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Successful 2015 financial year: Beckhoff increases sales by 22 % to 620 million euros
Beckhoff turned in an extremely successful performance in the 2015 financial year, generating global sales of 620 million euros, an increase of 110 million euros (+22 %) year-over-year. All sales regions and product segments contributed to this double-digit growth.

Beckhoff Automation posted annual turnover of 620 million euros in 2015, an increase of 22 %, following a similarly successful 2014 financial year in which sales rose by 17 %. Managing Director Hans Beckhoff is very satisfied with the company’s development: “We won market share and grew much faster compared to the market as a whole. Our PC Control technology is increasingly the acknowledged market standard, and we are winning new customers worldwide with this extremely powerful technology.” Beckhoff explains that the favourable euro exchange rate naturally helped increase growth, as with all German manufacturers who export a large share of what they make, but added that, even after revising the figure to compensate for exchange rate influences, the resulting growth rate is still an impressive 17 %.

Beckhoff is well-represented in more than 75 countries with 34 subsidiary companies and distributors. Exports in 2015 accounted for 65 % of total sales. “Asia is contributing strongly to our growth,” says Hans Beckhoff. “However, subsidiaries in southern Europe and North America are also performing quite well.”

Hans Beckhoff has an optimistic outlook on 2016 and anticipates continued double-digit sales growth: “We have strong and growing levels of incoming orders.” In order to prepare the company for this expected growth, the campus at our company headquarters in Verl will be expanded by a further 27,000 m² in 2016. Existing neighbouring industrial buildings have already been leased for this purpose and, after being renovated, will provide additional storage and production space in the second half of the year. “This appropriately prepares us for two further years of strong growth in terms of production output,” says a confident Hans Beckhoff.

Investment in research, sales and development
The Beckhoff sales and distribution network will also expand further in 2016, according to the Managing Director: “We aim to make our national sales network even larger with further regional offices in Hesse and North Rhine-Westphalia. Additionally, our global presence will be strengthened with new Beckhoff representative offices in Argentina, Colombia and Thailand.”

“We will again invest heavily in research and development in 2016, allocating funds of roughly 45 million euros. Technology is our business, but it is also a source of joy for us,” says Beckhoff, a graduate in physics. On the technological side, the hardware and software portfolio will be expanded in all Beckhoff PC-based control technology product groups. “Industrie 4.0 is becoming a reality. Ideas are being transformed into real products that enable machinery to be used far more productively, manufacturing more goods in higher quality,” states Hans Beckhoff. The first operational Industrie 4.0 and Internet of Things (IoT) products were presented at the SPS IPC Drives show 2015 and at Hannover Messe 2016. As a result, existing systems, and of course new machines, can be connected to the global cloud in order to extend their locally available functions to include cloud-based services, such as comprehensive analytics features to increase data insight.

Expansion of successful talent development programmes
Beckhoff currently employs approximately 3,000 people worldwide. Of these, almost 2,100 work in Germany, with around 1,900 of those at the company’s global headquarters in Verl. Trained engineers account for one-third of the workforce. Hans Beckhoff is especially pleased about how keenly interested young talents are to work for the company: “Our unwavering commitment to develop junior staff and apprentices focused on industrial and academic disciplines is resulting in considerable success.” The company offers various technology subject areas as part of industrial training, and continues to expand this concept of on-the-job study. For example, an onsite master’s course will be offered in the future at the Gütersloh branch of Bielefeld University of Applied Sciences in addition to the current bachelor’s degree course.
Hannover Messe 2016 – The platform for Industrie 4.0

As the world’s leading industrial exhibition, Hannover Messe 2016 again provided the premier platform for Industrie 4.0. The Beckhoff presence in Hanover was totally in line with this year’s lead theme ‘Integrated Industry – Discover Solutions’ and could be found in several locations focusing on IoT and Industrie 4.0, such as the Industrie 4.0 Forum on the Beckhoff booth as well as at the partner booths of it’s OWL, Microsoft and SAP. Beckhoff reported a marked increase in visitor numbers, reflecting the increasing awareness of the current topics Industrie 4.0, IoT and Integrated Industry in all of industry and society. In addition, the visit of US President Obama at Hannover Messe ensured increased publicity and underlined the high sociopolitical impact this trade show has besides its great importance for industry.

Beckhoff Trade Show TV: www.beckhoff.com/hannover-messe

Celebrating its 10th anniversary, the Tec2You talent initiative provided 533 students from schools in East Westphalia in this year again with an opportunity to get acquainted with the company and training offers of Beckhoff.
At the SAP booth, Beckhoff and other technology partners showcased the integration of manufacturing and business administration workflows. Visitors could experience a live demonstration of the SAP software directly communicating with the Beckhoff XTS on the basis of standardized services.

At the Microsoft booth, Beckhoff presented its new IoT products such as e.g. its easy and secure link between automation and field level and the Azure™ cloud.
Beckhoff solutions for Industrie 4.0 and IoT

Simple, open and standardised

As information technology and automation technology continue to converge, cloud-based communication and data services are increasingly used in industrial automation projects. Beyond the scope of conventional control tasks, applications such as big data, data mining and condition or power monitoring enable the implementation of superior, forward-looking automation solutions. New Beckhoff hardware and software products for Industrie 4.0 and IoT ensure the simplest possible implementation of such advanced solutions.
Industrie 4.0 and Internet of Things (IoT) strategies place strict requirements on the networking and communication capabilities of devices and services. In the traditional communication pyramid point of view (Figure 1), large quantities of data must be exchanged between field-level sensors and higher-level layers in these implementations. However, horizontal communication between PLC control systems also plays a critical role in modern production facilities. PC-based control technologies provide universal capabilities for horizontal communication and have become an essential part of present-day automation projects exactly for this reason. With the new TwinCAT IoT solution, the widely used TwinCAT 3 engineering and control software provides the ideal foundation technology for Industrie 4.0 concepts and IoT communication. Moreover, new IoT-compatible I/O components from Beckhoff enable easy-to-configure and seamless integration into public and private cloud applications.

**Definition of business objectives for increasing the competitive edge**

Industrie 4.0 and Internet of Things (IoT) applications do not start with just the underlying technology. In reality, the work begins much earlier than this. It is critically important when implementing IoT projects to first examine the corporate business objectives, establishing the benefits to be gained as a company from such projects. From an automation provider perspective, there are two distinct categories of customers that can be defined: machine manufacturers and their end customers – in other words, the end users of the automated machines. In the manufacturing sector in particular, there is an obvious interest in reducing in-house production costs, both through efficient and reliable production control and also by reducing the number of rejects produced. The traditional machine manufacturer pursues very similar objectives, and above all is interested in reducing the cost of the machine while maintaining or even increasing production quality. Optimising the machine’s energy consumption and production cycles, as well as enabling predictive maintenance and fault diagnostics, can also be rewarding goals. The last two points in particular offer the machine manufacturer a solid basis to establish services that can be offered to end customers as an additional revenue stream. Of course, what both customer categories ultimately want is for the machine or product to be designed more attractively and to increase competitiveness in the marketplace.

**Collecting, aggregating and analysing process data**

The process data used during production provides a foundation for creating added value and for achieving above-mentioned business objectives. This includes the machine values that are recorded by a sensor and transmitted via a fieldbus to the PLC. This data can be analysed directly on the controller for monitoring the status of a system using the TwinCAT condition monitoring libraries integrated in the TwinCAT 3 automation software, thereby reducing downtime and maintenance costs. However, where there are several distributed controllers in production areas, it may not be sufficient to analyse data from a single controller. The aggregated data from multiple or even all controllers in a production
system or a specific machine type is often needed to perform sufficient data analysis and make an accurate analytical statement about the overall system. However, the corresponding IT infrastructure is required for this purpose. Previous implementations focused on the use of a central server system within the machine or corporate network that was equipped with data memory, often in the form of a database system. This allowed analysis software to access the aggregated data directly in the database in order to perform corresponding evaluations (Figure 2).

Although such an approach to realise data aggregation and analysis in production facilities certainly worked well, it presented a number of problems at the same time, since the required IT infrastructure had to be made available first. The fact that this gives rise to high hardware and software costs for the corresponding server system can be seen right away. However, the costs with respect to personnel should also not be overlooked: Because of the increasing complexity involved in networking production systems, especially with large numbers of distributed production locations, skilled personnel are necessary to successfully perform the implementation in the first place. To complicate matters, the scalability of such a solution is very low. Ultimately the physical limits of the server system are reached at some point, be it the amount of memory available or the CPU power, or the performance and memory size required for analyses. This often resulted in more extensive, manual conversion work if systems had to be supplemented by new machines or controllers. At the end of the day, the central server system had to grow alongside in order to capably handle and process the additional data volume.

**The path to the public cloud**

Cloud-based communication and data services now avoid the aforementioned disadvantages by providing the user with an abstract view of the underlying hardware and software systems. "Abstract" in this context means that a user does not have to give any thought to the respective server system when using a service. Rather, only the use of the respective services has to be considered. All maintenance and update work on the IT infrastructure is performed on the part of the provider of a cloud system. Such cloud systems can be divided into public and private clouds.

The so-called public cloud service providers, such as Microsoft Azure™ or Amazon Web Services™ (AWS), for example, provide users with a range of services from their own data centers. This starts with virtual machines, where the actual user has control of the operating system and the applications installed on it, and stretches to abstracted communication and data services, which can be integrated by the user in an application. The latter, for example, also includes access to machine learning algorithms, which can make predictions and perform classifications regarding specific data states on the basis of certain machine and production information. The algorithms obtain the necessary contents with the aid of the communication services.
Such communication services are usually based on communication protocols, which in turn are based on the publish/subscribe principle. This offers definite advantages from the resulting decoupling of all applications that communicate with one another. On one hand, the various communication participants no longer need to know each other – in other words, any time-consuming disclosure of address information is reduced. All applications communicate via the central cloud service. On the other hand, data communication with the cloud service, via the message broker (Figure 3), involves a purely outgoing communication connection from the perspective of the terminal device – regardless of whether data is sent (publish) or received (subscribe). The advantages this offers for configuring the IT infrastructure are immediately clear: no incoming communication connections have to be configured, for example in firewalls or other network terminals. This significantly reduces IT infrastructure set-up time and maintenance costs. Transport protocols used for data communication are exceptionally lean and standardised, such as MQTT and AMQP. In addition, various security mechanisms can be also anchored here, for example, encryption of data communication and authentication with respect to the message broker. The standardised communication protocol, OPC UA has likewise recognised the added value of a publish/subscribe-based communication scenario and taken appropriate steps to integrate this communication principle in the specification. This means that an additional standard besides MQTT and AMQP is consequently available as a transport mechanism to the cloud.

The private cloud
However, such publish/subscribe mechanisms can not only be used in public cloud systems; they can also be used in the company or machine network. In the case of MQTT and AMQP, the infrastructure required for this purpose can be installed and made available easily on any PC in the form of a message broker. This means that both M2M scenarios can be implemented and any terminal devices, such as smartphones, can be connected to the controller. Moreover, access to these devices is further secured by means of firewall systems (Figure 4). The extensions of the OPC UA specification with regard to publish/subscribe will also simplify the configuration and use of 1:N communication scenarios within a machine network in the future.

Products for Industrie 4.0 and IoT
Beckhoff provides users a wide variety of components for simple and standardised integration into cloud-based communication and data services. The IoT products within the TwinCAT 3 automation software platform offer varied functionalities for exchanging process data by means of standardised publish/subscribe-based communication protocols and for accessing special data and communication services of public cloud service providers. Corresponding services can be hosted in public cloud systems, such as Microsoft Azure™ or Amazon Web Services™ (AWS), but can be used just as effectively in private cloud systems.
These IoT functions can be accessed alternatively via special function modules directly from the control program or can be configured via an application called the “TwinCAT IoT Data Agent” outside of the control program. The data to be transmitted can be selected easily via a graphical configurator and configured for transfer to a specific service. A major advantage here is that the data agent also allows integration of cloud-based services in older, existing TwinCAT systems. The process data can also continue to be exported here using the standardised communication protocol OPC UA, with the result that data can likewise be sent from non-Beckhoff systems (Figure 5). An additionally available smartphone app enables mobile display of a machine’s alarm and status messages.

If I/O signals are to be forwarded directly without a control program, then Beckhoff’s newly-announced EK9160 IoT Bus Coupler allows I/O data to be parameterised via an easy-to-configure website on the device for sending to a cloud service. The bus coupler then independently carries out the sending of the digital or analogue I/O values to the cloud service. An IoT coupling station consists of an EK9160 and a virtually limitless number of powerful and ultra-fast EtherCAT Terminals. The data is sent in a user-friendly, standardised JSON format to the cloud service and can also be transmitted in encrypted form if required. Extended mechanisms, such as local buffering of I/O data in the case of an interrupted Internet connection, are provided here in the same way as a monitoring function for connected fieldbuses. The I/O signals can therefore not only be collected by means of EtherCAT, but also via other fieldbuses, such as CANopen or PROFINET.

**Analytics and machine learning**

Once the data has been sent to a public or private cloud service, the next question is how the data can now continue to be processed. As previously mentioned, many public cloud providers offer various analytics and machine learning services that can be used for further examination of process data. Moreover, Beckhoff also has its own analytics platform for users to take advantage of, namely TwinCAT Analytics. This platform provides relevant mechanisms for data analysis, with all process-related machine data being recorded in a precise and cyclic manner. All machine processes can therefore be fully recorded as a result. Depending on requirements, this data can either be stored for evaluation locally on the machine processor, or within a public or private cloud solution. TwinCAT Analytics uses TwinCAT IoT to connect to cloud solutions, ensuring seamless data communication. Generally-speaking, this provides the power to create new business ideas and models for the machine manufacturer and respective end customers to capitalise on.

**Conclusion**

Industrie 4.0 and IoT are on everyone’s minds. Likewise, these concepts are important when the realisation of innovative new business models is a require-
ment for the underlying infrastructure. This also drives the increased convergence of IT and automation technologies. Cloud-based data services can help implement such automation projects, as they save the machine manufacturer or end customer from having to provide the corresponding IT expertise. With TwinCAT IoT and the EK9160 cloud bus coupler, Beckhoff provides customers with two new product series for integrating such cloud-based data services quickly and easily into the control project. Additionally, TwinCAT Analytics enables the support of such projects using a powerful analytics platform, which facilitates comprehensive analysis of the recorded process data.

Figure 6: TwinCAT IoT and Cloud Bus Coupler

Author: Sven Goldstein, TwinCAT Product Manager, Beckhoff

Further information:
www.beckhoff.com/twincat-iot
EK9160 for cloud-based control

“Plug-and-Cloud” with the IoT Bus Coupler
The EK9160 IoT Bus Coupler transmits all control data simply, safely and cost-effectively to all common cloud systems in plug-and-play mode. Neither a controller nor programming is required through the implementation as a Bus Coupler-based solution. Simple configuration is all that is necessary for the I/O terminals, cloud services and security functions used.

The EK9160 establishes a direct connection without any special control program between Beckhoff EtherCAT I/O and the Internet of Things (IoT). As a result, the coupler enables simple and standardised integration of I/O data with cloud-based communication and data services.

Via an integrated web server, the I/O data can be parameterised, such as in data processing and timing, through a simple configuration dialog. No special engineering tools are needed. The EK9160 IoT Bus Coupler then autonomously transmits the data, including time stamp, to the cloud service. Apart from that, extended mechanisms are available, including local buffering of I/O data on a microSD card (2 GB) to protect against data loss when the Internet connection is interrupted. The cloud services and security functions (encryption, firewall) can be configured via the web server in the same convenient way.

All major cloud systems are supported via the IoT protocols AMQP, MQTT and OPC UA (over AMQP): Microsoft Azure™, Amazon Web Services™ (AWS), SAP HANA, as well as and private cloud systems in company networks. The EK9160 is “Microsoft Azure™ Certified” and enables communication with clouds based on advanced multi-cloud capabilities.

Advantages offered by publisher/subscriber communication
For data communication, the IoT Bus Coupler uses the publisher/subscriber communication principle. As a publisher, the EK9160 sends data to the cloud, enabling other applications to access the information as a subscriber. This application can then publish data itself if required, which in turn can be accessed by the IoT Bus Coupler. The devices do not need to “know” each other or individual IP addresses, rather only the central message broker, so the individual applications operate in “decoupled” mode. Moreover, communication for both the publisher and subscriber is always active and directed externally. Both of these factors mean that the firewall configuration and setup in the IT infrastructure of a company are simplified considerably.

These advantages can be utilised in all areas of industrial Engineering and building technology. Standalone solutions, for example for small manufacturing systems, as well as complex machines and building services systems, for example, are possible. The selected cloud system is not a critical factor here, given the option to choose a public cloud or a local solution in a company network. Depending on requirements, services offered by the cloud provider and individual tools or services from third-party providers can be used as needed.

In conjunction with the industry-leading portfolio of EtherCAT I/O Terminals offered by Beckhoff, the EK9160 can be used to transmit the widest range of machine and building data types to the cloud, such as temperature, pressure, vibration or energy consumption. Added to this is the possibility to monitor connected fieldbuses. The I/O signals can not only be collected via EtherCAT, but also via the monitor operating mode of CANopen or PROFIBUS Terminals, for analysis by external specialists, for example.

Cloud-based control via the IoT fieldbus
In addition, the concept of cloud-based control can be implemented using the IoT fieldbus. In this context, TwinCAT software resides as an IoT controller in the cloud and acts as an MQTT message broker. The required data is supplied by IoT devices such as the EK9160 that can be installed in globally distributed locations, if required. In this application scenario, the IoT fieldbus, which has been implemented by Beckhoff based on the MQTT protocol, supports the necessary publisher/subscriber communication. As a result, all requirements can be fulfilled to simply and reliably relocate the control and data analysis processes to TwinCAT in the cloud.

Further information:
www.beckhoff.com/EK9160
“What do small and medium-sized enterprises stand to gain from the digitization of their production processes?”

VDI-Nachrichten: What do you think of the current hype surrounding industrial connectivity and Industrie 4.0?
Beckhoff: When we look back in the future from the year 2050 to the years between 2010 and 2020, we’ll say “That was the time when we started to connect people and machines with one another over the Internet. This put more information than ever online, as functions were moved onto the Internet and enhanced in so many incredibly different ways that it became possible to use machines more productively and achieve better product quality.” In 2050, it will probably be impossible to imagine a machine being able to work properly without being connected to the Internet.

The ‘hype’ started four years ago, and in the meantime, practical ideas have been transformed into real products. This applies to our company, too. We think it’s justified to call this an industrial revolution, even though it is more of an evolutionary process in day-to-day business.

You have driven change with your company before. How was it when you launched your PC-based control systems and stood up against the monopolies of established automation technology suppliers with their programmable logic control – PLC – systems?
In 1986, 30 years ago now, we delivered our first PC-based control system. At that time, we had about 30 employees and worked together primarily with SMEs – small and medium-sized enterprises. In fact, it was these customers who first enabled us to develop our PC- and software-based technology. For me, the fact that we initially developed our technologically advanced solutions more with SMEs and not really with big corporations is an important part of my corporate life experience.

Why is that?
You have considerably more freedom when you work with that kind of customer. What’s most important in those cases is the necessary functionality and not so much the name of the supplier. At that time, we worked with mechanical engineering companies in the wood and window processing industry in particular. With our PC Control technology, we made it possible for these SMEs to simply take a diskette up to a machine, which then produced huge quantities of one-off parts. That in itself was revolutionary at the time.

In 1990, we presented the overall concept of PC-based control for the first time at Hannover Messe, the world’s largest industrial trade fair. The solution consisted of an Industrial PC, a high-speed input and output system based on a fiber-optic fieldbus (Beckhoff Lightbus), powerful drive technology and our PC-based PLC and motion control software. Basically, it was the same approach as today, just a lot simpler back then.

What was the response at that time?
At first, we were laughed at. People thought we couldn’t be taken seriously and what we were offering was not suitable for industrial applications. We kept on working anyway because we could see the possible increases in terms of speed, the number of controllable axes and the scope of the programs that traditional control technology could not match. In addition, we were able to offer complete “IT features” on the machine that conventional control technology couldn’t offer at all, or if it could, only at a very high cost.

Through the consolidation of IT technology – i.e. the PC – and control technology, the solutions became much more powerful. The convergence of both these
technology fields provided our users enormous benefits, and this was clearly acknowledged by the leading technology experts. As a result, there were enough customers for us in every branch of industry who were willing to take on the perceived risk of this new concept in order to gain those benefits. That’s how PC-based control became a standard.

However, the real breakthrough didn’t come for you right away, either.

That’s right. In 1990, a journalist asked me how long it would take until traditional PLCs would finally be replaced by PC Control. I hadn’t been in the business very long at that point, and I said five years, which seemed like an incredibly long time to me in that moment. Five years later, the same journalist came back with the same question. Then I had to admit that, while our company had already tripled its sales, the market share for PC-based control still wasn’t very big.

How do you explain that?

The problem was that equipment manufacturers with a high market share in traditional industrial control systems had no interest in revolutionizing their own technological base. In addition, they might not have been able to do it anyway, as they would have to prepare their customers for evolutionary change. It’s usually the smaller suppliers who are responsible for the revolutions.

It is often said recently that SMEs are too slow to embrace Industrie 4.0. Do you see that differently?

Yes. For control technology, as well as for mechanical engineering, I see the German SMEs as innovators and international leaders, as far as we can see being an SME ourselves. Innovation is a core part of the business for technology-oriented companies; if that weren’t the case, we wouldn’t have so many hidden champions in Germany, many of whom are our customers, by the way.

PC-based control technology has now made its way into big companies and corporations. What has this changed for you?

That’s true. Today, PC Control is a widely accepted technology. We no longer come up against out-and-out rejection because by now the benefits found with the combination of IT and automation in one device are recognized by virtually every engineer in the world. If you go to the most popular trade fairs today, you’ll find solutions based on this concept at about every other booth, where we used to be pretty much alone. We can safely say that the technology has now gained a firm foothold and has become a standard for control solutions.

The basic concept of PC-based control technology is very simple and clearly structured. First of all, PC Control is based on what is arguably the most powerful, yet least expensive hardware in the world. We develop these technologies in-house from the bottom up to meet industrial demands. The motherboards in our control systems, for example, are “designed and made in Westphalia”! Sensors and actuating elements can be easily connected via EtherCAT and controlled quickly, reliably and deterministically. EtherCAT is perfect for PC-based control technology and, above and beyond that, has developed into a truly global standard in automation technology. And by the way, EtherCAT is also an original Beckhoff invention, which we first brought to market in 2003. Our TwinCAT control software then transforms an Industrial PC into a high-powered, real-time machine control system, while still retaining all the familiar PC and Windows features. The software is so flexible that you can put together all types of machine functions in one robust package. Everything is just a click away in
software, whether the focus is on additional drive axes, CNC control channels or even measurement functions. The latter are now much more frequently an integrated part of high-performance machines. As far as I am concerned, this functionality belongs together because it is possible to achieve far better results from the correlation of machine control and measurement data than strictly from external measurement.

With TwinCAT, we are also able to include simulation, and in the future we will also add image processing. That is only possible because we use x86 computers, which can be made virtually as powerful as you need through the use of multicore technology. The Windows software structure also helps us provide many IT services that a machine otherwise doesn’t have.

And of course we shouldn’t forget that drive technology is part of the overall concept. We have also optimally integrated our own motors, which we produce in Marktheidenfeld, and the corresponding drives into the control software. That applies in particular to our XTS linear systems, which are based on travelling magnetic fields calculated in the PC and which are currently making new mechanical engineering concepts possible, for example in the field of packaging and assembly.

**What do you consider as the biggest step: the one from traditional control systems to PC-based control or the one from PC-based control to connected control systems on the Internet?**

I’m not sure. Adding a global Internet presence to machines has a great deal of potential. That is sure to make a significant fundamental change in many different areas, but will that result in bigger changes than the developments that came before? That could very well be.

**Industrie 4.0 is about making data available in real-time. How do you define ‘real-time’?**

We specialize in automating high-speed processing machines. When controlling very large or slow machines, we talk about response times of approximately 10 ms – a good control system works with a response time of about 1 ms, and exceptionally fast control systems have response times down to as little as 100 μs.

**That’s hardly noticeable for people. Who really needs this speed?**

In fact, there are fields of application that make sense for all types of control systems. For electromechanical actuators, as an example, you can profit from the 100 μs cycle times because it allows you to control a hydraulic cylinder more cleanly and easily without overshoot. The same applies to electrical drives, which usually work with 62 μs. These machines also run more smoothly when the cycle times are shorter.

However, the advantages of high-speed control systems are also obvious for even simple machines that only have a forced sequence as their function; at our company we like to call them “piff-paff-puff” machines. The machine has to wait for the control system in every control-related transition because the control system works cyclically, while the machine runs asynchronously. At a response time of 10 ms, the machine loses half the time at each switching point on average, i.e. 5 ms. If there are several transitions each second, that equates to four in a “piff-paff-puff-piff” machine, meaning you lose more than 20 ms per second. When using a control system with a response time of 200 μs, on the other hand, the machine will be almost 2 to 3 % faster than before and will produce more parts. That adaptation is worth it for almost every type of machine.

**What machines need this?**

One of our North American customers manufactures injection molding machines for ‘pre-forms’ used to produce PET bottles in the beverage industry. The machine previously had a production cycle of approximately 5.8 s and the machine manufacturer was able to improve the cycle by up to 10 %. That’s all money in the bank because it improves both the profitability of the machines and the ecological scorecard. With greater control quality, it is also possible to produce high-quality bottles with thinner walls, saving material as a result.

**And what about the required computer hardware? Who produces your chips?**

We buy most of our chips on the global market. We use products made by the leading manufacturers, many of whom are headquartered in the USA, with Intel at the top of the list. But we also use German ICs made by Infineon and European ICs made by ST.

Some chips we develop ourselves, e.g. the ASIC chips for the EtherCAT communications standard, which was developed here at Beckhoff and then licensed for use by third parties around the world. Today, EtherCAT is established as international IEC and SEMI standards, which are used throughout the US and in China.

For us, it’s important to have end-to-end expertise inside the company: from IC to circuit and board design, to the firmware and operating systems required, the control and communications software, and right on up to the application knowledge. This makes us able to create very individualized, extremely powerful solutions. I find it essential for technology companies to have this level of extensive, in-depth knowledge in-house.

**Companies are now thinking about working together with large IT corporations. You’ve already been doing this for a long time with Microsoft. What do you recommend?**

We have been working together with Microsoft for 30 years by now. We’ve seen a lot at Microsoft and numerous personal contacts have grown out of this. As a German SME with currently €620 million in global sales, we are working with a corporation that makes more than 100 times that in sales. Sometimes that has more of an impact on the type of communication we have than any differences between Germany and America.
Then you think it’s important to build contacts like this in common projects?
That’s right. It’s exactly what we are experiencing again with IoT – the Internet of Things – where we have presented solutions based on Azure, the Microsoft cloud, at the Hannover Messe industrial fair. This cloud system offers many new functions that we believe could be useful in machines. Programmers all over the world can use it, for example, to evaluate data more easily than before. We currently have devices available that can very easily connect to the cloud, enabling easy processing of data from our machines in Microsoft Azure. That is a project where we meaningfully collaborate with Microsoft and one we will also present together. That’s when IoT turns from mere hype to reality.

Some SMEs get concerned when they think about the growth of “data monsters” such as Google and Facebook. What are your thoughts on that?
Data has to be protected by our laws, by contracts and by the necessary security technology. That applies in America just as it does in Europe, and I am sure that outstanding solutions will soon be found here, driven by user and customer demands, as well as by legislation. I advise everyone to assume that as a basic premise when they analyze and think about Industrie 4.0 or IoT or Big Data. The European defensive reflex of “data is not secure so this won’t come to much of anything” is a major innovation and imagination killer. One should just think positive first of all, and then it will be possible to discover what great new opportunities are out there.

When comparing the US to Europe, our point of view is that Microsoft, Google, Facebook and similar companies have built up a big head start in terms of knowledge in software-based business concepts. This is sometimes criticized from a European point of view, but they have built up this edge just as Mercedes and BMW have built up an edge in the production of automobiles. That also applies to the German company SAP and its edge in the field of ERP software: this edge is an outstanding starting point for Industrie 4.0 applications because they all have to work together with the ERP system or even be integrated deeply into it. That’s why we’re happy we were also able to set up a large technology demonstration together with SAP at Hannover Messe 2016.

I can only advise SMEs in particular to understand the head start in knowledge these IT and social networking companies have and to take advantage of it. Needless to say, Internet companies are dedicated to making money with it and we can do that right along with them if we add our own special know-how on the basis of these technologies.

How do you rate the efforts of the Industrial Internet Consortium (IIC) and the German Industrie 4.0 platform to create common standards?
There will always be new groups that get together to set new standards that we are all supposed to follow whenever a new wave of technology comes along. We keep an eye on these developments and support them to a certain point. However, I am convinced that the market is always a bit quicker than the development of a somewhat theoretical standard, and that other projects can produce some very different approaches that prove to be just as practical and useful. That’s why, as far as I am concerned, a general platform is a correct and honorable starting point, but there is no guarantee that it will ultimately become the accepted standard in the end.

“With TwinCAT, we are also able to include simulation, and in the future we will also add image processing. That is only possible because we use x86 computers, which can be made virtually as powerful as you need through the use of multi-core technology.”

What makes you so sure?
Experience has shown that different solutions can often result from a particular party’s economic interests or application-specific features. After all, a process industry enterprise that wants to monitor an oil-drilling platform has completely different requirements than a company that sells machine tools or solutions for buildings. There can be no doubt that many different standards will be created. For manufacturers of automation components, the trick will be the ability to master several of these different standards.

That reminds me strongly of the search for the one communications standard for the fieldbuses in the automation industry.
That’s right. Several different standards also emerged for the use of Ethernet in industrial communications. In my opinion, there is not just one, but three accepted standards overall: Profinet, Ethernet/IP and EtherCAT. Many other standards also exist alongside those three today and they all have good reason to in their own specific fields. I would be surprised if things happened differently for the new IoT solutions.

Martin Ciupek, Head of Automation at VDI Nachrichten
New CX81xx Embedded PC series

More computing power for small controllers

With the introduction of the new CX81xx Embedded PC series, small controllers now offer significantly increased computing power. The CX8190 for Ethernet is the first device in the series and is also the first PC-based controller in an ultra-compact “Bus Coupler format” for TwinCAT 3 automation software. The 32-bit, 600 MHz ARM Cortex™-A9 processor offers three times the CPU performance compared to the existing CX8000 series, as well as an eight-fold memory increase with 512 MB of RAM.

The CX8190 Embedded PC comes equipped with an Ethernet port and a 2-port switch for real-time Ethernet or EAP (EtherCAT Automation Protocol). Windows Embedded Compact 7 is the operating system used, and the small controller is programmed with TwinCAT 3 via the fieldbus interface or the additional Ethernet interface. TwinCAT 3 I/O software provides the basic runtime functionality, but further TwinCAT 3 supplements can be added as options.

The CX8190 also offers a 1-second UPS for storing persistent data, a 512 MB microSD card which can be extended up to 8 GB, and an impressive operating temperature range from -25 to +60 °C. EtherCAT Terminal (E-bus) and Bus Terminal (K-bus) I/O systems can be directly connected to the CX8190 Embedded PC, providing instant access to an industry-leading I/O product spectrum with more than 1000 available terminals.

The CX81xx Embedded PC series is being introduced with the device for Ethernet first and will be expanded to cover additional fieldbuses in the near future.

Further information:
www.beckhoff.com/CX8190
EJ-series EtherCAT plug-in modules provide an efficient wiring solution for machines built in large and medium-sized production runs. With new motion modules, space-saving compact drive technology from Beckhoff is seamlessly integrated into a plug-in module concept, enabling extremely compact I/O and motion solutions that perfectly match customer requirements.

EJ-series plug-in modules make it easy to implement a platform concept for large-volume production runs without sacrificing customisation capabilities. The modules, with electronics based on the popular EtherCAT I/O system, are directly inserted into an application-specific signal distribution board that transmits signals and power to the individual connectors. Connections via pre-configured cable harnesses replace the expensive installation of individual wires, reducing per-unit costs and minimising the risk of faulty wiring because the EJ components are clearly coded.

Compact drive technology in a new format
Compact drive technology from Beckhoff, already available in a Bus Terminal form factor for years, is now also available as a plug-in module concept. In combination with a broad portfolio of Beckhoff motors and planetary gear units, three new EJ7xxx EtherCAT plug-in modules now enable especially compact and cost-effective drive solutions.

The EJ7047 stepper motor module was designed for applications in the medium performance range. The device features two inputs for limit switches; the second input can alternatively be configured by the user as an output. This makes it possible to install a holding brake, for example. In conjunction with stepper motors from the AS10xx series, the user can optionally implement vector control, delivering enhanced motion dynamics and reduced power consumption.

The EJ7211-0010 servomotor module features high performance in an exceptionally compact design. This is, in large part, enabled by the integrated One Cable Technology (OCT), which combines motor cable and an absolute feedback system into a single cable. The EtherCAT plug-in module seamlessly integrates with motors from the AM8100 series, offering output current up to 4.5 A rms. Since the system reads the identification plate of the AM81xx motors electronically, wiring and commissioning efforts are minimised. The fast control technology, based on a field-oriented current and PI speed control system, is suitable for demanding, highly dynamic positioning tasks.

The EJ7342 2-channel DC motor output stage is designed for direct operation of two DC motors, and offers galvanic isolation from the E-bus. Speed and position are set by the automation device via a 16-bit value, so a simple servo axis can be implemented by connecting an incremental encoder.

For highly dynamic applications and when feeding multiple axes via a single power supply, integration of the EJ9576 brake chopper module is recommended. This protects the system against damage from overvoltage by absorbing part of the energy. If the voltage exceeds the terminal’s capacity, it discharges excess energy via a separate external resistor.

Further information:
www.beckhoff.com/EtherCAT-plug-in-modules
XTS recognized as innovation factor in mechanical engineering

eXtended Transport System: Practice-proven many times including in multi-XTS applications
Since its launch at the industrial trade show Hannover Messe in 2012, the eXtended Transport System (XTS) from Beckhoff has already found its way into numerous new machines. In the most diverse forms – from simple to highly complex – it has supported the development of innovative automation concepts. The usage possibilities, especially in large-scale applications, are illustrated by a multi-XTS application which was shown at SAP’s trade show booth at Hannover Messe 2016, among other venues, as a demonstrator of a smart factory production line.

The 4 × 6 m multi-XTS demo application, which is used in this example for transporting and sorting different beverage cans, consists of five XTS systems with a total track length of 26 m and 100 movers. 72 movers run on the inside of the 17-metre long outer XTS alone. In addition there are also two 4-metre long elevated systems, each with up to twelve movers running on the outside, as well as two lifting stations, each consisting of two vertical 25 cm XTS modules. Each of the lifting modules has one of the new 70 mm movers for increased payload.

Complex motion control enabled by simple software configuration
In this complex system the high flexibility of the software-based motion control functionality is obvious: each mover, as a self-contained servo axis, can be controlled individually or even synchronized to other movers or process sequences as required. As a property of each mover, the dynamics can be changed individually at any time and on the fly according to requirements. In the example application this means that a mover can transport a smaller white beverage can faster than the larger red cans and will move even more dynamically than that with no can at all.

Several processing and accumulation stations have been implemented. For example, the cans are transferred to the two elevated XTS systems by a lifting device, comprised of two movers connected by a mechanism consisting of a gear wheel and toothed rack. For the lifting movement, the arriving mover in the lower system and the first of the two coupled movers in the upper system must be synchronized with each other. Subsequently the second upper mover moves relative to the first in order to pick up the can from the lower mover via the gear wheel mechanism. This device allows the cans to be buffered according to the desired sorting procedure and subsequently transferred back to a mover in the lower system.
The multi-XTS application was shown for the first time at the SPS IPC Drives 2015 trade show in Nuremberg. It showed the transporting and sorting of beverage cans in different sizes and colours.

In a live demonstration of the manufacture of individual key fobs at the Hannover Messe 2016, SAP demonstrated the direct communication of the ERP software with XTS and further operating equipment on the basis of standardized services.
The synchronization of two cam plates ensures that no additional lifting movement of the two coupled movers is generated when driving through curves so that the can is transported without jerks. The relative distance between the movers will always remain constant, even when driving into and out of the curve. Through control software parameterization it is possible to switch between the two corresponding cam plates “can up” and “can down”, allowing the complex lifting function to be implemented in a very simple and extremely flexible way.

Preconfigured function blocks simplify the implementation

TwinCAT software provides ideal support for the simple implementation of any desired movement. The individual movers can be mapped as conventional servo axes with all common motion control functions such as flying saw, electronic gearbox and cam plate. Specific XTS requirements, such as automatic accumulation, collision avoidance, jerk avoidance and centrifugal force limitation, can be realized with functional extensions in TwinCAT.

In addition, complex kinematics involving two or more movers are already integrated within the XTS motion control toolbox, using which users can define, for example, a group of several movers as a 2-D axis (XY table) or a 3-D axis. The software will then control the entire mover group based on the selected kinematics. In addition, an interface is available via which kinematics can be directly implemented with CNC commands (G code). Furthermore, integrated condition monitoring enables online monitoring of the movers during operation. In this way maintenance work can be planned proactively, and machine downtime can be reduced to a minimum.

The preconfigured function blocks facilitate a station-oriented implementation of the transport and handling tasks. For instance, the cans must be accumulated before entering more time-consuming processing stations such as the lifting stations. This can be achieved through simple configuration, by defining corresponding accumulation zones at the desired system locations in the software. At a higher control level, the individual movers are then merely sent from one station to another, irrespective of whether they are configured as transport, waiting or processing stations. Thus a waiting station uses the collision avoidance provided by TwinCAT so that all movers automatically accumulate behind the mover in first place. If the first mover drives onwards, the second-placed mover simply takes its place. Synchronous movements, for example, can also be realized with similar ease. In this case the station to which the mover should travel synchronously with the next passing mover is configured in the corresponding function block.

Multi and many-core technologies tap performance potentials

The multi-XTS application is controlled by a C6930 control cabinet PC equipped with an Intel® Core™ i7 quad-core processor. One of the processor cores is responsible for the Windows operating system, while the other three cores are reserved for control functions via the TwinCAT Core Isolation function. One of these cores is responsible for NC axis control, while the other two calculate the respective XTS travel paths. Due to the parallelization, the available computing power is significantly increased compared with sequential processing by a single-core CPU, so that such a multi-XTS application can be realized with extreme efficiency.

Further improvement can be achieved by the use of the C6670 industrial server, which has up to 36 processor cores. This many-core technology provides significantly higher computing power for the integration of additional functions into the multi-XTS application. A prime example of this is computationally intensive condition monitoring functionality, which allows, for example, the very early detection of wear in a mover roller or soiling of the guide rails. For this purpose the computer platform must acquire a huge amount of data and continuously analyze it to detect certain threshold values or vibration frequencies. The immense computing power of the C6670 is required in order to be able to realize this not just at certain places in the multi-XTS application, but also for the complete track length and for all movers continuously.

The multi-XTS application as an Industrie 4.0 demonstrator

At Hannover Messe 2016 the close integration of manufacturing processes with business processes was presented by SAP, Beckhoff and other technology partners on the multi-XTS demo application. Here, the XTS transported the products to be processed to the individual processing stations and positioned them there – individually and highly dynamically and the SAP software communicated directly with XTS via standardized services. Acting as a “job languages” interface, the TwinCAT software established a link between the machine and SAP. The job communication was based on the concept of the service-oriented architecture (SOA), which was implemented with OPC UA.

The demonstration showed the manufacture of a key fob with integrated smart chip and personalized faceplate. One of the biggest advantages of product handling by XTS became apparent here because, following the entry of a job, the initial part was transferred to a mover, which then guided it through the processing machine – individually traceable at all times – where it was assembled to form a complete key fob. The paradigm change envisaged by Industrie 4.0 could thus be implemented: the manufacturing process is no longer centered on the machine, but seen from the point of view of the product to be manufactured and can also be programmed accordingly. Ultimately, an individual product can be produced in a lot size of 1 using industrial mass-production methods and managed by a higher-level ERP system.

Uwe Prüßmeier, Product Manager
Fieldbus Systems, Drive Technology, XTS, Beckhoff

Further information:
www.beckhoff.com/XTS
Interview with Dr. Ursula Frank about the ScAut and efa innovation projects within the it’s OWL Leading-Edge Cluster

Research findings optimize machine processes and increase energy efficiency

From the beginning in 2012, Beckhoff has been a core participant in the ‘it’s OWL’ Leading-Edge Cluster. (‘it’s OWL’ stands for Intelligente Technische Systeme OstWestfalenLippe or intelligent technical systems, East Westphalia Lippe.) As a consortium leader, Beckhoff manages two innovation projects – Scientific Automation (ScAut) and eXtreme Fast Automation (efa). In this interview, Dr. Ursula Frank, Project Manager, R&D Cooperations at Beckhoff, describes the research results achieved so far and their practical implementation.
What makes the it’s OWL research cluster so special, and what benefits have been realized through the cooperation among universities, automation specialists, machine builders and end users?

Dr. Ursula Frank: Collaboration within a network that extends across the entire value chain of individualized high-volume production benefits all participants. This applies to the automation provider who needs powerful control technology, to the equipment manufacturer who wants to build highly efficient machines and to the plant operator who has to satisfy high requirements for manufacturing flexibility. In addition, local universities are involved in a wide range of fields, either as direct project partners or via the cluster’s technology platform, which provides expert knowledge for improving sustainability, ease of maintenance, machine networking and engineering. it’s OWL also delivers benefits with regard to public relations and international relationships, which is why the East Westphalia-Lippe region has become well known outside Germany for its exceptional expertise in the automation field.

How do the ScAut and efa projects complement each other?

Dr. Ursula Frank: The Scientific Automation project (ScAut) aims to make machines more intelligent through automation technology in hardware and software. The eXtreme Fast Automation project (efa), on the other hand, focuses on high-performance control technology – enabling the actual implementation of these intelligent systems on the machines.

What are the most important focus areas of the ScAut project?

Dr. Ursula Frank: For us, ScAut represents the integration of engineering- and non-engineering-related findings into automation technology. Initially, the project looked at engineering-related issues, i.e. solutions for energy management, condition monitoring and analytics. To implement this, we are developing hardware components such as Bus Terminals with high-precision data acquisition, processing and measurement capabilities. The data is analyzed with algorithms developed as part of the project, tailored to areas such as general mathematics, analytics, statistics, closed-loop control technology and cognition. The results are intelligent technical systems that can recognize increased resource consumption or the need for maintenance, report these findings, and automatically switch to the operating mode that works best for the current conditions. We are also working to define what it actually means to achieve Scientific Automation in systems and production equipment. How are they designed from different points of view, such as mechanical, electrical or software engineering? What functions must be added to the process controls? What control components are required and may still need to be developed? Another topic involves the development of the system architecture, which must be able to support the interaction between systems, as well as the interface requirements according to the approach developed in connection with Industrie 4.0 concepts.

What about practical implementations in addition to the technological developments?

Dr. Ursula Frank: Both projects involve more than technologies. The ScAut project also aims to provide methodologies and design tools that enable developers to easily integrate Scientific Automation into their machines. Offering a consistent and modular engineering concept that includes simulation is becoming increasingly important. Some of these ideas have already become part of the TwinCAT automation suite from Beckhoff. Examples include the consistent object orientation of TwinCAT 3, the powerful TwinCAT Scope software oscilloscope, condition monitoring and energy management libraries, additional engineering capabilities through the integration of MATLAB®/Simulink® and UML, as well as an interface to integrate engineering tools from the electrical design field.

What was the scope of collaboration with machine builders in the ScAut project?

Dr. Ursula Frank: The practical feasibility of all project approaches was analyzed with the help of the partner companies Hüttenhölscher Maschinenbau,
IMA Klessmann and Schirmer Maschinen. The project results are already being used in various test beds, for example, with regard to the monitoring and analysis of vibrations, temperatures, energy consumption, pressures and weights. This information, in turn, is being used to monitor roller bearings, spindle bearings, drill guides, as well as processing tools such as drill bits and milling cutters for detecting wear.

**How has this actually been implemented in the test applications, for example, at Schirmer?**

**Dr. Ursula Frank:** Schirmer makes machines for processing window and door profiles. The project involved the installation of a wide range of small test beds, as well as a large test system for profile processing, in order to investigate the most diverse application scenarios. The large system implements a production workflow, ranging from inserting a cut-to-length profile, to drilling and milling a contour and into inspecting the finished profile. In addition to maximizing energy efficiency, the system includes a condition monitoring system that detects drill bit wear by measuring the drill's power consumption as well as its oscillation via the EL3632 EtherCAT Condition Monitoring terminal and algorithms from the corresponding TwinCAT library. Since the test bed has been programmed with TwinCAT 3, it is fully object-oriented and modular. Long-term measurements in existing production environments have shown that sawing is the most energy-intensive step in making window profiles. Based on these measurements, various strategies for operating the sawing modules were designed and analyzed. As a result, the saws are now being operated in various modes, integrating a new “idle mode”. In this mode, any modules that are not currently needed are switched to a special standby mode from which they can be reactivated more quickly than with a full shutdown. This reduces the power consumption of the sawing modules alone by an impressive 17 percent.

**What project results are being used by special machine manufacturer Hüttenthalölscher?**

**Dr. Ursula Frank:** One of the unique challenges at Hüttenthalölscher is the fact that their machines use drilling heads with up to 50 individual drill bits. Currently, users replace the entire drill bit set when only one becomes dull or is due for maintenance. Since the various bits are used at different frequencies and subsequently wear out at different times, it is much more efficient to test each bit individually and replace them one at a time when necessary. To accomplish this, a test process has been developed that measures the pressure exerted on the drill bits. The same process is used for the screwdriver module in the Hüttenthalölscher test system, which was recently installed at kitchen manufacturer Nobilia. It focuses on measuring the energy consumption of individual machine modules as well as of the system as a whole. The results are used to optimize the power consumption as a prerequisite for Nobilia’s energy management certification. In the remaining months, the ScAut participants intend to look into new condition monitoring approaches and uses of the new TwinCAT Analytics software from Beckhoff for Industrie 4.0 applications, which features the seamless recording and analysis of process and production data.

**What are the special features of the test system for IMA, a specialist in woodworking systems?**

**Dr. Ursula Frank:** IMA runs a wide range of demonstrations, including some directly on the machines. On the first machines, they implemented a ramp-up profile that optimizes itself in relation to speed and time factors, in addition to the integration of extensive measurement functions. The main objective of IMA is to improve its engineering processes, for which they currently record the actual process as well as the interfaces between the various engineering tools from order placement to commissioning.

**The ScAut project was originally scheduled to run through June 30, 2016, but there has been talk about extending it. What is the current status?**

**Dr. Ursula Frank:** We have already talked with the project management agency Karlsruhe (PTKA) and filed the corresponding requests. Since the organization recently approved an extension, we have another six months to make further improvements, implement some remaining ideas and conduct further analyses and validations in the existing pilot projects.

**The efa project runs through June 30, 2017. What are focus areas here, and what initial results have already been achieved?**

**Dr. Ursula Frank:** “efa” stands for eXtreme Fast Automation, which facilitates the deployment of ultra-fast control technology in connection with many-core computing technology. The project aims to exploit the potential of high-precision eXtreme Fast Control (XFC) technology from Beckhoff more effectively and also to develop new XFC hardware components. A second major aspect is the use of many-core processor technology as a high-performance platform for real-time-capable applications. This involves, for example, research into how many software applications can run on a single processor core. These “many-core” computers, such as the Beckhoff C6670 industrial server with up to 36 cores, require special configuration and diagnostic tools. This is an area where highly complex developments in areas like memory management and access are still needed. These will not be visible to the user; however, they will increase the savings potential of many-core technology immensely. We are also working with users on the development of innovative Industrie 4.0 control concepts, as well...
“The efa project includes, among other things, research regarding various control concepts for optimized usage of many-core technology.”

Dr. Ursula Frank, Project Manager R&D Cooperations, Beckhoff

as methods and software tools for designing, analyzing and optimizing existing machine manufacturers’ control applications. In this area, the focus is mainly on optimizing the hardware resources.

To what extent have initial results already been implemented?

Dr. Ursula Frank: For efa, test systems have been developed and are being used that also benefit the ScAut project. Plans call for condition monitoring, cross-functional analyses, and the coordination of processes that run side-by-side, all of which require significant computing power. At this time, this is still being done with multi-core computers, but the transition to many-core computers has already begun for some applications, because multi-core computers quickly reach their limits as more and more reporting, analytical and diagnostic functions are added. To optimize the use of many-core computers, a wide range of control concepts is being discussed within the efa project. For example, should each machine module, or rather individual function such as drilling or transportation, be controlled via a single processor core? Many different approaches are still being analyzed at this time.

The it’s OWL Leading-Edge Cluster is considered a trailblazer for Industrie 4.0 applications. What findings have the two projects produced so far in this regard?

Dr. Ursula Frank: The definition of Industrie 4.0 comprises, among other things, the networking and communication abilities of individual production systems. The goal is for these systems to learn from each other, coordinate their energy requirements, process orders collaboratively and conduct analyses in a cross-functional manner. Particularly where analytics are concerned, the ScAut project comes into play with corresponding analytical procedures and data collection hardware. To enable use of all data directly on the machine, as in a cloud-based, higher-level system, TwinCAT Analytics and TwinCAT IoT tools provide ideal solutions. In addition, many-core technology provides sufficient processing power so users can conduct preliminary analyses in-house, as well as send the data to the cloud, such as in a smart factory. All of these are important prerequisites for putting intelligence to work in technical systems.

Further information: www.beckhoff.com/itsowl

The it’s OWL Leading-Edge Cluster is the first major project within the overall Industrie 4.0 future project. The research activities for networked and intelligent systems are divided into five university-driven segments: self-optimization, human-machine interaction, intelligent networking, energy efficiency and systems engineering. These provide a technology platform for the 34 innovation projects of the core cluster companies. In addition, there are eight so-called sustainability measures, such as technology transfer-related activities. A 40 million euro subsidy will fund the whole project for a period of five years, which started in 2012.

The research and development projects of the Intelligent Systems OstWestfalenLippe (it’s OWL) Leading-Edge Cluster are funded by the Federal Ministry of Education and Research, and administered by Project Manager Karlsruhe (PTKA). The author is solely responsible for the contents of this publication.
Lightweight construction material lisocore® – drilling and bonding with precision

Drilling 15,000 holes in less than 20 seconds with TwinCAT multi-core technology

With the company’s lisocore® lightweight construction material, lightweight solutions is a pioneer both in terms of the end product and the manufacturing equipment that makes it. Advanced PC-based control technology from Beckhoff has been onboard the company’s machinery from the start. Beckhoff multi-core technology, implemented via a C6650 Industrial PC and TwinCAT 3 automation software, provides the required flexibility for lightweight solutions’ unique processes.

The structure of the lisocore® panel
The idea for lisocore® came to Michael Schäpers in 2004 during a lecture on statics at the Rosenheim University of Applied Sciences. This is when he realized that a shell structure as the center layer in a sandwich construction would be ideal as a load-bearing material.

Based in Bad Aibling, Germany, lightweight solutions GmbH is the result of that original idea. The company’s lisocore® product is an extremely efficient, lightweight construction material that consists of two thin cover layers over a three-dimensional core structure. Point-milling the cover layers creates indentations that lock the core structure firmly in place with the help of high-strength adhesive. The result is a classic sandwich-style element, but one with unique load-bearing properties compared to common chipboard, says lightweight solutions Managing Director Michael Schäpers: “Half the weight and twice the bending modulus of elasticity is what makes this material so special.”

**Customized solutions for special machinery**

When you manufacture a totally new product, traditional machines don’t get you very far – you need a customized automation solution, as Michael Schäpers remembers: “When we developed the first machine together with Beckhoff in 2005, we had to do some pioneering work. There were no standards and very little experience to design the machines we needed, so flexibility in automation was the top priority. We actually developed the exact production parameters while we were building the system. Accordingly, we had to be able to quickly respond to any changes, meaning that the entire system had to be connected by fieldbus technology. We also needed the ability to easily add new drives and safety modules that were not part of the original design. Pre-assembled modules or devices that could not be subsequently changed were not permitted.”

**A multi-core IPC controls the entire system**

Today, lisocore® is built on a line developed by lws maschinenbau GmbH, a subsidiary of lightweight solutions. Covering a floor area of 500 square meters, the line drills cover layers, applies the adhesive and combines the layers with the 3D core to form the sandwich boards before stacking and packaging steps. The core panels, in turn, are manufactured from a special non-woven fabric on one of four internally-developed down stroke presses, each of which is controlled by a C6920 control cabinet Industrial PC (IPC). The main challenge for this very large production line was the implementation of the complete automation system on a single IPC. What made this possible was the ability provided by PC-based control from Beckhoff to assign certain control operations to individual processor cores.
“Such a multi-core system would have been impossible without TwinCAT 3,” says Michael Schäpers. “To process the various tasks, we had four CPU cores at our disposal. Moreover, with the EtherCAT-based technology from Beckhoff, we did not have to worry about the communication lines within the system. It was very easy to feed the process data gathered from the machine back into the control system – a special feature that helps us when we develop new procedures and products. We must be able to fully interact with the machine and access the control data. Another Beckhoff benefit is the TwinCAT Scope tool, a software oscilloscope that lets you analyze workflows in detail and call up all necessary data for a new process. All of these features deliver huge speed benefits for your production and process development.”

**TwinCAT 3 offers broad multi-core support**

According to Michael Schäpers, the multi-core capabilities of TwinCAT 3 software were at the forefront of the decision to use the automation solution. These capabilities are used in the following ways: The first core runs the HMI under Windows. The second core handles additional HMI tasks and runs TwinCAT NC PTP to control the NC axes. The third core runs the TwinCAT software for servo-hydraulics of the flat press, and TwinCAT PLC runs on the fourth core.

One special feature of the servo-hydraulics, particularly with their large number of NC axes, is the way they interact with the control technology. Both the electrical and the hydraulic controls run under TwinCAT, which makes it possible to map the process cycle with great precision.

Leveraging these features of PC-based control technology, all functions can be bundled onto a single PC, delivering an additional margin of safety with regard to component availability. Since all programs run on a single computer, keeping a second IPC ready as a backup for redundancy is easy.

**Flexible access to all control data**

Although the system may look highly complex, it is actually quite manageable. The architecture is divided into various groups, each of which has its own control cabinet and its own I/Os. Michael Schäpers: “To optimize the line, we must be able to add or remove functions easily. To operate such a large system professionally, you need a controller with flexible access options, and the Beckhoff control system meets these requirements perfectly.”

Jens Hülsebusch, Project Manager Systems Engineering at Beckhoff, lists some of the key components to demonstrate the system size and complexity: “The C6650 cabinet-mounted IPC with quad-core Intel® Core™ i7 processor controls almost 900 EtherCAT slaves, including EtherCAT Terminals and EtherCAT Box I/O modules, as well as AX5000 Servo Drives split between two EtherCAT masters in the field. A total of 130 NC axes are calculated in a 2-ms task and moved via 73 AX5000 Servo Drives that, in turn, are equipped with AX5805 TwinSAFE cards and control AM8000 servomotors with One Cable Technology (OCT). The line also employs XFC (eXtreme Fast Control) technology, TwinCAT ‘Flying Saw’ functionality and four CP79xx Control Panels, making machine operation easy.”

Among the most difficult tasks that the machines have to perform at lightweight solutions is traveling to the immense numbers of drilling and gluing points. Adhesive must be applied to 15,000 drill holes in less than 20 seconds with high accuracy. “No one had ever done this before,” remembers Michael Schäpers,
since commencing production in Bad Aibling, lightweight solutions has steadily ramped up its production output to keep up with demand. Future plans call for a system with two- to three-times the capacity of the current line. "We will operate with four feed-in stations and two drill-and-glue stations," explains Michael Schäpers.

PC-based control can be scaled up to accommodate Industrie 4.0 requirements

The Beckhoff IPC proves its performance not just with regard to the increase in production capacity. Since the multi-core capability of TwinCAT 3 enables the IPC to handle additional tasks, lightweight solutions decided to integrate its building control system into the PC-based controller.

Industrie 4.0 is another important aspect for the future. As a first step on its implementation of this concept, the company has already connected the entire automation platform to its SAP system, which is why Michael Schäpers has already decided that "as a specialty machine builder, we will continue to count on support from Beckhoff as we move towards Industrie 4.0."
Boston Scientific Corporation in Marlborough, Massachusetts, USA, is one of the world’s largest manufacturers of medical technology devices and products for diagnosing and treating cardiac, digestive, pulmonary and vascular diseases, to name just a few. To ensure that customers and patients receive products that meet the strictest quality guidelines, the company employs PC- and EtherCAT-based control technology from Beckhoff in its testing stations for cardiac catheters.
Modern medical diagnostic and therapy applications employ a wide range of medical equipment and devices. Before they can be used on patients, however, they must pass a stringent inspection process for quality assurance. “This is a field where we excel,” says Roberto Listek, Principal Equipment Engineer at Boston Scientific. “We place great value on continuously improving our testing procedures and employing state-of-the-art technologies, which is why Boston Scientific uses a PC-based automation platform in its torque tester device for cardiac catheters.”

Cardiac catheters are used to diagnose and treat many cardiac and circulatory diseases. The catheter – a thin plastic tube – is guided through the patient’s blood vessels to the coronary arteries or cardiac chambers. To ensure the catheters work properly as they are being navigated through the patient’s arteries even under difficult conditions, they are subjected to stringent stress tests, with the final step employing a torque testing device. This type of test measures the rotational response at the distal end of a device while it is being rotated at the proximal end – an important value to know when operating a catheter during a medical procedure.

At the heart of the torque tester is a CX1020 Embedded PC which controls all test functions that are required for the qualification process.

Every cardiac catheter is subjected to extensive testing under cleanroom conditions before it leaves the factory.

PC-based platform meets all flexibility and reliability requirements
Boston Scientific had to accommodate a relatively short timeframe for developing and implementing the torque tester. Nevertheless, the list of technological requirements grew longer and longer as the project progressed. “It included, among other things, a stable control platform without any rotating media or fans. In terms of software, the engineering platform had to be based on the IEC 61131-3 standard. The PC-based control system from Beckhoff met these and other requirements,” says Roberto Listek.

Boston Scientific’s torque tester is controlled via a Beckhoff CX1020 Embedded PC. Since it is fanless and uses a Compact Flash card as a storage medium instead of a rotating hard disk, it met the requirement to have the fewest possible moving parts in order to maximize reliability. “The Beckhoff platform provides a wealth of standard connectivity options, such as integrated USB and DVI ports, which enables us to simply plug in a USB stick to call up system data for reference purposes,” explains Listek. “We then combined these hardware functions with TwinCAT, the powerful automation software from Beckhoff and Windows XP Embedded as the operating system to create
Further information: 
www.bostonscientific.com
www.beckhoffautomation.com

As the needs of the medical technology industry keep increasing and changing, Boston Scientific is definitely ready for the future,” concludes Roberto Listek.

The torque tester’s HMI clearly displays test results and system status information.

by implementing a PC-based control system from Beckhoff, we were able to develop a system that fully meets our requirements for comprehensive quality testing in terms of reliability, simplified data acquisition and efficient performance. As the needs of the medical technology industry keep increasing and changing, Boston Scientific is definitely ready for the future,” concludes Roberto Listek.
NASA develops
Modular Robot Vehicle

Research and development vehicle with redundant EtherCAT communication
“You should definitely buckle your seatbelt” was the advice from Mason Markee, one of the Mechanical Engineers from the NASA R&D team and driver for our test ride in the MRV (Modular Robotic Vehicle) developed by the space agency. The MRV is advancing NASA research on future vehicles that will be used on Earth and in space. We visited the Johnson Space Center in Houston to see the MRV and took turns riding in the passenger seat. The 2-seat, 4-wheeled vehicle looks like a “roadster” at first glance, but can be more accurately defined as a robot.
Each wheel and steering assembly of the MRV is referred to as an “e-corner” (to use NASA robot lingo) and each device in the e-corner is called a “joint”. The controls for each wheel’s propulsion, braking, and steering are controlled through a triple-redundant EtherCAT network. Having individual control of each steering and drive unit enables the MRV to travel in some very unorthodox modes, much like some of the NASA R&D team’s other robotic vehicles.

“MRV is a research and development platform for our mobility robotics program. Future applications include a potential lunar or Martian exploration vehicle. In particular, the focus of this R&D is on safety, reliability, maneuverability, and human interfacing. The previous iteration of this vehicle, which ultimately led to the development of the MRV, was referred to as the Surface Exploration Vehicle (SEV),” explains Ryan Reed, NASA Engineer and host of our visit to Johnson Space Center. “Our goal was to design a vehicle that would have reliable, fail-safe operator control. The MRV is intended to seat up to two passengers in high speed travel, making safety a primary concern.”

From afar, the MRV looks very much like a small open cart or roadster – albeit a high tech one with digital dash display, gold anodized parts, and even a place for your smartphone. It can drive in traditional modes, such as “two-wheel steering” and “four-wheel steering”, both currently used by commercial vehicles. However, once Mason Markee of NASA pulled out of the driveway and onto the road in front of the building where the vehicles are stored, he shifted into “omnidirectional mode”, (see figure 1) bringing sensations that can only be described as if you are sliding on ice. The direction the front of the vehicle is pointing has no correlation to where the vehicle is going. Control is deceptively simple, needing only the steering wheel and a joystick on the center console. The MRV is also capable of a “zero radius turn”, similar to a high-end riding lawn mower. Mason was able to switch from one mode to another effortlessly and elegantly while going at around 15 mph, dodging into and out of parking areas, avoiding medians, and generally doing his best to impress his passenger. The drivers in traffic on the road near Johnson Space Center seemed accustomed to the strange sight of a car sliding in unusual patterns on the roadway.

“We had some experience with CAN, MIL-STD-1553, Ethernet, and LVDS controlling other robots. However, we wanted a network that would allow us to continue operating the robot with at least one failure, and the ability to transport enough data to maintain control of the vehicle at high speeds,” said Reed. “After one of our teammates listened to an EtherCAT presentation at an ETG seminar we decided to try it based on the technical specifications. We set up a test bed and were quickly able to meet our requirements. The outcome was the MRV.”

When asked which properties of EtherCAT were of most interest to the R&D group, Reed replied that “the high bandwidth provided proved a major benefit, and the cable redundancy feature was one the most intriguing characteristics for us. In testing this feature, we maintained control of the joints from our master computer after disconnecting a single connection. Using all commercial off-the-shelf (COTS) components on the master computer made setup easy.” Reed continued, “Finally, radiation immunity of the ASIC was yet another interesting characteristic. While the MRV is strictly a terrestrial vehicle, we had the opportunity to test the ASICs after some other parts had completed their radiation testing. The ASICs did exceptionally well, and we are considering it for possible use on a future project.”

The redundancy scheme implemented in the MRV goes beyond what is typically used for cable redundancy in EtherCAT systems, however. Each of the joint’s slaves has dual EtherCAT Slave Controller chips (Beckhoff ET1100 ASICs) (see figure 2). Each of the EtherCAT slave chips are connected to one of two completely independent EtherCAT networks from two separate masters with shared memory between them, which each utilize the cable redundancy feature. So each device has dual ESCs connected to two separate redundant cable networks and to two separate master controllers. When asked if the MRV project is a success, Reed stated, “Absolutely! With this being an R&D project, the work is never complete. However, the MRV has been functional for a few years now, and our drivers feel safe operating the vehicle. It has been a great R&D project for us to practice implementing safe, redundant and reliable robots. In fact, some of the other NASA project teams were impressed with our implementation and have adopted it in their systems.”
Case in point, the ARGOS (Active Response Gravity Offload Simulator), which simulates the reduced gravity of lunar or Martian environments is already using EtherCAT, and the Wearable Robotics team is exploring EtherCAT as a networking solution for human exoskeleton robotics. So wherever advanced equipment and devices happen to be in the solar system, EtherCAT keeps the data moving.

Further information:
www.nasa.gov
www.beckhoffautomation.com
NASA uses Wheelift® heavy transporters

Since January 2014, Wheelift® Self-Propelled Modular Transporters (SPMTs) have successfully addressed the extreme material handling needs of NASA.
U.S. space agency NASA is currently working on the Space Launch System (SLS) rocket program for manned space exploration beyond a low Earth orbit. The SLS will be the most powerful rocket ever built, with a payload of around 130 metric tons (143 tons) in several stages. The initial Block 1 configuration of SLS will stand 322 feet (98 m) tall, higher than the Statue of Liberty, with a launch weight of 5.75 million pounds (2,500 tons). The first unmanned SLS mission – Exploration Mission-1 (EM-1) – is scheduled for the end of 2018 with crewed missions to follow. Today, the rocket components must be transported over long distances in large manufacturing facilities, and NASA uses Wheelfit® Self-Propelled Modular Transporters (SPMTs) from Doerfer Companies to move these giant shuttle components. The challenge is to maintain precisely synchronized coordination of multiple SPMTs carrying rocket components with enormous dimensions and heavy weights.

Large NASA production facilities, such as the Michoud Assembly Facility (MAF) in New Orleans, are among the largest manufacturing facilities in the world with over 1,870,000 square feet (173,728 m²) of floor space. A major activity at the MAF is assembly of components for the NASA SLS rocket program. The huge rocket components, which can weigh hundreds of tons, and various tank sections must be moved throughout assembly and manufacturing processes over distances of 1 to 2 miles (up to 3 kilometers). However, handling and moving heavy loads is nothing new to Doerfer’s successful Wheelfit transporters. The special challenge for the NASA application is that four SPMTs have to work in tandem, and that special support fixtures are required for the sensitive loads.
This requires Doerfer to gather continuous feedback from the fixture that supports the various tanks to maintain precise alignment of the load.

The four Wheelift SPMTs are each rated for load capacity up to 100 tons, and together move the rocket stage equipment onto a public road, over a levee and onto a barge which takes the SPMTs and rocket components to the next NASA facility. John Pullen, Principal Controls Designer at Doerfer Companies, explains the automation requirements necessary to successfully pull off this weighty balancing act: “It is challenging to maintain coordination of multiple SPMTs balancing a support fixture over difficult ground conditions, such as bumps and other elevation changes in plant floors and pathways. Managing these loads also requires heavy duty servomotors and tires, as well as an advanced automation and control system that can keep up with constantly changing conditions.”

One Embedded PC coordinates the movements of four heavy equipment transporters

The four SPMTs, working in tandem, constantly maintain safe velocity and steering centers. “This required a significant modification of the control architecture,” as Tom Phillips, Wheelift Business Manager, Doerfer Companies, explains: “We need one controller to coordinate the work of four vehicles.” Leveraging TwinCAT 3 automation software from Beckhoff, Doerfer has designated one SPMT that works as the “master” for the vehicle group with the others following as slaves in an object-oriented control architecture. The master PLC performs all the calculations for each of the vehicle groups. “This includes equalizing the torque and steering centers, velocities, load distribution and cylinder height every 10 milliseconds,” Pullen adds. The newest generation of Wheelift SPMTs accomplish this via Beckhoff CX2030 Embedded PCs. For the user interface, CP29xx series multi-touch Control Panels are used.

Increased performance with TwinCAT 3

“When we began integrating the Embedded PCs, we increased our software performance because we added so much processor capability. We also expanded our debugging functionality, implicit checks, and timing of the program organizational units (POUs),” says Ryan Canfield, Controls Engineer, Doerfer Companies. “Core isolation in TwinCAT 3 is another important consideration: we dedicated Core 1 for TwinCAT and assigned Core 0 to handle the Windows OS and InduSoft HMI software. This provided considerable benefits for maximizing processor efficiency and making our control software even more robust and responsive.”

Also key to Doerfer’s programming efforts for the Wheelift are the source code and version control features in TwinCAT 3. “We no longer have to worry about code loss when managing the work of multiple programmers – we can more easily collaborate in teams and merge work from Project A into Project B, for example,” Canfield continues. “We have drastically reduced our manual programming efforts and streamlined our engineering process using source code and version control in TwinCAT 3.”

Part of the challenge with the NASA projects was the requirement for Wheelift vehicle grouping: Doerfer now has vehicle “objects” in the programming that are grouped together. “We program Wheelift code using object-oriented extensions.
of IEC 61131-3 in TwinCAT 3,” Pullen explains. “This supports the creation of highly complex features, but also allows our programmers to be abstracted from the process and fine details of the functionality. Essentially, it’s like giving the objects a ‘start’, getting the parameters to function and letting those objects do the rest on their own. This approach is rather elegant and requires minimal engineering effort.”

EtherCAT as the integrated communication system
EtherCAT serves both as fieldbus system and drive bus system in the SPMTs. This creates the potential for flexible connectivity between EtherCAT and other bus systems and seamless integration of peripheral devices. For example, EL6751 CANopen Master Terminals are used to establish connectivity for engine diagnostics and inverters for battery systems, and to connect to the radio control interface used for manual SPMT operation by Wheelift operators. Safety functions, such as e-stop, are integrated into the control system via EL6900 TwinSAFE logic terminals. “EtherCAT is also indispensable for fault monitoring,” Pullen explains. “With the built-in diagnostic capabilities of the EtherCAT system, we can immediately point the operator to any specific cable or device in the event of a service or maintenance need.” In addition, Doerfer has implemented the EtherCAT Automation Protocol (EAP) for inter-vehicle communication. “We’re easily getting 10 millisecond communication latencies between the Wheelift vehicles,” Pullen adds. Wheelift vehicles in a group communicate wirelessly via radio equipment, but the operator can easily take control via a handheld interface.

The heavy equipment transporters can have as many as 24 axes per vehicle. The automation system must handle highly advanced positioning algorithms to successfully compensate for the movement of the heavy loads. Motion control for Doerfer’s heavy duty Uniload® wheels on the Wheelift is handled by AX5000 EtherCAT Servo Drives with AM3000 servomotors and high-torque planetary gear units. “With the servo drives, the Wheelift can achieve resolution for servo axes and hydraulic axes down to a thousandth of an inch,” Canfield reports. “In addition, the load distribution algorithms the Doerfer team programmed in TwinCAT 3 distribute the load throughout all of the present cylinders on the Wheelift. This remains true when driving over bumps or if the load is off-center.”

Further information:
www.nasa.gov
www.wheelift.com
www.doerfer.com
www.beckhoffautomation.com
Japanese company Mitsubishi Heavy Industries Plastic Technology (MHIPT) specializes in plastics injection molding machines. These solutions are primarily used in the automotive industry, but also in household appliance manufacturing and in the PC industry. The company chose PC-based control technology from Beckhoff for its latest MEIII machine series, regarding the openness of the control architecture as forward-looking, offering everything required for connected production facilities. In addition to an improvement in repeatability and greater production flexibility, MHIPT considers the simple integration of condition monitoring and implementation of predictive maintenance to be a major step forward.
Injection molding machines essentially combine an injection unit with a clamping unit. The injection unit heats up and plasticizes the raw material before injecting it through a high-pressure nozzle into the tool. The clamping unit opens and closes the tool (mound) and keeps the two halves of the mound closed during the injection process. The force exerted by the clamping unit is an indicator of the size and the mechanical power of the machine. The MHIPT machine portfolio encompasses machines with clamping forces that range from 350 to 4000 tons.

Open automation platform brings competitive advantages
The MEIII, which is the latest injection molding machine generation from MHIPT, features medium-sized machines with a clamping force that ranges from 550 to 850 tons. Where most injection molding machines are equipped with hydraulic drives, drive control in the MEIII is achieved with servomotors. “This leads to higher production quality and reduced power consumption,” says Takashi Mizuno, director and chief executive of the engineering department at MHIPT. “With regard to the automation technology, MHIPT has changed its previous development strategy for the MEIII machine series. We now rely on PC-based controllers throughout the series. Previously, we developed our controllers entirely by ourselves; the use of PC control systems allows us to concentrate our development capacities entirely on the software side. We aim to integrate all of our expertise as a company that specializes in injection molding machines into the software for the injection molding process, distinguishing ourselves from the competition.”
Like the preceding MEII series, the MEIII series comes equipped with DD (direct drive) motors developed in-house by MHIPT. These motors do not need reduction gears, as they generate a high force with a low number of revolutions; this gives the advantage of a dynamic injection drive and facilitates easy maintenance as pulleys, belts and other consumables are not required. The MEIII series is characterized by a design that replaces a mechanical connection system between the two DD motors with highly-precise software synchronization. "The speed, reliability and precision of the servo-electric controller directly determines the quality of the product," emphasizes Takashi Mizuno.

Open control technology: independence from vendor-specific standards and specifications

Takashi Takii, head of design in the MHIPT engineering department and project leader in the development of the MEIII, explains: "The big advantage of the control architecture openness is that we, and our customers, are no longer dependent on vendor-specific standards or specifications. PC-based control provides an extremely efficient control system based on open standards, while at the same time being flexible and universal, offering us the necessary reliability and quality."
High efficiency in machine development

Given the flexibility and expandability of the PC Control platform, MHIPT is able to offer its customers around 200 optional specifications for the use of different tools or molds to achieve the geometries of the plastic part to be produced. “That’s about three times as many options as a conventional controller. Specifications formerly available only at extra cost can now be offered to our customers with standard pricing and delivery times. In addition, the use of open standards gives us the flexibility to comply with the sensors and servomotors specified by our customers. Through the use of EtherCAT and TwinCAT, as a universal communication system and universal software platform respectively, a uniform data flow can be achieved that considerably increases the repeatability of the machine operation,” explains Takashi Takii.

“All in all, machine engineering is much more efficient through the use of the PC platform,” says Takashi Takii. “Modular design of the control cabinets is simplified through the use of decentralized I/O stations that communicate over EtherCAT, resulting in advantages not only with regard to the flexibility, for example the implementation of modifications at short notice, but also shortening the time required for the manufacturing, disassembly, transport and installation of machines. The high scalability of the PC Control platform ultimately makes it possible to control several injection molding machines of very different sizes and in different areas of application using one central PC-based controller.”

The MHIPT machine software must manage more than 30,000 data points in order to achieve the diversity and flexibility of the plastics injection molding applications. MHIPT uses an Oracle database to manage software design configurations. “The required close connection of the database could not be achieved using the tools of conventional control system vendors,” explains Takashi Takii.

“The seamless connection of TwinCAT with Oracle database represents a gigantic step forward for us to implement automatic or semi-automatic software configuration. In addition, the online debugger, software oscilloscope and other development tools offer valuable functionality.”

New business models enabled by the open control architecture

Takashi Takii also sees potential business benefits in the PC-based control architecture. “Large-size injection molding machines are typical examples of small-quantity and large-variety production, almost equivalent to special machine manufacturing. Our ideal scenario is to meet every single one of the customer’s requirements. Where conventional control technology often imposed restrictions on us, the controller used for the MEIII enables efficient and flexible software development. Diverse options for injection molding processes can be automatically generated from the software without the need for programming. I can confidently say that the software design has reached the point where we can enjoy high customer satisfaction. The magic triangle of quality, cost and time has made a quantum leap,” Takashi Takii stresses.

Ready for Industrie 4.0

Takashi Takii also sees benefits in the open control architecture with respect to the current trends in the manufacturing industries. “The open and flexibly-controlled flow of data with EtherCAT and TwinCAT is not just limited to the individual injection molding machine, but also enables modularization and uniformity of data flow throughout the entire factory. In this way, we can offer highly responsive support for the technologies targeted by Industrie 4.0 in Germany and the Industrial Internet of Things (IIoT) in the USA. I think it will be essential to use Big Data to extend the mean time between failures (MTBF) and shorten the mean time to repair (MTTR). We must put ourselves in the position of being able to collect, save and analyze large quantities of data in order to determine how our machines change over time, how they are used and how we can standardize and compare the data collected in different production environments,” Takashi Takii concludes, outlining future strategy.

Further information:
www.mhi-pt.co.jp
www.beckhoff.co.jp
The Technical Committee of the EtherCAT Technology Group (ETG) has unanimously accepted EtherCAT P as an addition to EtherCAT. Moving forward, EtherCAT P, which combines the well-known benefits of EtherCAT with power supply on the same cable, will be comprehensively supported and promoted by the ETG as well.

Introduced at the 2015 SPS IPC Drives trade show, EtherCAT P was developed by Beckhoff as an extension of the company’s EtherCAT product range. Currently, the ETG is extending the existing product specification into a EtherCAT P technology specification. Dr. Guido Beckmann, Chairman of the ETG Technical Committee, explains the decision to actively involve EtherCAT P into the ETG activities at Hannover Messe 2016: “EtherCAT P is the ideal supplement to the current portfolio of EtherCAT technology. Many prominent technology users have already expressed great interest in the technology extension and we’re convinced that soon after the specification is finished, numerous ETG member companies will support EtherCAT P through the introduction of new products.”

The key highlight of EtherCAT P is the combination of EtherCAT communication with system and peripheral voltage in a single Ethernet cable. Additionally, EtherCAT P supports power forwarding via the participants. Users will still enjoy the high-performance characteristics of EtherCAT, along with the flexible topology and many other beneficial features of EtherCAT systems. EtherCAT P represents the ideal solution for sensor, actuator and measurement technology: Material and assembly costs are reduced, as are the space requirements for drag chains, control cabinets and overall machine footprint. Beckmann continues: “With EtherCAT P, the devices have access to 2 × 24 V with a maximum of 3 A each, accomplished using traditional 4-wire Ethernet cables. This enables completely new cabling possibilities for our Ethernet fieldbus. With ‘daisy chaining’ and the transmission of two 24 V supply voltages, the former limitations when combining Ethernet and power supply no longer apply when using EtherCAT P.”
Toyota will make the most of EtherCAT in new factories worldwide

Toyota Motor Corporation has selected EtherCAT as their Industrial Ethernet technology of choice and will base its new factories around the world on EtherCAT. The global announcement was made by Morihiko Ohkura, General Manager of the Production Engineering Innovation Division at Toyota Motor Corporation, during an EtherCAT Technology Group (ETG) press briefing at Hannover Messe 2016.

Ohkura explains: "I am pleased to announce that Toyota Motor Corporation will make the most of EtherCAT in our new factories to be built around the world. We have conducted thorough analysis and evaluation to compare various Industrial Ethernet technologies. I believe the performance, determinism and simple wiring characteristics of EtherCAT, in addition to its openness, best fit with the needs of Toyota to evolve production systems with Industrial IoT concepts." EtherCAT is an essential part of Toyota's new IoT deployment strategy: "In order to smoothly introduce the new IoT concept into our factories, it is critical for us to be able to source necessary EtherCAT components in a timely manner. Thus, we strongly encourage our suppliers in Japan and the whole world to prepare high-quality EtherCAT components at competitive costs.

Furthermore, Ohkura stressed the willingness of Toyota to take an active role within the EtherCAT Technology Group: "What I expect from the ETG is to support us in becoming one of the leading EtherCAT users in our industry. In view of the growing community of supporters of EtherCAT technology, I am confident that the transition from our current technology should be a smooth one."

The decision to standardize on EtherCAT also factors in the latest addition to the technology, EtherCAT P: "The concept to integrate communication and power lines perfectly matches our lean production philosophy, TPS: the Toyota Production System. Simply put, the fewer cables, the better. Therefore Toyota is prepared to actively collaborate with the experts of Beckhoff while the new ETG specification is still in preparation in order to smoothly make the new technology available to us and the rest of the community."

Martin Rostan, Executive Director of the ETG, comments: "The significance of Toyota's choice to standardize on EtherCAT and EtherCAT P cannot be overstated. As the world's largest automotive company, Toyota is known for its highly efficient and high-quality production strategies, with many companies and industries following the successful path set by this manufacturing leader. This significant development will further accelerate the global adoption of EtherCAT — within the automotive industry and beyond." Rostan also welcomes the active involvement of Toyota in the EtherCAT Community: "The EtherCAT Technology Group has always been characterized by active user involvement. Having Toyota on-board will strengthen this vital element and ensure that user requirements are fully met or exceeded by EtherCAT technologies. In addition, the specification work for EtherCAT P, our latest enhancement of the technology, is in full swing — so the timing is simply perfect. I encourage the many other car makers already using EtherCAT in major manufacturing applications to join Toyota in taking such an active role within the ETG."
Trade shows 2016

Europe

Germany

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

FachPack
September 27 – 29, 2016
Nuremberg
Hall 3A, Booth 331
www.fachpack.de/en

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

Motek
October 10 – 13, 2016
Stuttgart
Hall 8, Booth 108
www.motek-messe.com

K
October 19 – 26, 2016
Düsseldorf
Hall 11, Booth G21
www.k-online.com

EuroBlech
October 25 – 29, 2016
Hanover
Hall 27, Booth D89
www.euroblech.com/english

FMB
November 09 – 11, 2016
Bad Salzuflen
Hall 20, Booth E14
www.fmb-messe.de/en.html

SPS IPC Drives
November 22 – 24, 2016
Nuremberg
Hall 7, Booth 406
www.mesago.de/en/sp

Denmark

Automatik
September 13 – 15, 2016
Brandby
Booth B-1058
www.automatik16.dk

Foodtech
November 01 – 03, 2016
Herning
www.foodtech.dk

Finland

PacTec
September 20 – 22, 2016
Helsinki

FinnBuild
October 12 – 14, 2016
Helsinki
Hall 6
www.finnbuild.fi

Energia
October 25 – 27, 2016
Tampere
Hall Main
www.energiamessut.fi

France

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

Norway

ONS
August 29 – September 01, 2016
Stavanger
www.ons.no

Sweden

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

Switzerland

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

Turkey

Robot Investments Communication Forum and Exhibition
September 29 – October 01, 2016
Istanbul
Booth A4
www.robotyatirimlari.com

United Kingdom

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

PPMA Total Show
September 27 – 29, 2016
Birmingham
Hall 5, Booth B100
www.ppmatotalshow.co.uk

LuxLive
November 23 – 24, 2016
London
Booth P8
http://luxlive.co.uk
Africa

South Africa

Electra Mining Africa
September 12 – 16, 2016
Johannesburg
Hall 7, Booth A18
www.electramining.co.za

Asia

China

AHTE
August 24 – 26, 2016
Shanghai
www.shanghaiahte.com

Nepcon
August 30 – September 01, 2016
Shenzhen
www.nepconsouthchina.com

China Brew & Beverage
October 11 – 14, 2016
Shanghai
www.chinabrew-beverage.com

India

AMTEX
July 08 – 11, 2016
New Delhi
Hall 11, Booth C-157
www.amtex-expo.com

North America

Canada

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

Further information:
www.beckhoff.com/trade_shows