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Automation solves a dilemma for machine builders and brand owners

**Frank Würthner, Global Business Management
Packaging, Beckhoff Automation**

Current market trends are having a major impact, and also present a dilemma: brand owners need to offer packaging that is cut-to-size, more flexible and, above all, more sustainable while meeting the demand for lower logistics and packaging costs. In addition, today's end consumer expects sustainability in all products and processes. Flexible packaging sizes should be just as feasible as efficient handling of blockbuster products, which have often been the center of attention to date. Machine builders in the packaging sector are now being urged to respond to all these needs immediately with their developments: they are facing their biggest challenges yet! Changing formats in just a few minutes is now a standard requirement from machine building customers, as is minimal footprint for the packaging equipment. In addition to these multiple aspects, new machine directives often add to the already extensive effort to meet requirements.

"Engineers must save the world" – this philosophy has been built into the DNA of Beckhoff as a technology provider since the beginning. Our commitment is becoming a self-evident fact, not least with the ever-increasing focus on energy and resource efficiency. Commissioning times need to be reduced, and supply chains have to stabilized or restructured depending on the availability of critical components. Last but not least, this means that all process flows in a company must be examined and optimized, and all this while companies in all sectors are desperately seeking qualified workers.

In such a complex environment, how can an automation specialist like Beckhoff work together with customers to turn all these issues to the customer's advantage? A close customer-supplier relationship is the first crucial building block. The focus here is to build a relationship based on trust, an ethos that Beckhoff lives out daily, in addition to its innovative products. All solutions, both old and new, are always scrutinized so that we can ensure that we, as automation specialists, together with the experience and expertise of the machine builder, feed all the knowledge that we can into the processes. Generally, this results in entirely new concepts that not only consume significantly less material and energy resources but also maximize output in a smaller installation space, in line with our motto: "Engineers must save the world".

The AMP8000 distributed servo drive system, the MX-System for control cabinet-free automation, the ATRO system for custom and adaptive robotics, and XTS and XPlanar for highly flexible product transport are just a few examples of innovative Beckhoff solutions that reduce resource consumption across the board. The entire carbon footprint needs to be considered, and, like automation as a whole, our PC-based technology is an important foundational technology that allows manufacturers to successfully overcome challenges and increase sustainability while reducing the carbon footprint, as we need to reduce energy and resource consumption to assure our planet's future. Precise, intelligent automation holds the key, and Beckhoff, with its PC-based technology, can increasingly benefit from developments in the IT world. Therefore Beckhoff's PC-based control with TwinCAT Machine Learning has already integrated artificial intelligence, which demonstrates just how significant data, including production and energy data, will be in the future, which can also be seen from the buzz around ChatGPT. As a family-owned company that acts on its own responsibility and strives to be net-zero, Beckhoff's approach to such developments is consistent and focused, and we know one thing for sure: in the future, decisions will largely depend on how sustainable the entire process for a product is. After all, Generation Z needs a planet worth living on; we need to build a future worth looking forward to!

Since the XTS elements with NCT are fully compatible with the standard system, they can be easily integrated into existing plants.

XTS with NCT: Linear transport system as a highly flexible multi-robot system

How XTS movers can replace robots

The XTS linear transport system from Beckhoff has already proven to be an innovation factor in thousands of machines, and the ongoing expansion of its range of functions offers plenty of market potential for the future. A prime example here is No Cable Technology (NCT), which provides contactless energy transfer and synchronous real-time data communication directly on the XTS movers. This allows the movers to perform a variety of different robot functions via end effectors. Furthermore, the ability to have a large number of movers on an XTS enables a flexible multi-robot system that increases area productivity many times over by executing process steps in parallel.

systems for the infeed or manufacturing process can benefit from this technology. This allows new breakthrough solutions to be created that enable sophisticated product and material handling in highly automated systems. In addition, the XTS and NTC reduce the required installation space many times over compared to conventional robotic systems, allowing significantly more functionality to be accommodated in less space.

Virtually unlimited application possibilities
As one of many examples, motion sequences can be implemented directly on the mover for performing tasks such as rotating and aligning a product for scanning a barcode or running quality checks. Electromotive grippers, magnetic grippers, or vacuum cups on the movers can pick up, transfer, and deposit products on the fly, making the movers mobile material flow systems.

XTS is a linear transport system in which a large number of movers move independently of each other along a track. The movers offer a host of functionalities, including forming groups and synchronizing to other process sequences. The track is made up of motor modules based on a modular principle, and can be open or closed to facilitate the implementation of application-specific system layouts. A closed travel path enables an increase in productivity, as the movers do not have to return to the starting point on the production line empty.

No Cable Technology as an extension supports the use of a wide variety of end effectors without reducing the high dynamics and flexibility of the XTS solution. End effectors mounted on the mover, such as standard actuators or sensors, are used to perform various process steps during linear travel. In the packaging sector, for example, almost all conveyor, sorting, robotic, or material handling

Countless applications stand to benefit from the use of a multi-gripper system such as this. In a meal kit filling application, for example, various electromechanical or vacuum grippers would collect the necessary ingredients to assemble a complete menu. The movers would pick up the ingredients from predefined stations and place them at individual product locations, facilitating an exclusively software-based format changeover up to production with a lot size of one. Thanks to the traceability of the XTS, every ingredient could be tracked seamlessly from picking to order labeling and supplier pickup. Pharmaceuticals are another similarly obvious use case. Here, the appropriate end effector could rotate a container so that it can be sealed or validated.

Fully compatible function extension
Since the XTS elements with NCT are fully compatible with the standard system, NCT can be integrated into existing XTS applications. The continued

The end effector on the XTS mover with NCT aligns the product to facilitate barcode scanning or quality inspections.

Equipped with a vacuum pump, the XTS mover with NCT plays an active role in the production process.
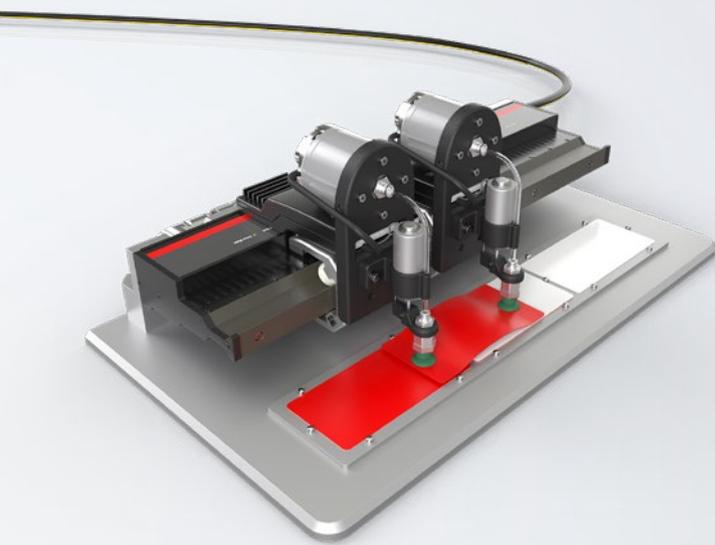
New possibilities through XTS with NCT: Coupled movers can work together to move even bulky products.
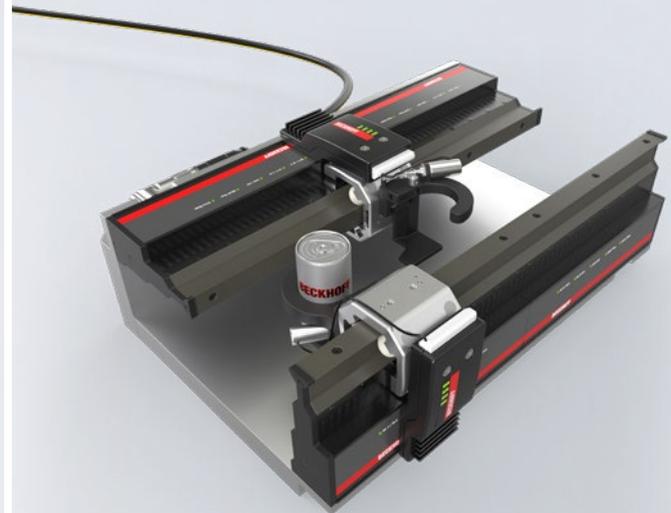
The transfer of a product from one production system to another is also possible with NCT – for example, for the optional integration of additional workstations or manual workstations.

use of existing system components not only cuts down on implementation time, but also saves resources. Furthermore, the complete integration into the XTS modular system offers the advantage that no additional components are required apart from the end effectors used. The end effectors on the movers are also controlled via the central TwinCAT automation software, allowing all processes in TwinCAT to be coordinated with microsecond precision, and the engineering effort to be reduced to a minimum.

Thomas Beckhoff, Product Manager XTS, Beckhoff Automation

More information:
www.beckhoff.com/xts
www.beckhoff.com/nct

MX-System: Plug-in system solution for control cabinet-free automation

Modular automation toolkit revolutionizes control cabinet design

With the MX-System as a modular automation toolkit, Beckhoff has packaged its comprehensive product portfolio in a new housing system, which is designed in such a way that the resulting solution can completely replace traditional control cabinets. In doing so, Beckhoff – in its role as a technology leader – is once again initiating a revolution in automation technology and setting new standards.

With the robust baseplate and plug-in function modules from the areas of IPC, bus coupler, I/O, motion, relay, and system technology, the MX-System provides a highly flexible, control cabinet-free automation solution with protection rating IP67.

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While the first Programmable Logic Controllers (PLCs) only took care of linking the input and output signals of machines and systems, today's PC-based control technology can take on all the automated functions found in modern manufacturing processes. I/Os, drive technology, safety technology, data inputs, connections to higher-level systems, and even image processing tasks – everything is handled by the central controller. This increase in different tasks explains why control cabinets often have not become more compact, despite the fact that electronics are constantly getting smaller and more powerful – even with safety functions integrated inside them. Often, the opposite can even be observed – additional automated machine functionalities have continuously increased the number of function-specific components in control cabinets.

A conventional control cabinet can usually be divided into different functional areas:

– energy supply, protection, and distribution
– generation and protection of auxiliary voltages
– sequence control with the inputs and outputs
– motor control
– connection level for the field devices

If we compare the control cabinet technology of past decades, it becomes clear that the basic structure, including the areas mentioned, has remained almost unchanged – regardless of the number and size of components. Today, manual processes are still used to place components and establish the electrical connection within and between the individual areas of the control cabinet. In order to dispense with the large amount of wiring effort involved, Beckhoff has recognized that the reduction of effort is only possible in the long term on the basis of uniform interfaces of all devices or functional units. The goal is not only to make the planning and production of control cabinets more efficient through digitization and automation, but also to completely substitute control cabinets in their current form. With this in mind, a modular toolkit – the MX-System – has been developed in which pluggable modules with standardized electrical and mechanical interfaces are interconnected via a base unit.

EtherCAT as the system-wide standard interface

EtherCAT forms the technological foundation for the standard interfaces of the MX-System. Due to its special functional principle – data processing on the fly – this globally established communication standard is ideally suited to this task. EtherCAT is able to connect a large number of I/O modules, drives, and other components to a controller in almost any topology and sequence. Functional safety is also integrated. The highly accurate synchronization of all components in the system is made possible by the distributed clocks of the EtherCAT technology, with which deviations of less than 100 ns are achieved. The extensive diagnostic features of EtherCAT ensure stable system communication, as any faults can be detected, localized, and eliminated at an early stage.

As EtherCAT covers the entire range of data transmission requirements, one bus system is sufficient for internal system communication as well as for external expansions, which can also be connected via EtherCAT P. This is the One Cable Automation extension of EtherCAT technology and involves the transmission of data and power on one line. Within the MX-System, only the power has to be transmitted in addition to EtherCAT, meaning that it is possible to reduce the number of internal interfaces to just two. The first interface includes the
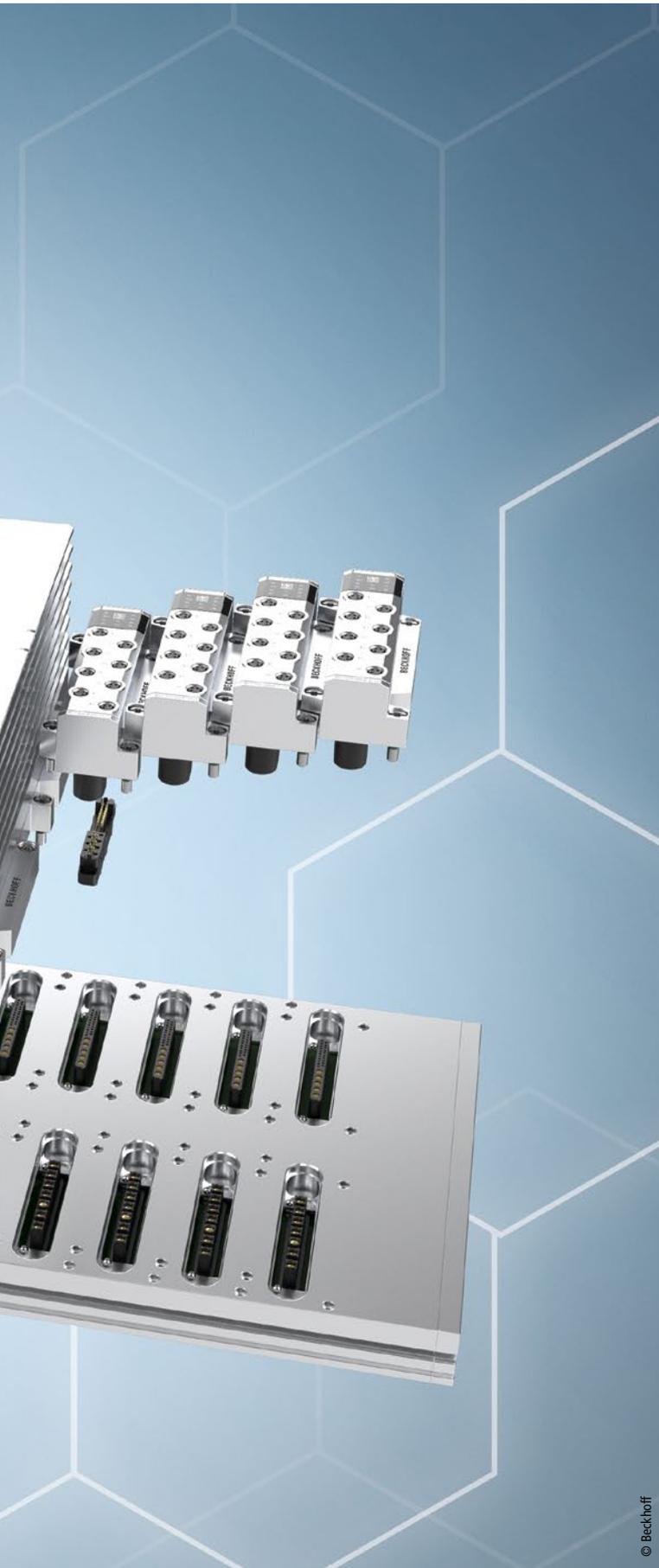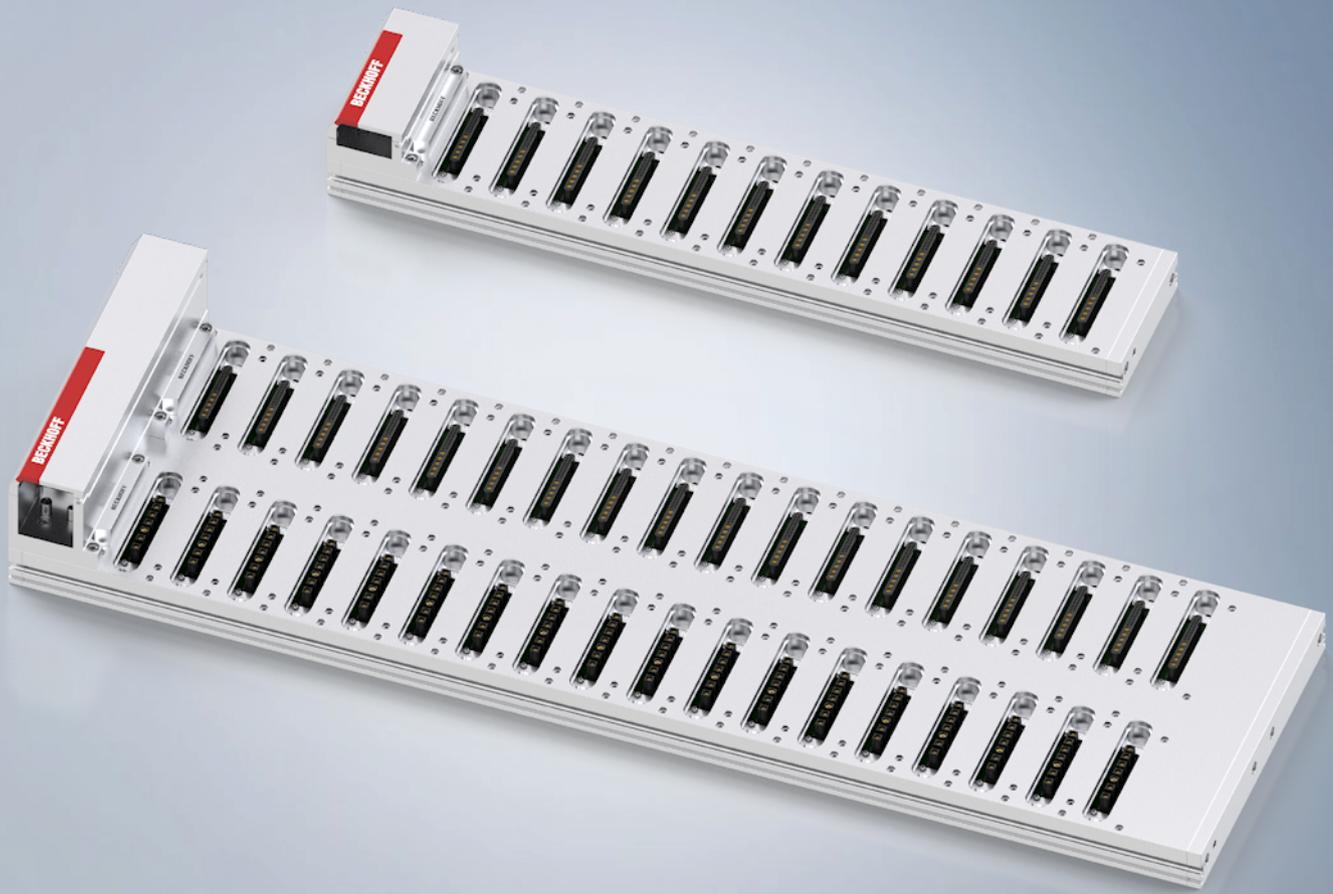
**Different baseplates – with data connectors or with data and power connectors –
can be used to suit specific applications.**

extra-low safety voltages 24 and 48 V DC as well as the EtherCAT protocol. This mix of voltages and signals is brought together on a single data connector. As a second interface, the mains voltage up to a maximum of 530 V AC (3-phase, plus neutral conductor and PE) as well as the drive system's DC link bus with a voltage of up to 848 V DC are output on another connector.

Baseplate concept as control cabinet replacement

The connectors of the MX-System, together with the PCB backplane, are well protected in a robust aluminum extrusion profile onto which the function modules are plugged and screwed in place. This unit, which consists of the housing and electronics, is called the baseplate and, in addition to the mechanical enclosure, also includes backplanes, on the one hand for control voltages and communication, and on the other hand for supply voltages. The combination of baseplate and function modules meets the requirements of protection rating IP67 and is passively cooled within a temperature range of 0 to +50 °C. This eliminates the need for additional protective housings and allows the unit to be

mounted directly on the machine or system. A central, manually installed control cabinet is therefore no longer necessary. To create a complete MX-System assembly, only a single tool is needed to screw the modules to the baseplate.

The baseplate's current carrying capacity of 63 A for power and 30 A for the extra-low voltages for machine safety is able to cover most requirements in automation. The length of the baseplate is initially limited to 1 m and 24 modules. The integrated housekeeping system records environmental parameters such as temperature and humidity as well as vibrations and shocks within the baseplate.

The baseplate is available in different versions. A compact control for direct mains connection can be set up even with the 1-row baseplate with data connectors for the function modules measuring 110 mm in height. The 24 V power supplies and IPCs required for this are included in the function module portfolio. The 2-row baseplates include both data connectors and underlying power connectors. Further baseplate variants will offer, among other things, a hybrid mix
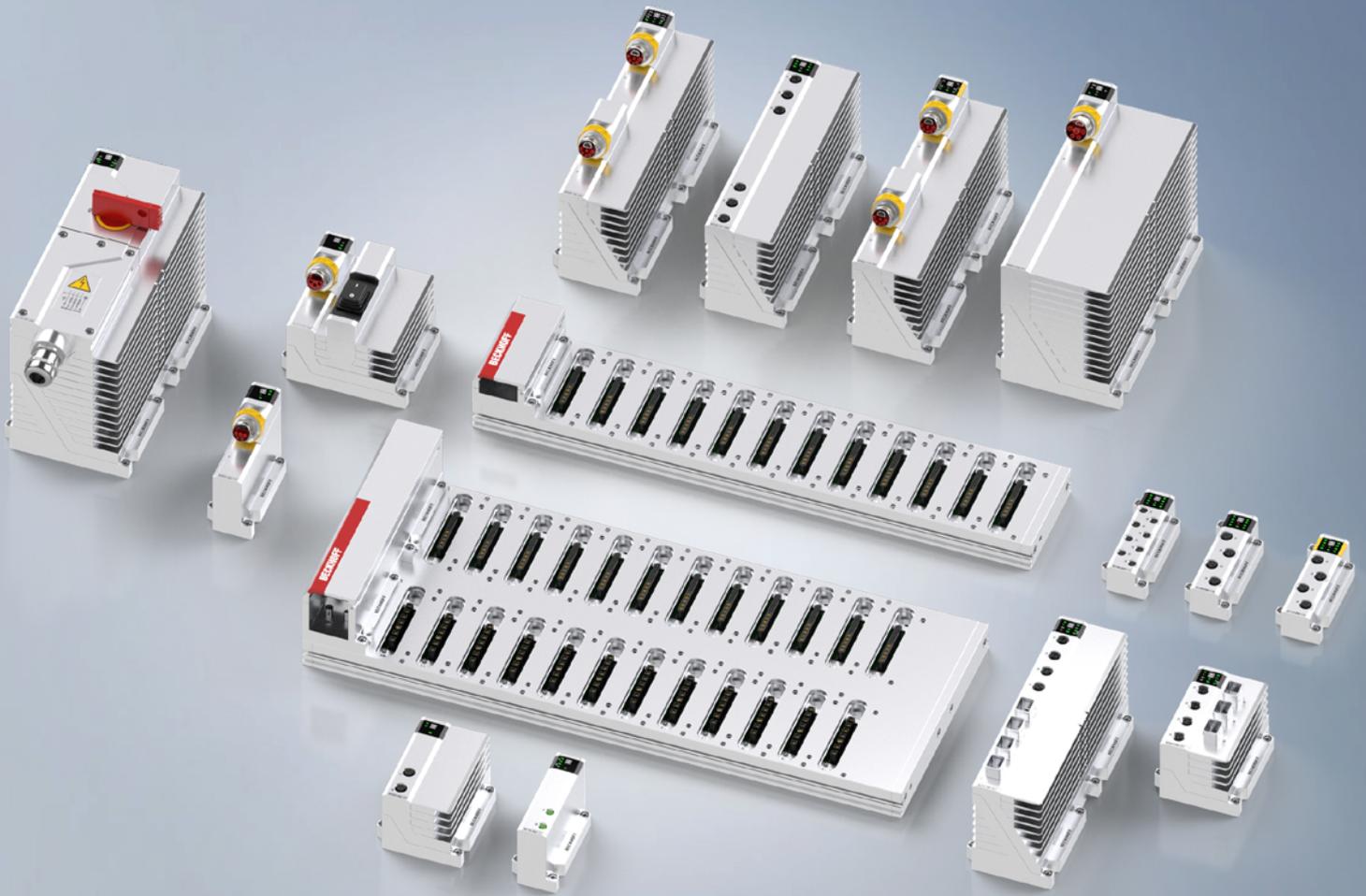
The MX-System is highly modular and can be optimally adapted to the application at hand with a wide range of function modules.

of connectors within the rows as well as an expansion stage with three rows, something that is required for more powerful drive modules.

Modules for all control cabinet functions

The MX-System baseplate replaces the wiring between the components of a control cabinet and in this form is a real innovation in automation technology. The function modules take over the essential properties of the components typically installed in a conventional control cabinet. However, they are not a 1:1 replacement, as several control cabinet functions are always combined into one function module. Each module comes with various features already integrated. These include protection for outgoing lines and the connection level, which is provided via M8 and M12 signal connectors or connectors from Beckhoff's ECP/ENP series if higher power levels are involved. In addition, many power modules provide integrated inputs for the sensors associated with an actuator. These and many other solutions have been developed in close collaboration with leading customers from various industries.

The hot-swappable function modules cover all functions required on a machine and are divided into the IPC, bus coupler, I/O, motion, relay, and system product areas. They are based on the proven range of PC- and EtherCAT-based control and drive technology from Beckhoff. This portfolio has been expanded to include functions for direct switching of 1- or 3-phase AC actuators such as asynchronous motors or electric heaters. The motion product area has been expanded to include frequency converters. Also new for Beckhoff are the system modules that provide the required infrastructure for the control functions. Examples include switching power supplies for 24 and 48 V DC, UPS modules, and Ethernet switches.

In addition, modules with a hybrid design have been developed. These include power infeeds that provide, among other things, the mains connection point, main switch, mains filter, energy measurement technology, residual current measurement and 24 V DC power supply as a functional package in one housing. Another example are EtherCAT P outputs including devices

EtherCAT + 400 V AC, 600 V DC

EtherCAT + 24 V DC, 48 V DC
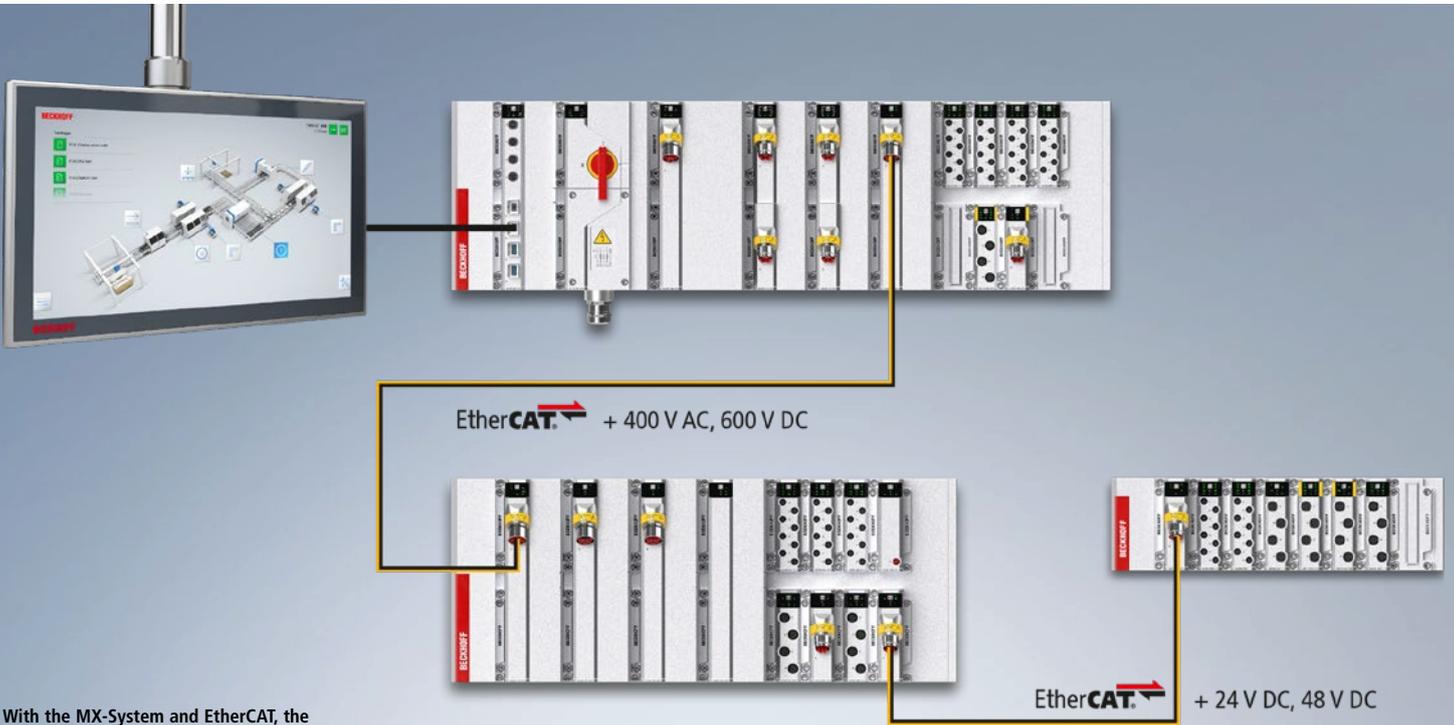
With the MX-System and EtherCAT, the conventional centralized control approach is replaced by a decentralized, distributed control platform.

EtherCAT + 400 V AC, 600 V DC

EtherCAT P + 600 V DC
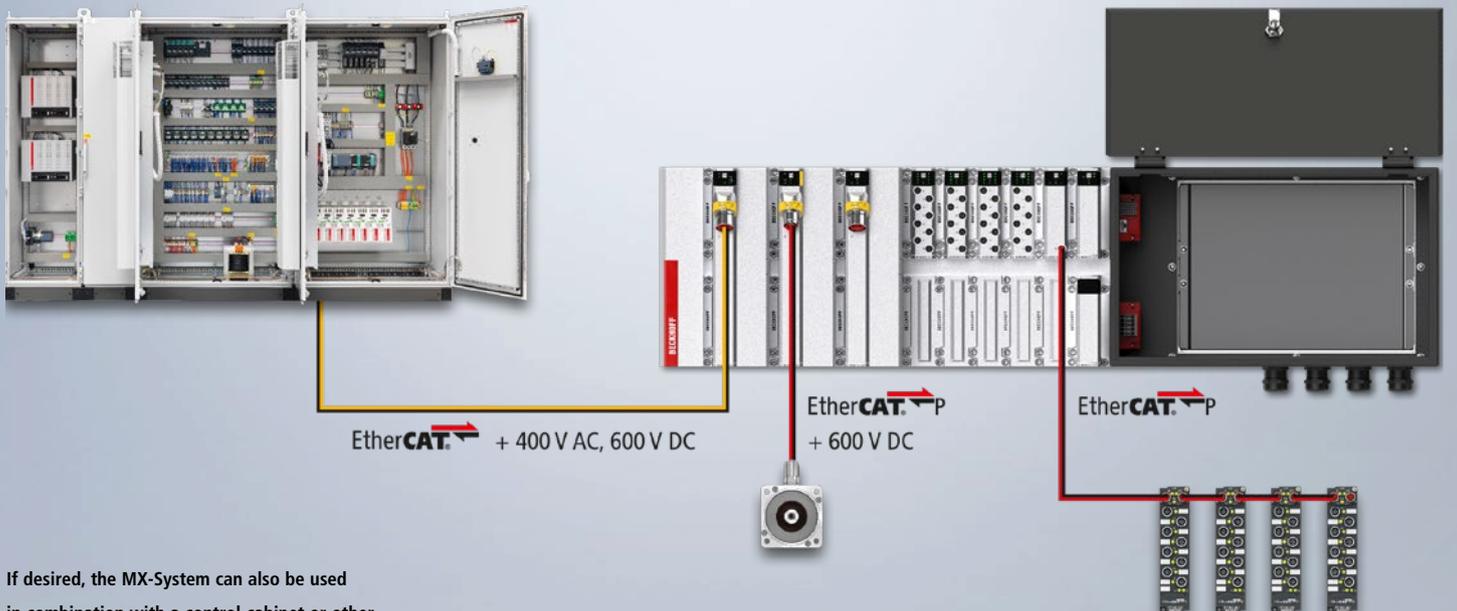
EtherCAT P

If desired, the MX-System can also be used in combination with a control cabinet or other IP67 products from Beckhoff, connected via the EtherCAT or EtherCAT P standards.

for line protection for both the protective extra-low voltages and the low voltages.

In the event that a function needs to be mapped by a device installed in a traditional control cabinet, the baseplate extension function module is available. This extends the baseplate beyond the right side and provides a protected installation space for IP20 devices. Here, both the voltages of the data connector and power connector as well as an EtherCAT connection are provided. Just like all other function modules, the system modules are characterized by the fact that they are EtherCAT devices. This enables high adjustability, actual value evaluation and detailed diagnostics directly from the machine control.

Advantages for machine builders

The inherently modular MX-System significantly reduces the planning effort and the required number of components for the machine builder in the design phase. According to initial experience, the scope of the circuit diagram and the work involved are reduced to only 20% in some cases. This will also be reflected in a corresponding reduction in overall costs.

Machines and systems can also be designed to be much more space-saving and application-specific. Machine builders can mount the compact MX-System directly on the machine, which eliminates the need for a separate control cabinet with its own cable routes. This reduces the overall installation effort, especially in conjunction with pre-assembled cables. In addition, the pluggable installation can be handled by a mechanic rather than specialized electricians only. Machine modularity, which is now an absolutely essential prerequisite, is also consistently and optimally supported by the MX-System as it can be distributed across the machine in modules.

Certification is another important aspect from a machine building perspective. The MX-System is a control cabinet replacement that complies with the relevant control cabinet standards and, unlike conventional cabinets, is already IEC, UL and CSA-compliant, making it a globally standardized solution. The machine builder can therefore manufacture from stock without any problems and does not have to consider which target country the machine is intended for when assembling it for delivery.

Advantages for control cabinet construction

The control cabinet and panel builder industry is set to benefit enormously from the simple plug-in solution that eliminates complex individual wiring. For example, a control cabinet assembly process that previously took 24 hours can now be reduced to approximately one hour of system installation. In addition, the significant risk of wiring errors, especially in the case of sophisticated control cabinets, is avoided. The error-prone individual production processes that the control cabinet builder previously had to carry out manually have now been transferred to the prefabricated functional modules.

There are also advantages for control cabinet construction from a logistical point of view. Analyses have shown that, in some cases, 90% of previous parts list items required for classic control cabinets are no longer needed. Furthermore, many machine builders will be able to simplify their logistics processes, since this easy-to-install technology often eliminates the need for external control cabinet construction.

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Daniel Siegenbrink, Product Manager MX-System, Beckhoff Automation

Advantages for the machine end user

One major diagnostic advantage compared to the classic control cabinet is that the MX-System only uses networked components. This means that the status of each individual circuit breaker, power supply or main switch module, for example, can be queried at any time – as would normally be the case for a device in an EtherCAT network. As part of the new Beckhoff Device Diagnostics, the familiar extensive diagnostic options of EtherCAT are supplemented by a serial number that is unique for each module. This is placed as a data matrix code on the front of the module and can be scanned using a smartphone app. The smartphone connects to the controller by wireless technology and displays the respective diagnostic data, such as the module status or error memory. In this way, the smartphone becomes a "universal digital voltmeter and scope", which goes above and beyond simply replacing traditional measuring devices. Maintenance and service technicians benefit from precise information about the state of a function or assembly without having to measure up the hardware. This has an overall positive effect on plant operation.

Simplified maintenance and servicing offer many advantages for the operator of machines and systems, e.g. repairs take significantly less time, as the maintenance engineer can identify the fault location (e.g. cable or module) with the aid of the device diagnostics. The pluggability of the modules makes it easier to replace them if necessary. The hot-swap functionality even enables this during operation. The encapsulation of individual functions in a function module brings the additional advantage of only a few spare parts that need to be stocked. The complete EtherCAT networking of the system ensures that the requirements of modern predictive maintenance management are fully met. All in all, it can be seen that the individual advantages resulting from the use of the MX-System reflect the requirements of both machine builders and machine operators, thus paving the way for a future without control cabinets.

More information:
www.beckhoff.com/mx-system

Automation Technology for Robotics (ATRO): The modular industrial robot system

The perfect robot for every application

Beckhoff has launched a breakthrough concept for robotics applications in the form of ATRO. This exceptionally flexible, modular system allows users to put together robot kinematics that fit their application perfectly. A highlight of the system is the internal media feed for data, power and fluids, which provides endless rotation capabilities to all robot axes.

ATRO enables users to create almost any robot design for their application from the available modules – from a simple 1-axis rotary indexing table application or delta kinematics through to multi-axis articulated robots. The holistic approach of the Beckhoff technology plays a key role in user-friendly commissioning and handling, not least because the direct integration of the robot system into the PC-based control platform is the only way to create a truly optimized and complete solution for a machine or plant. This reduces the number of controllers needed to just one industrial PC, even with multiple robots.

Exceptionally diverse kinematics with internal media feed

ATRO kinematics are made up of active joints in the form of motor modules. The motor modules are available in different designs: straight modules in I-shape or angled modules in L-shape, which are available in five power classes. Each motor module forms a complete drive system for one axis of the robot – i.e., all of the electronics needed to control the axes are built into the modules, including an EtherCAT-based servo drive, the motor complete with brake and a highly compact gearbox. This reduces the control requirements to just one controller or else integrates it into the existing machine control system. It also means that the only external components required are a power supply and a control system, which significantly reduces the space required in the control cabinet.

In addition to the active motor modules, the following connection modules without drives are available:
– base modules for mounting, including media feed
– link modules with I, L and Y-shapes for implementing individual robot configurations
– system modules that can be used to integrate additional functions such as a camera

With all these components, optimal robot structures can be assembled for a wide variety of applications on an individual and flexible basis. After all, not every application requires a 6-axis articulated-arm robot, for example. A pick-and-place task will often get by with four degrees of freedom and so only requires four axes. Saving on two drive axes in this way not only cuts costs, but also reduces the weight and increases the permissible payload accordingly. In addition, the same motor and link modules can be used to assemble completely different kinematics, which minimizes variance in the inventory and increases flexibility. This is especially the case since the standardized motor modules, together with link modules in various designs and lengths, enable almost limitless mechanical combinations for users to implement their own kinematics. These include:
– 1-axis rotary indexing table with integrated power feed
– 2-axis tracking unit
– 3-axis delta robot
– 4-axis pick-and-place robot
– 5-axis palletizing robot
– 6-axis serial robot
– 7-axis system to increase the reach/articulation for hard-to-reach areas

All modules used are interconnected via the ATRO interface, which guarantees a rigid mechanical connection and passes through the media that is fed in. Data,

With ATRO, a robot/cobot solution can be adapted precisely to the task at hand with any number of axes, and is freely scalable, modifiable and expandable..
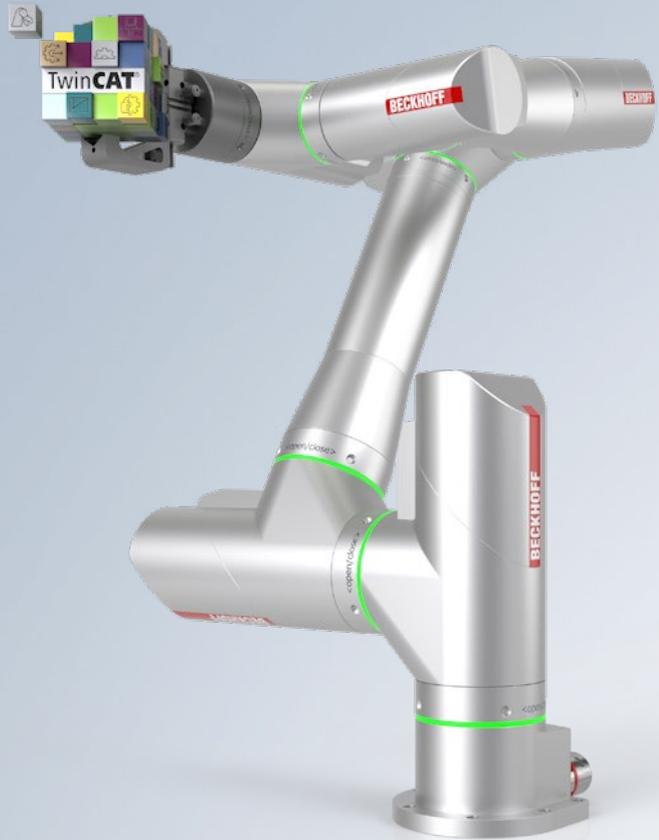
Above left: Internal media feed from the base to the end effector

Left: The internal media feed allows endless rotation for all axes.

Above: With ATRO, users benefit from optimally matched hardware and software components from a single source.

power and fluids (compressed air, vacuum or water) can therefore be guided internally through the modules in the ATRO kinematics. Conventional robotic solutions, on the other hand, route media externally and are therefore limited in rotation and use of the workspace. These limitations are completely eliminated with the Beckhoff solution – each axis can be rotated endlessly, which enables better Cartesian accessibility as well as short positioning paths. Furthermore, interfering contours (due to externally located cables, for example) and interfering torques (especially in the case of cobots) are avoided by eliminating external media feeds.

The media is also supplied again via the ATRO interfaces, and virtually any robotic tools can be integrated with ease, including mechanical, pneumatic or electric gripper systems. Another major advantage is that all media feeds are designed in a way that preserves the endless rotation of the axes right through to the end effector.

System integration without limits

With ATRO, Beckhoff offers a highly flexible robot system that provides all essential machine functionalities due to its deep integration into the TwinCAT automation software. These include image processing for sophisticated applications (such as bin picking), optimized motion performance through machine

ATRO interface on all motor, link and base modules
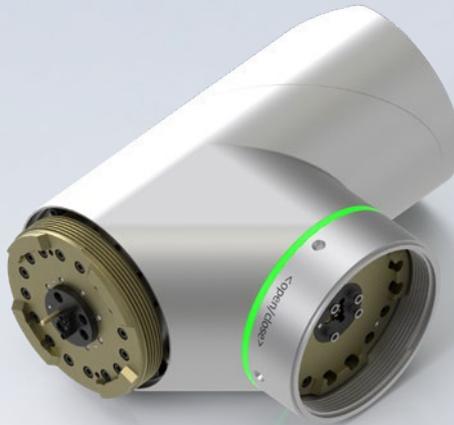
learning, and direct cloud integration for analysis and maintenance. The use of open interfaces and universal standards enables plug-and-play operation of the user's robot configuration and simplifies engineering.

The great scope of functions concentrated in a single control platform not only minimizes hardware costs, but also ensures maximum synchronization of all components and minimal delays in data communication. This even includes the direct combination with intelligent transport solutions such as XTS and XPlanar. Other areas such as communication, functional safety and the actual application can be integrated with little effort. This approach not only enables the configuration of an extremely powerful overall solution with maximized productivity, but also a previously unattainable reduction in machine footprint.

The ATRO product management team (from left to right): Dr. Guido Beckmann, Uwe Bonin, and Thomas Rettig

By expanding the Beckhoff portfolio with the ATRO modular plug-and-play robotics system, machine builders and end users have the opportunity to implement fully integrated automation solutions for the first time. The benefits of the holistic system concept are twofold: First, it features optimally matched hardware and software components from a single source, from the machine's power supply to cobot-enabled modules. Second, all functions such as robotics, PLC, vision, safety, cloud connectivity and machine learning are fully integrated on a single control platform.

Flexibility and openness for real investment security

As a seamlessly integrated control component, ATRO marks a real turning point in the development of robots and enables machine builders to offer production-ready machines with fully integrated robotics and their own kinematics. The modular and scalable features of the complete solution ensure both the future compatibility and investment security of the machine. The robot can be used flexibly on different machines and the application can be easily adapted to new tasks.

The key feature is absolute freedom in the robot or cobot configuration. After all, the scalable and easily pluggable motor and link modules make it possible to implement individual robot solutions combined with the capacity to be expanded and modified at any time. Machine builders benefit from the flexibility to imple-

ment their own kinematics, while end users can quickly and easily adapt their robotics solution to changing production conditions at any time. The process for modifications is extremely efficient: the respective structures are scanned by the control system and the TwinCAT robotics functions automatically create the corresponding new control application – including a digital twin.

In terms of the control architecture, ATRO benefits from the familiar open structure of the Beckhoff PC-based control technology. The ATRO system, which comprises a complete robot system that meets the requirements of the corresponding EN ISO 10218-1 standard, can be connected to all conceivable interfaces in cell or plant communication (PROFINET, EtherNet/IP, OPC UA) or to a cloud solution. As a high-performance communication system, EtherCAT is used to control the modules in sub-millisecond cycles. The many benefits of this also include easy integration of I/Os and feed axes.

More information:
www.beckhoff.com/atro

Beckhoff Vision: Hardware portfolio complements TwinCAT Vision software

Cameras, lenses and illumination for a complete control-integrated vision solution

As a specialist in PC-based control technology, Beckhoff is constantly looking at ways to integrate all machine functionalities consistently into a single control platform. This also includes image processing on the software side since the launch of TwinCAT Vision in 2017. With the introduction of the comprehensive Vision hardware portfolio, this product area is now complete.

Beckhoff Vision offers machine builders and end users a complete image processing system that covers all the necessary components from software to illumination. Seamlessly integrated into EtherCAT-based control technology, it opens up significant competitive advantages for users, including highly accurate synchronization with all machine processes, reduced engineering and hardware costs, and simplified commissioning and support. In addition to TwinCAT Vision software, the vision portfolio now also includes the following hardware components:

– the VCS2000 area-scan cameras
– the rugged VOS2000 and VOS3000 C-mount lenses
– multicolor LED illumination in bar, panel and ring designs (VIB2000, VIP2000 and VIR2000)
– the complete units (Vision Unit Illuminated, VUI) consisting of camera, illumination and focusable optics

Optimal design and concept for industrial image processing
From the very beginning, the development process at Beckhoff was focused on ensuring optimum suitability for industrial use – both with respect to the individual vision components and the entire image processing system. Relevant design aspects include the IP65/IP67 anodized aluminum and tempered glass housing, smooth glass surfaces providing high resistance to cleaning agents and other chemicals, various options for flexible mounting and application, and optional shatter protection. Further advantages are offered by the in-house vision development and production facilities at Beckhoff, which ensure a first-rate complete solution in terms of technology and quality, where every aspect is perfectly coordinated.

Seamless integration – not only of the individual hardware and software components to form a complete system, but also with the machine control system – opens up huge application potential for industrial image processing and, conversely, optimization potential for machines and systems. It also means that the vision system can be synchronized highly precisely with all control processes and machine sequences. Implementation in the standard automation application also enables consistency in the interaction of all other components. In addition, the camera system and illumination components can be mounted either separately or together as an integrated unit, depending on the application requirements. The integrated concept also offers significant advantages from a

The new vision hardware components from Beckhoff impress with rugged, attractive design as well as high scalability and long-term availability.

Bernd Stöber, Senior Product Manager Vision, Beckhoff Automation

project planning perspective: it reduces the engineering effort and hardware costs, and simplifies system integration, commissioning and support.

The implementation of real-time applications is also perfectly supported and facilitated by full integration into the EtherCAT system. For example, it is possible to achieve simplified and synchronized trigger generation for image capture and exposure directly from the system. In addition, the vision system can be linked and synchronized easily with all control processes and cloud-based services, and utilize all the usual benefits of powerful and convenient EtherCAT diagnostics. Overall, from a machine perspective, these factors result in increased process efficiency through shorter response times, higher cycle rates and accelerated processing procedures, all with reduced hardware and wiring effort as well as a minimized installation space and system footprint.

Powerful cameras for exact evaluations

The area-scan cameras from the VCS2000 series use color and monochrome CMOS sensors with up to 24 megapixel resolution to generate high-quality data for industrial image processing. A wide portfolio of established Sony sensors with 3.45 µm and 2.74 µm pixel pitch is available for different vision tasks and image analysis functions. With their high frame rates and rapid 2.5 Gbit/s image data transmission, the cameras are ideal for automated visual inspection and precise product tracking in EtherCAT-synchronized applications.

The cost-effective 2.5 Gbit/s transmission rate enables the performance potential of the cameras to be fully exploited: It is a prerequisite for efficiently utilizing increased frame rates and achieving extremely fast response times via industrial LAN technology with any cable lengths. What's more, this makes the vision system a perfect match for the powerful industrial PCs from Beckhoff.

The rugged, industrial-grade cameras support the established international GigE Vision standard and can be used flexibly over a wide temperature range. The lens protection tube with thermally hardened anti-reflective glass ensures the invariability of the focus position and provides high resistance to cleaning agents and handling effects without the need for additional housing. Flexible mounting options and the small installation depth (incl. connections) in the optical axis also offer exceptional freedom of machine design.

Robust C-mount lenses with mounting-oriented design

The high-resolution lenses of the VOS2000 and VOS3000 series, which can be used universally due to the C-mount connection thread, are ideal for use in harsh industrial environments on account of their rugged and easy-to-mount design. The focus and fixed aperture are easy to adjust and can be locked easily and precisely using compact screws. The lenses also feature a broadband anti-reflective coating from 420 to 1050 nm, which is well matched to the multicolor LED illumination. Moreover, vibration and shock resistance up to 10 g enable reliable measurements in the visible and near infrared range.

Two lens series are available: The VOS2000 is optimally designed for image sensors up to a format of 2/3 inch (11 mm) while the VOS3000 is ideal for maximum image resolution with an image circle up to 1.2 inch (19.3 mm). In addition to the generally available broadband anti-reflective coating from VIS to NIR, the VOS3000 series offers excellent chromatic aberration correction in the spectral range up to 850 nm for the large image circle.

Flexible, high-precision and energy-efficient illumination

The multicolor LED illumination components in three designs – bar (VIB2000), panel (VIP2000) and ring (VIR2000) – produce constant lighting conditions for

The rugged, industrial-grade cameras can be used flexibly over a wide temperature range and are also available in IP65/67 housings with lens protection tube.

With Beckhoff Vision, industrial image processing is holistically integrated into machine and system control.
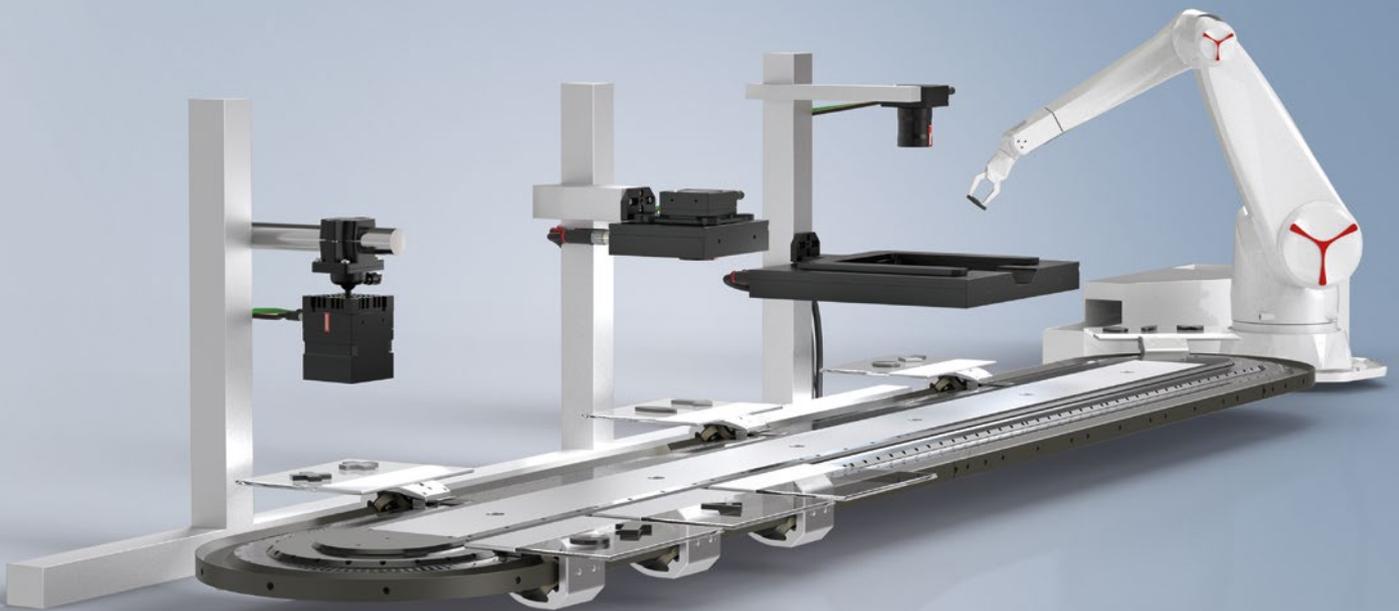
The multicolor LED illumination components in three designs (here: VIP2000 panel design) provide an indispensable basis for precise evaluation in image processing.

The new vision hardware portfolio also offers an all-in-one approach with the VUI units, which combine a 2.5 Gbit/s camera, multicolor LED illumination and optics in one assembly.

Handling of the lenses is optimized by two grips for easy adjustment, two rotatable fixing rings for focus and aperture, and two M3 fixing screws for secure locking.

consistently high-quality images. This provides an indispensable basis for precise evaluation in image processing. The illumination creates the best possible contrast between the feature to be inspected and its surroundings – even in spectrally adjustable pulse mode.

The light color of an illumination assembly can be adusted to object-specific requirements in terms of color and brightness. Mixing the individual color channels makes it possible to produce spectrally complete white light. The direct integration of the power electronics into the illumination assembly achieves a high level of brightness, which is essential for reliable freezing when capturing highly dynamic movements. Full integration into EtherCAT allows users to make individual settings in terms of light color, brightness and triggering for each individual test object.

Furthermore, high-precision control and efficient electronics minimize energy requirements. The EtherCAT P one-cable solution with distributed clocks function and the responsive power electronics enable high-precision synchronization with all machine processes and help avoid unnecessary illumination times. Blue LED chips form the basis for high light output and temperature stability, as well as increased efficiency at high ambient temperatures. The EtherCAT-controlled flash mode reduces the power supply output along with the required cooling effort while decreasing the overall energy consumption for the illumination.

Complete solution with focusable optics

The Vision Unit Illuminated is a compact unit consisting of camera, illumination and focusable optics with liquid lens technology. It significantly reduces installation and commissioning effort and, due to focus adjustment during runtime,

is particularly suitable for applications with variable component heights, such as those found in logistics. All functional components are encapsulated in a visually appealing anodized aluminum housing with IP65/67 protection rating. The thermally hardened and anti-reflective glass ensures high mechanical and chemical resistance in cleaning and handling. The VUI's EtherCAT P connection is positioned on the side and allows mounting with small installation depth in the optical axis, while large mounting surfaces ensure good heat dissipation. The dedicated ground connection, also located on the side, makes it easy to implement grounding and EMC concepts.

For image acquisition, the PLC controls all settings of the individual functional components (camera, illumination, lens) via EtherCAT during runtime – to a high level of precision and in exact synchronization with all processes in the application. For example, electronic adjustment of the focus position means that the focus is adapted directly to different working distances. The light color as well as the intensity and length of the light pulse or the parameters of the camera for image acquisition can also be controlled via EtherCAT. Focusing during runtime is made possible by a robust, position-invariant liquid lens that has very high shock and vibration resistance as well as an extremely long service life due to the high number of cycles.

More information:
www.beckhoff.com/vision

PC-based motion control on a labeling machine for the pharmaceutical industry

Central motion control facilitates modularity and reduces overall effort

The ME8081 magazine unit from Bausch+Ströbel can be used in a host of applications, including to magazine ampoules, cartridges, and vials with piece-count accuracy.

The CP3918 multi-touch Control Panel with 18.5-inch display is installed on a mounting arm and makes the ESA1025 labeler easy to operate.

© Bausch+Ströbel

For more than 50 years, Bausch+Ströbel SE + Co. KG, headquartered in Ilshofen, Germany, has been developing packaging and production systems for the pharmaceutical and related industries. The company's goal is to offer the best technical and economical solutions for the challenges of the modern market. The new ESA1025 labeling machine for various pharmaceutical containers shows exactly how this is implemented with PC-based control from Beckhoff as the central motion controller.

High-quality liquid and powdered pharmaceuticals are filled into syringes, vials, cartridges, and ampoules on Bausch+Ströbel filling and packaging lines worldwide. The process starts with cleaning and sterilizing the objects and extends to labeling and syringe assembly. The ME8081 magazine unit, for example, contributes to the optimization of products and processes by efficiently and accurately storing vials and other essentials. The machine usually forms the end of a filling and packaging line, especially for the high-performance range with correspondingly large output and

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A typical pharmaceutical vial that has to be handled quickly and as gently as possible.

The way the vials are handled within the labeling machine is designed to ensure that neither the object nor the applied label is damaged, based on advanced features including the high-performance motion control.

high process reliability, and can also be combined with testing equipment or object printing.

Modular label dispenser with servo drive technology

Self-adhesive labels on a roll are used for labeling vials and similar pharmaceutical containers. In a bid to ensure these can be applied particularly quickly, accurately, and with process reliability, the ESA1025 labeling machine has now been equipped with a new modular label dispenser. The associated benefits are manifold, including precise and gentle labeling, fast tool-free changeover to other object and label sizes, and even increased print quality through servo drive technology from Beckhoff. At the same time, the system is extremely compact, as the entire electrical system and control components have been integrated into the machine to save space.

The high control technology requirements can be seen in the complexity of the process flow alone:

–   Object transport in the system: The vials are transported in via an infeed screw, which is engaged and disengaged on the main star while the system is running – at a reduced speed due to the mass inertia. The main star can have different star pitches (ratios) depending on the object size, which is relevant when coupling with the inlet screw and the electronic cam switch. The outfeed wheels are mechanically coupled to the main star and have no drive of their own.
–   Accumulation: This is operated at a constant speed derived from the label dispenser. Good synchronization is required here to avoid wrinkling.

–   Labeling: The label dispenser is operated in a cycle – i.e., the gearless label web feed is restarted at full speed every 75 ms. The label web feed is stopped by means of a sensor, which detects the gap between the individual labels. A special logic ensures that correct positioning takes place even in the absence of labels (missing triggers). The servo drive of the label tape feed generates different, highly accurate trigger signals that are required to control the vision and printing systems.
–   Options: If required, an additional drive can be integrated to decouple the printing from the labeling process and thus enable a continuously running label web. For all-round vision inspection, it is also possible to ensure that the objects are continually rotated at the same angle at any machine speed by means of a rolling system coupled to the main star via electronic gearing.

Gerald Kreft, programmer in the Software Development/Standardization department at Bausch+Ströbel, explains further special features that are important for transporting pharmaceutical containers: "The ESA1025 labeling machine can also process objects with very thin walls (such as vials) and/or fragile (like ampoules with a crushing ring). It is also essential to ensure that the labeled object shows no signs of cosmetic damage (in terms of the imprint, for example). This is precisely why the through transport has to be as 'stress-free' as possible." When it comes to labeling, it is essential to support the current trend of moving away from paper-based substrates toward substrates made of plastic with the thinnest possible walls, as Gerald Kreft goes on to note: "Substrates made of plastic are much more unstable, by which I mean

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**The new ESA1025 labeling machine combines
all servo axes in a central TwinCAT controller.**

more prone to stretching, than their paper counterparts. This trend makes high-speed processing much more difficult. With our new label dispenser, however, the printing can be decoupled from the labeling process via a separate servo drive, which allows us to achieve fast and accurate positioning of the printing even with plastic substrates."

Benefits of the central control architecture

In the previous model of the ESA1025, the servomotors for the label dispenser and for the through transport were each controlled via separate servo drives. Gerald Kreft explains the optimization potential offered by central motion control implemented with PC-based control as follows, "Separate controls meant having to establish, manage, and maintain several communication paths. There were also several software projects that had to be handled and documented separately. By merging all servo axes into a central TwinCAT controller and achieving a higher degree of standardization, we are able to achieve a lower overall cost here. In addition, PC-based control from Beckhoff makes optimum use of the already limited installation space due to the integrated control cabinet."

The ESA1025 stands out in particular on account of its super-fast label dispenser, which is capable of handling up to 48,000 units per hour. As Gerald Kreft points out, "The actual maximum output that can be achieved depends on the material being processed, such as the vial size and label length; however, the new dispenser makes it possible to cut right down on the dependence

on the label material. The consolidation of all servo drives in a central motion controller was essential for this, and as mentioned, with minimized space requirements." Another advantage is the modular design, both in terms of software and hardware. This means that the labeling system can easily be used on other types of machines. It also means that further drives for special solutions could be integrated without much effort if required, in the case of an object transfer to a downstream machine, for example.

The core of the centralized motion control system is formed by a Beckhoff CX2062 Embedded PC with 8-core processor and TwinCAT software as well as the AX8000 multi-axis servo system. The latter features a modular design consisting of an AX8620 power supply module and three AX8206 dual-axis modules, which control the OCT servomotors in the AM8000 series. The range of PC-based control systems used is rounded out by various EtherCAT Terminals and the operating unit, consisting of a CP3918 multi-touch Control Panel and the C6930 control cabinet Industrial PC connected via the single-cable solution CP-Link 4.

More information:
www.bausch-stroebel.com
www.beckhoff.com/packaging

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Controlled by PC-based control, the SEALPAC Traysealer A7max achieves a high processing capacity of up to 120 packages per minute.

PC-based control and drive technology in packaging machines for the food industry

Open and integrated automation unlocks optimization potential

SEALPAC GmbH, a globally active manufacturer of food packaging machines headquartered in Oldenburg, Germany, found that their old automation technology had reached its limits. The open and integrated PC-based control system solution from Beckhoff brought SEALPAC up to speed, and in the process uncovered a variety of options for optimization in engineering and machine operation, with full conversion achieved at just 14 months.

Thomas Hegeler, project manager at SEALPAC, confirms that PC-based control and drive technology can be implemented quickly: "The control system for the entire packaging cycle, including the safety application, took a mere six months to convert, meaning that we could start delivering packaging machines to customers in just over a year. We have implemented this for a variety of systems, including our Amax tray sealer series, and will successively replace the control technology in our other machine types as well."

The Amax series tray sealers are high-performance machines for automated food packaging in a variety of performance classes. Machines need to be able to reliably process sustainable materials, which are becoming increasingly lightweight, but equally, they must also be efficient, economical and precise. This means that the demands in terms of machine technology are constantly growing, while the operation and maintenance of the machines need to be simplified.

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The customized stainless steel multi-touch control panel (the CP3918 for the A6max is shown here) and the display created with TwinCAT HMI enable optimal machine operation.

SEALPAC offers solutions for a wide variety of food products and packaging.

PC-based control for more efficiency

PC-based control is an open, integrated and, above all, tried-and-tested system for control and drive technology that provides the perfect solution to elicit more efficiency in machine automation. Thomas Hegeler explains the impetus for SEALPAC: "We needed end-to-end automation, right up to the HMI, to provide a holistic machine concept with a wide variety of machine types. The technology that we had at that point was holding us back from reaching this goal. PC-based control has significantly reduced the time and integration work here."

Beckhoff Sales Engineer Thomas Kaiser clarifies a particularly important aspect here: "PC-based control can be finely scaled and thus optimally adapted to the respective application, and even to more stringent requirements later on if needed. For the tray sealers, for example, an industrial PC with the average

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Thomas Hegeler (right), project manager at SEALPAC, and Thomas Kaiser,
sales engineer at Beckhoff, in front of the A6max tray sealer

processing power of an Intel Atom® processor would suffice, but a C6032 ultra-compact Industrial PC with Intel® Core™ i5 CPU is used due to the powerful HTML5 visualization implemented with TwinCAT HMI." In particular, visualization and machine data processing are of great importance to SEALPAC, as Thomas Hegeler confirms: "This is a main focus for us, which will certainly lead to heightened control requirements in the future. As a modular software platform that is also easy to use, TwinCAT offers all possibilities, e.g. with functions for motion, HMI, vision and machine learning. In addition, the hardware can easily be scaled, meaning that if we need to, we can simply use the C6032 with a more powerful processor without having to change the IPC form factor and thus the machine design."

Packaging machines need to be extremely capable, especially in the motion sector. With EtherCAT-based drive technology from Beckhoff, SEALPAC was able to improve here in three aspects, according to Thomas Hegeler: "Overall, working with the Beckhoff experts, including our direct contacts in product development, was a huge advantage. In drive design, which is incredibly complex, this has really paid off and has cut development time massively. The second aspect is the high quality and performance of the Beckhoff drive technology – the AX8000 multi-axis servo system and AM8000 servomotors. With our previous servo technology, we had reached our limits in terms of speed. Thirdly, we need fewer types of motors and, with the AX8000 system, we have machines that are

suitable for all voltages worldwide, up to the 200 V/3-phase grid in Japan. This also resulted in a significant reduction in inventory."

Convenient machine operation as an important criterion
Optimum machine operability is a crucial for SEALPAC. Customized CP39xx stainless steel multi-touch Control Panels from Beckhoff are used as hardware to assure this, with a 15.6-inch display for smaller machines and an 18.5-inch version for larger systems. Thomas Hegeler explains: "Multi-touch, high-quality full-HD graphic displays and a CI-compliant design with labeling and matching push button extension constitute clear quality criteria for us in machine building. Their importance will definitely grow in the future, due to the increased use of graphics and animations and the increasing prevalence of smartphones and how they shape operators' expectations and habits. In some instances, machine operators already have a say in choosing machinery."

Thomas Kaiser describes some of the implemented customer-specific features of the control panel: "One requirement was to be able to easily integrate SEALPAC's own RFID solution. This was easy to implement with minor adjustments, based on our standard housing. Furthermore, the housing, including the stainless steel mounting arm adapter was precisely matched to the appearance of the sandblasted machine housing by sandblasting it with the appropriate grain size."

The basic prerequisite for fast and smooth visualization is sufficient computing power, as provided by the C6032 ultra-compact Industrial PC. According to Thomas Hegeler, the extremely compact design swung the decision, as control cabinet space is always in short supply. As a modular IPC variant with scalable interface and function extensions, the C6032 also offers excellent connection adaptability for future system additions and has proved its worth in this application by running without any failures.

Fast EtherCAT communication, efficient One Cable Technology

With regard to data communication, PC-based control from Beckhoff also offers numerous application advantages for SEALPAC. The system's openness and the wide range of EtherCAT Terminals make it easy to integrate third-party components, such as valve terminals, frequency inverters, and IT into the control technology. In Thomas Hegeler's experience, EtherCAT has also made good on its claim of being the fastest Industrial Ethernet system on the market, demonstrating this in practice with its excellent performance.

The EtherCAT-based servo drive technology from Beckhoff also simplifies machine design in other ways, clarifies Thomas Hegeler: "One Cable Technology (OCT) from Beckhoff significantly reduces the time and material required for cabling. In addition, the machine looks far cleaner and is more ordered. In addition, the electronic identification plate makes commissioning easier." Customization also played an important role here: "The motors that we had previously used were connected in the classic way, via two cables, but the cables were very thin, making them easy to lay within the machine. However, in close cooperation with Beckhoff, a comparable solution was found here for the OCT motor connection cable: since the motors do not require brakes, two cable leads could be dispensed with, thus reducing the cable diameter. Furthermore, a motor connection plug angled at 60° has been developed, which saves additional installation space. All of this has helped us a lot."

Future-proofed with PC-based control

The continuous further development and portfolio expansion within the scope of PC-based control offers an additional high level of investment protection with a view to future machine requirements. Beckhoff's TwinCAT/BSD operating system is included in the latest product innovations that SEALPAC will test. It was designed as a multi-core-capable, Unix-compatible operating system for TwinCAT 3 real-time applications and unites the advantages of Windows CE, namely that it is low cost with a small footprint, with the numerous features of the major Windows operating systems. Thomas Hegeler states: "We see the advantages here in the high performance, despite the small footprint, and in gaining independence from Windows, which some customers want for security reasons, among other things."

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Above: The AX8000 multi-axis servo system, in conjunction with the AM8000 dynamic servomotors, ensures that the packaging processes are run with precision.

Below: The C6032 ultra-compact Industrial PC offers sufficient computing power for both machine control and powerful visualization.

More information:
www.sealpac.de/en
www.beckhoff.com/packaging

PC-based control and drive technology in a packaging line for microbatteries

Only high-precision labeling reliably puts hearing aid batteries into a deep sleep

When packaging products as small as microbatteries, it goes without saying that precision is just as important as speed and efficiency. This is particularly true of hearing aid batteries, which can only maintain their performance by being hermetically sealed with a label to keep them in a state of deep sleep until they reach the end customer. High-precision labeling processes are key here, and this is precisely where KOCH Pac-Systeme comes in with its packaging line equipped with Beckhoff technology for the end customer VARTA.

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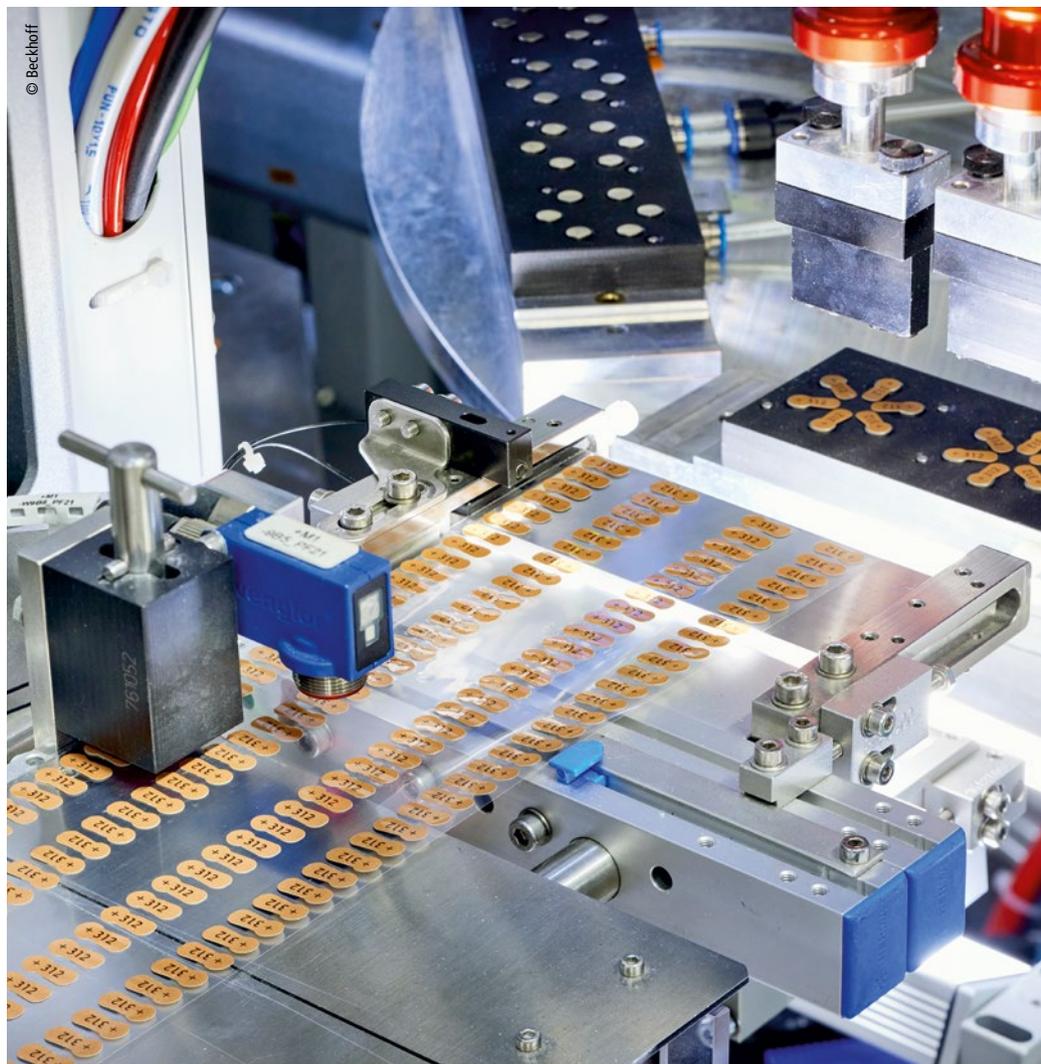
Feeding and applying the label to the microbatteries in the workpiece carrier

A mere overview of the production line, which measures around 20 x 6 meters, gives an idea of the complexity of the packaging process for hearing-aid batteries.

Pfalzgrafenweiler-based KOCH Pac-Systeme GmbH is a member of the Uhlmann Group and has been developing and implementing customer-specific, modular blister machines and packaging lines for the consumer goods, healthcare, and contact lens sectors for over 50 years. This also includes microbatteries, as in the case of the complete packaging line for VARTA in Ellwangen. The internationally active specialist in microbatteries for a wide range of applications, among other things, uses this system to package hearing-aid batteries with a special technical feature: These zinc-air batteries lie completely dormant until they come into contact with atmospheric oxygen.

Klaus Schöbel, Head of Efficiency & Data Management at VARTA, explains exactly what this property of microbatteries means for packaging technology: "The positive terminal of the battery has air holes that facilitate contact with atmospheric oxygen; however, premature contact with air would cause the battery to dry out and lose its available capacity. To ensure the batteries can be delivered to the end customer without a loss of capacity, the holes have to be sealed airtight during the packaging process with protective film in the form of a label, essentially putting the batteries into a kind of deep sleep." Jürgen Welker, Director Automation and Technology at KOCH Pac-Systeme,

The AX5000 servo drives result in powerful, precise, and – in conjunction with One Cable Technology (OCT) – compact motion control.

Left: The delta robot for stacking the blister packs is supported by the AM8000 dynamic servomotors (above) to enable rapid movements.

adds, "It is precisely this technique of being able to apply a high-quality seal with maximum precision that represents the special feature of this packaging line. What's more, a huge amount of development effort has been invested in the transfer technology and optical inspection systems to ensure that only correctly sealed batteries are transported further in the process."

Close cooperation for an optimal solution

The overall machine building responsibility for this sophisticated system lay with KOCH Pac-Systeme, whereby consistent modularization meant that both standard machine modules and specially developed workstations could be used. These workstations were developed in close cooperation with VARTA to create an optimal overall solution. Michael Bühler, Software Engineer at KOCH Pac-Systeme, notes that, "The optical control of the label position on the battery represents a clear example of where the expertise on both sides could be combined. And so, we were able to come up with a self-optimizing, camera-based system that can also handle the enormous variety of around 1,500 packaging types, confirming an extremely low error rate of less than 0.02%."

Klaus Schöbel cites the data link to the ERP system as yet another special feature: "When the relevant production order is scanned in at a packaging line, all necessary production parameters – such as print data or label types

and colors – are loaded directly into the machine control system from the higher-level databases. System operators can also count on comprehensive documentation, which is essential for error-free handling given the large variety of types and numerous packaging variants, and ensures batch changes can be made on the fly."

When it comes to flexibly and efficiently implementing specific customer requirements, KOCH Pac-Systeme has to be able to rely on universal and open control technology, as Jürgen Welker confirms: "This packaging line contains a wide range of technologies and machine concepts. After all, it's not just about packaging, it's also about the interaction of product processing and handling, and it is precisely through overall concepts like this that PC-based control from Beckhoff really comes into its own. The open and modular control platform opens up a host of possibilities for us to flexibly integrate any necessary functions, such as packaging, handling, testing, and even third-party components."

From blister to transport packaging

The diverse process sequences within the packaging line equipped with Beckhoff control and drive technology start out with the production of the blisters. These are created from a supplied film, which is heated, shaped, and punched accordingly. The blisters are transported further via a pallet system and loaded with the microbatteries, which have previously undergone electrical checks, as well as visual checks in the plant itself, to ensure correct labeling. In the next step, the blisters are sealed with a card to form individual packs complete with a quality label and the expiration date, which is also verified via cameras. Finally, the system stacks the individual packs in a small cardboard box before these are checked for filling weight and their own respective labels and subsequently grouped to form a larger transport pack.

Klaus Schöbel explains that it is not only this process sequence that has to run as efficiently as possible: "The notable focus with this packaging line, as with every one of our new systems, was also on optimizing changeover times. This is because the numerous packaging variants mean that the systems have to be changed over six times a day on average." Jürgen Welker confirms this, adding, "Minimizing setup times is another important goal for us. We have already achieved significant improvements in this area in recent years. In the case of the new packaging line, there is also the fact that the system performance has

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The experts in front of the packaging line for hearing-aid batteries (from left to right): Fabian Jungkunst, Manager of Zinc Air Packaging (VARTA), Michael Bühler, Software Engineer, and Jürgen Welker, Director Automation and Technology (both KOCH Pac-Systeme), as well as Winfried Wolf, Head of Production BU Micro, and Klaus Schöbel, Head of Efficiency & Data Management (both VARTA)

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Klaus Schöbel describes the uniform VARTA operating concept based on the CP3216 multi-touch Panel PC from Beckhoff.

Unified production HMI

The diversity of the production processes at VARTA poses challenges not only in the collection of energy data, but also in terms of operating and monitoring the wide range of machinery and equipment. Klaus Schöbel describes the solution: "We have developed a central interface that runs via an industrial PC and works for all systems, regardless of manufacturer. The basis is the CP3216 multi-touch Panel PC with 15.6-inch display, which we get from Beckhoff as a plug-and-play solution complete with a customer-specific software image. The plan is to implement around 300 devices throughout our production processes. These will also serve as communication interfaces between the plants and our cloud applications for material handling or bookings, for example. The system is based on an SQL database, whose key features include the ability to implement a central change history and centralized production control."

increased from 15 to 18 pallet feed cycles per minute compared to the previous system, notably via the highly efficient blister stacking by the delta robot at the end of the system implemented with Beckhoff Drive Technology."

Powerful drive technology with future potential

The PC-based drive technology controlled with TwinCAT NC I ensures fast and precise process sequences throughout the system. The approximately 50 servo axes are implemented via AX5000 servo drives and AM8000 servomotors from Beckhoff. Efficient use of installation space is a crucial factor for Michael Bühler, who points out that, "At KOCH Pac-Systeme, we consistently rely on One Cable Technology (OCT). This saves an enormous amount of material and installation effort, not to mention space, with further advantages including the avoidance of wiring errors and the use of an electronic identification plate. For optimum use of the available installation space, we also use compact drive technology from Beckhoff in our machines wherever possible, especially the 48 V versions of the EL/ELM72xx servomotor terminals or the EP72xx EtherCAT Box modules. In some applications, these already account for over 30% of the servo axes."

Jürgen Welker sees future optimization potential in the motion environment, and particularly in the new modular ATRO industrial robot from Beckhoff: "We see an immense advantage in this technology because our plants are always full of pick-and-place units. ATRO would allow us to save on space considerably compared to the previous mechanical axis systems with servomotors, and in terms of software, machine modularization would be optimally supported and simplified."

Sustainability through system-integrated measurement technology

Sustainability is particularly important in the packaging sector, as Klaus Schöbel is keen to underline: "To take one particular example, we are currently working together with KOCH Pac-Systeme on the possibilities of plastic-free packaging. A second major topic is energy consumption, in terms of not only minimizing it, but also looking at the exact distribution of the respective energy consumption in relation to the individual battery types. The latter in particular is not easy due to our extremely diverse production environment. The measurement technology integrated into the PC-based control system from Beckhoff helps to collect sufficient current data and transfer it to a central database for further evaluation. With the complex integration of non-electrical areas such as compressed air, vacuum, and cooling water, this is certainly another longer-term project."

Jürgen Welker also confirms the importance of sustainability and explains the energy-saving mode of the systems: "In energy-saving mode, almost all field devices are completely switched off and only the control station PC remains ready for operation. This is the prerequisite for being able to start up the systems automatically, according to the work shifts or workloads for example, and in good time before the start of production. It also allows us to ensure our manufacturing processes are as energy efficient as possible."

More information:
www.koch-pac-systeme.com
www.varta-ag.com
www.beckhoff.com/packaging

Servo drives replace mechanical cam plate in tea-bag packaging machine

High-performance motion control increases flexibility and machine speed

Did you ever stop and think about how tea gets into those tiny bags, or how the leaves stay inside when brewed? Teepack has been doing exactly that since 1948. In what they describe as their masterpiece – the Perfecta 450 – Franz Andel and Sascha Theine rely on PC-based control and drive technology from Beckhoff to set new benchmarks for speed and precision in their tea-bag packaging machines.

Beckhoff, the system partner: Never before has the tea-bag packaging machine manufacturer Teepack used so many components from a single supplier in a machine as in the Perfecta 450.

Control of the sophisticated kinematics via TwinCAT NC I and AM8000 servomotors increases the machine cycle as well as flexibility for bag geometry and different packaging materials (e.g., filter paper, wrapping paper, and film).

The name says it all: Up to 450 tea bags per minute are filled, folded, and sealed with the utmost precision by this top model from the Meerbusch-based manufacturer of tea-bag packaging and form-fill-seal machines. "It's important to bear in mind that absolute speed is by no means the only way to measure things," emphasizes Franz Andel, head of automation technology at Teepack. For Franz and his colleagues, it is vital that the tea-bag packaging machines always produce flawless tea bags, whether from a standing start or with changes in speed. This calls for a great deal of process expertise and precise automation technology.

The production process itself is already tricky enough, and this is compounded by the fact that the filter paper used for the tea bags has to be as thin as possible. "Our customers are looking for sustainable and efficient production

processes, which – in addition to an accelerated machine cycle and lower energy consumption – also means minimal material usage," Franz Andel explains, outlining an important market requirement. "The thinner the filter paper, the more sensitive it is to fluctuations in tension as a result of different web speeds in the individual production areas, for example," adds Sascha Theine, who is responsible for hardware and software development at Teepack.

Motion control replaces mechanical cam plate

The higher speed and precision compared to the previous model stems from switching to an electronic coupling of the main axes via servomotors and software. "Previously, we had the main process mechanically linked via cam plates," recalls Franz Andel. In the Perfecta 450, this is now handled by the AX8000 multi-axis servo system and AM8000 servomotors in conjunction with

The CP39xx multi-touch Control Panel with push button extension enables optimum operation and monitoring of machine processes.

The compact AX8000 multi-axis servo system and OCT connection technology save valuable space in the control cabinet.

Dynamic synchronization of all axes, safety, HMI, and individual database application – the complete automation project runs on a single CX2043 Embedded PC.

TwinCAT NC I. "The web tension control implemented with Beckhoff technology across all drive axes prevents the filter paper from tearing – even with dynamic speed changes," says Sascha Theine. Where previously the filter paper transport was rigidly coupled to the main movement, for example, the motion sequence is now controlled by two separate servo drives. "This allows us to vary the paper length of a tea bag, for example, and also to adjust the speed in relation to the other drives," notes Franz Andel. This offers Teepack and its customers more options when processing different types of tea and materials.

With up to 450 tea bags being processed per minute, the actual process is no longer visible to the naked eye: The filter paper is drawn in from the feed unit and passes under the dosing station. Here, the tea is fed from the top and distributed via a dosing station with various dosing chambers on the filter paper. Teepack is renowned for the unmistakable shape of its tea bags: "We were the ones who invented the double-chamber principle," Franz Andel points out.

More surface area, more taste
In contrast to simple tea bags, the tea in double-chamber bags is steeped from four sides, allowing it to release its aromas into the water better on account of the larger surface area. Experts have even recorded up to 30% more flavor for the same brewing time. This is why a cup with the same amount of tea is tastier, or else capable of developing the same intensity with less tea.

Once the portioning phase is complete, the filter paper is folded to form the double-chamber tea bag, which is performed exclusively by means of mechanical forming and folding in the downstream station. This is also where the thread is fed and knotted through the bag. "We manage the whole process without the need for metal clamps," underlines Franz Andel. The individual tea bags are then lined up and packed in the packaging cartons that have already been set up and glued in the Perfecta 450. This not only saves valuable space in production, but also increases process reliability, as the tea packs are already sealed when they are discharged via a conveyor belt.

The software-based axis synchronization also increases flexibility in development and reduces the effort required for fine-tuning the motion sequence. Previously, the process involved calculating, milling, and hardening a cam plate, which typically took three weeks. "Today, kinematics experts can calculate such a curve in two days and give us a table that is loaded into the servo drives in two minutes," reveals Sascha Theine, adding, "This means we only have to wait two days to find out whether the motion sequence fits and where readjustments could still be made." Franz Andel also notes, "We get results much faster and can optimize our processes much better than before." And with a performance increase of up to 20%, this optimization is clear to see.

More time for application creation
The Perfecta 450 is the first machine generation to be implemented completely with the Beckhoff platform. Teepack was looking for a supplier that could offer the entire portfolio of components: PLC, safety, motion, including IPC technology and an operator panel. Franz Andel comments, "Before Beckhoff, we were 60% concerned with the automation system and only 40% with

"With Beckhoff as a platform supplier, we can channel 98 percent of our focus into the application," emphasizes Franz Andel, head of automation technology at Teepack (left) – pictured here with Sascha Theine, electrical design and software development (center), and Wilm Schadach, head of the Beckhoff branch in Monheim, in front of the Perfecta 450.

© Beckhoff

the application. Now, we can devote 98% of our time to the application." This is also due to the excellent support, which even extends to the development department if necessary. What's more, application experts from Beckhoff can also provide support with the implementation and selection of suitable components and systems as required. "Since the beginning of the cooperation, our specialists have provided support in all technical areas for the implementation and optimization of customer concepts," explains Wilm Schadach, manager of the Beckhoff branch in Monheim.

In the Perfecta 450, all applications – from the control and synchronization of all servo drives, safety and HMI, through to data acquisition and database application for monitoring – run on a single CX2043 Embedded PC with a multi-core CPU (AMD Ryzen™ with four cores and a 3.35 GHz system clock). "The ability to still be able to run an HMI and a database along with the demanding motion control application without compromising real-time capability is not something we take for granted," emphasizes Wilm Schadach. In the maximum configuration, up to 30 AM8000 servomotors are controlled via the AX8000 multi-axis servo system or via the servomotor terminals in the ELM72xx series. As for the safety technology, this is system-integrated with TwinSAFE. The entire TwinCAT automation project and the HMI can be flexibly assembled according to the selected machine configuration.

"Flexibility in project planning was a key objective when selecting our automation platform," underlines Sascha Theine. Teepack can scale the hardware to match the machine configuration without having to change the control platform. The benefits of compact automation technology are often underestimated. "Control cabinet volume is a big issue with packaging machines, and we're actually always short on space," says Sascha Theine. This is where the AX8000 multi-axis servo system and the compact ELM72xx

drive technology in combination with OCT connection technology provide significant relief in the control cabinet and during assembly. Wilm Schadach confirms these advantages, "Over 90% of our drives are now supplied with One Cable Technology."

Bursting with ideas for the next expansion stage

Further relief for crowded control cabinets can be expected from the distributed drives in the AMP8000 series with integrated servo amplifiers. The head of automation technology also sees the potential for further innovations based on Beckhoff technologies in the case of the carton erector: "XPlanar offers a host of different approaches as far as the different packaging formats are concerned." With the free-floating movers, the cartons could be moved flexibly in front of the glue nozzle to apply individual glue dots, for example. This would simplify the mechanical structure of the gluing station significantly and also reduce the effort required for the heating station. Ideas for the next Perfecta generation include the use of an image processing system for inline quality control. "Integrated into the system and coupled with the machine cycle in real-time via EtherCAT, Beckhoff Vision is an ideal fit," says Wilm Schadach, "especially since the system does not take up any additional space in the control cabinet." TwinCAT Analytics and TwinCAT Scope are also part of the concrete considerations for the next expansion stage. The plan is to collect additional operating data for machine status and key performance indicators. Franz Andel is thinking of aspects such as motor temperatures, motor currents, and torques: "We want to use the correlations to determine knowledge about wear and tear so that we can trigger preventive maintenance if necessary."

More information:
www.teepack.com
www.beckhoff.com/packaging

Stand-up pouch machine crushes legacy performance limits using PC-based Control

Faster changeovers, more intuitive operation and less scrap in converting

Converters understand how many steps and purposeful decisions go into transforming rolls of film into bags and pouches. To ensure that the 760-SUP stand-up pouch system would continue to flexibly adapt to new requirements, U.S. machine builder CMD Corp. decided on a complete redesign. With control technology from Beckhoff, they achieved 40% faster changeovers combined with 90% uptime and large performance reserves for the future.

The redesigned 760-SUP stand-up pouch system from CMD features Beckhoff technologies for greater flexibility and enhanced performance.

Right: AM8000 series servomotors from Beckhoff with One Cable Technology (OCT) boost performance and reduce cabling in motion control.

While the earlier iterations of the 760-SUP stand-up pouch system were well received in the market, outdated machine control and networking were holding CMD back. The engineers had pushed the legacy platform to the limit, and it didn't provide flexibility for further customization. That capability is important to ensure CMD lives up to its name, which is an acronym for Custom Machinery Design. For more than 40 years, the Appleton, Wisconsin-based company has delivered custom-tailored converting and packaging equipment, aiming to provide their customers with unique competitive advantages. Thus, the CMD engineering and product teams began working on a redesign of the 760-SUP in late-2021. Rather than make incremental adjustments, they decided to redesign the machine from the ground up. That meant many mechanical changes and a new control platform. Scott Fuller, Product Line Manager, Intermittent Motion Products at CMD, explains the objectives: "The market is

telling pouch machinery OEMs that their systems need to provide even faster changeovers and more intuitive operation – as well as less scrap."

New room to move
"The first change we made to give converters an edge was 'taking off the hood,' so to speak," Fuller says. Using light curtains instead of physical barriers supported an open design. Operators can step into the machine for changeovers, which is more user friendly, simplifies the identification of machine components and accelerates changeovers.

Second, the company focused on the actual sealing technology. Bag or pouch converting machines typically fold material the same way, but sealing requires many different specifications for each film and process. "Our sealing and zipper

crush technologies support high-performance handling of legacy films," Scott Fuller says. "But this stand-up pouch machine delivers advanced capabilities for emerging recyclable pouch materials and new digital printing methods."

These design changes also required automation technology with enough power and speed to ensure high-quality, repeatable operation as well as flexibility for the future. CMD evaluated new automation platforms and, in the end, selected EtherCAT and PC-based automation from Beckhoff for the next-generation 760-SUP.

New performance reserves
CMD worked closely with Beckhoff's local engineering team on the 760-SUP redesign. Beckhoff Regional Sales Manager Don Seichter, Applications Engineer

The real-time communication of EtherCAT enabled synchronization of a gusset punch with fast-moving pouch film – without any specialized hardware.

© Beckhoff

Dave Ross and General Technical Support Rob Lecheler assisted in specifying components and providing support while migrating to TwinCAT 3 automation software. "CMD already had a firm foundation of engineering expertise," Dave Ross says. "That allowed them to rapidly move from their previous platform to Beckhoff. For example, they already used object-oriented programming (OOP) paradigms, which sped up conversion of existing code."

TwinCAT provides an end-to-end engineering and runtime environment for all aspects of machine control from PLC to IoT. Integrated into Microsoft Visual Studio, TwinCAT empowers engineers to program in the right language for their application. TwinCAT Scope, Drive Manager 2 and other pieces of the software toolkit also enhanced CMD's capabilities in design and commissioning.

The TwinCAT runtime is on a CX2033 Embedded PC from Beckhoff. Backed by a Beckhoff uninterruptible power supply (UPS), the CX2033 serves as the sole machine controller for the 760-SUP. A dual-core AMD Ryzen™ processor supplies ample performance, according to Jason Plutz, electrical engineer at CMD: "We're running at about 15% CPU load on just one of the controller's two cores. We're scanning extremely quickly with the CX2033, and we could run it even faster. I've never seen performance like this with previous controllers."

Fast and safe control with EtherCAT
The 760-SUP machine features a continuous motion section for feeding and folding film as well as an intermittent motion section for sealing and zipper crush. In the past, a gusset punch on the continuous side required additional hardware and excessive engineering efforts to synchronize actuation with the

material position. Here, EtherCAT further boosted performance. "EtherCAT's speed, combined with deterministic control and an encoder module from Beckhoff, seamlessly incorporated the incoming material position and punch with standard I/O modules," Don Seichter from Beckhoff says. "The Beckhoff solution just worked to reduce complexity."

EL3314 and EL3318 analog input terminals enable compact, direct connection of thermocouples for accurate temperature control of the sealer bars. Another space-saving technology, the EK1914 EtherCAT Coupler offers standard digital inputs and outputs alongside two safe inputs and two safe outputs, all built in. This means CMD can distribute a small amount of TwinSAFE I/Os with integrated functional safety capabilities on each tool in the machine line. TwinSAFE also allowed CMD to easily incorporate the necessary light curtains, E-stops and other safety devices to protect operators while maintaining an open machine design. "On our previous design, we had to run cabling from each tool back to a standalone safety system. TwinSAFE really cleaned that up," Jason Plutz says.

The high synchronization of EtherCAT extends to motion-intensive applications, and provided an edge in combination with the AX8000 multi-axis servo system and various AM8000 servomotor solutions. "These servo technologies offered incredible performance with high-resolution feedback in a space-saving design," says Plutz.

Repeatability and high performance
Before film materials make it to CMD's machines at converting facilities, they must undergo extrusion, printing and lamination. So waste material is at

A CX2033 Embedded PC from Beckhoff serves as a machine controller with large performance reserves, backed up by the UPS units CU8130-0120 and CU8130-0240 and complemented by numerous EtherCAT Terminals.

At the CMD facility (from left): Don Seichter (Regional Sales Manager, Beckhoff), Scott Fuller (Product Line Manager Intermittent Motion Products) and Electrical Engineer Jason Plutz (both CMD), Applications Engineer Dave Ross and Rob Lecheler (General Technical Support, both Beckhoff)

The AX8000 multi-axis servo system provides high-performance drive technology with simplified installation.

its most expensive point at that time, Scott Fuller from CMD explains. But less waste through high accuracy is not the only way to improve machine efficiency. The CMD engineers remain cognizant of setup time and downtime.

Switching to the Beckhoff platform reduced test and debug times for the CMD developers by several weeks. EtherCAT accelerated commissioning by scanning in all devices on the network. Use of Drive Manager 2 reduced the time needed to tune motors by a factor of three. The Beckhoff technologies ensured precise, repeatable motion control for the zipper crush. The safe, open machine design enabled by TwinSAFE led to 40% faster changeovers than competitive machines. Altogether, the redesigned system ensures high throughput with uptime rates higher than 90%, according to CMD customers. All these changes led to better, faster Return on Investment rates for end users. To illustrate this, CMD has an ROI calculator on its website showing the details.
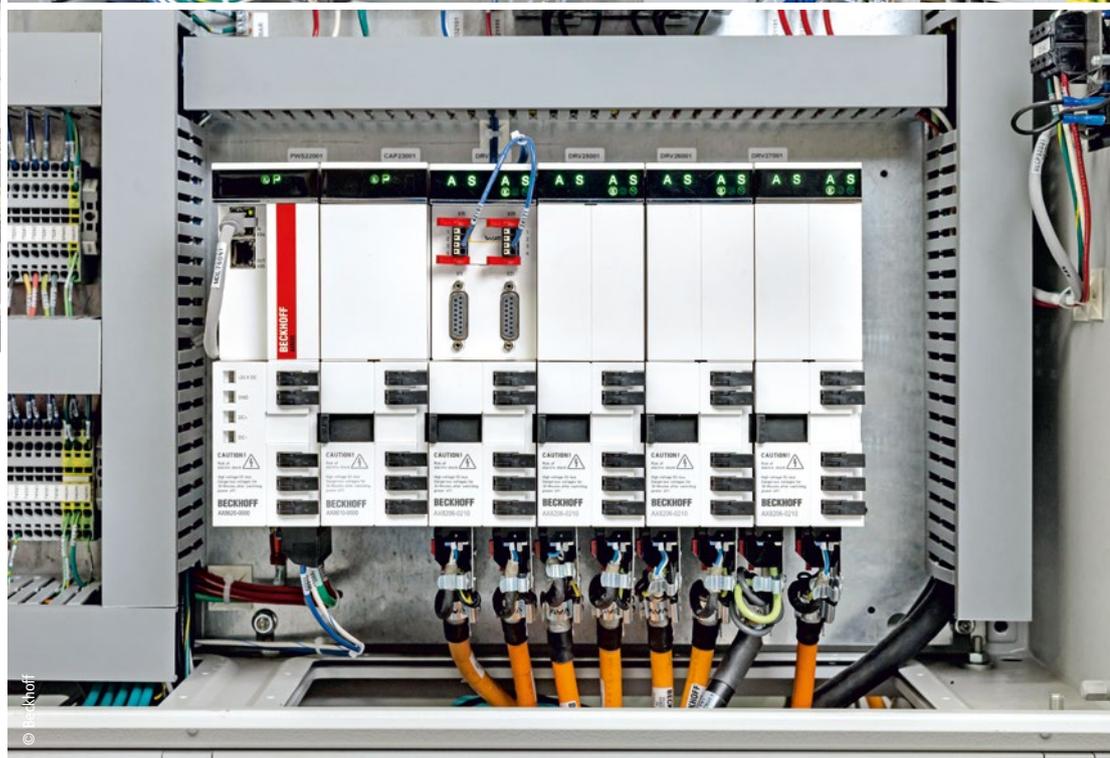
Beyond that, PC-based automation technology and EtherCAT leave CMD room to grow with its customers. CMD intends to leverage the inherent connectivity of PC-based control to implement edge computing and IoT functionality in the future. And moving forward, CMD plans to migrate even more of its machine lines to Beckhoff.

More information:
www.cmd-corp.com
www.beckhoff.com/packaging

Servo drive technology for case packer with integrated robotics

Over 80% reduced changeover times in packaging of high-volume consumer goods

The CP-30 case packer developed by U.S.machine builder R.A Jones is an excellent example of custom machine design. It is a high-performance case packer for a large, multinational manufacturer of coffee products. In the application, high-volume products are fed in at such high speeds that a high level of automation was crucial for continuous operation. This could be implemented using EtherCAT and PC-based control and drive technology from Beckhoff.

© R.A Jones

While best known for a vast array of standard packaging machines for aerosols, cup filling, chub packaging, multipacking, pouching, case packing and cartoning, R.A Jones also offers completely custom machinery. Part of the Italy-based Coesia Group of packaging machine builders, R.A Jones serves many of the world's biggest brands in consumer products with highly automated primary and secondary packaging machines. They are used to package food and beverage products, over-the-counter medications and other high-volume consumer products. R.A Jones leans on its over 100 years of packaging industry experience to back up the support given to every installation in the field.

Highly automated packaging of high-volume products

When R.A Jones was contracted by a manufacturer of coffee products to develop a case packing machine, the sheer volume of custom equipment was a tall order, with 12 machines to manufacture in a tight timeframe, but so was the high level of automation required by the end user. "With coffee products coming in as fast as 1,200 per minute, the machines had to run continuously, even in the event of a jam," said Bob Burkhardt, Product Portfolio Manager for Cartoning, Robotics & Pouching, R.A Jones. "So we sought a machine control platform that could automatically diagnose and correct machine stoppage without an operator's manual adjustments. This eliminates the burden on workers to stop production and pull reject boxes, which is crucial in such a fast-paced production environment."

The resulting CP-30 machine automates all aspects of case packing, including jam clearance and packaging changeovers via over 70 dynamically controlled servo axes. It can automatically eject cases that don't open correctly under the magazine without stopping the packaging process. The machines feature a case feed robot inside to move flat corrugated cardboard into the case erecting segment. "We worked with Beckhoff application engineers to create custom kinematics software for this specialized robot," Bob Burkhardt said. "While similar to a SCARA, this robot is completely custom to provide a high degree of rotation for the pick head as it pulls cardboard out of the magazine." If the case fails to open, sensors will automatically detect this, and the pick

R.A Jones developed the CP-30 case packer for a large, multinational manufacturer of coffee products for the consumer market.

head will reject the case. Afterward, the case feed robot will pick a new case. While the automated reject handling is a key benefit for the end user, so is the notably high throughput and flexibility in carton handling.

Automation from a single source

"The processing power we get from PC-based control is impressive," Nick Werner, Custom Controls Group, R.A Jones, said. "Practically speaking, this means the difference between implementing one Beckhoff controller and having to juggle multiple controllers from a traditional PLC vendor to handle machine automation." A Beckhoff C6030 Industrial PC (IPC) with Intel® Core™ i7 pro-

cessor provides ample power for all the computationally intensive functions in case packing.

"One of the biggest things we observed with the Beckhoff IPC was impressively low scan times – around 1 millisecond scan time for more than 70 servo axes," said Austin Rismiller, Electrical Project Engineer, Research & Development/Innovation, R.A Jones. Another enabler of low scan times is the fast communication over the EtherCAT protocol connecting all drives and I/O on the CP-30. "EtherCAT provides an outstanding level of speed in our machine communications," Nick Werner added. "And the ease of setup when
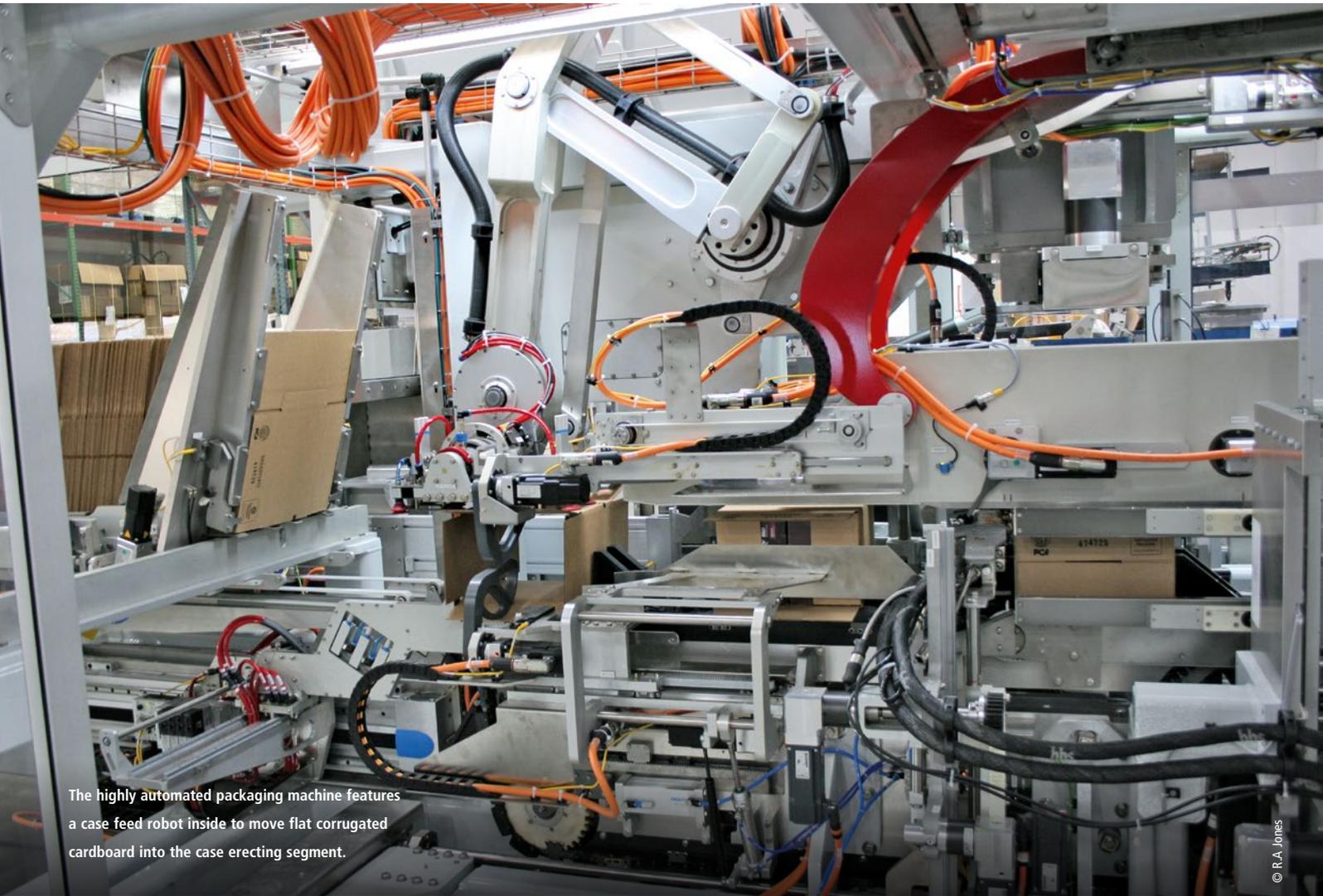
The highly automated packaging machine features a case feed robot inside to move flat corrugated cardboard into the case erecting segment.

© R.A Jones

automatically scanning devices into the network greatly helped with startup, commissioning and troubleshooting. This and built-in EtherCAT diagnostics make it easy to quickly localize and correct any wiring mistakes or breaks that may have happened down to the exact I/O terminal." The EtherCAT I/O system also provides direct connectivity to other industrial networks, such as IO-Link, and thus to various third-party devices, such as RFID readers, programmable stack lights and smart photo eyes.

With the servomotor terminals in the EL72xx series, R.A Jones also uses compact drive technology from Beckhoff for space-saving control of the AM8100 series servomotors. EL9576 terminals add brake chopper functionality in the same 12 mm wide format. "Beckhoff directly addressed the small motor and drive sizes required for CP-30, which is a major benefit," said Paul Schuster, Product Portfolio Manager, Coesia Digital & Aerosol, R.A Jones. "Combining the power and feedback cables into one line using One Cable Technology (OCT) added to our space and wiring savings." The machine's footprint is smaller than comparable case packers and its electrical cabinets even fold down, so the entire machine can be shipped in a normal semitruck.

Machine safety is integrated into the standard control platform and EtherCAT network via the TwinSAFE system. TwinSAFE I/O terminals connect to guard doors and e-stops throughout the machine and safety data is sent via Safety

over EtherCAT (FSoE). The servo drives in the application also communicate via FSoE to provide a variety of safe motion functions. The system is broken up into two safety zones with dedicated TwinSAFE logic in each. A cartoner side zone is on the operator side, where the case feed robot picks all the cases. A second zone is on the transfer side where the cartons come in from the infeed and go to the upstacker. This provides the ability to stop the appropriate zone during safety events instead of stopping the entire machine.

Modern PLC programming standards

On the programming side, TwinCAT 3 as an engineering environment and runtime for machine control also demonstrated major advantages. The universal TwinCAT platform handles all aspects of machine control, including PLC, safety, motion control and more. "I'm a fan of how TwinCAT XAE is presented in a standard Microsoft Visual Studio shell," Austin Rismiller said. "That's refreshing compared to traditional PLC vendors' software offerings. TwinCAT 3 integrates all computer science standards in programming, like C++ and Python which meshes into my programming knowledge from college. Providing these options in addition to PLC programming standards such as structured text is a key benefit."

As part of the project, R.A Jones used the existing Coesia Automation Framework Library (AFL) in TwinCAT. "TwinCAT offers the ability to protect Coesia and
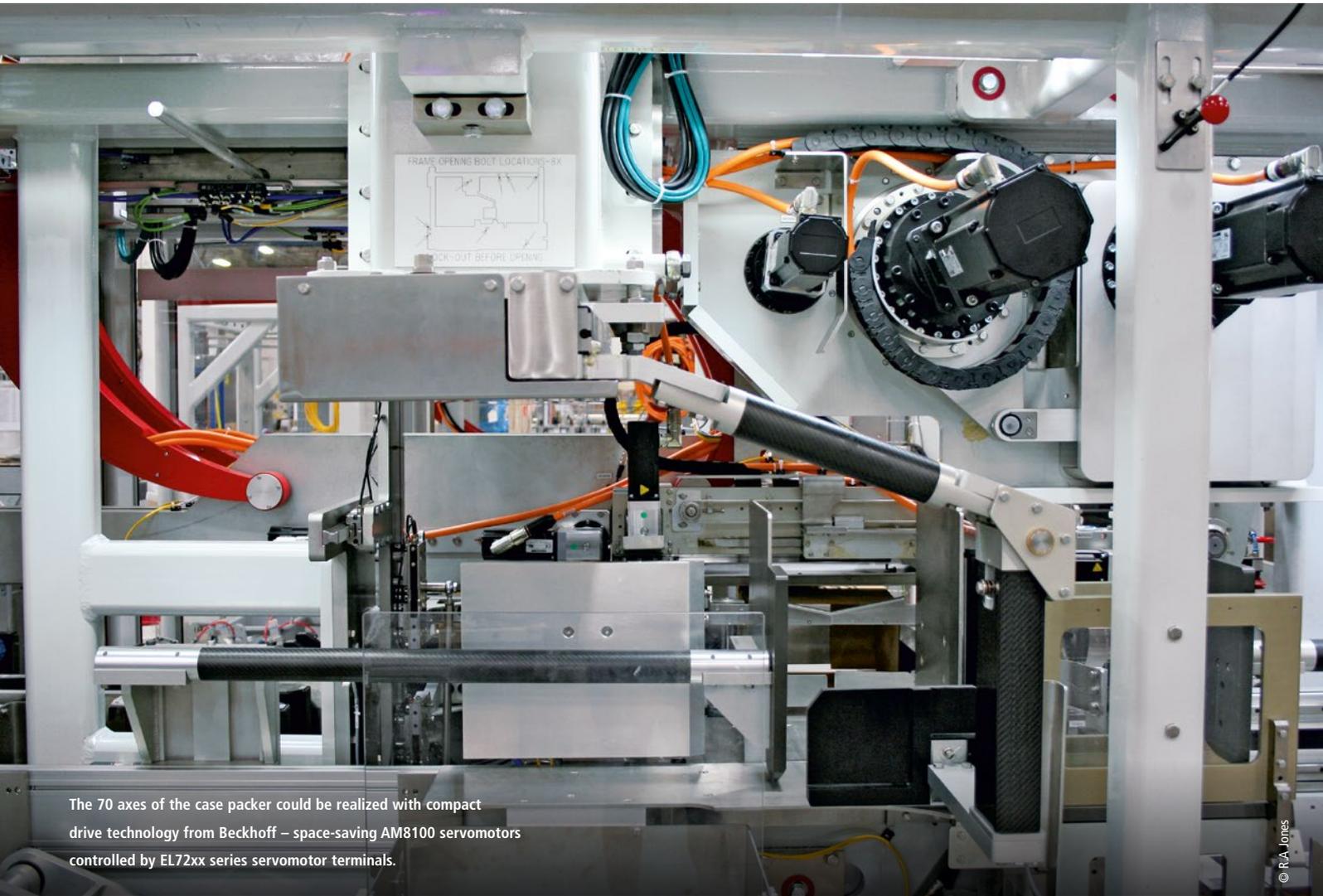
The 70 axes of the case packer could be realized with compact drive technology from Beckhoff – space-saving AM8100 servomotors controlled by EL72xx series servomotor terminals.

© R.A Jones

R.A Jones software and function blocks as intellectual property," Nick Werner said. "Even better, end users never have to trouble themselves with the PLC code for troubleshooting and maintenance since these interactions are handled via the HMI." Assisting in this user-friendly approach is a CP3918 Control Panel in 18-inch widescreen format with multiple push buttons selected for machine control functions – all designed right into the panel.

The timeline for critical electrical design and installation of the CP-30 machines was compressed into a rigorous six-month period to stay on schedule for the end user's plant upgrade. This required close and constant teamwork among engineers at R.A Jones and Beckhoff to meet a tight delivery window. "Our effective collaboration and local support resources were up to the challenge of these development milestones," said Mark Ruberg, Packaging Industry Manager at Beckhoff USA.

For the changeover of the future
The flexibility of the machine is boosted by the Acc-U-Change Plus™ solution from R.A Jones that allows users to handle changeovers with the push of a button, ensuring a vertical start-up and high case quality during production. The removable components are RFID-enabled, so operators can verify that the right equipment is installed in the right place for all case sizes and patterns. "Where changeover times to a different sized case often take 20 to 30 minutes

in other case packers, we've been able to bring changeover time to around five minutes or even less on the CP-30," Nick Werner said. "Using automation from Beckhoff, we've taken 19 manual moves out of the equation — with one touch on the HMI and the automated changeover can move from largest size to the smallest size and vice versa."

After these positive experiences, R.A Jones has at least two new machine projects in development that will have Beckhoff as the standard machine control platform to similarly boost throughput, reduce machine footprint and shorten changeover times.

More information:
www.rajones.com
www.coesia.com
www.beckhoff.com/packaging

In a typical Weightpack filling line, over 50 axes are precisely controlled via TwinCAT.
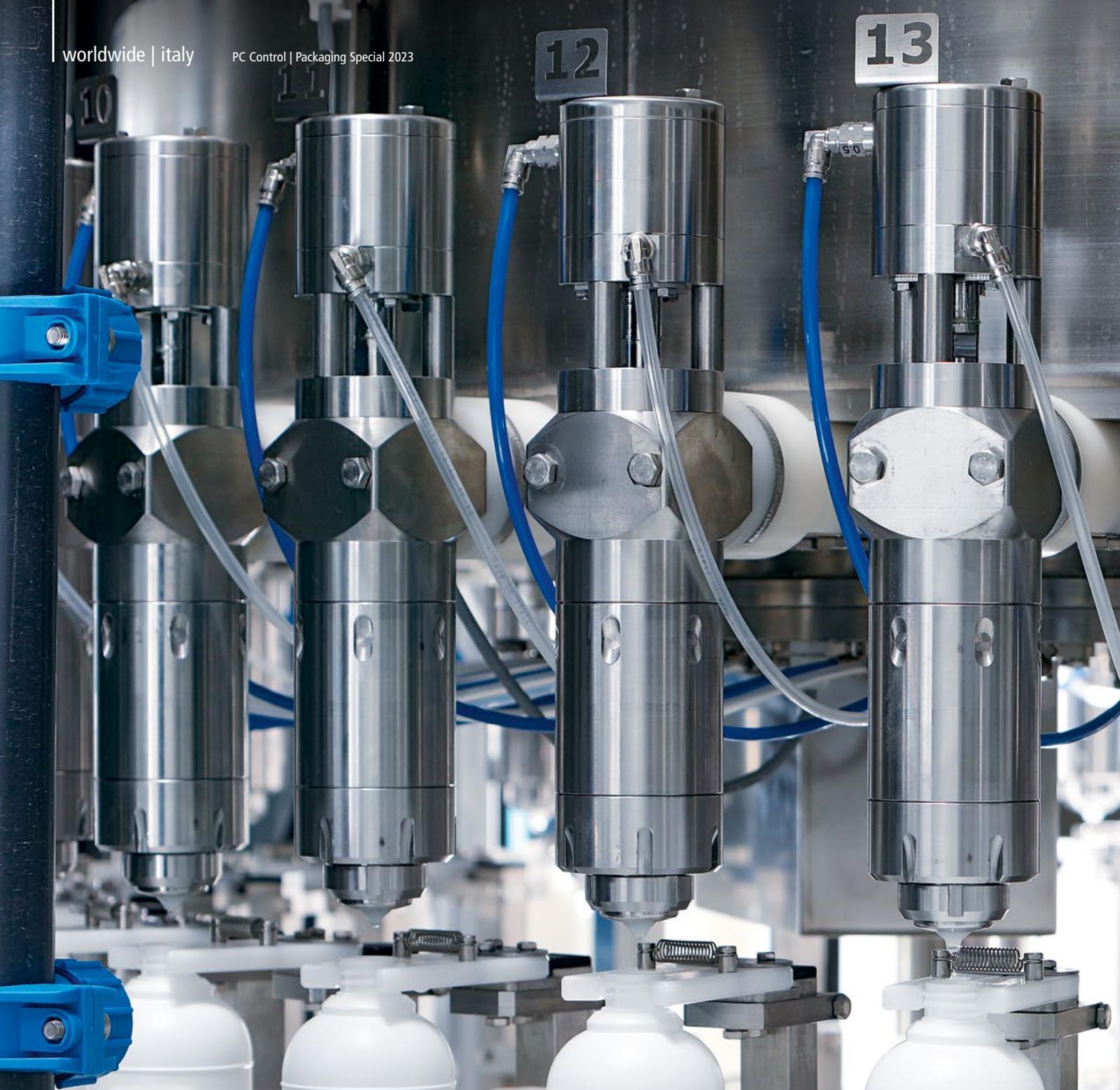
PC-based control in filling lines for liquid, viscous, and powder products

Automation makes metering faster, more precise and more efficient

If there is one innovation that is inextricably linked with the Italian filling equipment manufacturer Weightpack, it is the electronically controlled net weight rotary filler, which founder Carlo Corniani first introduced in 1979. The principle behind it is still implemented in a wide variety of filling machines today, with Weightpack Technical Manager Paolo Marogna relying on PC-based control from Beckhoff for the company's automation needs.

Leading brand-name manufacturers such as Real Chimica rely on Weightpack equipment to fill their products.

© Real Chimica

Based in Goito in the Italian province of Mantua, Weightpack has always been characterized by its innovative spirit. Indeed, this is reflected in the sheer volume of different filling lines it offers for liquid, viscous, and powder products. Real Chimica is one of many companies that rely on these solutions. In fact, this leading brand manufacturer of detergents, fabric softeners, laundry soaps, and degreasing agents (including Chanteclair Vert) relies exclusively on Weightpack machines at its production site in Sant'Agata Bolognese. With regard to automation technology, Paolo Marogna has been won over by the innovation potential afforded by PC-based control: "Our mission as an industry leader is to continuously improve our machines and create real benefits for our customers in the process."

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In contrast to conventional weight-based filling solutions that use a tank with constant pressure, Carlo Corniani had a novel idea for his net weight filling systems: in his patented design, he replaced the large tank containing the product to be dispensed with a distributor equipped with filling valves, which is continuously fed with the product by a positive displacement pump. Precise and fast drive control ensures that the pressure in the distributor remains constant. This ensures that the product flow fed to the individual filling valves contains the exact quantity of product to be filled – provided that the pressure in the distributor is precisely controlled by the pump drive in real time.

Another essential consideration is that the sophisticated motion sequence of the bottle holders and other sub-functions must be controlled in sync with the filling process. This quickly adds up to over 50 axes in one machine, which calls for an advanced, flexible automation solution: PC-based control. Paolo Marogna states, "The powerful, flexible and scalable architecture of Beckhoff technology, the high-performance products, and the comprehensive technical support are the key elements that allow us to meet our customers' challenges in terms of innovation and efficiency."

PC-based control technology replaces PLC
Weightpack originally adopted a more traditional approach to automating its plants, using a PLC and separate control panel. It wasn't until 2012 that Paolo Marogna replaced the control unit with a panel PC, which also took over the initial secondary functions. After these positive early experiences, the company began to run tests with a view to equipping the most delicate elements of the Weightpack systems with Beckhoff controllers, namely the pressure regulation for the filling distributor and the associated control of the product pump. Today, a C6030 ultra-compact Industrial PC or a CX5130 Embedded PC, supplemented with a CP3918 multi-touch Control Panel, manages the core functions and all filling line processes depending on the system version. This includes the weighing

system, motion control for all axes in the filling station, and all other machine parts, such as the sealing machine and the ejection system for faulty packaging.

TwinCAT automation software can monitor the filling distributor in real time, and even control each individual valve and the product pump as required to modulate the product feed depending on the feedback on the pressure measured in the distributor. This solution offers significant advantages, as it reduces the volume in the filling process to a minimum. This increases the efficiency and environmental friendliness of production, as cleaning requires less detergent, energy, and time when products are changed. It also cuts costs for materials and production downtime.

Modular plants benefit from scalable architecture
PC-based control and industrial PCs from Beckhoff provide the scalability required in terms of computing power. "They combine the world of automation with the typical process and IT infrastructure for our machines' production environment into one simple standard architecture," Paolo Marogna says, stating an equally important factor for Weightpack. Controlling all machine functions with a single controller is a huge advantage, he adds, which hugely simplifies project planning and programming work while simultaneously guaranteeing optimized performance at system level. "We see TwinCAT as a complete technological solution that not only enables automation and control applications, but also integrates them with the typical technology of the IT world – a domain that, although related to automation, remains purely IT-based," emphasizes Paolo Marogna.

EtherCAT also plays an important role in Weightpack's automation concept. This communication system is not only fast and robust, it also supports a wide variety of topologies and provides enough bandwidth to integrate safety and TCP/IP communication as well: "All these features make EtherCAT a versatile

CX5130 Embedded PCs (shown here) or C6030 ultra-compact
Industrial PCs are used depending on the system configuration.

Fast control of the pressure pump – via the AX5000 servo
drive and AM8000 servomotor – is crucial for precise filling.

Left: Weightpack also controls all secondary processes, such
as capping the bottles, with PC-based control.

and universal communication platform," explains Paolo Marogna. The EtherCAT
protocol, currently the fastest industrial Ethernet technology, offers a huge ad-
vantage in that applications can be controlled in real time without overloading
the processor of the industrial PC. This allows Weightpack to position or move
applications with more than 50 axes that need to be moved synchronously with
an error of less than 0.05%. "This precision is essential to prevent bottlenecks
or jamming at the high speeds at which our customers want to – and indeed
can – fill and seal their products," points out Paolo Marogna.

Crises bring communities together

For Weightpack, the COVID-19 pandemic presented a huge challenge, but also
set the seal on Weightpack and Beckhoff's close partnership. "The demand for
explosion-proof equipment for filling products containing alcohol and for cor-
rosion-resistant machines for handling aggressive media was extremely high.
Beckhoff provided us with crucial support during this difficult phase," recalls
Paolo Marogna. During the pandemic, Beckhoff prioritized all requests from
companies manufacturing equipment for medical products and hygiene articles,
like Weightpack.

The large number of different components, along with the easy scalability of the
TwinCAT applications, enabled Weightpack to cover the great demand for indi-
vidual specific components with other solutions. "The line of communication to
sales was always open, and the technical support from the Beckhoff engineers
was second to none – even in the most critical phases," says Paolo Marogna.
Thanks to this consistency, Weightpack was able to adapt the control architec-
ture to the available components.

"At Weightpack, we know that focusing on a structured but fully standardized
solution is the best option," says Paolo Marogna. Weightpack is thus aiming to
equip all of its machines entirely with Beckhoff architecture. Two pilot projects

Paolo Marogna, technical manager at Weightpack:

> Beckhoff's scalable system architecture allows us to integrate all functions
> into a single platform. After complete motion control and sequence control
> of all processes, safety, vision, and AI are the next projects on the agenda."

for integrating TwinSAFE and TwinCAT Vision have been launched recently. An-
other project aims to extract structured information from the mass of machine
data with the help of TwinCAT Machine Learning. Intended benefits of this ap-
proach include the ability to optimize energy consumption, minimize downtime
through predictive maintenance, and suggest the best machine settings for
optimal performance (golden batch). "We are in no doubt that Beckhoff is the
right partner for us when it comes to implementing these ideas and achieving
our goal of working with high-performance machines that meet our needs,"
concludes Paolo Marogna.

More information:
www.weightpack.com
www.beckhoff.com/packaging

XTS enables flexible bottle handling in the pharmaceutical industry

Linear drive system increases plant efficiency

EtherCAT and PC-based control has long been used by the Marchesini Group, one of the world's leading manufacturers of packaging machines and filling lines for the pharmaceutical and cosmetics industries. Nowadays, the Italian machine builder also benefits from Beckhoff's XTS linear transport system. In a monoblock machine for filling and capping bottles containing tablets, capsules, or pills, XTS makes transport more flexible while reducing setup times and energy requirements.

© Marchesini

Since it was founded 50 years ago, the Marchesini Group has always paid particular attention to the key components of its systems. This also applies to the machine software, which the company develops entirely in-house. "Unlike system integrators, our hallmark is that we are an all-round manufacturer: We develop all of our machine technology in-house and therefore know it all inside out," explains Stefano Gualmini, head of Automation R&D at Marchesini. Fitting entirely with its concept, Marchesini's cooperation with Beckhoff dates back to the 1990s and is based on a precise shared vision with a solid foundation.

From proprietary to open and PC-based architecture

"Since the early 1990s, we have focused our area of interest on standardized and open platforms. We wanted to move away from PLC-based control architectures," recalls Stefano Gualmini. "This was primarily due to the availability and reliability of PC hardware and its excellent price/performance ratio." In fact, the company implemented EtherCAT back in 2007, soon after it had been launched on the market. "We consider EtherCAT to be the backbone of our automation processes in every respect," states Stefano Gualmini. He points out that the company's selection criteria were – and still are – based on the platform's open nature, efficiency, and ease of implementation. What's more, it has been using EtherCAT to exploit the potential of functional safety via FSoE since 2013. At Marchesini, integrating safety functions on the same bus system has resulted in a huge reduction in wiring work – by some 50%. Taking this approach also optimizes the communication between the safety and standard components.

Motion control represents another core area of expertise for suppliers of packaging and filling machines. After an intensive benchmarking exercise between 2018 and 2019, the company once again decided that Beckhoff was the right choice. "We knew that we would have to take a quantum leap in terms of motion control and mechatronics to prepare for the challenges we would face in the coming years," notes Stefano Gualmini. But the Marchesini Group didn't just choose Beckhoff as a partner for motion applications due to their previous partnership – it was also impressed by the quality and diversity of the technologies available. Although initially classic rotary motion components were used, the XTS linear transport system now also serves as a mechatronic drive solution. One example of where it can be found is the Compact-24 monoblock machine, designed for counting solid products (tablets, capsules, pills, etc.) and adding them to bottles.

With their interchangeable bottle holders, the individual XTS movers can synchronize accurately with the capping unit turret.

During a product change, the plug-in bottle holder design enables the carriers for the XTS movers to be adjusted just as quickly as the pre-configured motion profiles are called up via the HMI.
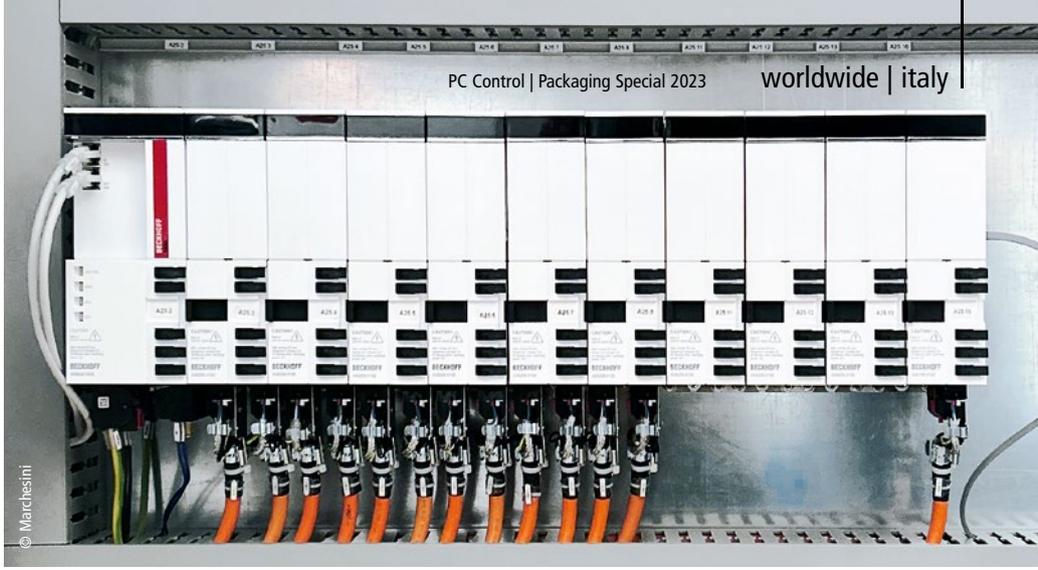

© Marchesini

Marchesini uses a C6930 control cabinet industrial PC
to automate the entire Compact-24 filling line.

Using the DC intermediate circuit, the AX8000 multi-axis
servo system enables energy savings of up to 20%.

Using XTS to achieve efficient processes

The Compact-24 is a typical example of a linear machine: At the infeed, a mechanical system takes the medication bottles from a stack and places them individually on an XTS mover. The movers then move to the filling station, where hoppers appropriate for the task fill multiple bottles simultaneously with pills that have already been counted. The bottles are then transported to the next station, where they are transferred to the rotating capping unit. After that, XTS is used to move everything back to the unloading station, from which point the containers are sent on for further processing after a series of checks.

According to the Marchesini experts, the Compact-24 breaks the mold through its use of XTS for bottle transport. Each mover moves autonomously and is positioned or grouped according to the desired work sequence. With this technology, Marchesini machines now boast high linear speeds that minimize the times required for returning the empty movers to the pick-up station and for changing bottles. XTS also makes it easier to convert the format. Using the control panel, the movers can be positioned in groups and moved to defined locations for exchanging product-specific adapters.

The Compact-24 offers two special features. For one thing, the in-and-out movements of the bottles at variable intervals can be synchronized. Furthermore, the software enables the movers to be configured and adapted to the new containers and their properties when the product is changed – for example, the shape and capacity of the bottle and the distance to be maintained between the products. "XTS enables us to provide flexible and consistently optimized transport," enthuses Stefano Gualmini. Adding pills or tablets to bottles is not quite as simple as it might seem, as these products tend to fall from the feed system hoppers into the bottles at different speeds. In addition, the filling time for each individual bottle is affected by a visual integrity check and multiple bottles are always filled in parallel. That is why each bottle must be handled individually. Compared to conventional mechanical solutions, XTS can fully exploit its strengths with the individually controllable movers in the Compact-24. The XTS technology enables

each bottle to be handled individually – an unbeatable advantage when it comes to efficiency. "Given that the filling station has to count the tablets for each bottle, XTS was the ideal solution for our synchronization problems," explains Stefano Gualmini, an automation expert.

In mechanical terms, the XTS motor modules and guide rails are fully integrated into the machine frame. From a software perspective, the movers are integrated into the automation project like normal drive axes. Several dozen axes may be involved, depending on the design, but this does not affect the application in question. "This offers considerable advantages in terms of flexibility and speed compared to conventional motion solutions," emphasizes Stefano Gualmini.

Machine cycles increased by 25%

Measurable improvements have been achieved. By integrating XTS into its machines, Marchesini has been able to improve accuracy (with respect to tracking errors) in certain applications by up to two orders of magnitude. This has helped to increase the Compact-24 production speed from 120 to 150 bottles per minute. What's more, using the AX8000 multi-axis servo system with its intermediate voltage circuit (DC bus) has resulted in significant energy savings of up to 20%. "Beckhoff provides us with a constant incentive to exploit the potential that new technologies can bring in relation to efficiency and innovation. For that reason, I'm positive that our long-standing partnership will be even closer in the future," concludes Stefano Gualmini.

The TwinCAT 3 XTS extension greatly simplifies the programming
of motion sequences by automatically preventing collisions.

More information:
www.marchesini.com
www.beckhoff.com/xts

Hamer has developed the HP96, a thermoforming machine
for sustainable packaging based on recyclable cellulose.

© Hamer

Automation of a thermoforming machine for recyclable, compostable, and disposable packaging

Combining expertise to develop sustainable packaging from cellulose

Thermoforming is the most common method for producing trays, dishes, and packaging from plastics at low cost; however, many consumers take a critical view when it comes to using plastic as a packaging material. Renewable cellulose, on the other hand, offers a strong alternative, which is why Hamer has joined forces with Beckhoff to develop a thermoforming machine for water-based cellulose pulp.

When asked what prompted Hamer to embark on such an ambitious project in the first place, the member of the electrical and software department of the company, Joan Ferrer, points out, "Concern for the environment led us to develop a technology for fully recyclable and environmentally friendly cellulose packaging." The special feature of the technology is the way the cellulose is dried out by means of a specific combination of pressure and temperature. This creates dimensionally stable packaging with clearly defined contours that can be adapted to the dimensions and shape of the item it contains, making it suitable for a wide range of products. Joan Ferrer notes, "With the HP96 Thermoforming Machine for Pulp, we can now offer our customers a sustainable alternative to conventional plastic packaging for the first time."

The process is entirely environmentally friendly, both in the extraction of the raw material and in the way it is subsequently recycled. The packaging material is biodegradable and 100% compostable, and its breathability makes the pulp-based trays equally suitable for fruit and vegetables. Once laminated, it can even be used for products that need to be packaged under inert gas, and the fact that cellulose does not become electrostatically charged means it can be used to package electronics safely too.

The Hamer HP96 also offers a whole host of advantages in terms of both technology and productivity. Running four cycles per minute, it outperforms comparable machines on the market by more than double, with a forming area of 900 x 600 mm and a forming depth of up to 100 mm. The machine can process up to 300 g of cellulose CTMP (chemi-thermomechanical pulp) per cycle, equating to around 72 kg per hour or 576 kg per shift.

Extensive vertical integration plus an open automation platform

The foundations for this innovation were laid over 40 years ago, when the Swiss Schiess family first founded Hamer in the Spanish town of La Granada in the early

1980s. Fast-forward to today and this Barcelona province-based company can now look back on four decades of experience in the packaging industry. Boasting a high level of vertical integration, the company maintains firm control over all processes, including design and automation technology. Joan Ferrer confirms, "This allows us to enter new markets and develop solutions in line with current requirements."

The latest evidence of this can be found in wet fiber thermoforming, which Hamer has developed together with Beckhoff. "The development project was really challenging, technically speaking," recalls Octavi Marti from the sales division at Beckhoff's Barcelona branch. The business relationship between the two companies was very close throughout the project, with Beckhoff's comprehensive automation portfolio piquing the interest of the Hamer team.

Wet fiber thermoforming for sustainable packaging

The process starts with preparing the fibers, which involves mixing the basic materials with water to achieve the required consistency. A vacuum absorption process then transports the cellulose pulp from the main tank into the thermoforming machine. This is where high-quality 3D-molded products are created in the thermoforming mold through sophisticated control of the temperature, pressure, pressing time, vacuum, and hot drying. The result of this process is packaging with a high level of mechanical strength along with an ideal surface finish and shape. Any remaining production materials flow straight back into the production

tion, we can very easily check whether everything is working properly and how energy consumption behaves under different working conditions."

The anodized housing and high IP69K protection rating of the servomotors in the AM8700 series offer ideal protection against the large amounts of steam and water that are produced during the process. What's more, the One Cable Technology (OCT) of the servomotors also cuts down on wiring work. Other key elements for the development manager include the IP65-protected CP3916 control panel and TwinCAT HMI (TF2000). "Both of these allow intuitive control of all processes performed with the equipment while also increasing the efficiency and safety of the thermoforming machine," notes Joan Ferrer. The visualization is entirely based on HTML5 and is therefore platform-independent, making Hamer's HMI future-proof since the machines can be operated from any PC or other mobile device. Implementing TwinCAT even makes it possible to extract machine data in a variety of different ways, object-oriented programming makes it easier to reuse code, and Git version management software is also incredibly beneficial.

This project is evidently an important milestone for Hamer and demonstrates how innovation and collaboration can lead to unique and effective solutions. "I am confident that our collaboration will produce more innovative and efficient packaging solutions going forward," enthuses Joan Ferrer. "In fact, we have already identified the Beckhoff technology that we have our sights set on next, namely TwinCAT Vision, TwinCAT Analytics, and TwinCAT Cloud Engineering."

Cellulose packaging is a sustainable alternative to conventional plastic trays.

The special process conditions call for components that offer IP65 protection, including the control panel and AM8700 servomotors, which are designed for the food and packaging industry with their anodized housing and IP69K protection rating.

cycle via closed conveyor and water circuits to cut down on both material consumption and disposal costs.

The project was a real challenge in terms of not only motion control, but also the need for real-time control of the energy consumption of the drying and forming stations. The typical power consumption of an HP96 is around 140 kWh. EL3443 EtherCAT power measurement Terminals are used in conjunction with high-precision SCT3215 and SCT1111 ring-type current transformers to record and control the energy consumption in real time. Joan Ferrer explains, "By looking at the energy and power consump-
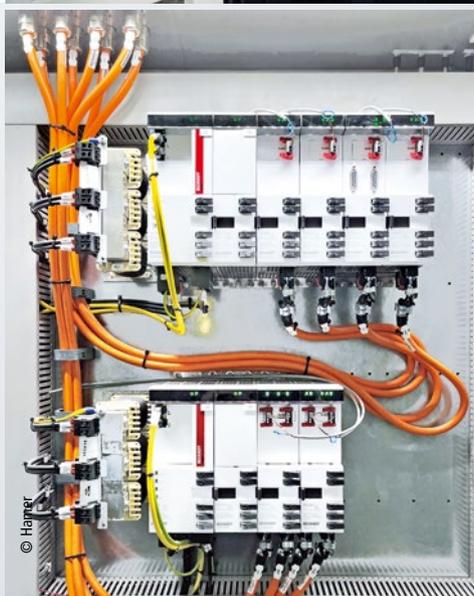
Precise control of the motion sequences and temperature regulation are essential aspects of thermoforming processes. This is why Hamer relies on the AX8000 multi-axis servo system and TwinCAT 3 extensions for this machine.

More information:
www.hamer-pack.com
www.beckhoff.com/packaging

Modular IP65 servo drive technology in a packaging machine for the food industry

Flexible adaption to changing market requirements with distributed drive technology

From the food to personal care to the electronics industry – mid-sized companies in particular rely on factory automation to secure growth. This requires reasonably priced and robust technologies that optimally support their production targets, which is precisely why Syntegon's UK-based subsidiary brought automation specialist Beckhoff on board to expand its modular packaging solution portfolio. The aim was to develop a cartoning machine for the food industry that could be flexibly integrated into a production line anywhere without taking up floor space with bulky control cabinets.

Using the distributed servo drive technology from Beckhoff, the new BEC machine from Syntegon does not require large control cabinets.

© Syntegon

Syntegon, a global supplier of process and packaging technology for the food and pharmaceutical industries, has designed the new end-of-line cartoner as an entry-level machine and recently equipped it with AMP8000 distributed servo drives rather than mechanical drive technology. According to Pete Hyde, electrical and software engineering manager at Syntegon, this is a key requirement for stable processes: "Switching to servo technology allows us to ideally synchronize different drive components, securing repeatable product placement. The flexibility and reliability that this achieves are key to the success of our equipment."

According to Syntegon, changing customer and economic requirements mean that in food manufacturing, consistency wrestles with flexibility at every turn. From adapting recipes based on changing ingredients to navigating supply chain demands and limitations, flexibility in food manufacturing is the name of the game, they say. Packaging is a critical part of this procedure, especially when the packaging machine is required to load the food product into the packaging before sealing. The tolerances for variation are extremely low, so machines must be optimized for light handling of products and flexible enough to carry out multiple functions so as not to lose valuable time in the manufacturing process. While the main components of a cartoning solution are usually made to be modular anyway, traditional machines rely on extensive wires. These would also

be connected to a control cabinet, which not only increases the machine footprint significantly, but also decrease the flexibility within the production facility.

Control cabinet-free drive technology implemented in close collaboration

Syntegon was able to count on Beckhoff's comprehensive expertise and dedication in the field of automation and drive technology without cabinets to surpass all of its expectations for a new carton erector in the form of the Basic End-Load Cartoner (BEC). But the successful partnership between Syntegon and Beckhoff goes further back than developing this modular machine together. Indeed, the two companies were already global technology partners, and Beckhoff works closely with Kliklok – part of the Syntegon Group – in the UK. The Kliklok ACE Topload Carton Former, for example, also involved beta testing of some of the latest Beckhoff technologies, including the AMP8000 distributed servo drives. Pete Hyde explains, "Because Syntegon were beta testing the components, there were many changes required to accommodate continuous improvement. It was obviously being developed and designed to our needs as we were testing it. We agreed that we would be a beta tester, so we knew there would be challenges along the way. When we hit problems we would liaise with the Beckhoff team in Germany as well as the UK. We would have regular meetings between both Beckhoff sites, and the team would make

changes that we wanted to be implemented; any updates would also be done, and they would be done quickly."

Both the test results and feedback from ACE end users confirmed the success of the collaboration, which is why Syntegon co-developed with Beckhoff on the BEC machine not only in terms of electronics, but also right from the ground up. The machine is a cartoner that loads the products to be packed from several in-feeds into a carton before closing and sealing it. The difference between the BEC and comparable systems is that this machine does not require control cabinets and so the cabling is much more straightforward. It also offers a plug-and-play solution for a food manufacturer's production processes.

The BEC cartoner uses the AMP8000 system, which allows the servo drive to be relocated from the traditional control cabinet to the machine. The AMP8000 distributed servo drive system consists of a combination of the proven AM8000 servomotors with a highly efficient servo drive and power electronics with cold switch technology that limits power loss to unprecedentedly low levels. It also reduces the mounting space required for the electronics to a minimum. At the same time, the motor retains almost its original size; negating the need for a larger drive train and achieving almost the same performance data as a comparable motor/servo drive combination without attached power electronics.

Added flexibility with EtherCAT and TwinCAT

The EtherCAT P one-cable solution, which combines communication and power supply in a single cable, is the universal basis for the cabling of the AMP8000 distributed servo drive system. Apart from the simple connection options, the BEC cartoner generally benefits from the advantages of EtherCAT communication, as Pete Hyde explains, "With its cycle times of less than 100 µs, using XFC (eXtreme Fast Control Technology) and distributed clocks, EtherCAT realizes synchronous real-time data, aligning with Industrial Internet of Things (IIoT) strategies of modern machine architectures. EtherCAT also enables a flexible topology and a simple line or tree structure that requires no costly infrastructure components. The result is outstanding, cost-effective performance paired with highly dynamic servo drives and ease of configuration."

TwinCAT 3 automation software from Beckhoff is also used in Syntegon's BEC cartoner. Pete Hyde adds, "Combined with EtherCAT, it provides the fundamental technologies and tools needed to achieve Industry 4.0 concepts and IIoT connectivity – all via one PC-based control platform." TwinCAT stores the BEC process data locally, on the server or in the cloud, always synchronized with the machine cycle. The TwinCAT IoT functions support common protocols for cloud communication, facilitating data transmission to smart devices for real-time monitoring and maintenance. The software is also quick and easy to configure and, together with a Beckhoff Industrial PC as the IoT controller, establishes a seamless connection between all components of the BEC cartoner.

"The team from Beckhoff UK visited us regularly and helped with developing the application program and with commissioning," reports Pete Hyde. "We also had regular team meetings with Beckhoff in Germany. Beckhoff application engineer Jon Hampshire supported us on site during the commissioning period, and if we hit an issue, Jon set up a team meeting with Beckhoff in Germany at short notice, so we had a good number of Beckhoff specialists involved in the process."

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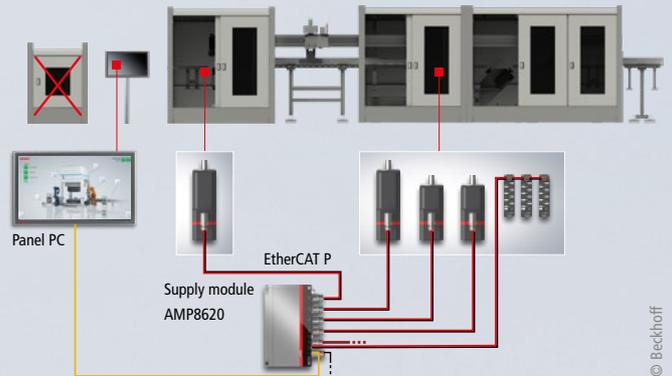
Completely control cabinet-free drive technology can be achieved with the AMP8620 supply module and the AMP8000 distributed servo drives.

Optimizations with potential for the future

Pete Hyde mentions another optimization aspect, in that, "The development of the new machine enabled Syntegon to align the components corresponded with other machines in our portfolio, simplifying our inventory supply and supply chain processes. For the end user, the BEC provides easier maintenance by using fewer electronic components and connections, making the machine simpler and easier to integrate. The BEC is based on the OMAC PackML standard, so that it can easily be integrated into customers' lines, and can communicate across their network to pass PackML details, efficiency reports and Smart machine data. A number of sensors have been added to detect vibration and temperature of mechanical parts which are displayed on the HMI. For ease of maintenance a full 3d model is displayed on the HMI showing all components within the machine. These will then show trends to the end-user, providing a real-time picture of how the BEC is running." And he continued: "For example, for a bearing within the machine, we can show trends on what its temperature is and how much vibration it is generating. From that, we can detect if the bearing is at risk of failing, or whether the chain tension is too loose or too tight."

Commenting on the joint development of the BEC cartoner, Bradley McEwan, business development manager at Beckhoff UK, explains, "The way that we co-developed control technology and software already offered a high degree of modularity; now, because of the new way the machine is wired and the decentralized drive technology, it is fully modular and can adapt to any production line. Also, by temporarily repositioning a machine module, end users can easily check which configuration works best." This modularity also makes it easy to set up smaller production lines – for example, to run test batches of new products. This also helps demonstrate how to scale up for larger production, whilst accurately determining a time to market estimation. The new BEC machine is also to be expanded into a product range with added versions for the mid-end and high-end segments, offering even more flexibility and modularity for the food industry.

More information:
www.syntegon.com
www.beckhoff.com/amp8000
www.beckhoff.com/amp8620

XPlanar in a hygienic design used in a handling system for sliced foods

Floating product transport cuts footprint in half and speeds up handling and cleaning

Provisur Technologies GmbH in Flawil, Switzerland, has developed an extremely compact, flexible, and hygienic handling system for sliced foods such as cheese, salami, and bacon. At the heart of the machine is the Beckhoff XPlanar planar motor system with its stainless-steel housing, which not only significantly reduces the machine footprint, but also significantly improves system performance, flexibility, and cleanability with incredibly flexible floating product transport.

Headquartered in Chicago, USA, Provisur Technologies has established a strong reputation for the development of innovative industrial food machinery as well as integrated production systems for processing a wide variety of food products. The same also applies to the Swiss subsidiary in Flawil, which is active in the pressing and slicing sectors with its Hoegger and Formax brands, among others, and has developed a new handling system for use in conjunction with the tried-and-tested Hoegger presses and Formax slicers. This Free Movement System (FMS) is designed to be more compact, flexible, and hygienic, revolutionizing product handling between the slicer and the packaging line, according to the Swiss experts at Provisur.

Maximum system performance in minimum space

According to Gerd Stratenwerth, Sales Manager Slicing at Provisur, the Formax FMS significantly reduces the space required compared to conventional systems. At the heart of the system is a handling and buffering system built from 48 XPlanar tiles and a flexible number of XPlanar movers. Through its modularity, XPlanar optimally supports the FMS concept as an individually adaptable standard machine. With the control technology placed underneath the stainless-steel worktop to save space and maximize functional reliability, the result is a particularly compact design – especially since the additional modules otherwise required, such as the turning station, buffer, inliner, and overlapper,

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The XPlanar planar motor drive system also meets the high hygiene requirements of Provisur's Formax Free Movement System (FMS) by using non-magnetic stainless steel for the tiles and movers.

A C6670 control cabinet industrial server (left) with TwinCAT controls the entire system, including XPlanar as well as the AX5000 servo drives (right) and the AM8800 stainless-steel servomotors of the infeed and outfeed conveyors it controls.

© Beckhoff

Equipped with a specific comb-like structure for the respective end customer's application, the XPlanar movers pick up the food flexibly and as required from an infeed belt (right).

are no longer required. The core task of the FMS is to buffer products for the downstream packaging machine to ensure a continuous supply during the slicer's loading pause. In conventional lines, this task is solved with belt systems, which require more space and cleaning effort. The FMS can also be used to perform tasks such as turning portions or else merging or distributing product streams.

Explaining the advantages for the end user, Gerd Stratenwerth notes, "Thanks to the fast, free-floating movers, the portions can be processed with a high output for this typical application segment. Even multi-type portions can be put together flexibly and in the smallest possible space. Because the XPlanar movers can move to any point on the work surface and rotate freely, the whole process of picking up cut products for transport is more straightforward than ever. This also means that the transported food always arrives at the packaging station in the optimal orientation. The entire process is characterized by an enormous amount of flexibility, because handling a new article or a different packaging variant does not require a changed system design, just an adjustment in the software program."

Stainless-steel design for optimum hygienic properties
The FMS offers excellent hygienic properties due to the stainless-steel housing of the XPlanar tiles and the use of stainless-steel XPlanar movers. The sliced products are transferred directly from the slicer to one of the movers, whether in shingles, stacks, folded slices, or multi-variety or overlapping portions, depending on the specifications. Once the products have been transferred to the packaging line, the movers can be cleaned and sterilized by an optional cleaning station during operation, generally on the return trip to the slicer. In addition, according to Fatih Yaman, automation engineer at Provisur, the floating and non-contact transport avoids any kind of abrasion: "Not only does this offer

© Beckhoff

The PS3031-2420-0001 power supplies – 3-phase, 24 V DC devices with 20 A output current and 480 W output power – reliably supply the control technology and, with high efficiency and low heat loss, have a positive effect on system availability and energy costs.

direct protection for the food against contamination, but it also noticeably simplifies the level of cleaning compared to the often more convoluted assembly work associated with conventional systems. This is becoming an increasingly important consideration, not least in light of the current staffing issues currently affecting food processing companies."

Gerd Stratenwerth adds, "The FMS eliminates the need to touch the product and thus the human factor as a source of contamination. This also has a positive effect on product shelf life." Another important aspect is the increased plant availability. Due to the lower number of mechanical components – for example, as a result of the conveyor belt structures being reduced by around 90%, the time required for cleaning is reduced to roughly 10 min and the associated maintenance effort is also lower.

© Beckhoff

Project participants (from left to right): Thomas Gubser, Technical Support at Beckhoff Switzerland, Automation Engineer Fatih Yaman, Product Developer Klaus-Dieter Schroff, and Sales Manager Slicing Gerd Stratenwerth (all Provisur), as well as René Zuberbühler, Managing Director Beckhoff Switzerland

Software functionality replaces mechanics

The flexibility of XPlanar does not simply stop with the customization of the FMS either, as Fatih Yaman makes clear: "The system is also completely open in terms of packaging type. Thermoforming machines, for example, usually operate on multiple lanes, while form-fill-seal machines tend to operate on a single lane. This can be responded to flexibly and quite easily via a corresponding requirements profile in the software, which is particularly useful since changes to customer orders can happen over and over again in the world of food packaging. In conventional scenarios, the complex handling area between the slicer and the packaging machine would have to be replaced and mechanically adapted each time. The same applies to the product handling itself, which allows faster and safer manipulations than the mostly manual activity associated with conventional applications. In the case of multi-variety portions, for example, the different cutting directions sometimes required can be taken into account simply by turning the mover."

Replacing mechanics with the software functionality of the XPlanar has even more decisive practical advantages for Fatih Yaman, "Wear is a crucial issue that crops up time and again in our discussions with customers. This is because a conventional handling system consists of a very large number of mechanical components, such as conveyor belts, and is accordingly subject to a high level of wear. What's more, the level of cleaning effort is significantly higher, but also indispensable due to the constant contact with the food. Then there's the fact that there are always numerous transitions between the individual belts in systems like this, and each of them can change the position of a food portion, which in turn can lead to complications during subsequent insertion into the packaging. Generally speaking, a mechanical system is much more susceptible to a decline in positioning accuracy. But with XPlanar, all of these aspects are eliminated."

## Easy implementation in line with Industrie 4.0 concepts

The fact that the software partially solves tasks previously solved mechanically, does not mean that the effort required for implementation is increased on the software side. Instead, with the TwinCAT 3 XPlanar Function (TF5890), systems can be easily commissioned or new configurations created via an XPlanar configurator that is seamlessly integrated into the familiar engineering environment. As Fatih Yaman explains, "With the functions of the default library, the XPlanar system can be handled in the same way as conventional drive technology with a corresponding number of axes. The complete control of the entire system via the central TwinCAT controller also enables perfect synchronization between the movers and the infeed and outfeed conveyors."

With their inherent system openness, TwinCAT and PC-based control are also proving advantageous with regard to the increasingly important topic of Industrie 4.0, as Gerd Stratenwerth adds, "The connection of our machines to higher-level control systems at our customers's sites is becoming immensely important. However, since these vary greatly depending on the customer, we need open control technology if we want to be able to work with as many different platforms as possible. And for this, the PC-based solution is much better suited than our previous conventional control technology."

More information:
www.provisur.com
www.beckhoff.com/xplanar
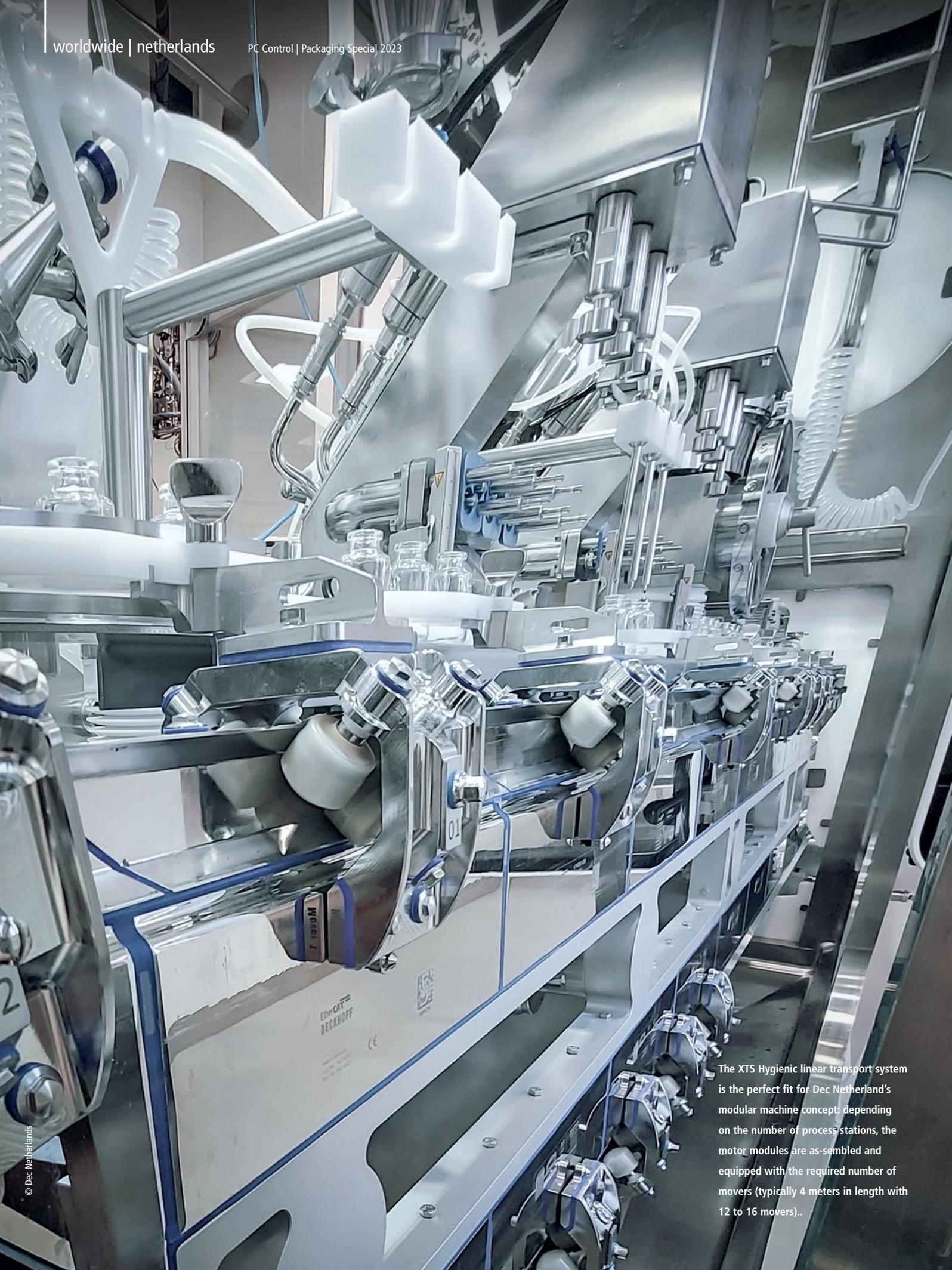
The XTS Hygienic linear transport system is the perfect fit for Dec Netherland's modular machine concept: depending on the number of process stations, the motor modules are as-sembled and equipped with the required number of movers (typically 4 meters in length with 12 to 16 movers)..

© Dec Netherlands

XTS Hygienic: Stainless steel version of the XTS in the pharma industry

Dynamic and flexible product transport increases output of sterile filling lines

With XTS Hygienic, Dec Netherlands has revolutionized product transportation of its pharmaceutical filling lines, moving away from chain drives in favor of dynamic yet careful transport of different containers. Specially designed for the food and pharmaceutical industries, the stainless steel version of the linear transport system from Beckhoff forms an integral part of Dec's modular DecFill PS platform.

© Dec Netherlands

The C6032 ultra-compact Industrial PC with TwinCAT XTS Extension, Collision Avoidance, and NC PTP controls the movers precisely and without sloshing any liquids during start-up and braking.

"I don't know of any other linear magnetic transport system that meets the requirements of the pharmaceutical industry," says John van Veen, technical director of Dec Netherlands B.V. in Breda. The company had been looking at linear, magnetically driven transport systems for some time in a bid to avoid the production downtimes caused by the link chain system that they previously used. Unfortunately, there was no solution that met the requirements of Dec Netherlands and the pharmaceutical market for filling pharmaceuticals at that time, but that all changed in 2017 when Beckhoff introduced XTS Hygienic, an IP69K-compliant variant of the linear transport system. "We immediately contacted Beckhoff Netherlands, and when it was clear that XTS Hygienic had the necessary properties for use in pharmaceutical production, we immediately started an internal development and implementation process," recalls John van Veen. Fast forward to today and a whole host of customers are now using XTS Hygienic in a variety of filling lines.

Dec Group provides powder handling solutions for various industries and consists of several divisions, including Powder Handling Technologies, Particle Size Technologies, Containment Solutions Technologies, Continuous Processing Technologies, and Filling Solution Technologies. The headquarters are located in Switzerland with production facilities in Poland, UK, the USA, India, and the Netherlands, and sales offices around the world. Dec Netherlands is part of the Filling Solutions Technologies business unit and specializes in sterile filling of active ingredients. The containers transported with XTS Hygienic include the vials, syringes, dual-chamber syringes, and even cartridges and (infusion) bags commonly used in the pharmaceutical industry. The active ingredient can be dosed as a powder, for example, using a technique specially developed by Dec; liquids and gels can also be dosed and filled.
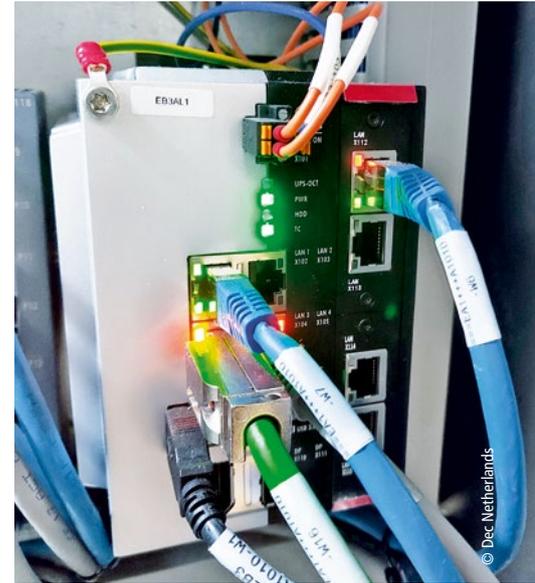
Faster, more flexible primary processes

With XTS, the syringes, ampoules, and vials fixed in special brackets mounted on the movers are transported quickly and vibration-free within the filling machines, from infeed through the individual process stations (filling, weighing, closing, and sealing), to discharge from the hermetically sealed system. Before XTS Hygienic, it was common to transport the containers along all stations using a chain-based system; however, this rigid chaining technique meant that the overall process could only ever be as fast as the slowest station. XTS, on the other hand, decouples the process stations, thus giving the option to continue the downstream process if one of the stations stops. "This allows us to guarantee less production downtime and so achieve a higher output," enthuses John van Veen, highlighting a USP of Dec Netherlands' filling lines.

The filling lines are all built in line with customer specifications. Depending on the requirements, Dec Netherlands configures a new filling line by adding or omitting stations. Individually assembled from straight and curved motor modules, the XTS accommodates the modular machine concept and can be flexibly adapted to the plant layout and the number of process stations required. A typical system is around 4 meters long (8 meters for rotary systems) and uses between 12 and 16 movers for product transport.

Each XTS mover picks up the containers to be filled on the infeed side from a star wheel. As soon as all brackets on the respective mover are loaded with vials, the mover moves to the first station. At each station, the mover either stops or moves synchronously with the axis of the process module. At the end of the filling process, the containers are removed from the mover and the mover returns to the input side.

The structure, design, and material selection of XTS Hygienic meet all the requirements for the pharmaceutical industry, including regular decontamination with hydrogen peroxide gas.

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Optimized design and material for every application

The transport system is mounted vertically, which ensures not only optimal cleanroom and air flow conditions during the filling process, but also excellent ergonomics. This arrangement, with container transportation at the top and mover return at the bottom, allowed the designers to create a narrower machine. "Operators can only access the hermetically sealed machine using permanently mounted rubber gloves which ensure that sterile conditions are maintained," stresses John van Veen. The encapsulation of the system also serves to protect the operator: In the event of direct contact, some of the medications being filled could cause the machine operators to experience skin or respiratory irritation or even build up resistance.

In some cases, the drug may also be toxic. This is why it is common practice to have a wash down (CIP) system and to decontaminate the hermetically sealed area of the machines with hydrogen peroxide gas before each new batch of product is loaded. "For this reason, it was important to test the material compatibility of XTS Hygienic with aggressive gases like these," emphasizes John van Veen, highlighting an important selection criterion. The XTS Hygienic also assures sterility through elements including the combination of materials

used, their surface finish and simple design, as well as their pre-cleaning and suitability for pharmaceutical cleaning processes.

XTS Hygienic's flexibility, namely being able to move each individual mover separately and independently, is another huge argument in its favor. In this way, each process station can be operated with its optimum cycle time, because XTS decouples the process steps that were previously rigidly connected via the chain. Another aspect relates to temperature development, which could potentially affect the airflow in the machine that is necessary to ensure sterility.

Synchronizing the movers with the servo axes of the various stations proved to be yet another challenge, not least since end customers in the pharmaceutical sector sometimes insist on a machine controller from specific manufacturers. To handle the synchronization, a coupling between the C6032 ultra-compact Industrial PC used to control the XTS and the third-party system had to be developed. As John van Veen recalls, "The PROFINET connection was easy to configure and program in TwinCAT." The interface is structured in such a way that only the number of XTS movers and process stations along the route have to be specified.

XTS was installed vertically to streamline the machine and allow operators to access the relevant areas of the machine via glove ports.

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Ready for larger installations

In addition to TwinCAT Motion Collision Avoidance, Dec Netherlands uses TwinCAT NC PTP for motion control. TwinCAT receives the respective positions from the higher-level controller, and the gear-in-position function is used to synchronize the movers with the axes of the process stations. To enable flexible scaling of the physical synchronous axes, Dec developers have created virtual axes with configurable acceleration factors. "This means that the system can be easily converted to fit new products," notes John van Veen, pointing out the potential of TwinCAT.

TwinCAT and PC-based control allow classic controls to be combined with an advanced transport system such as XTS if required. This applies not only to XTS integration, but also to the addition of other motion functions such as leading and synchronous axes. "PC-based control offers sufficient potential for this and for future, larger installations," explains John van Veen.

Practical advantages of XTS Hygienic

– increased output through individual mover movements
– compliance with all pharmaceutical standards, including cleaning with hydrogen peroxide gas
– flexible system layout due to variable number of stations
– variable installation position for ergonomic operation, making it easier to clean
– open interfaces and diverse software functionalities

More information:
www.dec-group.net
www.beckhoff.com/xts

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In-line packaging machine optimized with PC-based control

Control technology minimizes transport volumes for increased sustainability

Transporting excessive amounts of air from A to B is neither sustainable nor efficient. Yet, many parcels are too large for their contents and this increases shipping costs. It's a problem every dispatch manager knows only too well, but now Ranpak has come up with the perfect solution: the Cut'it!™ EVO, a fully automated in-line packaging machine that measures the height of the box contents and places precise crease lines and cuts on the side walls to fold the lid with millimeter precision. When it comes to creating the right size parcel, the Ranpak engineers rely on motion control and PC-based control from Beckhoff.

One could think that Ranpak was putting itself out of business when they came up with the Cut'it! EVO. After all, the Dutch company in Heerlen has been producing paper filling and protective materials for packaging since 1974 and is now considered the market leader in the field of paper-based in-the-box packaging. Ranpak box lining and void fill materials can be found in countless packages, but with this new machine series, Ranpak is seeking to reduce parcel volumes and the need for filling material along with it. Committed to sustainability and encouraged by the growth in the e-commerce sector, Ranpak decided to buy a French company that marketed machines for height reduction at the parcels end of packaging lines. "Their technology complements our product lines perfectly," recalls Noël Ritzen, head of automation engineering at Ranpak.

While the acquired company mainly produced customer-specific machines and could therefore only deliver a few units per year, Ranpak's engineering team develops and designs its machines with a view to standardized production for

higher volumes. "We decided to implement height reduction technology in a production-ready design," recalls Paul Spronken, automation product manager at Ranpak. This is how the Cut'it! EVO came to life. The in-line packaging machine determines the maximum height of the contents of commercial boxes and automatically cuts their sides, creating flaps from the excess material. These flaps are then folded over the products ready for shipment and a lid is glued on. The result is an easy to open, tamper evident box with minimal amount of air in the box.

The system is streamlined for maximum throughput, so to ensure it does not come to a standstill, overfilled boxes are detected and passed through. Comprehensive online monitoring, including access to integrated video cameras, ensures maximum productivity. With a capacity of up to 15 parcels per minute, the Cut'it! EVO is the ideal solution for e-commerce companies, large-scale logistics operations or logistics service providers looking to increase the throughput of their packing lines and cut down on shipping costs.

Ranpak uses almost the entire product range from Beckhoff, including a CX20x3 Embedded PC with a series of EtherCAT Terminals (center) and the AX8000 multi-axis servo system (top).

Noël Ritzen (left) and Paul Spronken in front of the Cut'it!™ EVO: "We can now use PC-based control and the extensive product range from Beckhoff to individually configure any machine series, making 95% of it from standardized parts."

From customer-specific to series production via automation

"We are currently producing up to eleven machines at a time," enthuses Noël Ritzen. This requires clear work instructions, perfect technical drawings, and scalable automation technology in terms of both hardware and software. "Software standards help to quickly develop, commission, and subsequently maintain the machines," explains Paul Spronken, citing the user interface as an example. The HMI is essentially identical for all machines, with only minor adaptations for the different functions. Beckhoff's extensive product range also helps with this standardization thanks to elements such as the controls. "Regardless of whether we are automating a simple machine or a huge plant with a whole host of functions, we can always use the same software platform and only have to adapt the performance of the industrial PC to the the specific machine or module," says Noël Ritzen, highlighting one of the many advantages of having Beckhoff as a control supplier. "Ranpak specifically chose Beckhoff because TwinCAT and PC-based control are so flexible," recalls Stijn de Bruin, sales executive at the Beckhoff site in Eindhoven.

"The benefits of standardization become immediately visible and noticeable when you start producing on a larger scale," explains Noël Ritzen. 95% of each Ranpak machine now consists of standard elements, and programming is more like parameterization. What's more, around 50 systems are now manufactured each year. Even the service department benefits from this standardization. "We used to need an experienced engineer in the after-sales department to handle customer issues. Now, we have a 24/7 hotline with teams in Europe and the US serving over 50 countries," reveals Paul Spronken. Technicians can provide support far more easily and have easier access to spare parts.

By using standardized components, Ranpak also benefits from the continuous further development that large, dedicated teams at Beckhoff are constantly working on. Paul Spronken cites the linear guides that Ranpak used to develop as an example, "Standard components increase reliability and accelerate the development of our own innovations." More than simply being practical, sometimes this is also necessary. Here, the product manager refers to European regu-

lations that place stricter requirements on the amount of air found in packaging. Noël Ritzen states, "It used to take us three years to come up with an innovative machine concept that would allow our customers to meet their specifications."

With drive technology from Beckhoff, Ranpak saves a lot of development time for machine functions that are generally driven by servomotors. "Our optimization processes are thus better than they would be with conventional drives," emphasizes Paul Spronken, "because we can control more directly and precisely with inherent position feedback from the servo drives and have much better control of the entire process." Ranpak uses this to control acceleration, for example, to prevent the package contents from slipping.

Specific motion curves and intelligent sequences can easily be programmed with a servo drive. Product development is therefore much faster and more flexible than with older concepts, which required much more investment in internal mechatronics. "That was a real eye-opener for us, too," Noël Ritzen recalls. Ranpak also makes intensive use of the distributed I/Os from Beckhoff – i.e., the EtherCAT Box modules, in which all sensors and actuators converge and which are connected to the controller via EtherCAT. This not only reduces assembly time, but also allows Ranpak to build and stock the individual functional units separately from the machine. "This ensures we can manufacture several machines at once, if required," says Paul Spronken. Overall, the result is more manageable development, faster time to market, and reduced maintenance requirements.

Feedback from the field via OPC UA

TwinCAT OPC UA from Beckhoff, which Ranpak uses to generate analyses and reports, is another example of off-the-shelf high-end technology. "We see exactly how the machines behave at the customer's site, what their availability is, right down to faults and their possible causes," says Paul Spronken. These evaluations are then incorporated into the maintenance intervals as well as into user training and consulting.

The vast majority of Ranpak's customers are in the field of e-commerce, and demands on the user-friendliness of the systems are high, which reflects this. "Operators now expect machines to be as user-friendly as a smartphone," says Noël Ritzen, highlighting the challenge facing the machine's HMI. Compared to others, the TwinCAT HMI offers a wealth of possibilities in terms of ease of use and design. "We wanted to standardize the interface for all our machines, so we are now in the final stages of a completely new HMI that is all about maximum ease of use," says Paul Spronken.

Standardization across all automation disciplines also helps to shorten the time to market for new products, as Noël Ritzen confirms, "When we develop a prototype, we want to be able to test whether it works as intended rapidly." This is why Noël's team also needs access to new automation components fairly quickly. "Working with Beckhoff, the whole process runs smoothly from start to finish without red tape," emphasizes Paul Spronken. "For example, if Ranpak wants to test a particular software enhancement, we provide short-term technical support and defer issues such as licenses," adds Stijn de Bruin.

More information:
www.ranpak.com
www.beckhoff.com/packaging

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XTS increases flexibility in the packaging of dental components

Quickly and easily from blister to carton packaging

Elos Medtech from Gørløse, Denmark builds its own machines for the production and packaging of dental components, and aims at standardizing automation throughout. An XTS-based blister packaging machine from 2018 demonstrates the advantages of the platform concept. After expanding the XTS linear transport system, Elos was able to easily add new machine modules for cartoning the blisters.

Elos Medtech is one of Europe's largest and leading manufacturers in the field of orthopaedic and dental implants, headquartered in Sweden. The company employs 570 people in Sweden, China, the U.S. and Denmark and is part of the listed Elos Group. The factory in Gørløse, Denmark, specializes in the development and manufacture of dental components.

In 2018, Elos Medtech was the first company in Denmark to develop a new packaging machine based on the XTS from Beckhoff. Leveraging the flexibility of the modular transport system with the individually controllable movers, Elos was able to automate the previously manual packaging of dental components

in blisters. In day-to-day operations, the fast changeover capabilities of XTS help to increase productivity and reduce resource consumption. "We need to run many different, small-volume batches every day, so the flexibility of the machine and its quick changeover capability is crucial for us. It only takes 10 to 30 min to adjust the packaging machine's setup," says Rune Callesen, head of the automation department at Elos Medtech. "This packaging machine is fully validated against the strict requirements applicable in the medical industry for a clean and dust-free environment, high precision, reliability, quality control and testing for complete traceability."

Product insertion into a blister transported by a XTS mover

Rune Callesen (left), head of the automation department at Elos Medtech, and Rasmus Jensen (right), support engineer at Beckhoff Denmark, in front of the control cabinet of the blister packaging machine that will also provide carton packaging in the future.

Simple machine expansion with XTS

For Elos Medtech as a machine builder, the goal is to standardize the automation of its machines across the board. According to Rune Callesen, the recently expanded packaging machine is a good example of this: "We are very far along in standardizing our automation, not least compared to the larger machine automation vendors, where this is an extensive and lengthy process. With 'Elos Medtech Modulized Automation Standard' we have created a uniform platform that includes hardware, software and networking. This means we can easily move modules and add hardware, and all cable or network connections and software interfaces are standardized. With this packaging machine, we fully applied our standard, which benefited us when we added extra modules."

With the new modules, the machine will be able to package components in both loose blisters and blisters with cardboard outer packaging and printed labels in the future. This requires an additional paper cutter in the machine, a magazine module for the carton blanks and a new printer module. Cartonpackaging

will be fully introduced in the summer of 2023, and until then, packaging will continue in loose blisters. Elos has also added two vision modules that check the items being packaged as well as the placement and content of the labels. Previously, the machine contained two robots installed in the machine bed. After the expansion, the robots are mounted on rails on the ceiling of the machine cell and can move freely back and forth to free up space and to handle more tasks.

Maximum flexibility and integration capability

Rune Callesen says it inspires great confidence that the technologies on which the 2018 machine is based are so well thought out to enable long-term use. Everything is modular and reusable; everything is open and easy to use, he explains. This allowed Elos to simply add machine modules without any hassle, instead of building a whole new machine, which ensures both sustainability and investment protection.

"The open platform from Beckhoff supports our way of thinking. We can tie everything together and even integrate third-party hardware seamlessly. In doing so, we don't have to work with multiple types of automation software. That's a big advantage for us. For example, our vision cameras and the servo euipment for the robots come from two other suppliers. It would have been more difficult for us to integrate these with automation technology from any other supplier than Beckhoff," says Rune Callesen.

He also points out that third-party software can also run on the Industrial PC without additional effort. One example is the printer, which uses specific software, yet can be installed directly. The alternative would have been to develop a complicated solution involving the transmission of print commands via the network or to use an separate PC for printer control. The network structure is also easy to work with because the EtherCAT Coupler from Beckhoff with Fast Hot Connect ports takes care of identifying the modules in the network topology if they are moved. This technology makes it easy to quickly create the correct configuration for all connected components, according to Callesen.

"The technologies just work – for us there is no real alternative to Beckhoff. In my opinion, the solutions from other suppliers don't integrate as well," says Rune Callesen, continuing, "The support is also top-notch. We have two programmers in the Danish branch and have to ensure 24-hour operation. Beckhoff always steps in quickly when needed and is also happy to share know-how and even Gray code that we can adapt ourselves. We see working with Beckhoff as a true partnership, and the many benefits for us as a company reinforce our decision to choose Beckhoff as a supplier."

More information:
www.elosmedtech.com
www.beckhoff.com/xts

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Runhua Intelligent packaging machines are designed for efficiency and flexibility and can be optimally integrated into Industrie 4.0 concepts with open Beckhoff control technology.

PC-based control in packaging machines for hygiene products

Speed and precision through rapid control and drive technology

More speed, flexibility and, of course, sustainability: these are the features that most tenders for new packing machines are calling for. Runhua Intelligent, a Chinese manufacturer of systems for hygiene products, meets these requirements for its packaging lines for wet wipes with the help of PC-based control and drive technology from Beckhoff.

The typical packaging process for wet wipes is as follows: At the end of the packaging line, the wet wipes are placed in a bag to be closed with a cover. This is followed by secondary packaging of the bags – i.e., boxing and palletizing as well as storage. The high demands on the corresponding machine processes are notably influenced by current market conditions, including:

– rapidly increasing demand for wet wipes
– high cost pressure from large retail chains
– increasing diversity of variants
– frequently changing packaging designs
– smaller and smaller batch sizes
– sustainable use of packaging materials

Zhengzhou Runhua Intelligent Equipment Co. Ltd is responding to these market trends by developing increasingly powerful packaging machines. For a solid five years now, these machines have been built around PC-based control from Beckhoff, including embedded PCs, TwinCAT 3 software, EtherCAT Terminals, and servo drives and motors. Runhua Intelligent now asserts itself as a leading mar-

ket player with its consistently high product quality and production efficiency as a result of investing in advanced automation technology.

High efficiency and flexibility

The increasing demand for disinfecting wet wipes, not to mention ever smaller and more diverse packaging solutions, prompted Runhua Intelligent to develop machine modules that work even more efficiently, reliably, and flexibly than ever before. These notably include:

– cover stickers
– secondary packaging machines
– collective packers
– intelligent post-packaging lines

The cover stickers are the core element of the packaging lines. This process step requires dimensional accuracy at high cycle rates, specifically with a tolerance of ±1.5 mm at up to 120 units/min. In addition, the picker must be able to reliably grip and apply a multitude of different covers. With all of this in mind, this ma-
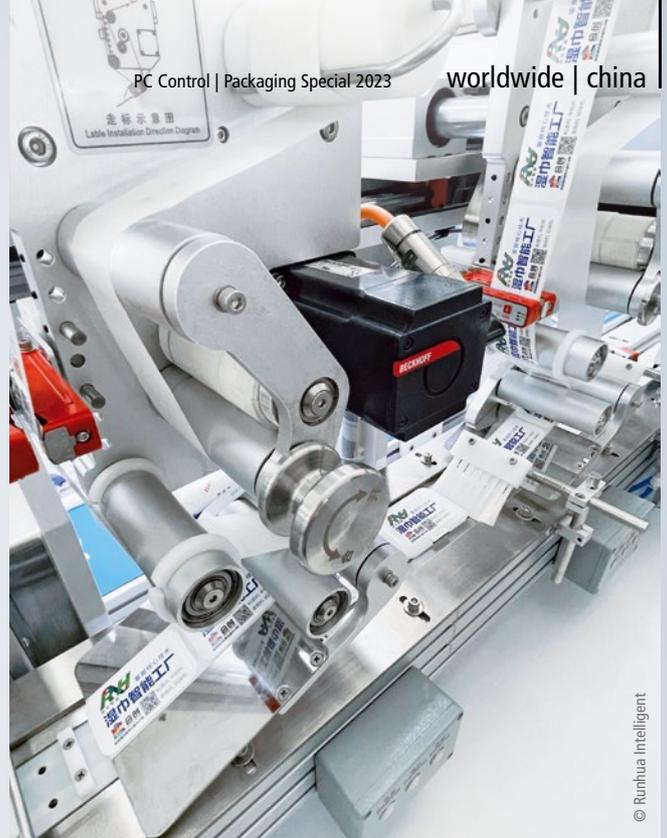
chine unit requires a high-performance motion control system for synchronizing the pick-and-place robot with the material flow.

This module was implemented using a CX5130 Embedded PC, EtherCAT I/Os, and AX5206 and AX5106 servo drives. The high computing performance of the embedded PC with an ARM Cortex™ CPU facilitates the combination of sophisticated multi-axis movements with conventional sequence control.

When it comes to handling the wide range of products effectively, automatic format adjustment and control software that supports parameterization of many axes are essential. TwinCAT 3 also provides extensive motion control functions for sophisticated path planning and control to this end. Runhua Intelligent explains that this flexibility allows its engineers to customize workflows with a simple click, thereby accelerating the development of new variants, shortening the time to market, and ultimately securing the company's technological lead.

Turning data into knowledge

Never a company to sit on its laurels, Runhua Intelligent is keen to go beyond simply improving the performance of its machines. This is because there is further potential for improvement between the various machine modules, pro-

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In addition to AX5000 servo drives (shown here), Runhua Intelligent also uses AX8000 multi-axis servo systems in other machine modules.

duction lines, and robots. Runhua Intelligent identifies these based on comprehensive data recording and analysis, with the aim of creating a truly intelligent wet wipe packaging line supported by Industrie 4.0 concepts and innovative tools from Beckhoff.

As an open and real-time capable fieldbus technology, EtherCAT takes on an important role here by enabling a straightforward connection between different machines and production lines and synchronizing the multiple servo axes of a machine in real time. At the same time, EtherCAT creates the basis for seamless and integrated data communication between multiple packaging processes.

Combined with the openness of PC-based control, this Chinese packaging machine manufacturer is laying the foundations for sending detailed machine and production data to higher-level ERP systems or to the cloud. Cloud services open up new ways to increase the efficiency of production planning and control. The analysis of the data also enables highly efficient energy and lifecycle management, right through to online monitoring and product traceability.

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Above: The labels are applied to the sealing lids synchronously with the machine cycle and fed to the delta robot in parallel with the packs. The AM8000 servomotors with One Cable Technology (OCT) save valuable installation space in the process.

Below: Rapid and precise control of the AM8041 servomotors is crucial for applying the cover sticker.

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