More effective software engineering with TwinCAT 3

Hans Beckhoff is interviewed by Open Automation magazine about current and future developments

Baader-Johnson optimizes production and reduces costs in food processing
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Advanced Blending Solutions, USA: PC-based Control increases performance and optimizes system communication

XTS: Significantly higher performance, simplified engineering with TwinCAT

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PC Control – The New Automation Technology Magazine
Published:
Beckhoff Automation GmbH
Eiserstraße 5
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Picture Proof:
Advanced Blending Solutions, USA
Baader-Johnson, USA
Bolefloor.com
BMBF, Germany
IPTE Factory Automation, Belgium
Oy Delta-Enterprise Ltd., Finland
Stadtwerke Konstanz, Germany
Steel Construction and Robotic Machinery (S.Co.R.E), Lebanon

Graphic Design: www.a3plus.de
Printed by: Richter Druck- und Mediencenter, Germany
Circulation: 30,000
Successful career start for 21 students and 33 apprentices at Beckhoff

Great commitment for the next generation of industry professionals

The training of young people has a long tradition at Beckhoff and goes back to the early roots of the company. For Managing Director Hans Beckhoff, the qualified training of the workforce of next generation is part of the corporate philosophy and social commitment.

Including the 33 school graduates who started their apprenticeships on September 1, 2012, Beckhoff now employs a total of 98 apprentices. The Verl-based global automation company presently offers apprenticeships in eight vocational fields: the spectrum extends from electrical engineering technology with its various fields to IT and commercial fields.

Already in the program’s third year, Beckhoff continues to successfully dedicate company resources to training a new generation of engineers and scientists. In close cooperation with the University of Applied Sciences Bielefeld at the Göttersloh, Germany study site, Beckhoff offers practical places for the dual BSc study courses in mechatronics/automation technology and industrial engineering. A total of 21 first-year university students started their practical phase at Beckhoff in August 2012. The numbers of applicants show the strong interest in the practically-oriented engineering education. Beckhoff has allocated 66 practical places at present, of which 17 are for the industrial engineering course and 49 for mechatronics/automation. The concept of the dual study course provides for each term to start with an industrial practical phase, which is then followed by a theoretical phase at the University of Applied Sciences. This leads to a close meshing of the theoretical principles learned at the university to the practical implementation and use of this knowledge.

Hans Beckhoff welcomes this development and declares: “We as a company also benefit from the practically-oriented education of the students: after seven terms, in other words 3.5 years, we have well-trained engineers, practically and theoretically. The induction phase usually required for young engineers can be circumvented as a result.”

A total of 33 school graduates began their apprenticeships at Beckhoff in Verl on September 1, 2012. A total of 21 students from the practice-integrated BSc courses in mechatronics/automation and industrial engineering at the University of Applied Sciences Bielefeld, Göttersloh study site, started their practical phase at Beckhoff for the winter term 2012/13.
Scientific Automation integrates high-precision temperature measurement and dynamic load cell analysis in the control system

Ultra fast and precise: EtherCAT measurement terminals

Measurement applications with demanding requirements for accuracy and dynamics can now be seamlessly integrated into a standard control system with new EtherCAT Terminals from Beckhoff. These new terminals handle measurements for temperature or weighing. The 4-channel EL3314-0010 thermocouple input terminal, for example, meets all requirements for high-precision temperature measurement. Also, the new EL3356-0010 is an analog input terminal for direct connection to a resistor bridge or load cell.

With the EL3314-0010 EtherCAT Terminal, Beckhoff extends its impressive range of measurement terminals even further. This dynamic terminal integrates temperature measurement into the standard automation system so that a dedicated and separate measurement system is no longer required. The analog input terminal enables direct connection of four thermocouples. Compared with the previous EL3314, the measuring accuracy of the new EL3314-0010 has more than doubled. For sensor type K this equates to ± 4.11° for the EL3314 and ± 1.8° for the EL3314-0010. The terminal circuit can operate thermocouple sensors in a 2-wire system. A microprocessor implements linearization over the whole, freely selectable temperature range. Cold junction compensation is dealt with via internal, high-precision temperature measurement in the terminals. The EL3314-0010 can also deal with mV measurements.

The new EL3356-0010 EtherCAT Terminal makes the range of Beckhoff solutions for weighing applications even more finely scalable. The high-precision and fast sampling of signal values – every 100 μs, with 24-bit resolution and a measuring error of less than ± 0.01 % – was developed for weighing applications and for vibration measurements on moving structures. The single-channel analog input terminal enables direct connection of a resistor bridge (strain gauge) or a load cell. The terminal determines the ratio between the bridge voltage $U_b$ and the supply voltage $U_{ref}$ with high precision. The load value is output directly as a process value based on the settings in the terminal. High-speed, synchronous data sampling is achieved thanks to the EtherCAT distributed clock functionality.

Further Information:
www.beckhoff.com/EL3314
www.beckhoff.com/EL3356
New: The CP3918 version combines a 18.5” multi-touch display with electro-mechanical keys.

Modular expansion of the CP2xxx and CP3xxx multi-touch Control Panel and Panel PC series

The ideal HMI Panel offers multi-touch functionality and much more

With the CP2xxx and CP3xxx Control Panel and Panel PC series with multi-touch functionality from Beckhoff, industrial applications can utilize the familiar features from smartphones and touch pads for machine operation. In order to obtain a truly optimum HMI, a wide range of application-specific industrial requirements must be met. This Panel series already offers a practical and highly versatile HMI hardware toolkit, which will be complemented with further mechanical push-button extensions, display sizes and Panel PC options, all to be shown at SPS IPC Drives 2012 trade show in Nuremberg, Germany.
These days a robust, industry-standard design is expected as a matter of course for advanced HMI panels. However, operating units can only achieve genuine added value and the associated competitive advantage for machine manufacturers if they offer innovative technologies coupled with comprehensive application expertise. The implementation of technologies that are familiar from the consumer world, such as multi-touch and widescreen displays, paves the way for new operating concepts. In addition, an elegant, ergonomic HMI design that matches the respective application contributes to user-friendly, error-free machine operation.

The built-in CP2xxx Panels and the CP3xxx Panels for mounting arm installation from Beckhoff are perfect examples for such HMI concepts. Originally introduced in November 2011, they are now available with 20 housing options, and the product range continues to expand. The latest additions are three further display sizes, offering eight new device options in total, in the form of built-in Panel PCs along with built-in and IP 65 Control Panels:

- 7” (16:9.6, WVGA, 800 x 480 resolution) as Control Panels
- 12” (4:3, SVGA, 800 x 600) for all Panel versions
- 21.5” (16:9, Full-HD, 1920 x 1080) for all Panel versions

They complement the existing Panel range in the following sizes:

- 15” (4:3, XGA, 1024 x 768)
- 15.6” (16:9, HD-ready, 1366 x 768)
- 18.5” (16:9, HD-ready, 1366 x 768)
- 19” (5:4, SXGA 1280 x 1024)
- 24” (16:9, Full HD, 1920 x 1080)

The expansion of the modular multi-touch product range is complemented by additional electromechanical keys for existing standard devices. This C9900-G0xx push-button extension includes an emergency stop button and several push buttons keys with a signal lamp that can be labeled individually. Selection and key switches, and other elements can also be integrated. The range of processors will be expanded continuously. For example, two completely new ARM-based Panel PC series, CP26xx and CP36xx, will become available in the second quarter of 2013. These Control Panels with Ethernet connection are based on the ARM Cortex™ A8 processor and therefore offer higher performance than the devices with Intel® IXP 420 533 MHz. According to Roland van Mark, Product & Marketing Management, Industrial PC, Beckhoff, this highly versatile HMI toolkit offers immense application potential: “It is the Panel and Panel PC platform of the future, suitable for all machines and plant operation tasks as well as in building automation.”

Clear practical benefits – cost-effective and convenient

Although widescreen (16:9) formats and multi-touch technology are new in the Panel market, many machine manufacturers still prefer conventional 4:3 displays and single-touch operation. The wide range of devices offered with the new product lines not only meets this demand, but offers customers significant benefits for such applications. Roland van Mark explains: “The two series are characterized by elegant and slim housing designs. In addition, they offer an optimized price/performance ratio, resulting in cost savings up to 28 % compared with existing devices. The machine manufacturer therefore benefits in terms of design effort and investment costs and is able to use their existing visualization without additional engineering effort.”

As a result of their excellent technical features, multi-touch-capable displays offer fundamentally increased operator comfort: with their continuously dimmable LED backlight in combination with Beckhoff’s own controller technology the displays are bright, with high contrast. The backlight can automatically be switched to energy-saving mode if no touch operation is detected after a set time, e.g. after 10 minutes. A good viewing angle ensures optimum image visibility, even if the display is viewed from the side.

Multi-touch toolkits meet all user requirements

IPC expert Roland van Mark describes a further important market requirement: “Notwithstanding all the benefits offered by multi-touch
operation, many machine manufacturers still want to retain the option of electromechanical buttons, e.g. for emergency stop. The reason is the desire for real mechanical actuation feedback. The concept of milling the Panel housings from solid aluminum, which Beckhoff introduced with the first Control Panel generation as early as 1998, is ideal for this purpose. This principle offers numerous benefits such as low weight, high strength, environmental resistance, a wealth of processing options and full recyclability. The key is that no forming tools are used, which means that Beckhoff is able to respond flexibly to customer enquiries with low production runs. In addition, Beckhoff is now able to offer cost-effective multi-touch devices equipped with the C9900-G0xx extension and basic buttons as standard, which will be presented at this year’s SPS IPC Drives show.

The comprehensive application expertise, which Beckhoff has realized in custom solutions in the past, can also be utilized in the new multi-touch Panel series. Key switches, membrane keys and ring-illuminated short-stroke keys, for example, can not only be integrated via the standard USB port, but also via EtherCAT or other fieldbuses, and directly in the TwinCAT environment, if required. Of course all functions can be leaded out with a connector. But in order to avoid complex wiring, the emergency stop button can be integrated via TwinSAFE, the flexible safety solution from Beckhoff. Thanks to the openness of the Beckhoff control system, integration into other “fieldbus worlds” is also quite straightforward, e.g. for implementing safety features via PROFINET.

A key feature is that the CP2xxx and CP3xxx product lines are able to implement conventional and innovative operating concepts, with different display options. It is this wide range of options that offers machine manufacturers genuine design freedom. Roland van Mark explains: “Only with such a versatile range of options are we able to talk to customers in the most open-minded manner about their machine operation. For users, the bottom line is that they are able to choose the most suitable solution, without being limited by what is offered from the supplier.”

Multi-touch opens up new opportunities for machine operation

Single-touch screens are well-established in industrial applications. Driven by smartphones and Windows 7 touch pads, multi-touch will soon become the norm here. For Roland van Mark the question is therefore not whether, but how quickly this operating philosophy will prevail. For example, there are customers today who want two-finger operation, i.e. pressing a button and operation via a second button on-screen. Further options are offered by functions such as zooming for detailed information, browsing in a user guide or gesture (pattern) recognition in 5-finger mode. All this can be achieved with low engineering effort. In one case, a user was able to realize two-finger operation and gesture recognition within just a few days, using only the basic Windows 7 functionality.

Several tangible application benefits illustrate that these aren’t just marketing gimmicks, as Roland van Mark explains: “Multi-touch may force the operator to use two hands, which means that the Panel automatically requires full attention, which can increase safety.” Visualization becomes significantly more user-friendly, particularly in the case of large and extensive machines or systems, since the operator is able
The highlights of the Control Panel/Panel PC series:

- Display sizes of 7, 12, 15, 15.6, 18.5, 19, 21.5 and 24"
- Formats: 16:9, 5:4, 4:3
- Multi-touch: e.g. for 5-finger touch with high resolution
- High-quality aluminum housing, milled from a solid block
- Metal perimeter protection for the display front
- LED backlight technology
- Landscape and portrait format
- Built-in and compact devices
- Control Panels with DVI/USB Extended connection
- Panel PCs with choice of processors: ARM, Intel® Celeron®, Core™ i7
- Cost-optimized panel design
- Optional electromechanical push-button extension
- Customer-specified versions

Windows 8 runs on all Windows 7 computers, so that no new hardware is required. Beckhoff experts were able to confirm this in initial tests for the embedded WES8-CTP version. The Metro UI options are particularly useful for multi-touch systems. A gesture filter, for example, can be used to catch touch actions, similar to the keyboard or dialog filter for suppressing Windows dialogs.

The choice of touch technology is crucial

The resistive touch technology is widespread and has generally become accepted but – according to Roland van Mark –, because it is based on a sensitive film it is less robust than capacitive touching directly via the glass pane. To ensure suitability for industrial applications Beckhoff therefore uses what is known as projective capacitive touch screen (PCT) technology. The high touch-point density offered by this technology enables exact and reliable operation with short reaction times. Even virtually continuous touch operation in very small steps is possible in a jerk-free manner.

The touch controller developed by Beckhoff enables the sensitivity of the touch surface – an antireflective glass pane – to be programmed individually and parameterized such that it can also be operated with thin work gloves (e.g. Latex). For most applications this eliminates the common PCT disadvantage that capacitive touch screens cannot be operated with (normal) work gloves. In addition, the touch controller automatically prevents faulty operation, e.g. caused by water drops or the operator’s ball of the hand.

New options through Windows 8

Multi-touch functionality is available from Windows 7 and already offers excellent application options in conjunction with this reliable basic software. Further innovation potential is expected with Windows 8, which is optimized for touch pads. The programs – now referred to as apps – are visible on the start screen as individually placeable "tiles." The benefits of this new interface include convenient and fast access to regularly used applications via the new Metro interface.

Future-proof technology

Innovations offer new opportunities, but also uncertainty: Is the technology really future-proof? For the multi-touch Panel series from Beckhoff the answer is a clear “Yes.” In any case, multi-touch is certainly not a passing fad, but has already become the norm in many areas. And the CP2xxx and CP3xxx Panel series certainly offer future-proof technology: This is ensured by the Beckhoff electronics, high-quality and robust glass panes, the elegant and timeless design and the long-term availability of display sizes and resolutions.

Further Information:
www.beckhoff.com/Multitouch

Product announcement

Estimated market release of the news:
CP29xx and CP39xx with display sizes of 7, 12 and 24":
2nd quarter 2013.
CP26xx and CP36xx with ARM processor:
2nd quarter 2013.
Focus on user benefits

Based on this philosophy, Beckhoff is extending its automation platform consisting of PC-based Control technology, I/O systems and drive technology, in order to ensure maximum benefit for users. Ronald Heinze, editor-in-chief of Open Automation, spoke to Managing Director Hans Beckhoff about current and future developments.
"Our high-performance, PC-based Control technology with decentralized I/Os and drive technology forms the ideal foundation for covering a wide range of market segments," said Hans Beckhoff, commenting on the strategy of his high-tech company. He lists application options in different fields such as high-performance machine construction, water treatment and entertainment engineering as examples. "Our customers should be able to generate the maximum benefits and – based on our platform – map their own innovative solutions."

The company is broadly based in terms of its customers: in addition to alternatives energies such as wind and solar energy, Beckhoff clientele includes companies from the machine construction and building automation sectors. "We are first and foremost a platform provider. For selected industries we also offer special solutions," said the Managing Director.

The company has grown significantly over recent years and adapted its structure to this growth. More space for staff was made available with the acquisition of additional buildings at the company’s main location in Verl, Germany, thereby strengthening existing infrastructure. "We highly value stability," said Hans Beckhoff. "Dynamic adaptation combined with steadiness form a good working basis for customers and staff. We don’t regard the principle of constant change as an end in itself as productive."

Transferring simplicity from IT to automation technology

"Our PC-based machine control systems are characterized by exceptionally high performance, coupled with technological stability and long-term availability of supply," said the visionary Hans Beckhoff. "In the early years of PC control the performance benefits found immediate acceptance, although to some users the technology appeared to be somewhat fast-moving. However, after 26 years of practical experience we know that long-term availability is in fact one of the advantages of PC control. Long original product service life combined with the principle of functional replacement ensures long-term solution availability with broad-based investment security. This is, of course, aided by the fact that we develop and produce the motherboards for all our Industrial PC products in-house. They are, of course, optimized for long-term availability," said Hans Beckhoff. "A sensible and balanced life-cycle policy offers many obvious benefits."

"Simplification of the engineering is one of the core responsibilities of automation engineers."

A primary intention of Beckhoff is to transfer the increasing simplicity of IT to automation technology. For many applications this makes automation more understandable and easier to work with: the user merely has to adjust a few settings or parameters, and the application can start. Although in high-performance machine applications the requirements are somewhat more demanding: "In this field the software becomes a distinguishing feature," said Hans Beckhoff. "Customized automation solutions will always play an important role in machine construction." But here too, automation will become less complex, since the engineering toolsets will become simpler. "Further refining of automation solutions is crucial for the future technical and commercial development of the industry," said Beckhoff.

"The ideal automation tool can be used to roughly describe the functionality, refine it step-by-step, and compile the program. Simplification of the engineering is one of the core responsibilities of automation engineers."

New TwinCAT 3.1 version

The fulfillment of this vision necessitates convergence of IT and automation engineering, which forms the foundation of the entire Beckhoff technology offering. With TwinCAT 3 we take a huge step towards this convergence. Through its modularity TwinCAT 3 supports the reusability of software modules. Building on this, application-specific wizards and frameworks have started to emerge to increase efficiency and functionality.

TwinCAT 3 already offers many features that offer developers of automation technology more options to improve their work. In addition to a consistent object-oriented approach this includes the use of Visual Studio® as an optional framework. Hans Beckhoff: "The fact that we don’t use a special framework for TwinCAT makes access to automation easier for many engineers." Visual Studio® is familiar and popular as a software development environment around the world. This offers significant savings potential for engineering teams.

"At SPS IPC Drives 2012 we will present the new TwinCAT 3.1 version. It is mainly characterized by its consistent support for 64-bit Windows operating systems." Hans Beckhoff said and continued: "In addition, version 3.1 includes a wide range of new and enhanced functions.” Hans Beckhoff regards the integration of Matlab®/Simulink® in TwinCAT 3 as a particular success. It means that IEC 61131, C++ and Matlab®/Simulink® can be mixed as required, and part-simulations with real-time and non-real-time components are possible too. Further progress was also made in PC control measurement technology. TwinCAT Scope now enables a wide range of long-term monitoring options and can be integrated into custom HMI projects.

Industry 4.0 right from the start

According to Hans Beckhoff, the current Industry 4.0 trend also refers to the convergence of IT and automation: "Industry 4.0 precisely matches our ideas and is a handy description of what we have been doing for more than 25 years. Our control architectures are designed to enable integrated communication."
However, Beckhoff is skeptical about a fully decentralized structure: “Fully decentralized intelligence is not a helpful concept for automation architectures. In the 1990s there was a time when fully decentralized intelligent automation configurations were discussed under the notion of ‘holonic agents’ – without tangible success.” Just like nature, automation needs a clear, functional, hierarchical structure, with compaction of information towards the top.

For Beckhoff as a company, the area of functional safety is a key revenue generator. “Today, safety is a must for control equipment suppliers,” said Beckhoff. “For us, the need to integrate safety technology was clear right from the introduction of the I/O terminal system in 1995.” Meanwhile TwinSAFE, the integrated safety solution, which enables safety-relevant communication in non-safety-related systems and is therefore naturally very suitable for EtherCAT, has met with a high degree of acceptance. TwinSAFE is an open safety protocol, which in principle can be tunnelled via a wide range of communication systems. It is recommended by the EtherCAT Technology Group as a standard EtherCAT safety protocol and can be used by third parties via licenses.

“Incidentally, EtherCAT is also highly suitable for redundancy concepts,” said the Managing Director. It is used in a wide range of applications. In addition to the existing solution for cable redundancy, master redundancy for TwinCAT will become available in the foreseeable future.

Right at the front in the Leading-Edge Cluster

Beckhoff is among the driving forces for the “Intelligent Technical Systems Ostwestfalen-Lippe” – in short: “it’s OWL.” With the “it’s OWL” Leading-Edge Cluster competition, a flagship project for the high-tech strategy of the German Government, the Federal Ministry of Education and Research supports the best technology clusters in industry and science. Between 2007 and 2012, 15 Leading-Edge Clusters were selected in three competition rounds, which will each receive funding of up to 40 million euros over five years. The Leading-Edge Cluster concept focuses on technological developments for solving socially relevant areas of future need. The “it’s OWL” cluster was awarded Leading-Edge Cluster status during the third competition round in January 2012.

One of the projects initiated by Beckhoff is “ScAut” (Scientific Automation). It is managed by the Heinz Nixdorf Institute at the University of Paderborn and implemented in collaboration with industrial partners. “We want to establish a global knowledge base for automation expertise,” said Hans Beckhoff. The goal is to catalog university-based automation science expertise. “We want to implement particularly exciting topics in TwinCAT and make them available in the form of software libraries”, said Beckhoff. “We see this as a good opportunity for bridging the often bemoaned gap between practice and science.” The project is initially scheduled for four years, with the first two years focusing on collecting relevant data. “What practical uses can we extract from science?”

The graduate physicist, Hans Beckhoff is convinced that the project will provide clear answers to this question.

On the way to becoming an even stronger motion technology company

More good news: according to Hans Beckhoff, the joint-venture company Fertig Motors is growing and thriving, and is currently relocating to larger development and production premises at Marktheidenfeld. The standard AM8000 motor series and the AM88xx stainless steel motors have been available to the market for some time. “Users particularly appreciate the benefits of One Cable Technology,” said Beckhoff. One Cable Technology integrates the previously separate power and feedback cables of a servomotor into one integrated cable.

XTS opens up a completely new dimension for simplifying design, for example in conveying equipment, packaging machines and printing equipment.

A more recent addition are servomotors in the smaller and higher performance ranges. In order to meet the demand for higher performance, the AM8000 series is now also available with external ventilation, which increases the motor performance by up to 50 %. For CNC applications in tool and woodworking machines the AM8500 series offers a complete range of motors with increased rotor inertia. The eXtended Transport System (XTS) is a linear transport system also based on cooperation with Fertig Motors. “The joint venture offers fantastic reinforcement for our company,” said Hans Beckhoff. Motion applications, consisting of motors and drives, are expected to generate 30 % of the company turnover by 2020.

“XTS is already a real success story,” said Hans Beckhoff. “A wide range of machine manufacturers have expressed their serious interest. XTS opens up a completely new dimension for design simplifications, for example, in conveying equipment, packaging machines and printing equipment.” Several machine manufacturers have already committed to using the new system. Even a highly innovative company such as Beckhoff can’t issue revolutionary technologies such as XTS on a daily basis. “An idea has to reach a critical mass, driven by technical feasibility and concrete customer requirements,” said Hans Beckhoff.

Published in Open Automation 06/2012, VDE-Verlag, www.vde-verlag.de
During 2010 and 2011 Beckhoff experienced cumulative growth of around 100%, based on the general growth in alternative energies. This year the situation is different: “Since the end of last year, manufacturers of solar equipment and wind turbines have been in a structural crisis,” said Hans Beckhoff. “For this reason we expect no growth for this year.” Although to some extent this will depend on the development during the last quarter of 2012. Last year the renewable energy sector alone contributed 20% to Beckhoff’s total sales. This has now shrunk to a smaller, single-digit figure. According to the Managing Director, the alternative energy market is currently “in a holding pattern.”

“In all other areas we see good growth,” Hans Beckhoff continued. “Overall we are satisfied with the development, since the downturn in the renewable energies sector during 2012 was not unexpected.”

“Next year is difficult to predict,” said Hans Beckhoff, “in view of uncertainties in the macroeconomic development.” Due to the effect of replacement investments, developments in automation technology are closely related to the development of the gross national product: if gross national product rises, companies invest more in replacement and therefore more automation is implemented. According to the entrepreneur, overall there is no reason for pessimism: “Alternative energies are set to make a comeback. We have not lost any customers; we merely experienced a pause in turnover due to higher-level developments.” The Managing Director wants to see his company grow by 15% next year, which should be achievable provided the underlying conditions of the world economy remain positive.

Hans Beckhoff on current economic conditions
The integration of Visual Studio® into TwinCAT connects the standard development environment from Microsoft with the proven Beckhoff automation technology. It is evident that the product philosophies of TwinCAT and Visual Studio® are ideally suited to each other. The result of this integration is simplified software engineering for automation technology: the programming languages and platforms are freely selectable. Source code control tools can be simply integrated and the automatic generation of code will replace many manual steps in the future. The TwinCAT runtime system enables the distribution of the tasks to different cores and will thus increase the performance several times over. 64-bit operating systems are also supported from TwinCAT version 3.1, which will be presented for the first time at SPS IPC Drives 2012 trade show in Germany. The TwinCAT runtime can now also be used alongside the engineering environment on PCs with these 64-bit Windows versions.
The successful execution of large software projects in the IT world is based on a method that supports tools developed over many years. The question of whether one can also use this method and IT tools in automation technology can be answered with TwinCAT 3. Beckhoff has sought for and pushed the convergence of the worlds of IT and automation since the introduction of PC-based Control technology: first of all, Beckhoff made the “primary” IT tool – the PC – work for automation technology in 1986. This enabled users to make use of the great advantages of PC technology – price, performance and familiar “look and feel” – for machine automation too. With TwinCAT 2, Beckhoff opted as early as 1996 for the modern Windows operating system and for IEC 61131, the language of PLC programmers for standard and safety PLCs. The integration of Matlab®/Simulink® can also be pointed to as a further language. Those who wish to create control tasks or a simulation can use the Matlab®/Simulink® package made available by Mathworks with TwinCAT 3. C or C++ code is then created via the coder and suitably compiled in Visual Studio®. The Visual Studio® philosophy of making various programming languages available is thus supplemented in TwinCAT 3 by the languages that are important for automation.

**Freedom in the choice of programming languages**

Visual Studio® from Microsoft is by far the world’s most used tool for software production. With TwinCAT 3 this tool can now also be used to great effect for automation technology. Visual Studio® is a platform that encompasses several programming languages and provides programmers with the possibility to use the language with which they are most adept and which is most suitable for the solution to the problem or task at hand. TwinCAT 3 supplements the list of languages with IEC 61131, the language of PLC programmers for standard and safety PLCs. The integration of Matlab®/Simulink® can also be pointed to as a further language. Those who wish to create control tasks or a simulation can use the Matlab®/Simulink® package made available by Mathworks with TwinCAT 3. C or C++ code is then created via the coder and suitably compiled in Visual Studio®. The Visual Studio® philosophy of making various programming languages available is thus supplemented in TwinCAT 3 by the languages that are important for automation.

**Support for different platforms**

The paradigms of Visual Studio® additionally include the fact that different platforms are made available to the programmer in a single tool. In addition to the code generators for the .NET world, there are also further different platforms such as the 32-bit or 64-bit operating systems as well as the well-known Windows operating systems XP/Windows 7/Windows 8 or CE with C/C++. Naturally, ARM platforms are supported in addition to the x86 processors. The TwinCAT system is designed in exactly the same way: PLC and Motion Control are executable on different controller platforms with different processors and on different operating systems without the programmer having to adapt the software. The problem is solved by having different code generators. As a result, the TwinCAT components are once again well suited to the architecture of Microsoft Visual Studio®. The runtimes for the 64-bit operating system and the CE platforms are supported with TwinCAT version 3.1.
TwinCAT 3.1:
new items at a glance

- TwinCAT 3.1 (pre-release)
- Runtime also for 64-bit operating systems
- PLC runtime for Windows CE (x86)
- Improved integration of source code control databases
  (such as Team Foundation Server)
- Automation interface (automatic code generation)
- Open CNC interfaces (transformations)
- Scope configuration in Visual Studio®
- Integration in Visual Studio® 2012
- Condition Monitoring release
- TwinCAT Scope Professional
- Long-term recording
- Integration in the user HMI
- Reporting/print functions
- OPC UA
- PLCopen-compliant function blocks

Integration of configurators
Apart from the programming, a configuration part is also always required. Visual Studio® has many configurators for different compiler and debugger options. TwinCAT 3 supplements Visual Studio® with the System Manager familiar from TwinCAT 2. The configuration of system properties, of axes for Motion Control applications, of PLC and safety PLC projects and of course the configuration of fieldbuses and fieldbus components, is integrated in a single project – the so-called solution.

Debuggers make life for programmers easier
Those who program naturally must also debug. Programmers rightly want a debugger here that they are as familiar with as possible and with which they can track down errors quickly and effectively. For C/C++ that is the proven debugger included in Visual Studio®. TwinCAT 3 uses it and extends its functions in order to enable the debugging of applications that run in the TwinCAT hard real-time. If an application is created in Matlab®/Simulink®, then the programmer values the possibility to debug in their tool – Matlab®/Simulink®. PLC programmers, conversely, want a PLC debugger: the monitoring of current values, sequence control in all languages and also the use of breakpoints are on the wish list here. All of this is possible with TwinCAT 3 and is completely integrated into Visual Studio®.

Use of existing know-how
In parallel to Visual Studio®, which encompasses a series of packages and libraries that facilitate programming, TwinCAT provides more than 70 different libraries and tools for the most diverse functions. This puts the programmer in the position of not always having to reinvent the proverbial wheel, but of being able to build on existing know-how.

Modular programming
With the aid of software modules, re-usable functions can be simply encapsulated, tested and released. As a result, these modules can be used in further projects with no great effort. An elementary prerequisite for this is the definition of interfaces. In addition, a mechanism is required in order to use functions from different manufacturers in a skillful and safe way. Microsoft has developed the Component Object Model (COM) for this. The COM technology has been adapted for automation technology in TwinCAT 3. TwinCAT modules – regardless of the programming language in which they were written – can call and use methods of other modules at runtime under real-time conditions, so that re-use is simplified.

Source code databases for automation technology
Applications in IT and in automation technology have a tendency to become increasingly extensive. In order to cope with the extra software, a database for the management of the source code has long been used in IT – a solution that is also recommended for automation applications. So that users do not get accustomed to new, special tools, all known source code control tools that have a plugin for Visual Studio® are supported in TwinCAT 3.

Many new features are available in TwinCAT 3.1 for the source code control tools. In order to store source code sensibly, all source code for programming and configuration must first of all be stored as a text file, and that must of course be done for each object – e.g. for each function block – in a single file. TwinCAT uses XML files here for configurations; PLC modules are stored in the standardized PLCopen XML format. Apart from the pure storage of source code, versioning is a frequently desired property to enable the simple determination of
of the differences between versions. TwinCAT 3.1 offers a comparison tool here that can display graphic differences between versions for the different programming languages and configurations. If two programmers work on the same object, the changes must be merged. This merging technique is fully supported for all configurations and languages with TwinCAT 3.1.

**Automated code generation**

Software is often generated automatically in complex applications or in series machine manufacturing. TwinCAT 3.1 now makes the familiar automation interfaces from TwinCAT 2 completely available. The automation interface conveniently supports the creation or modification of complete applications, including configuration and programming in different programming languages, as well as the distribution of the application in the network. Each node in the tree can be created, deleted or modified. As an XML file, the parameters of each node are readable and changeable. For the PLC modules these are then the files saved in PLCopen XML. In this way the automated creation of complete projects is possible – once again in keeping with the philosophy of Visual Studio®.

Beckhoff is presenting the pre-release of version 3.1 of the TwinCAT automation software at SPS IPC Drives 2012, Germany. Version 3.1 of TwinCAT provides the user with new and extended functions: Integration in Microsoft Visual Studio® 2012 means that the latest version of the world-famous software suite can now be used. The source code control databases such as Microsoft Team Foundation Server or Subversion are available in TwinCAT 3.1, including compare and merge function for all programming languages. Configuration and programming can be generated automatically with the extended automation interface, which is new for the PLC sector.

TwinCAT 3.1 also offers extended possibilities for Motion Control applications; for example, one can integrate one’s own transformations conveniently in NC I and CNC. New Scope 2 functions facilitate the display and analysis of data even over a long period with many new trigger functions. Additional reporting and print functions are available. The user benefits from the cooperation with TwinCAT Scope 2 in particular in connection with the Condition Monitoring library. In addition, the TwinCAT OPC UA implementation has been extended by function blocks. A connection from the PLC to a further OPC UA server can be established directly via the OPC UA channel.
XTS: Significantly higher performance and simplified engineering with TwinCAT

The linear transport system XTS (eXtended Transport System) from Beckhoff combines the benefits of rotary and linear drive into one system. Where up to now the application options for rotary motors essentially ended, XTS adds the features of linear drive systems and offers new approaches for realizing highly dynamic machine concepts. An additional benefit of the XTS is its compactness, enabling machine manufacturers to design space-saving machines. The TwinCAT automation software ensures simple engineering. All "movers" of the XTS system are mapped as "normal" servo axes. Functions such as automatic accumulation, collision and jerk avoidance are integrated in TwinCAT.
In servo technology for mechanical engineering, a distinction is made between rotary and linear servomotors, which each have specific features.

With rotary motors and suitable mechanical systems such as toothed belts or conveyor chains, it is relatively easy to generate an endless circulating linear transport movement. However, such a configuration has the disadvantage that the rotary motor always moves the belt or conveyor chain uniformly in all sections. It does not allow velocity variation in different areas, e.g. in order to compensate for variance in a flow of products, to group products in different ways or to account for different processing times in a continuous flow of products. Further disadvantages include higher wear and lower rigidity of the mechanical components, resulting in poorer dynamics, performance and service life.

Linear motors have the advantage of direct force coupling between the motor and the moving product or drive task. If necessary, they can execute the task with several independent carriages. However, a significant disadvantage is the finite travel path, which necessitates a return movement of the movable elements of the linear motor. This significantly disrupts the continuous flow of products in a highly dynamic machine and reduces the production clock rate. The dual braking and acceleration process is also unfavorable from an energy perspective.

**State of the art servo technology**

Approaches for utilizing the linear motor principle so that wireless carriages or movers can travel along an active path formed by exercisable coils have been considered for some time. The movers are returned along a second track, so that they do not have to be moved against the product flow of the machine. However, previous approaches have been subject to the following technical restrictions:

- An electronic servo function energizes and controls a section with a uniform field for all movers on this section. Transitions between sections are also energized in the same way.
- In curves, the movers are moved via a rotary motor and an auxiliary mechanical unit.
- Closed position evaluation is not possible, so that in some sections only controlled movements are possible.

XTS, the new linear transport system described in this article combines the benefits of rotary motors with those of linear motors and at the same time eliminates the disadvantages and restrictions of existing approaches.

**The design of the new XTS linear transport system**

In the XTS linear transport system concept the individual coils of the linear motor are arranged along the travel path and the movers are equipped with permanent magnet plates. Via the dynamic control of the individual coils along the path, a dedicated three-phase current-equivalent travelling field is generated for each mover, which moves it. The previous fixed link (wiring) between converter and motor winding is broken up and replaced with software that runs on a centralized Industrial PC.

Figure 1 shows an overview of the whole system. Signals from the position sensor are linked with the IPC via fast EtherCAT communication. Servo axis software is used to calculate the position and velocity of the mover, with subsequent execution of the control and phase transformation. During the phase transformation, the sinusoidal phase currents of all coils below the mover are calculated from the rated current of the velocity controller and dynamically transferred to the current controller for the respective coils via EtherCAT. In this way each mover is controlled exactly as required for its current travelling field. Only coils with a mover above them are energized and controlled. The system enables each individual mover to be positioned exactly, with position and velocity control synchronized within 250 μs.

**Motor modules**

Figure 2 (p. 20) shows a straight and a curved motor module. The modules are connected in a series. The 24 V control voltage and the 48 V power supply voltage are fed in every 3 meters, along with an Ethernet cable for the EtherCAT interface. The motor design is based on a series of individual coils, each controlled by integrated power electronics configured as H-bridges. This also applies for the 180° curve, so that the ability to freely position each mover is ensured for the curve.

Since the drive power for this system is not provided by a central axis, e.g. a rotary motor and a linked chain, but is distributed to the individual movers, a lower DC link voltage of 48 V with efficient MOSFET transistors can be used. These transistors offer the benefit of lower conduction losses and short switching times, enabling highly efficient power electronics (efficiency > 99 %). The H-bridge is operated with a switching frequency of 32 kHz and an FPGA-based current controller, with an update rate of more than 300 kHz. The power electronics are regenerative and enable energy exchange between the sections in which movers brake and feed back energy, and those sections in which motor
energy is provided. Through integration of the power and Position Measurement electronics in the motor modules the space required in the control cabinet is reduced significantly.

The new motor design also minimizes losses: The magnetic circuit of the motor features an iron core double air gap. This enables efficient coil utilization and reduction of friction losses in the guide mechanism. The following equation applies for the force acting on the guide mechanism:

\[ F_{\text{air gap}} \sim 4 \cdot F_{\text{driving}} \]

It follows that around four times the motor feed force acts in the direction of the air gap. In a configuration with a single air gap, the mover guide has to absorb these forces, resulting in increased friction losses and guide wear. In a double air gap motor configuration, such as the one implemented in the XTS, the forces will ideally cancel each other out – apart from forces resulting from tolerances in the mechanical system and the permanent magnets. Overall, at a nominal speed of 4 m/s, a nominal force of 30 N and losses of about 12 W, this configuration achieves an efficiency of:

\[ \eta = \frac{F_R \cdot v_R}{F_R \cdot v_R + 12W} \cdot 100\% = 90.9\% \]

Figure 3 (p. 21) shows a mechanically critical point in a circulating transport system, at the transition between straight section and curve. If this transition occurs on a circular path, the result is a sinusoidal increase in velocity in y-direction. The acceleration results in step changes, which in turn results in a theoretically infinitely high jerk, with associated stress on the guide mechanism. For this reason the 180° curve motor module, including the guide, was executed as a clothoid [1]. A clothoid (blue curve in diagram 3) is an arc with a changing radius. At the start of the transition the radius is greater and becomes continuously smaller up to the apex of the curve, before the clothoid opens up again towards the second straight section. As a result, the acceleration increases continuously, which increases the service life of the mechanical components.

The system includes an easy to operate lock so that the movers can be replaced, if necessary. To make this system as versatile as possible – using only a few standard components – the motor modules have an additional mechanical guidance interface, consisting of locating pin and screw connections. This enables different specific guides for special requirements to be developed and installed, even for the standard motor modules. Also, the installation position of the system is not specified, but is freely selectable.

Position Measurement

Position Measurement is integrated in the XTS system and enables the absolute position of each mover in the system to be calculated without active components on the mover. The inductive displacement sensor principle used here is very resilient against EMC interference. It can be imagined as an unwound resolver: An excitation winding and several internal sine- and cosine-shaped receiver loops are laid out on a level surface. An encoder flag made of light, robust and fiber-reinforced material travels in parallel with the mover, with an air gap of 0.5 mm to the fixed displacement sensor. The flag contains several metallic surfaces, resulting in an interaction with the electromagnetic fields of the excitation winding and a position-dependent voltage, which can be measured in the secondary windings. This voltage curve has a sinusoidal shape, if the encoder flag is moved with constant velocity over the fixed sensor, for example. The absolute position of all movers can be calculated centrally by the IPC, based on the voltages, the inverse tangent function and a fixed position allocation of the secondary windings or their voltages in the system. The position measurement is contactless and absolute for all movers, so that no further homing or movement for commutation finding is required.

During the transition between two modules a position calculation from both modules is possible within a short transition section. In this way the position of all movers can be calculated reliably and consistently, immediately after switching on. In automated measurement travels, any position discontinuity, which may be caused by mechanical installation tolerances, can be taught and compensated for once the system has been assembled in the machine. In contrast to an optical measuring principle, the inductive procedure is insensitive to non-conductive contamination. High precision, for example, a standstill repeatability of less than 10 μm at a position resolution of approx. 0.2 μm, can be achieved through a suitable geometry. Excitation, sampling and digitization (controlled by an FPGA), can take place within a cycle time of 10 μs.

The surfaces of individual encoder flags can be customized without reducing the precision of position measurement such that movers are identified and uniquely assigned to the servo axes in the application software.

EtherCAT connects all elements to form an innovative system

A key prerequisite for realizing the linear XTS transport system is fast and synchronous EtherCAT communication between the IPC and other hardware. A motor module with a length of 250 mm encompasses 132 bytes of process data, consisting of set and actual current values, position measurement data, as well as control and status words. A 2 m long transport system with an unwound length of 5 m, consisting of curves and straight travel and return sections generates around 2640 bytes of process data, which are transferred synchronously in two EtherCAT segments with a cycle time of 250 μs. This corresponds to a data quantity of 84 Mbaud. The system can be subdivided into different 100 Mbaud EtherCAT segments, so that the data transfer takes no longer than half the cycle.
time of 250 μs. If necessary, a port multiplier bundles the process data of the 100 Mbit strands to form a 1 Gbit EtherCAT connection to the IPC and also handles – via distributed clocks (2) – synchronization of the connected hardware in the segments with nanosecond precision. The following calculations of the servo algorithms of all movers take place during the remaining cycle time of at least 125 μs:
- Axis monitoring of the different signals of the position measuring system
- Position calculation
- Velocity calculation
- Fine interpolation of the set axis values
- Position control
- Velocity control
- Higher-order load filter
- Phase transformation of the set current value to the respective hardware channels

Thanks to the short delay times in the FPGA-based hardware components (Position Measurement and power electronics), the central system achieves deceleration and cycle times that are comparable to a distributed solution, but offers the crucial advantage that the hardware associated with an axis is moved and switched continuously via axis monitoring software. Additional communication – with associated delays between intelligent modules – is not required. Figure 5 shows the chronological sequence in the system.

**Configuration and machine programming**

At first glance, this kind of system change – away from axes with fixed assignment between control, power electronics, motor and its own motion space – may appear daunting and complicated, particularly due to the large amount of data that have to be transferred and allocated in the system. For this reason, the development of XTS has been focused on simplicity and ease of operation for the user. The hardware is assembled and connected to the PC via EtherCAT. All hardware components in the system are detected and added to the configuration with a simple scan command in the TwinCAT [3] control software, which is issued with a mouse click. No other hardware settings are required. The current controller is already optimally adapted to the individual coils and movers. The individual process data in the system are allocated via an XTS I/O wizard. The wizard automatically detects the system components connected in the configuration after a further scan command, visualizes them and offers an option to move the segments in the visualization. Once the modules have been arranged, a further mouse click generates all allocations and links, so that all I/O data are

![Figure 5: Time sequence and transfer in the system](image)


available in a servo axis interface. The corresponding number of control axes, including their links with the axis interfaces of the hardware, is then created as SoftDrive from a parameter file. Users can edit this XML or tmc file as required for setting the control values determined for their mechanical configuration. Different parameterization, e.g. to account for different masses in certain position sections, is also possible. In this way the new "substructure" of this system can be easily mapped and configured in the controller based on conventional, tried and tested TwinCAT NC axes (see Fig. 6).

A further difficulty arises due to the fact that all movers alternately move in the same path. For this reason, an XTS group was developed as a software component which monitors the interdependencies of the movers without the need for intervention by the application programmer. Collision monitoring enables automatic continuation in the event of jams. For example, a mover may have transferred a product to a downstream production step at a transfer point. It now has a waiting position allocated as a target position, just before a new product is picked up. If several movers are in a queue at this stage, the approaching mover detects this and brakes automatically – and in an optimized way, based on the set dynamic parameters – before it reaches the end of the queue. As soon as the first mover receives a new instruction and leaves the waiting position in order to synchronize with a newly arriving product, all movers in the queue continue to move, again based on the set dynamic parameters. Once the mover has reached its target position, it reports the movement as complete. Each mover can receive a new travel command at any time. Collision monitoring is permanently active along the whole travel path and in all movements. The individual travel commands are programmed from TwinCAT PLC with standard blocks according to PLCopen. The familiar motion set value generators of an advanced control system, such as robot kinematics, “flying saw,” cam plate or PTP positioning can be used without restriction.

Further Information:
www.beckhoff.com/XTS

Product announcement
estimated market release:
1st quarter 2013

**XTS – benefits for mechanical engineering**

Application examples and further analyses of machines from the packaging, printing or production industries illustrate the high potential for performance gains and simplification offered by this innovative system. Particularly beneficial effects for mechanical engineering:

- Smaller and more efficient machines.
- Improved functionality.
- Simpler and faster system design.
- Simplified construction and assembly thanks to fewer components.
- Highly specialized mechanisms are no longer necessary.
- Format changes become significantly simpler.
- There are fewer and more standardized wearing parts.
Cutting-edge research in Ostwestfalen-Lippe, Germany: Beckhoff a core player in one of the most dynamic technology regions in Europe

According to a study carried out by the Stockholm School of Economics, the Ostwestfalen-Lippe region (OWL), Germany, is among the 12 strongest production locations in Europe. Particularly strong sectors there include machine construction, electronics and suppliers for the automotive industry with a total of 400 companies, 80,000 employees and 16.5 billion euros in turnover, which ensure high employment concentration, high capacity for innovation and impressive export figures. Many of these companies are highly active in the global market and are technology leaders, especially in industrial electronics.

In parallel to the high-performance industry, a strong scientific landscape has emerged in OWL, with 16 universities and research institutes. The universities of Bielefeld, Paderborn and Ostwestfalen-Lippe are national leaders in self-optimization, cognition and industrial automation.

These facts speak for themselves. Accordingly, it is not surprising that the region was selected as a "Leading-Edge Cluster" for intelligent technical systems ("it's OWL") during a national competition in Germany promoted by the Federal Ministry of Education and Research. As part of this cluster, OWL-based industry and science organizations intend to cooperate even closer than in the past in order to further strengthen OWL's position as a dynamic and powerful region for commerce and science. The Leading-Edge Cluster status offers the opportunity to establish OWL as an internationally recognized center for high-tech products and stay ahead of the field among global competitors. "Moreover, new, attractive jobs in industry and science will emerge, which will further increase the concentration of high quality careers in OWL."

Leading-Edge Cluster: "it's OWL"

The Federal Ministry of Education and Research launched the Leading-Edge Cluster competition in 2007 with the aim of strengthening and expanding the best industry and science technology clusters in Germany. Between 2007 and 2012 three competition rounds were held and 15 Leading-Edge Clusters were selected from 83 participants. Each cluster receives funding for five years. The "it's OWL" cluster is the brand name of OWL as a technology center. The Federal Ministry of Education and Research is making 40 million euros available for the development of new technologies in the area of production engineering and machine construction. Further funding to the tune of 60 million euros is provided by the cluster partners. In the "it's OWL" Leading-Edge Cluster, 174 companies, universities, research facilities and organizations collaborate in 47 research and development projects.

Beckhoff is one of the driving forces among the 25 core companies of the "it's OWL" Leading-Edge Cluster. These are companies that implement concrete development projects and bring new products to market maturity. Other core companies are KEB, Harting, Lenze, Phoenix Contact, Wago, Weidmüller and Wittenstein. This means that no less than eight companies from the automation industry are represented in the cluster, which collaborate in concrete development projects with other companies, universities and research centers and bring new products to market maturity.

Intelligent technical systems

The research and development efforts focus on new generations of intelligent technical products and processes. Claas, the agricultural machinery manufacturer, for example, intends to develop an environment detection system for harvesters. Denios, the hazardous goods specialist, intends to develop an intelligent automatic system for safe storage and treatment of hazardous substances. Wincor Nixdorf is working on new procedures for cash management, Gildemeister on machine tools that optimize themselves. Kannegiesser is developing an efficient large-scale laundry, for which Beckhoff will integrate the measurement technology into the standard automation system.
The aim is to develop high-tech products that are tailored to user needs. The products are intended to excel through high user-friendliness, safety, reliability and efficient use of resources. The companies involved are convinced that these intelligent products will help them to secure and extend their competitive position not only in Germany and Europe, but also worldwide.

“In order to achieve this we need to gain further insights into the potential of engineering and computer science and link them in a clever manner,” said Ursula Frank, who works in Beckhoff’s R & D project management division. “Pure mechatronic approaches are no longer sufficient. We need systems with inherent intelligence. There are numerous opportunities that can be realized with the versatile and easy to expand Beckhoff control platform.”

The research projects aim to use methods, techniques and procedures from IT and also non-technical disciplines such as cognitive science, neurobiology or linguistics to integrate actuator and cognitive functions in the technical systems. Such systems are then referred to as intelligent technical systems with inherent partial intelligence. They interact with the environment and adapt autonomously, deal with unexpected situations, anticipate future effects of influences and possible system states and “consciously” interact with the user.

Beckhoff initiated two innovation projects with the goal of opening up this potential:

- “ScAut | Scientific Automation: Integration of engineering findings in standard automation”
- “efa | eXtreme fast Control – efficiency improvements for standard processing machines”.

“ScAut”: Integration of measurement technology increases productivity

The competitive pressure on machine and system manufacturers is increasing continuously. Customers demand machines and systems that are even more efficient, environmentally friendly and reliable. It is not uncommon for manufacturers to be faced with demands for an 8% productivity increase through reduction of cycle times and faulty parts, a 10% reduction in energy consumption and a 20% reduction in pollutant formation, coupled with an increase of 30% to 40% in the service life of the tools used. These targets can only be achieved if the systems are utilized to their full potential.

This is where the “ScAut” innovation project comes in. Equipped with additional measurement technology and complex mathematical evaluation methods, the plan is to operate systems right up to their limits, without overloading them.

A very simple example is drilling as a manufacturing process: Parameters that can be measured include not only the current consumption and the drilling speed, but also the vibrations occurring at the drill and the workpiece, the temperature in the drill hole and the chip formation. Thanks to increasing IT capacities the accruing data can be brought together with complex mathematical procedures, analyzed and used for optimizing the drilling process. Any corrections that may be required can be implemented during operation.

Fast control technology eliminates delays

The main aim of the “efa” innovation project is to increase the efficiency and precision of standard processing machines through the application of fast, very
Global market for intelligent technical systems in the cluster industries of mechanical engineering, electrical and electronics, automotive supply industry

**Subsystems**
- Examples: Intelligent sensors, Drives, Automation components
- They form the basis for systems.

**Systems**
- Examples: Production machines, Household appliances, Cash dispensers
- They form the basis for partly geographically distributed, networked systems.

**Networked systems**
- Examples: Smart Grids, Production plants, Cash management systems
- Variable, new functions at run-time through the interaction of systems.

**5 cross-section projects**
- Self-optimization
- Man-machine interaction
- Intelligent networking
- Energy efficiency
- Systems engineering

**8 measures for sustainability**
- Create development dynamics beyond sponsorship
- Preview
- Technology transfer
- Market orientation
- Acceptance
- Prevention of product piracy
- Training and further training
- Equal opportunities, integration
- Establishments of companies

Based on Leading-Edge Cluster funding from the Federal Ministry of Education and Research, the aim is to implement 47 projects by 2016 with a total volume of 100 million euros.

Source: OstWestfalenLippe GmbH

precise matching automation technology. In this way the production equipment becomes more productive and the products are of higher quality. The way to achieve this is eXtreme Fast Control Technology (XFC) from Beckhoff in conjunction with multi-core computers.

In both projects the requirements for new automation solutions are developed, tested and validated in cooperation with the system manufacturers Hüttenhölscher Maschinenbau GmbH & Co. KG (Verl), IMA Klessmann GmbH timber processing systems (Lübbecke), Schirmer Maschinen GmbH (Verl) and kitchen manufacturer Nobilia-Werke J. Stickling GmbH & Co. KG (Verl). Research into the technical and scientific background is carried out in collaboration with the University of Paderborn and Bielefeld University of Applied Sciences.

**Structural support**
For Beckhoff, the project partners involved and the whole OWL region, the Leading-Edge Cluster offers an opportunity to further enhance the strengths of each individual partner and the region as a whole. Primary goals include increasing the innovation capabilities and competitiveness of the companies as well as the associated safeguarding and expansion of OWL as a leading business location. In accordance with the cluster strategy, the plan is to establish 50 new high-tech companies in the region, set up five new research institutes, attract 500 further scientists, create 10,000 additional jobs and set up four new degree courses with a total of 500 students. “A milestone in this direction was the establishment of the practice-integrated mechatronics/automation degree courses and industrial engineering with business studies degree courses at the Gütersloh site of Bielefeld University of Applied Sciences. These courses currently have 200 students, with further sites in the process of being established,” said Ursula Frank.

Further Information:
- [www.itsowl.de](http://www.itsowl.de)
- [www.beckhoff.com/itsowl](http://www.beckhoff.com/itsowl)

*[This research and development project is/was sponsored with funds from the Federal Ministry of Education and Research (BMBF) in the context of the Leading-Edge Cluster ‘Intelligent Technical Systems OstWestfalenLippe (it’s OWL)’ and attended by Projektträger Karlsruhe (PTKA). The author is responsible for the contents of this publication.]*
The EP1518 EtherCAT Box integrates numerous functions in a single box: 32 bit counters, digital inputs with sensor diagnosis and adjustable filter characteristics. The combination of these functions in just one module enables flexible use and also reduces logistics expenditure.

The EP1518 encompasses eight digital 24 V DC inputs as well as an EtherCAT input port and an EtherCAT output port for linking to the process level. The EtherCAT Box counts fast pulses with a counting frequency of up to 1 kHz. The integrated data pre-processing enables the counting pulses to be counted reliably, independent of the control cycle time.

In the delivery state the EP1518 is set to two up/down counters with a resolution of 32 bits. Each counter has an up/down and gate input that can be deactivated. Two inputs are available for standard functions. Beyond that, all eight signal inputs of the IP 67 Box are transmitted as "normal" digital signals over EtherCAT.

In addition, the EtherCAT Box is equipped with short-circuit detection via diagnosis of the sensor supply. The software-based adaptation of the inputs to the most diverse sensors/switches can be adjusted by filter characteristics between 0 and 100 ms.

Further Information:
www.beckhoff.com/EP1518
**Innovative solutions for industrial food processing**

**Baader-Johnson optimizes production and reduces costs in food processing**

It’s no secret that processed meats, fish and other food products have to come from somewhere; they don’t just magically appear in our meals, refrigerators or freezers pre-packaged, labeled and ready to go. Baader-Johnson, a company based in Kansas City, Kansas, specializes in machines for processing poultry, fish and other meats. Through innovative solutions the company intends to expand its position in the highly competitive North American food market. To achieve this aim, Baader-Johnson uses PC-based Control technology from Beckhoff. Based on Embedded PCs, EtherCAT I/Os and the TwinSAFE safety solution, Baader-Johnson has been able to increase the flexibility of its machines and significantly reduce machine development times and costs.

Baader-Johnson is a member of the Baader Group with headquarters in Lübeck, Germany. With subsidiaries and service locations in more than 70 countries, Baader is a worldwide leader in the manufacturing of innovative machines and systems for the food processing industry. The successful strategy of the company, which revolutionized fish processing as early as 1922 by introducing the first fish filleting machine, is based on process optimization through automation, safety and quality. In this way consumers can also be sure that the food they buy meets the highest safety and hygiene standards. With customer satisfaction as a top priority, Baader-Johnson machines supply real-time data for each stage of production with full traceability. This enables machine operators to change settings during production, in order to improve the quality and the production output, for example.

*Beyond our primary North American customer base with a particular focus on the poultry industry here, we also serve other food markets with our weighing and packaging solutions, such as fish, pork, beef, fruits and vegetables,* explained Ryan Foltz, Sales Project Manager, Baader-Johnson.

*The processes for fish and poultry are similar,* said Ryan Foltz: *“Primary machinery from the Baader Group fillet and trim the product, then they utilize sizing equipment that weighs, sorts and delivers the product to packing stations where boxes and bags are packed according to pre-defined criteria such...*
Clear advantage in control technology
Baader-Johnson has been using PC-based Control solutions from Beckhoff Automation for about six years now. “I originally encountered Beckhoff during a search for a robust, flexible hardware platform that was able to communicate in a variety of ways such as via EtherCAT, PROFIBUS and Modbus,” Foltz recalled. “Meanwhile, there are approximately 70 Baader-Johnson food processing machines with Beckhoff control architectures worldwide, such as the 1910 Sizer, the 1902 Carton Weigher and the 1914 Check Weigher, the market’s most accurate systems for sizing, weighing and transferring poultry at high speeds,” Foltz explained.

The control platform used by Baader-Johnson incorporates a CX1030 Embedded PC, to which the EtherCAT Terminals including safety terminals are connected. Additional EtherCAT nodes utilize EK1100 EtherCAT Couplers to distribute the I/O across the machine. “The Embedded PCs helped to significantly improve our reliability compared to the previous machine generation. The CX1030 processor is stable and with the use of solid state memory, there are no moving parts aside from a simple and easily replaceable fan cartridge. These factors keep critical processes running,” explains the Project Manager. “Additionally, the Beckhoff solution gives us one centralized controller that can be easily programmed in one standard software platform and operating system. This also reduces costs and greatly simplifies system design efforts. An additional advantage is that the Beckhoff technology in our system solutions easily interfaces to our production management software.”

TwinSAFE simplifies safety
Baader-Johnson also uses TwinSAFE, the integrated safety system from Beckhoff. “TwinSAFE helps us efficiently implement important safety functionality for E-stops and in other areas,” says Foltz. With distributed safety I/O terminals such as the Beckhoff EL6900 EtherCAT Terminal with integrated TwinSAFE Safety PLC, Baader-Johnson can efficiently and effectively manage safety throughout the plant while adjusting safety zones by using TwinCAT as the standard TwinSAFE programming tool. “On large, plant-wide projects it’s beneficial to use EtherCAT Terminals as the standard I/O system,” explains Foltz. With the installation of the TwinSAFE architecture it is possible to shut down Baader-Johnson machines and conveyors very quickly if anyone on the plant floor enters an unsafe part of the machine. “The methodology for E-stop wiring in the past was rather cumbersome, especially in a large plant. TwinSAFE cuts down on wiring and provides the flexibility to properly manage our safety implementations.”

“In addition to supporting our safety programming efforts, our technicians appreciate the TwinCAT software platform’s ease of use. It operates hand-in-hand with the familiar Windows OS and is the definition of reliable,” Foltz explained. “I find that Windows-enabled machinery is much more user-friendly and our technicians can more easily manage troubleshooting efforts. Before heavily utilizing Windows, we frequently had to rely on upper level support and specialized programmers in order to properly support every application.”

Remarkable cost savings
Baader-Johnson is very satisfied with the changeover to the PC- and EtherCAT-based control platform. “It gives us flexibility and openness for realizing further innovations and enables far more user-friendly operation, monitoring and control of our machines.”

“Thanks to the compactness of the Beckhoff control platform we have reduced our electrical cabinet space by around 25%. This is a significant cost factor, considering these plants typically require stainless steel cabinets, which come at a premium price,” said Ryan Foltz.
Conveying and blending systems for plastic film production

PC-based Control increases performance and optimizes system communication

The plastic manufacturing industry can count the food, medical and electronics markets as major growth areas for flexible packaging. The American company Advanced Blending Solutions is a supplier to the plastics industry of auxiliary equipment for material handling, blending and controls. Focusing on the plastic film and fiber markets, ABS equipment supports higher end applications such as in food and medical packaging as well as fiber and resin compounding. Based on PC- and EtherCAT-based control technology from Beckhoff, ABS offers its customers flexible solutions that are robust, cost-effective and innovative.
Advanced Blending Solutions (ABS) offers scalable blending technologies ranging from simple to highly complex systems. “Finding the optimum recipe is crucial for product quality and throughput,” said James Wood, Director of Engineering at ABS. PC-based Controls from Beckhoff handle this important function in ABS blenders.

Inside the 99,000 sq. ft (appx. 10,000 sq. m) production facility in Menominee, Michigan, plastic blenders, vacuum receivers, pump packages and weigh hoppers are just a few of the advanced machines manufactured on-site. The blenders perform simultaneous metering of all raw material components, in the form of granules, which eliminates the need for mechanical mixing, while consistently producing the desired blend.

“We are committed to being a single source provider for our customers’ industrial blending/extrusion needs, starting from system design to on-site installation,” said James Wood. “Our machinery handles and stores the raw material upon first arrival to the customer’s facility and then conveys the resins to ABS blending equipment. Our equipment functions in one of two modes: either as the master controller on the machine line, overseeing all aspects of the process or as a slave device, integrated to and communicating through another vendor’s downstream plastic processing equipment,” said James Wood.

**PC-based Control as integrated control platform**

During an ambitious campaign to all at once overhaul design, boost controller performance and improve system communication, ABS decided to offer their Simplicity Series Blenders with Industrial PC (IPC) technology from Beckhoff in 2007. Today, the PC- and EtherCAT-based control platform has essentially become the norm for ABS. “Utilizing Beckhoff technology gave us the ability to more easily manage our equipment by standardizing on a uniform control platform consisting of Beckhoff Panel PCs, TwinCAT PLC software and EtherCAT I/O,” explained Wood.

ABS uses the 15-inch Beckhoff CP6202 built-in Panel PC with touch screen as standard. “The multi-core processor technology offered by the CP6202 gives us plenty of performance. With Compact Flash as the storage media it’s an exceptionally stable piece of hardware which is of critical importance in the harsh environments typical of plastics applications,” said Wood.

“With the integrated TwinCAT PLC and Motion Control software, we took a major step forward with regard to performance, engineering and the organization of our applications in software libraries,” said Wood. “TwinCAT offers excellent control support for our blenders, extruders and material handling systems.” EtherCAT controls the air flow velocity that’s moving the material through the vacuum pump and feeding machines that perform simultaneous metering of all components. Using the EL6751 CANopen master terminal, ABS is able to integrate CANopen devices from other manufacturers in its customer-specific machines. The data from all connected CANopen devices are transmitted over one standard Ethernet cable and one EtherCAT network. “EtherCAT is the standard network for our Beckhoff control solution, with approximately 99 % of our Beckhoff controls and I/O devices having EtherCAT connections,” said Wood.

**Shorter engineering time – lower costs**

“TwinCAT has enabled us to simplify the entire programming process, which is extremely beneficial for our product development cycles,” said Wood. “Using the Beckhoff PC-based Control solution has saved us between 20 % and 30 % on control hardware costs, compared with our previous solution.” In addition, the new control system is more energy efficient: “We’ve achieved significant energy savings in the material conveying process through better velocity control of the pumps,” said Wood.

Future plans are well underway at Advanced Blending Solutions: “With the powdered form of plastics growing in popularity as the raw material for blending and extrusion, we are working on a line of automated feeders that will convey and blend powders. Based on our previous successes, we will use PC-based Control from Beckhoff,” said Wood.

Further Information:
www.adv-blend.com
www.beckhoffautomation.com
The AEG control system from Stadtwerke Konstanz had been operating since 1989 and was showing its age. For some time it had become apparent that the spare parts supply for the system could no longer be guaranteed in the long run. A project to implement a new system was initiated, with the aim of controlling and monitoring all the equipment at the water works. Fully automatic operation was a must, and security of supply had to be maintained at the present level as a minimum, if not improved. Business unit manager Wolfgang Fettke and his technology team headed by Wolfgang Treib from Constance Water Works sought a state-of-the-art solution. “Our decision in favor of the Beckhoff system clearly gave us added value,” said Wolfgang Treib. The user-friendly monitoring and documentation of the production data, which the new control delivered, wasn’t one of our main objectives initially. What was important to those responsible for the project was openness of the system. Cegelec, the contractor, was given the following instructions: no manufacturer-specific dependencies for the selection of hardware and for the communication protocols.

Meticulous water treatment
The water works supplies a population of 87,000 in Constance and the surrounding area. It could deliver up to 50,000 m³ of drinking water per day. The current delivery volume is 14,000 m³ per day on average. The trend is falling because, like the rest of the population, the inhabitants of Constance use drinking water with increasing efficiency. The water is extracted from a depth of 40 m, below the thermocline or metalimnion. At this depth the water is very clean and protected from surface contamination. The Constance Water Works supplies three zones with different elevations, which are operated at different pressure levels.

Raw water is extracted from Lake Constance via a 700 m long pipeline and initially, in the first step of the water treatment, fed through micro-strainers with a mesh width of 23 μm. In a second step the water is disinfected with ozone, which is generated from ambient air directly at the water works. The third and last step is a sand filter, which in 2005 was upgraded to a multi-layer filter. Small quantities of iron (III) chloride are added to improve the filtration results, although the water from Lake Constance is of such high quality that the dosage can be 200 times lower than usual.

Modular Bus Terminals replace expensive I/O cards
It would have been relatively simple and cost-effective to replace only the plant “intelligence.” This was indeed the initial intention. A conversion would have been non-critical, and reusing the old CPUs would have been simple. "However, since we wanted a trend setting solution, everything pointed to an open system architecture, which we found in the open and modular Bus Terminal technology," said Wolfgang Treib, commenting on the specification requirements. “We regarded and still regard this as the most economical solution.” Wolfgang Treib can substantiate this based on practical experience: “The cost of an I/O card 20 years ago today buys us several Industrial PCs, including Bus Terminals today.” Keeping a few Bus Terminals in stock for MRO doesn’t tie up too much capital.
One of the key requirements for the new automation system was to avoid proprietary components and serial bus protocols. "The primary goal for the type and structure of the new control system was to improve plant availability. The decision to use the Industrial PC (IPC) system gave us much more freedom in the design of the applications, and the current structure has also made interfacing to subsystems much simpler," said Wolfgang Fettke: "The decision to use the Beckhoff system has led to significant benefits because sensitive, demand-based control comes with detailed information from many different points within the plant. These data are provided by a wide range of sensors. In addition, measuring systems that provide an IP-capable protocol, such as Modbus TCP, can be integrated easily."

Control retrofit completed during operation

The new control system based on Beckhoff components was configured and linked to the two IPCs in parallel with the existing process. One of these IPCs operates as a master, the other is available as "cold standby." Both are equipped with a dedicated switch for process connections.

"Critical system functions run on Embedded PCs," said Wolfgang Treib. If necessary, these system components can be operated autonomously, in order to ensure system availability. Modbus TCP is used for integrating the operating panels with the control system.

The conversion took place while the plant was in operation. The task was facilitated by the system architecture: Constance Water Works has three distinct sections, referred to as "supply channels." Each section from one step can operate with a section from the next step, for example, microfilter 1 with ozonation 2. This variability must be mapped in the control system. One of the three "channels" at a time was converted to Beckhoff technology, while the other two "channels" ensured the supply.

A total of six Panel PCs are used for functions that require local control. The operators of Constance Water Works wanted the operation to be "as simple as possible." Via the touch screen Panel PCs the process can be controlled, and actual and set values can be checked. Wolfgang Treib is sure that the operating personnel will quickly get used to the new technology: "We have an HMI that enables world-class local control that is convenient for the user."

Signal communication with the master control system of the municipal services takes place via the IEC 60870-5-104 telecontrol protocol. Information from around 1,600 data points is transmitted in this way. During the changeover the respective station addresses were changed one by one, and the corresponding parameters set. According to Wolfgang Treib, adapting these data to the Beckhoff system wasn’t a problem. "It was a diligent but routine piece of work."

Integrated system maximizes flexibility

Conversion of a sensor structure that has evolved over decades, such as in a water works, could turn out to be "interesting" to say the least. "The sensors have essentially remained unchanged," said Wolfgang Treib. The different signals, whether they are 0…10 V, 4…20 mA or digital outputs, are now all "wired" in a consistent manner. Bus Couplers were installed wherever critical process data are generated for the water works operation. Because of the flexibility of Beckhoff Bus Terminal technology, the system has become truly integrated. Since the type of input signals is essentially irrelevant from the perspective of the Bus Terminals, most signals required no modification. "Only in a few instances was it necessary to install buffer amplifiers or duplicate measuring signals," said Dieter Völkle, sales representative at the Beckhoff office in Balingen, Germany. "This was more for redundancy reasons rather than the actual function." Extensions could be easily implemented, if necessary. The open system could accommodate additional bus devices at virtually any point.

According to Wolfgang Treib, the PC-based Control system has a further benefit: "On-call staff no longer have to be on-site, e.g. during weekends, but can conveniently log into the control system via a PC and check the status of the plant. If, for example, a microfilter fails, the system would issue a signal. The duty officer can check remotely whether one of the two other microfilters has taken over. If this is the case, attendance at the water works is not required. The current system reduced the number of on-call deployments – a side effect which we didn’t plan for, but it is very welcome."

The operators of Constance Water Works also expect the new control system to result in improved energy efficiency. "With a consumption of more than 2 million kWh per year, a reduction of just one percent would be a nice, additional benefit," said Wolfgang Fettke.

Further Information:
Stadtwerke Konstanz www.stadtwerke.konstanz.de
Cegelec Deutschland GmbH www.cegelec.com

Raw water is extracted from Lake Constance via a 700 m long pipeline and fed through micro-strainers, followed by disinfection with ozone. The ozone is generated from ambient air directly at the water works.
Development of image-processing systems for industrial applications is a core business area of the Finnish Oy Delta-Enterprise Ltd. One of the latest customer-specific developments of the company is a wood scanner for wood flooring. It records the shape of the natural edges of the wood and also recognizes defects such as knots and sapwood that affect the cutting. The scanned-in data are transmitted to the Beckhoff Industrial PC via TwinCAT ADS and Gbit Ethernet. TwinCAT controls the transport system and the light barriers.

A board is moved through on a conveyor belt and recorded from above and below as it travels past the two cameras. An encoder operates the cameras at intervals of about 0.5 mm.
The camera system, that uses colour and 3D, records the wood board simultaneously on both sides: The external contour, knots and the sapwood at the edges of the heartwood are measured online and the cutting program is calculated from this data.
The image processing system was ordered by Bolefloor, a Dutch company based in Amsterdam that is breaking new ground in the industrial production of solid wood flooring. Instead of the usual straight edges to the wood, the floorboards follow the natural growth and grain of the tree, and are curved. In addition to the aesthetic effect, this process gives minimal wastage and an optimal use of the natural resource of wood.

A highly developed technology is needed for the industrial production of wooden flooring like this. The raw, still unedged wood boards are first planed and accurately measured. Then the wood scanner developed by Delta Enterprise comes into play. The camera system, that uses color and 3D, records the wood simultaneously on both sides: the external contour, knots and the sapwood at the edges of the heartwood are measured online. The data are stored in a database. Then the scanned wood items are put into temporary storage. Then, using the image and the contour data, a semi-automatic CAD program seeks out the boards that suit a particular floor area and works out the close matching of the contours of the boards so that when they are laid later they will fit together accurately. Finally a CNC machine is used to cut the floor boards accurately, followed by sanding and packing.

Following preliminary studies in which Delta Enterprise developed the image processing techniques and the corresponding algorithms for this order, the mechanical and electrical equipment had to be designed and selected.

Control is by PC-based Control from Beckhoff

A board is moved through on a conveyor belt and recorded from both sides as it travels past the cameras. Both inverter-driven belts are fitted with an encoder and the speeds are synchronized. The same encoder operates the cameras at intervals of about 0.5 mm. Accurate measurement is ensured by a special measurement process and the encoder signal.

Delta Enterprise took the decision to base the processing and control system on Beckhoff components. In weighing up the pros and cons of the offerings from different suppliers, considerations such as flexibility, reliability, performance and long-term availability spoke for the PC-based Beckhoff platform. The system uses two powerful Industrial PCs C6920, each with a Gbit Ethernet connection to one of the high-speed 3D color cameras. The two image-processing systems that record the wood from above and below, operate virtually independently of each other. By using two PCs, the flow of data from the process can be processed at very high speed. The cameras simultaneously record color images and height profiles to capture all the features of the wood – both those wanted for the next processing stages and the unwanted ones. An image-processing algorithm uses this data to calculate the optimum way of cutting the wood. The HMI is provided by a touch-screen control panel of type CP6902; the Embedded PC CX9000, with rows of Bus Terminals and TwinCAT PLC, controls the transport and image processing system and reads in the sensor data.
The Real-Motion® driving simulator promises the feeling of undiluted motor racing. Not only because the driver takes their seat in an exciting vehicle, but also because the driving experience is simulated with such realism that the feeling of a real racing circuit is undeniable. The developer and manufacturer of Real-Motion® is Steel Construction and Robotic Machinery (S.Co.R.E). The company with headquarters in Amchit, Lebanon, specialises in dynamic motion simulators for various areas of application. The racing simulator is controlled by a PC- and EtherCAT-based control platform from Beckhoff. The implementation of the project was supported by Industrial Technologies S.A.L. (ITEC), the exclusive Beckhoff partner in Lebanon.

“Up until 2010 all driving simulators from S.Co.R.E were equipped with conventional PLC systems. However, with Real-Motion® we hit the technical limits”, explains Gaby Mike, Managing Director of Real-Motion. The greatest challenge of this project was to create a precisely synchronised Motion Control platform that reacts in real-time to the data from the external racing engine. Further requirements were the mathematical calculation of the customer-specific motion curves as well as the possibility to change the target points during operation of the simulator.

**Higher data throughput over Ethernet**

“The decisive criteria for choosing Beckhoff were the openness of the PC-based Control platform and the high data throughput”, says Jad Wehbe, Managing Director of Industrial Technologies. “The Beckhoff C6915 Control cabinet Industrial PC, which functions as the controller here, has an integrated Dual-Ethernet adapter. The synchronisation of several simulators on a server takes place over Ethernet. Only with fast Ethernet can we achieve data throughputs of up to 200 packets per second”, adds Gaby Mike. Thanks to the use of Ethernet and UDP packets, longer data cables and an unlimited number of network nodes can also be used.

The movement of the racing simulator is based on the interpolation between separate axes. Hence, each delay in their synchronisation causes an unwanted movement in various directions. EtherCAT, the real-time Ethernet bus system from Beckhoff, provides here with its Distributed Clocks function the conditions required for the highly precise synchronisation of the various drives.

The racing simulator from Real-Motion® promises exhilarating fun: it perfectly simulates the handling of a real race car.

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**Adjustment of the servomotors to the customer-specific movement curves**

In a vehicle simulator the target points of the movement must, on account of the actions of the operator, be driven to very quickly by the servomotors. The conventional setpoint generators in the TwinCAT NC PTP automation software have therefore been extended by the external setpoint generation which is a component of the NC PTP package. The calculations for the external setpoint generation were programmed in the standard PLC with the aid of structured text. Hence, it was simple to combine the complicated calculations of the customer-specific movements (optimised 7 segments) with the standard algorithms of the NC PTP. In this way it was simple to solve the very dynamic change of the target points. Due to the high-performance of the PC-based platform, the complicated mathematical algorithms for the new setpoint values can be computed in real-time.

**Improved safety functions with TwinSAFE**

Safety is an important aspect for motion simulators. If the emergency button is pressed, the simulator must stop immediately, taking into account the jerk and deceleration limits. “Thanks to the TwinSAFE modules EL6900 and EL1904 we are able to guarantee fail-safe functionality of the emergency stop button”, said the Managing Director of Real-Motion.

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Further Information:

[www.real-motion.com](http://www.real-motion.com)
[www.iteclb.com](http://www.iteclb.com)
The checking and testing of photovoltaic cells is a significant element of quality assurance in solar cell manufacturing. Prior to assembly into solar modules, these cells must be checked for a number of criteria of which efficiency and power are of the most important. IPTE Factory Automation, headquartered in Genk, Belgium, has introduced a new SOL-TS: An integrated testing and sorting system for photovoltaic (PV) cells. Up to 3,600 PV cells can be processed per hour with this highly efficient, compact and cost-effective solution.
The SOL-TS developed by IPTE is a fully automatic system for testing and sorting photovoltaic cells. The testing unit can process 3,600 PV cells, up to 6 x 6 inches in size, per hour.

Before they are assembled in solar modules, the photovoltaic cells must be subjected to a series of intensive tests as described by the IEC standard. A very important parameter, among others, is the measurement of efficiency and power.

Precise measurements require precise positioning
The SOL-TS testing and sorting system developed by IPTE consists of three units: 1) the power supply section, 2) the test section and, finally, 3) the sorting and packaging unit. The testing unit can process 3,600 PV cells per hour that are each up to 6 x 6 inches in size. The cells are fed to the testing unit by means of intelligent conveyor belts which are driven by Beckhoff type AS1060 stepper motors. The photovoltaic cells must be precisely positioned for the tests. A 3 x 10 ms pulse emitted by a Class AAA multi-level solar simulator permits precise measurement of the voltage and current on each PV cell. Connected to a programmable load and multiple sampling allows verification of the performance of the PV cell. Since the PV cells are extremely thin (< 200 micrometers), they must be conveyed and connected under controlled conditions.

After the test, the results of the PV cell measurements are saved in a file and at the same time transmitted with the cells for further processing in the sorting system. The measurement results also represent an important source of information for manufacturers of solar modules. The data will be used in quality testing and traceability systems.

Control of robots with TwinCAT Kinematic Transformation
The sorting of the PV cells according to the test results is handled by a robot. The controller for the robotic system, including the drive technology with Beckhoff AM3033 servomotors and the AX5000 EtherCAT Servo Drive, was developed by IPTE in-house. “We opted for a cost-effective double drive system with one single and one double axis drive. For software we are using TwinCAT Kinematic Transformation, developed by Beckhoff for pick-and-place applications among other robot types,” explains Dimitri Paque, a Software Developer at IPTE. “This Kinematic software is ideally suited to motion interpolation in G-code (DIN 66025), the standard for CNC machines,” Koen Kerkhofs, Technical Support at Beckhoff Belgium emphasizes. Starting from Cartesian data, the setpoints for the robot can be set easily. The mass and the moments of inertia for dynamic control of the robot arms can also be entered.

All the internal I/O communication takes place via Beckhoff EtherCAT Box modules with IP 67 protection. This results in a compact and clearly laid out cabling. The photovoltaic cells are sorted according to their electrical characteristics and placed in small, ready-to-ship polystyrene containers.

Further Information:
www.ipte.com
www.beckhoff.be
The popular EtherCAT road shows take place around the globe: By the end of 2012, the EtherCAT Technology Group (ETG) will have held Industrial Ethernet seminars on a total of five continents. While numerous stops in Europe, Asia as well as North and South America have been on the road map up to now, further seminars will take place in the final quarter of 2012 in Australia, New Zealand, Singapore, Malaysia, and South Africa.

Worldwide interest in the Industrial Ethernet seminars continues unabated; this was shown above all by the road show in China last September: with a total of 600 participants, the ETG set a new attendance record. “Interest in the Chinese seminars was overwhelming and is a clear indication of the outstanding potential that EtherCAT has in the Chinese market,” explains Beryl Fan, ETG representative in China and manager of the ETG office in Peking. “Chinese engineers are very interested in cutting-edge technologies, especially if they make financial savings possible.” Due to that continuing high demand, the ETG plans to hold further seminars in China in the coming year.

The ETG Industrial Ethernet seminar series had its start this year in Brazil: over 250 visitors from device manufacturers, machine builders, system integrators, and end users gathered at the one-day events, which were spread over six cities. Given the fact that typically employees in Brazil cannot simply take a day off for a seminar, the number of participants testifies to the importance attached to EtherCAT by the aspiring Brazilian market. “We are delighted at the great interest in the events – in particular since this was the first EtherCAT Seminar series in South America,” says a pleased Dr. Guido Beckmann, Chairman of the Technical Committee of the EtherCAT Technology Group. Due to the good response, further events are, of course, planned in the future.

Naturally, the Industrial Ethernet seminar series focuses on EtherCAT itself. Starting with a detailed introduction to the technology, the advantages of EtherCAT for the user are shown in particular: costs are reduced while at the same time both the throughput and the efficiency of machines and plants are increased. The program is rounded off by various user presentations, which provide information on the use of EtherCAT in practice as well as on the simple switch from traditional fieldbus systems to EtherCAT.
Almost nine years after its establishment, new member influx into the EtherCAT Technology Group not only continues unabated, but in fact continues to accelerate: to this point, the ETG welcomed its 2,000th member in summer 2012. In October of this year there were already over 2,100 members from 55 countries. Both Switzerland and Italy welcomed their respective hundredth member this year; the 250 mark has already been reached in Japan and the USA.

"From the very outset our approach has been to make it possible for every company to use and to implement EtherCAT. The development in the last nine years and the present number of companies that implement EtherCAT in practice and invest in this technology prove that we have lastingly hit a nerve with EtherCAT," explains Martin Rostan, Executive Director of the EtherCAT Technology Group.

The personal exchange of views and expertise is a further important aspect of the Plug Fests. Whether discussing implementation approaches or possible difficulties during the development: The events offer an effective platform for the developers to talk to one another and to the ETG employees present. "The dedication of the participants at this year’s Plug Fest in North America was remarkable. Thanks to the lively exchange of views we were able to work extremely efficient and constructive," says Rainer Hoffmann, Technologist from the EtherCAT Technology Group, who was present as an ETG contact person.

Almost nine years after its establishment, new member influx into the EtherCAT Technology Group not only continues unabated, but in fact continues to accelerate: to this point, the ETG welcomed its 2,000th member in summer 2012. In October of this year there were already over 2,100 members from 55 countries. Both Switzerland and Italy welcomed their respective hundredth member this year; the 250 mark has already been reached in Japan and the USA. "From the very outset our approach has been to make it possible for every company to use and to implement EtherCAT. The development in the last nine years and the present number of companies that implement EtherCAT in practice and invest in this technology prove that we have lastingly hit a nerve with EtherCAT," explains Martin Rostan, Executive Director of the EtherCAT Technology Group.

Following the basic development of EtherCAT, the EtherCAT Technology Group was founded in 2003 with the purpose of supporting the publication of the technology and of promoting its spread across the globe. The road that the ETG would take in the future was already clear at the time of its origin: back then over 30 companies had signed on as founder members within three weeks. "On average we receive more than one new application per calendar day in the ETG head office here in Nuremberg. There is no end in sight!" says Liliane Hügel, who is responsible for member administration at the ETG among other things.
Motek 2012: Positive reaction to the new XTS transport system

“Process applications of robot and handling systems” were the main topic of the Motek 2012, which took place from 8 to 11 October in Stuttgart, Germany. 1,062 exhibitors from 23 countries – hence around 10 % more than last year – presented solutions for assembly and handling technology to an international trade public. The Motek attracted a total of 35,647 visitors from 93 nations.

The main attraction at the Beckhoff trade show booth was the eXtended Transport System (XTS). The innovative transport system optimizes the flow of material in assembly technology and offers savings potentials in the mechanical costs and in the engineering. Supply, handling and assembly are integrated in a single system, as a result of which new machine concepts are possible that offer the user maximum flexibility. With XTS, processing steps can be controlled individually and independently of one another.

Beckhoff at Husum WindEnergy 2012

The Husum WindEnergy 2012, which took place from 18 to 22 September at the exhibition center in Husum, Germany, provided a comprehensive overview of current solutions for “new energies” and ended with positive response for both exhibitors and visitors. Over 1,171 international exhibitors demonstrated the major trends in the wind power industry to 36,000 trade visitors from around 90 countries.

With its international wind expertise team, Beckhoff presented its complete range of solutions for open automation. The new items were centered on the PC-based automation solution that unites all components of a wind turbine on a single platform. A further highlight was TwinCAT 3: in addition to the integrated Condition Monitoring solution, Matlab®/Simulink® can be used to simulate plants, for example for load calculation.

“We were able to make many new contacts at Husum WindEnergy 2012. Particularly pleasing for us was the extremely positive reaction to the ultra-fast wind farm networking with EtherCAT. We have initiated a major impulse here and optimized the effectiveness and speed in the networking of wind farms”, says Dirk Kordtomeikel, Business Manager Wind Energy.

Further Information:
www.beckhoff.com/HusumWind
EU PVSEC 2012: Open automation solutions for photovoltaic production

Beckhoff was present at EU PVSEC, which took place between 25 and 28 September in Frankfurt am Main, Germany, to demonstrate its open automation solutions for photovoltaic equipment to visitors from Germany and abroad. More than 656 international exhibitors documented the key trends in the photovoltaic industry. The event was attended by 31,500 visitors from 102 countries.

Andreas Schulze, Business Management Photovoltaic at Beckhoff, says: “We were able to strengthen our position in the photovoltaic sector and were particularly pleased with the large number of visitors and new contacts. With the new TwinCAT 3 software generation we took an important step for the photovoltaic industry”.

Further Information:
www.beckhoff.com/EUPVSEC

FachPack 2012: Save mechanical costs and gain flexibility with XTS

Packaging, refinement, technology and logistics were the topics at FachPack, which took place from 25 to 27 September in Nuremberg, Germany. 1,466 exhibitors presented their packaging solutions to the 37,000 visitors – of whom around one fifth were from foreign countries.

The Beckhoff trade show booth focused on XTS – eXtended Transport System. XTS offers an optimized flow of material for packaging technology. “XTS was our trade show highlight. The large crowd of visitors – from development managers and mechanical designers to decision-makers – showed us that XTS is a step in the right direction”, says Frank Würthner, Branch Management Packaging Technology at Beckhoff. “Despite the crisis, the packaging industry is growing annually by 4 to 8 %. New trends are heading in the direction of intelligent packaging. Beckhoff offers the flexibility required for that in XTS and TwinCAT 3 automation software.”

Further Information:
www.beckhoff.com/FachPack
# Trade shows 2012 | 2013

## Europe

### Germany

- **Tire Technology Expo**
  - February 05 – 07, 2013
  - Cologne
  - Hall 1, Booth 2081
  - [www.tiretechnology-expo.com](http://www.tiretechnology-expo.com)

- **ISH**
  - March 12–16, 2013
  - Frankfurt
  - Hall 10.3, Booth C79
  - [www.ish.messefrankfurt.com](http://www.ish.messefrankfurt.com)

- **Hannover Messe**
  - April 08 –12, 2013
  - Hannover
  - [www.hannovermesse.de](http://www.hannovermesse.de)

- **Prolight + Sound**
  - April 10 –13, 2013
  - Frankfurt
  - [www.prolight-sound.com](http://www.prolight-sound.com)

- **Ligna**
  - May 06–10, 2013
  - Hanover
  - [www.ligna.de](http://www.ligna.de)

- **Sensor + Test**
  - May 14–16, 2013
  - Nuremberg
  - [www.sensor-test.de](http://www.sensor-test.de)

- **EMO**
  - September 16–21, 2013
  - Hanover
  - [www.emo-hannover.de](http://www.emo-hannover.de)

- **FachPack**
  - September 24–26, 2013
  - Nuremberg
  - [www.fachpack.de](http://www.fachpack.de)

- **Motek**
  - October 07–10, 2013
  - Stuttgart
  - [www.motek-messe.de](http://www.motek-messe.de)

### Austria

- **EEWA**
  - February 04–07, 2013
  - Vienna
  - Booth A-K85
  - [www.events.eewa.org/annual2013](http://www.events.eewa.org/annual2013)

- **Power-Days**
  - March 13–15, 2013
  - Salzburg
  - [www.power-days.at](http://www.power-days.at)

###比利时

- **Indumation**
  - April 24–26, 2013
  - Kortrijk
  - [www.indumation.com](http://www.indumation.com)

###挪威

- **Nor-Shipping**
  - June 04–07, 2013
  - Oslo
  - [www.nor-shipping.no](http://www.nor-shipping.no)

###瑞士

- swissTfair Zurich
  - June 06–07, 2013
  - Zurich
  - [www.swissfair.ch](http://www.swissfair.ch)

- swissTfair Yverdon-les-Bains
  - June 11–12, 2013
  - Yverdon-les-Bains
  - [www.swissfair.ch](http://www.swissfair.ch)
Ineltec
September 10–13, 2013
Basel
www.ineltec.ch

**Asien**

**India**

EMAT
November 29 – December 02, 2012
Pune
www.emat-int.com

**Indonesia**

Manufacturing Indonesia
December 05–08, 2012
Jakarta
Hall D, Booth 8040
www.manufacturingindonesia.com

**Japan**

Semicon Japan
Dezember 05–07, 2012
Chiba
www.semiconjapan.org

**Malaysia**

Automex
May 21–25, 2013
Kuala Lumpur
Hall 5, Booth 5210
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