessel "Thor Heyerdahl" embarks on its annual voyage under the motto "Classroom under Sail". The ship, moored when not at sea in Kiel, Germany, also makes shorter trips in the North Sea and the Baltic. The operator of the 75-year-old schooner with its volunteer crew is the "Segelschiff Thor Heyerdahl gemeinnützige Fördergesellschaft mbH" (Sailing Ship Thor Heyerdahl Non-Profit Support Association Ltd.), Kiel, Germany.

Industrial PC as safety-critical equipment
Temperatures ranging from the freezing point to 50 degrees Celsius (122 degrees Fahrenheit), relative humidity of up to 90 percent, fine dust, and aggressive saltwater are tough not only on the crew, but also on the installed electronic equipment. Mario Bregulla, who is in charge of the technical equipment on board, remembers: "Until 2009, we used off-the-shelf consumer PCs for the ship's communication systems. They lasted for about two years, after which they became completely unusable. Some of the laptop displays actually corroded internally. That's when we installed two Beckhoff C6320 control cabinet IPCs, with one functioning as a backup. Their most important feature is their reliability, and the integrated uninterruptible power supply provides additional safety against failures."

Since 2012, each ship must have an Electronic Chart Display and Information System (ECDIS), powered by a suitable computer. On the Thor Heyerdahl, this job has been performed by a C6320 Industrial PC, which will be replaced this fall by a C6920 control cabinet IPC as part of a general upgrade project. The new model delivers increased performance while taking up less space, and its interfaces are still compatible, which means a quick and easy upgrade process. The new control cabinet IPC will provide robust and reliable hardware for the navigation and information system, which handles a wide range of alphanumeric data such as planning and navigation data, in addition to digital ocean charts. Besides delivering status data and using GPS to display the ship's position, it is capable of recognizing dangerous situations.

Planned waypoints and routes provide the foundation for guiding the ship to its destinations. "In the English Channel, for example, you may have up to 200 ships at the same time, and you obviously don't want to collide with any of them," says Mario Bregulla. "Besides collecting and providing all the technical data, the Industrial PC also handles all the communication with the mainland."

Further information:
www.thor-heyerdahl.de
www.beckhoff.com/IPC

PC-based control automates production building of AEC Pole Division

Efficient LED lamps and intelligent lighting control reduce average power consumption by 30 percent

The factory built by AEC Pole from 2012: An automatic twilight function is used to switch the external lighting on or off, depending on the available daylight.

Just in time for the Expo 2015 trade show, which took place under the motto, "Feeding the Planet, Energy for Life", the city of Milan converted its street lighting to modern LED technology and is now a pioneer in Italy in terms of energy- and cost-efficient lighting. The contract to convert more than 100,000 lamps was awarded to AEC Illuminazione, a well-known company in the field of outdoor lighting (streets, urban, tunnels, architectural) and indoor lighting (commercial and industrial). Sustainability and energy efficiency are part of the corporate philosophy of AEC, so when it came to designing a new production building it was only logical that the focus was on reducing power consumption through advanced LED lamps and intelligent lighting control. The project was implemented by systems integrator LedControl, based on Beckhoff building automation components.

AEC Illuminazione, with corporate headquarters in Arezzo, Italy, has been active in the field of public lighting equipment for more than sixty years, and is today regarded as the Italian market leader in LED street lighting. Since 2012, the company has also been producing lamp posts under the name of AEC Pole Division. A new production plant was built for this purpose with a total area of 30,000 m², 7,000 m² of which is indoors. The building is not just architecturally sophisticated; it also follows an advanced technological concept with regard to building automation.

CX-series Embedded PCs provide an integrated platform for lighting control and energy measurement

The company LedControl, based in Lentate sul Seveso, Italy and an established software developer and system integrator, was commissioned to handle the implementation of an energy-efficient lighting control system. The decision in favor of Beckhoff technology hinged on the high level of integration in the solution, which enables lighting control via DALI, and the control of power measuring devices, brightness sensors, and EnOcean switches on the same hardware platform.

AEC Pole Division produces and stores poles for street lights on a 7,000 m² production area.

The production building is illuminated by 300 75-Watt LED lamps, which AEC custom-designed for this purpose. The control system consists of a CX1010 Embedded PC with directly connected I/O modules:

- 4 KL3062 analog input terminals, 0 to 10 V, for connecting the brightness sensors
- 1 KL1889 high-density Bus Terminal with 16 digital inputs, 24 V DC, for connecting conventional pushbuttons
- 1 KL6581 EnOcean master terminal for connecting the KL6583 EnOcean module and integrating the EnOcean radio switches
- 6 KL6811 DALI master terminals for controlling the DALI lamps

The CX1010 is connected to the company IT network via an Ethernet interface. A BC9050 Ethernet Bus Terminal Controller is used to integrate remote inputs. The communication between the BC9050 and the control system also takes place via the Ethernet interface. The KL3404 power measurement terminals for measuring power consumption are directly attached to the Bus Terminal Controller.

Light intensity is kept constant at the workplaces, regardless of fluctuating daylight, by means of a constant light control system. The target light levels for the constant light control are specified for individual sections via a time-based (daily/hourly) switching schedule. Outside, an automatic twilight function is used to switch the lighting on or off, as a function of the available daylight. Manual interventions to override the automatic functions with conventional buttons or EnOcean devices are also possible.

Convenient remote monitoring

In addition to local monitoring, the PC-based control system enables remote operation of all components as well as modification of the operating parameters by the user, in addition to displaying power consumption and any device malfunctions. The DALI technology not only enables selective control of each individual lamp, but also monitoring of all DALI devices in terms of their function and display of lamp failures. The installation effort for the lighting system is minimized by using a standard cable for up to 64 lights on a DALI strand.

Access rights tailored to the needs of the user

The application software developed by system integrator, LedControl enables control of the lighting system via a simple and intuitive graphic user interface. The application runs via the web server integrated in the CX1010 and enables access to the HTML control pages for all devices that feature a web browser. The functions made available to different users are specified based on categories, i. e. maintenance specialists, installers or general users, depending on their responsibilities. The power consumption data is saved and exported in a format that is compatible with Microsoft Excel and can be accessed remotely.

PC Control reduces power consumption and enhances application flexibility

The light management system offers significant energy saving potential, compared with a conventional installation. During much of the day, the total capacity of approx. 22 kW can be limited through the daylight-dependent lighting control. Average energy savings of 30 percent can be achieved, with peak values of more than 50 percent at certain times of the day. In addition to energy and cost savings, the system also offers significant benefits in terms of functionality: with DALI technology, the working areas can be configured in software, i. e. it is possible to create lighting function groups, which are controlled with a homogeneous brightness level. Suitable light intensity values are determined for each working area, for example, manual or automatic production or warehouse, and so on. Thus, any modifications in the plant utilization layout do not necessitate recabling measures, which would be very costly and complicated in view of the large number of operations carried out in the plant, instead requiring only a software update.

Further information:
www.aecilluminazione.com/pole-division
www.ledcontrol.it
www.beckhoff.it

The 2015 Japanese EtherCAT Plug Fest in Yokohama, Japan, was characterized by great openness and intensive knowledge exchange.

EtherCAT Plug Fests in Japan and USA

Impression from the 2015 North American EtherCAT Plug Fest in Newark, New Jersey, USA.

This September the EtherCAT Technology Group (ETG) conducted two Plug Fests: The 2015 Japanese EtherCAT Plug Fest was held on September 10th and 11th on the premises of Beckhoff Japan in Yokohama. The ETG was pleased with the improved quality, variety, and functional range of devices under test at the event, even when compared to the impressive results achieved the year before. In 2015, the Plug Fest had significantly more devices exhibiting advanced features such as highly-precise synchronization through Distributed Clocks, as well as modular device description (modules/slots). Additionally, the number of new and unique EtherCAT Slave Controller (ESC) implementations was deemed remarkable by the attending ETG officials.

The 2015 North American EtherCAT Plug Fest took place in Newark, New Jersey, USA. Hosted by ETG member company Panasonic, a wide variety of international and local participants attended the Plug Fest to test their EtherCAT master and slave devices for interoperability. The new version of the EtherCAT Conformance Test Tool (CTT), which is currently in the approval process, garnered overwhelmingly positive reviews from all attending slave manufacturers during the testing process, especially regarding the comprehensive extension of the test coverage. This feedback is of particularly valuable for the responsive ETG Conformance Working Group.

Both events were characterized by great openness, highlighted by the energetic knowledge exchange among the participants. Attendees to both Plug Fests confirmed the value of these events and the opportunity to learn more about the EtherCAT protocol and the ETG organization itself.

EtherCAT Technology Group

Further information:
www.ethercat.org

EtherCAT Seminar Summer 2015 in China

The EtherCAT Technology Group (ETG) turned this year's summer into a veritable EtherCAT Seminar Summer and offered numerous EtherCAT seminars throughout China. A total of 10 events at 10 different locations attracted more than 500 participants who wanted to learn more about EtherCAT and ETG. The participants were informed about the outstanding features of the EtherCAT technology by presentations of the experts around Beryl Fan, Manager of the ETG Office China. Additionally, the attendees had the opportunity to discuss their current EtherCAT projects with the experts on-site. Moreover, various product demonstrations showed how EtherCAT works in practice and how versatile its benefits are. The EtherCAT seminars that are held all over the world free of charge are a useful and successful means of promoting the EtherCAT technology: At the moment the EtherCAT Technology Group counts around 1,200 member companies in Asia.

More than 3,400 companies are organized in the ETG to date

Being the world's largest Industrial Ethernet and fieldbus user organization, the EtherCAT Technology Group (ETG) is still growing continously – even 12 years after its foundation. Currently, the organization which stands for the support, the promotion and the continuous development of EtherCAT technology, counts more than 3,400 member companies from 58 countries. In Asia, for instance, where the ETG counts around 1,200 members, the organization recently reached the number of 400 members in Japan alone; and not long ago the association in the USA cracked the 400 member mark, too. The actual figures as well as the upward trend are once more evidence of the fact that the worldwide interest in EtherCAT is still unabated.

Husum Wind 2015

"The show lives – Husum Wind continues to be the industry event for the wind industry," as Dirk Kordtomeikel, Business Manager Wind Energy at Beckhoff, is pleased to note. "For us, Husum is a networking venue and a place to exchange innovative ideas; this is where the 'practitioners' gather, the industry's real experts." The visitors were particularly interested in the idea of Industry 4.0 in the context of wind power. "The wind power industry is well aware that Beckhoff is an innovative company that was quick to introduce the market to ideas such as condition monitoring and wind farm networking," says Dirk Kordtomeikel: "Developments have shown that we were right in setting those trends, and that has earned us our customers' trust."

Further information:
www.beckhoff.com/husumwind

FachPack 2015

At FachPack 2015, which was held in Nuremberg from 29 September to 01 October 2015, 1,565 exhibitors gave over 43,000 visitors from home and abroad a comprehensive overview of current packaging technology. Frank Würthner, Business Management Packaging at Beckhoff, sums up: "The lively interest shown in XTS demonstrated that manufacturers of packaging machinery have recognised the immense potential for innovation provided by this highly compact system, whose comprehensive software functionality also makes it extremely flexible. When combined with PC-based control technology, XTS offers both maximised freedom of design and the widest range of different geometries. And indeed, a number of well-known exhibitors at this year's FachPack presented specific examples of just such machinery and packaging concepts."

Further information:
www.beckhoff.com/fachpack

Motek 2015

In Stuttgart, at Motek, more than 1,000 exhibitors attracted a record number of over 38,500 interested visitors. As Frank Saueressig, Head of the Beckhoff branch in Balingen, points out, the show's visitors have clearly recognised the benefits of XTS: "In a conventional assembly process, the product is conveyed by means of a transport system and has to be repeatedly identified, grasped and possibly also analysed. This requires a great deal of mechanical and sensor activity. With XTS, the product is usually picked up only once and then transported by the same mover throughout the entire process. It follows that the control program always knows exactly where the product is and its current state. This makes for absolutely optimal product handling and highly flexible production processes."

Further information:
www.beckhoff.com/motek

EMO Milano 2015

The number of visitors at EMO Milano 2015 exceeded all expectations: 155,362 visitors from 120 countries attended the trade show for the machine tool sector, which took place between 5 and 10 October in Milan. On around 120,000 square metres of exhibition space, 1,600 companies from 33 countries presented the whole range of machine tool industry products. "The CNC industry is doing well, and we are very satisfied with the result of our first presence at EMO in Milan", said Frank Saueressig, CNC Product Manager. Pierluigi Olivari, Managing Director of Beckhoff Italy, also gave an upbeat assessment: "At EMO, Beckhoff was able to convincingly present itself as a leading supplier of PC-based CNC solutions, ranging from mid-size to high-end CNC." "The acceptance of Beckhoff in the CNC sector has increased visibly," added Gerhard Meier, Key Account Management and Member of the Executive Board of Beckhoff Switzerland. "This is not least helped by the fact that some of our customers, who successfully use our CNC solution, were highly visible at EMO. Trade show visitors find such credentials very convincing."

Further information:
www.beckhoff.com/emo-milano

Trade shows 2015/2016
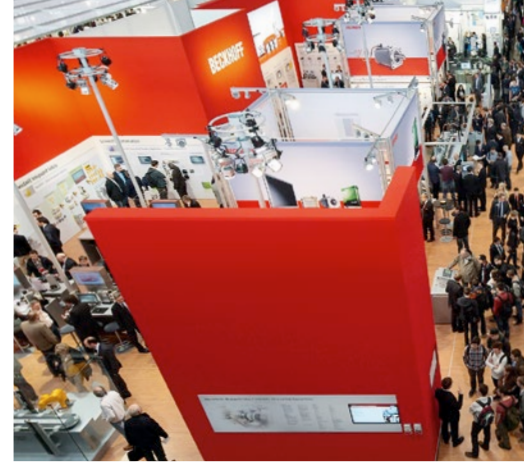
Trade shows 2015

Asia

India

Engimach
December 03 – 07, 2015
Ahmedabad
Hall 12, Booth E15
www.engimach.com

Japan

System Control Fair
December 02 – 04, 2015
Tokyo
www.scf.jp

Trade shows 2016

Europe

Germany

E-World
February 16 – 18, 2016
Essen
Hall 1, Booth 220
www.e-world-essen.com

Tire Technology Expo
February 16 – 18, 2016
Hanover
Hall 20, Booth 3004
www.tiretechnology-expo.com

Light + Building
March 13 – 18, 2016
Frankfurt
Hall 11.0, Booth C56
www.light-building.com

Fensterbau/Frontale
March 16 – 19, 2016
Nuremberg
Hall 3A, Booth 113
www.frontale.de/en

Prolight + Sound
April 05 – 08, 2016
Frankfurt
Hall 3.0, Booth B72
www.prolight-sound.com

Hannover Messe
April 25 – 29, 2016
Hanover
Hall 9, Booth F06
www.hannovermesse.com

Sensor+Test
May 10 – 12, 2016
Nuremberg
Hall 1, Booth 350
www.sensor-test.com

Automotive Testing Expo
May 31 – June 02, 2016
Stuttgart
Hall 1, Booth 1105
www.testing-expo.com/europe

Drupa
May 31 – June 10, 2016
Düsseldorf
Hall 14, Booth A48
www.drupa.com

Automatica
June 21 – 24, 2016
Munich
www.automatica-munich.com

SMM
September 06 – 09, 2016
Hamburg
Hall B6, Booth 218
www.smm-hamburg.com

FachPack
September 27 – 29, 2016
Nuremberg
www.fachpack.de/en

WindEnergy Hamburg
September 27 – 30, 2016
Hamburg
Hall B6, Booth 319
www.windenergyhamburg.com

Motek
October 10 – 13, 2016
Stuttgart
www.motek-messe.com

K
October 19 – 26, 2016
Düsseldorf
www.k-online.com

EuroBlech
October 25 – 29, 2016
Hanover
www.euroblech.com/english

SPS IPC Drives
November 22 – 24, 2016
Nuremberg
www.mesago.de/en/sps

Austria

Smart Automation Austria
May 10 – 12, 2016
Vienna
www.smart-automation.at/wien

Belgium

Indumation Network Event
February 18, 2016
Leuven
Hall Red box, Booth Red-13
www.indumation.be/networkevent

Utility2Build
March 23 – 24, 2016
Kortrijk
Hall 4, Booth 78
www.utility2build.be

Czech Republic

Amper
March 15 – 18, 2016
Brno
Hall V
www.amper.cz

Denmark

El & Teknik
May 10 – 12, 2016
Odense
Hall Vandrehal 2, Booth C-5122
www.elogteknikmessen.dk

RoboBusiness Europe
June 01 – 03, 2016
Odense
www.robobusiness.eu/rb

France

SEPEM Industries
May 31 – June 02, 2016
Colmar
Hall 2, Booth Allée E / bloc 11/3
www.sepem-industries.com

Emballage
November 14 – 17, 2016
Paris
www.all4pack.fr

Netherlands

ISE
February 10 – 12, 2016
Amsterdam
Hall 10, Booth 10-N136
www.iseurope.org

Poland

Automaticon
March 01 – 04, 2016
Warsaw
Hall 1, Booth B-18/C-17
www.automaticon.pl

Slovenia

IFAM
January 27 – 29, 2016
Celje
Hall L, Booth L201
www.ifam.si

Sweden

Nordbygg
April 05 – 08, 2016
Stockholm
Hall A, Booth A33:21
www.nordbygg.se

Elmia Automation
May 10 – 13, 2016
Jönköping
Hall D, Booth D06:32
www.elmia.se/automation

Scanautomatic
October 04 – 06, 2016
Gothenburg
Hall B, Booth B08:52
www.scanautomatic.se

Switzerland

Swissbau
January 12 – 16, 2016
Basel
www.swissbau.ch

Sindex
September 06 – 08, 2016
Bern
www.sindex.ch

Turkey

WIN Automation
March 17 – 20, 2016
Istanbul
Hall 3, Booth C140
www.win-fair.com

United Kingdom

Drives & Controls
April 12 – 14, 2016
Birmingham
Hall 3, Booth D210
www.drives-expo.com

Manufacturing & Engineering North East
July 06 – 07, 2016
Newcastle
Booth B31
www.menortheast.co.uk

PPMA Show
September 27 – 29, 2016
Birmingham
Hall 5, Booth A70
www.ppmatotalshow.co.uk

Asia

India

Imtex Forming
January 21 – 26, 2016
Bangalore
www.imtex.in/imtex2016

Acrex
February 25 – 27, 2016
Mumbai
Hall 5, Booth N13
www.acrex.in

ACMEE
June 16 – 20, 2016
Chennai
Hall B, Booth B-75
www.acmee.in

Automation
August 22 – 25, 2016
Mumbai
Hall 1, Booth E-3A
www.iedcommunications.com

Israel

Motion Control & Power Solutions
January 12, 2016
Lod
www.new-techevents.com/motion-control-power-solutions

New-Tech Exhibition
May 17 – 18, 2016
Tel Aviv
Booth 58
www.new-techevents.com/new-tech-exhibition

Japan

M-Tech
June 22 – 24, 2016
Tokyo
www.mtech-tokyo.jp

Malaysia

Tenaga Expo & Forum
May 23 – 25, 2016
Kuala Lumpur
Hall 4
www.tenaga.org

Singapore

IoT Asia
March 30 – 31, 2016
Singapore
Hall 1B, Booth A18
www.internetofthingsasia.com

North America

Canada

Fabtech
March 22 – 24, 2016
Toronto
Hall J, Booth 2316
www.fabtechcanada.com

ATX Montreal
November 30 – December 01, 2016
Montreal
Booth 1615
www.atxmontreal.com

USA

ATX West
February 09 – 11, 2016
Anaheim
Hall B, Booth 4538
www.atxwest.com

Modex
April 04 – 07, 2016
Atlanta
Booth 2315
www.modexshow.com

Offshore Technology Conference
May 02 – 05, 2016
Houston
Hall NRG Arena, Booth 9439
http://2016.otcnet.org

Wind Power Expo
May 23 – 26, 2016
New Orleans
www.windpowerexpo.org

ATX East
June 14 – 16, 2016
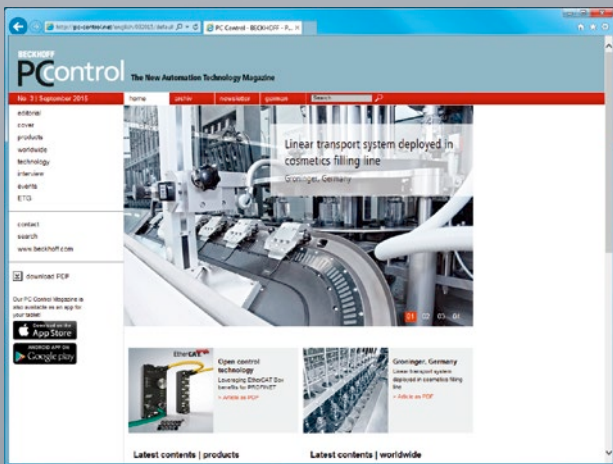New York
Hall 3B, Booth 2411
www.atxeast.com

Industrial Automation North America
September 12 – 17, 2016
Chicago
Hall East, Booth 4905
www.imts.com/iana

Pack Expo
November 06 – 09, 2016
Chicago
Hall North, Booth 6125
www.packexpointernational.com

Fabtech
November 16 – 18, 2016
Las Vegas
www.fabtechexpo.com

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www.beckhoff.com/trade_shows

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www.pc-control.net