FAST MOVING TECHNOLOGY

STÄUBLI

Trends & Topics

2022 Special Edition 40 Years Robotics

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Editorial

Dear readers,

Finally, the time has come again, and we are proud to present you our latest issue of Trends and Topics. As always, an exciting mix of topics awaits you here, including interviews, new products, reports, a look inside a smart factory and news of a very special anniversary: Stäubli Robotics is celebrating its 40th anniversary.

It is a good occasion to take a closer look at the company‘s success story. With pioneering developments, Stäubli Robotics has repeatedly succeeded in setting milestones and enabling automation in areas where no robot had previously entered. I am thinking, for instance, of our Stericlean robots, which can work under aseptic conditions in the medical and pharmaceutical industries, as well as our wash-down capable HE robots. They withstand the aggressive and frequent cleaning procedures in the food sector and help robot-assisted automation to make a breakthrough there.

What else has happened in the last 40 years can be seen particularly impressively in the article on smart production starting on page 6. When we entered the robotics business in 1982, no one could have imagined that Stäubli Robotics would one day become a global player in robotics with a full-range offering AGVs (automated guided vehicles), AMRs (autonomous mobile robots), POWER Cobots for human-robot collaboration and autonomous mini-stackers in addition to four-axis and six-axis robots. This unique product range qualifies us today for supplying the holistic equipment of fully automated and digitalized production lines.

Today, Stäubli solutions continues to set the standard, as we prove in an interesting use case on the wind-turbine manufacturer Siemens Gamesa starting on page 10. At the Cuxhaven plant, heavy-duty AGVs from Stäubli WFT transports nacelles with a weight of up to 350 tons for offshore wind turbines. The AGVs have a maximum payload of 450 tons and can move 900 tons coupled in synchronous operation with millimeter precision - an incredible performance in my opinion.

The 40-year story of Stäubli Robotics highlights how much courage, heart and soul, commitment and expertise previous generations have put into our success. A history that at the same time represents a commitment to top performance for our current management team. You can find out how we intend to master this challenge in the interviews with Stäubli WFT Managing Director Jan Louwen and myself on the following pages.

I hope you enjoy reading.

Yours sincerely
Christophe Coulongeat
Executive President Robotics

Dear readers,

Digitization and Industry 4.0 have set highly dynamic developments in motion throughout industrial production. Concurrently, innovative manufacturing processes such as 3D printing are taking on great importance. We are all experiencing a speed of change and innovation that has never been seen before on this scale.

In some industries, not only products, but also the technologies and business models that underlie them are changing dramatically. Take, for example, the automotive industry, where we are witnessing an unprecedented pace of transformation (more about this on page 16).

In short, we are currently living in a world of "VUCA" – volatility, uncertainty, complexity and ambiguity – a term that was actually coined in an era when there was far less uncertainty than there is today! In this climate, it is especially advantageous to have reliable partners at your side who accompany and support you in navigating immense challenges, and in the adoption of new products and production methods.

This is precisely how we at Stäubli Robotics have seen our role for the past 40 years. Our guiding principles and business aims have not changed in this time, but the way we support industries and the products and services we provide have evolved. We are seizing the opportunities of digitization to systematically expand and improve our customer services. Today, customers all over the world benefit from our customer portal, IoT, hotline support via video, augmented reality and more.

The performance of Stäubli robots also meets the highest expectations. The machines are characterized by an optimized cost-benefit ratio. And, these high-precision robots are proving themselves in flexible laser applications as well as in the production of batteries and charging plugs for electromobility.

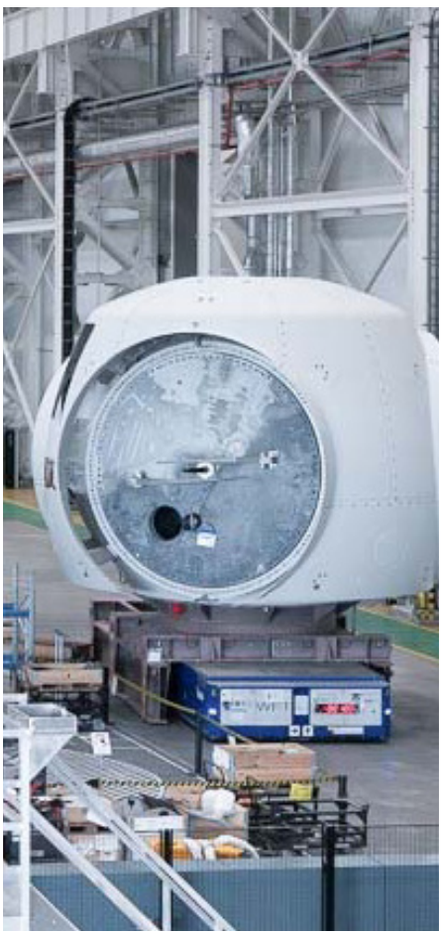
Together, we work in partnership with you to open up new markets and remain steadily on the path to higher efficiency, more sustainable production, and even more flexible automation. We all benefit from this – but you most of all, as the operators of machines and production lines equipped with Stäubli robots.

Sincerely,
Adrien Brouillard
Global Head of General Industry and Customer Services

Adrien Brouillard was appointed Global Head of General Industry and Customer Services at Stäubli Robotics, effective June 1, 2022. He is responsible for the company's business in general industry worldwide, particularly with the automotive sector, as well as customer service and Stäubli's rapidly growing service business.

All of this considerably expands Adrien's managerial scope. He has been with Stäubli Robotics since 2008, most recently in the role of Global Head of Customer Service.

Adrien Brouillard is a French citizen. He is married with two children and based at the Stäubli plant in Faverges, France, though his duties frequently take him away on visits to customers, subsidiaries and partners worldwide.



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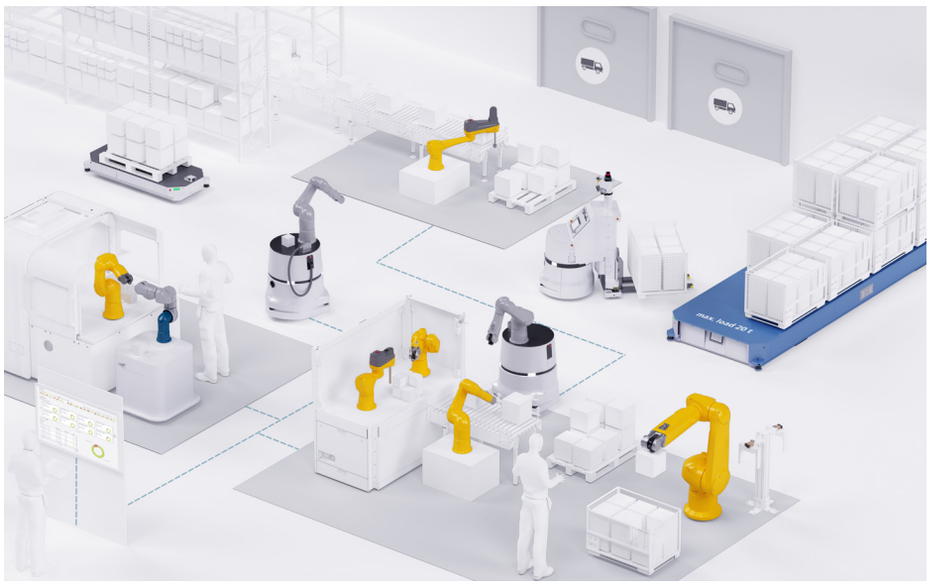
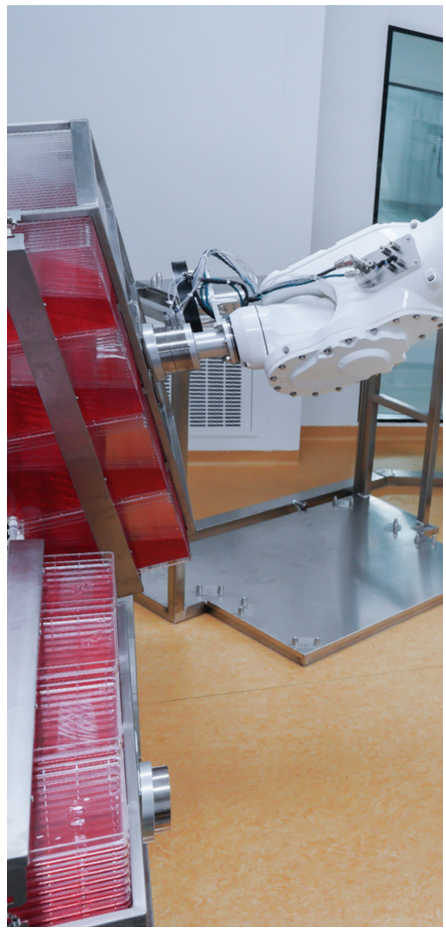




Eyes firmly fixed on expansion

Interview Christophe Coulongeat, Executive President Robotics | Photos: Stäubli

As Executive President Robotics, Christophe Coulongeat has led Stäubli's global robotics business since January 2021. In this interview, he talks about developments, prospects and strategies.

You have been Executive President of the Robotics Division at Stäubli for over one year now. What have been the main highlights since you started in the role?
Coulongeat: It was an exceptional year in many ways: I was happy to recruit and develop our Robotics Global Management Team, and we had the opportunity to finally meet in person! Along with this, we completed the formation of dedicated market teams to support our goals in several new markets. We hit record orders, net sales and manufacturing output. And we were recognized with the Red Dot Design Award for our TS2 range, which was a great achievement.

Of course, it has not all been plain sailing; like many we suffered and continue to suffer from the global chip and e-component crisis. Despite these ongoing challenges, we are reinforcing our investments in R&D and manufacturing capabilities to double our output by 2025.

How would you assess the global robotics industry and its potential to keep growing?
Coulongeat: The robotics industry offers a world of possibilities, as it is the cornerstone of the fourth and fifth industrial revolutions. Robots are closely associated with cutting-edge technologies like vision systems, machine learning, human-machine collaboration, mobility and industrial connectivity. These offer a number of benefits, as they enable different industries to reduce their carbon footprint with localized production and increase energy efficiency with higher productivity and lower consumption. Further, robotic technology improves quality of work life and safety by eliminating difficult manual tasks for operators. They also help companies be more competitive. More broadly, robots and automation are key enablers for developed countries to remain competitive.

In which sectors is the most growth currently taking place for robotics? And what are the key objectives and next areas of focus for Stäubli Robotics?
Coulongeat: In the past, the robotics industry was primarily driven by the automotive and electronics industries. Today, the robotics industry continues to support these industries, but it is also seeing growth and uptake in a variety of other areas.

For Stäubli, in addition to general manufacturing and automotive, I would highlight food, pharmaceuticals, medical robotics and photovoltaics. We are experiencing particularly strong and stable demand in these four sectors. We want to sustainably outperform the industrial robotics market and be recognised as the undisputed leader in these areas, and our technologies are continuously evolving to support the changing needs of this wider variety of customers.

What makes Stäubli robots the preferred choice in these industries?
Coulongeat: Stäubli has the world's most extensive range of special kinematics and can therefore offer the optimum robot for every application in these industries. All four impose the highest demands on robots in

terms of hygiene – and this is the main USP of our machines.
All of our special version robots meet the strictest industry-specific hygiene standards. They can work in sterile environments in medicine and pharmaceuticals as well as food processing, where they are subjected to aggressive cleaning agents, and in photovoltaics, where sensitive production conditions apply. This is the decisive advantage of the encapsulated, wash-down-compatible design of our robots, which makes them the benchmark in sensitive production areas.

What else do you offer customers in these areas?
Coulongeat: In these sectors in particular, we facilitate a form of partnership that has never been practiced before in the development of new robotics solutions. In the future we will focus on proprietary innovation, bringing in proven industry specialists. Under their guidance, we are setting up country-specific expert teams with on-site support in close proximity to customers. The aim is to collaborate with international producers to develop industry-compliant robotic and digitally networked production solutions that deliver new dimensions of flexibility, process reliability and business efficiency.

You mentioned digitally networked production, but this doesn't stop at robots. With Stäubli WFT, you now have your own in-house AGV expertise. What are the prospects for AGVs in sensitive environments?
Coulongeat: Our complete range of robots, cobots and mobile robots now also includes AGVs for deployment in cleanroom environments. Stäubli WFT is in the process of expanding the nascent cleanroom AGV industry in a targeted manner. After initial projects in the semiconductor industry, where cleanroom-compatible vehicles with payloads of up to 24 tons have been deployed, we are also expanding our product range with dedicated AGVs for use in pharmaceuticals and medical technology. Stäubli WFT has exceptional expertise in this field and a dominant position that allows us to offer integrated solutions from a single provider.

Wouldn't cleanroom-compatible mobile robots be another useful addition to the product range?
Coulongeat: Absolutely! That is exactly what we're working on at the moment. The required competence is in-house: Stäubli WFT develops the mobile platform and integrates our best-in class Stäubli robots on top. At our cleanroom production facility in Sulzbach-Rosenberg, these mobile robots can be upgraded to the required cleanroom classification. It's a perfect solution that we are working on right now to serve users in sensitive industries."

On the subject of new products, what else can we expect?
Coulongeat: Stäubli is currently setting the standards in terms of quality and performance with the TX2 and TS2 series. In the near future, we will replace the existing TX200 with the new TX2-200 and expand the series even further. The new six-axis TX2-140 and TX2-160 will also be supplemented by the somewhat larger TX2-180. The modular design of our robots allows this fine gradation with relatively little expenditure of time or capital. And of course, software and programming are also top priorities for our R&D department.

Looking at the industry overall, what differentiates Stäubli Robotics in an increasingly competitive market?
Coulongeat: I see four main factors, having to do with the company itself: First is our commitment to building long-term partnerships. This year, the Stäubli Group will celebrate 130 years since its establishment, and 40 years since the founding of Stäubli Robotics. Our group remains long-term oriented and focused on adding value for customers and shareholders over the coming decades.

We value and are recognized for our customer collaboration, which has led to numerous outstanding automation solutions. A prime example is the first Stäubli Stericlean robot. Together with a leading pharmaceutical company, we developed something entirely new – a breakthrough in automation under aseptic conditions for the industry.

The next point I would emphasize is that we have over 40 years of passion for innovation. Stäubli Robotics originated from the acquisition of Unimation's robots and SCARAs from Bosch Rexroth in 2004, combined with our core mechatronics know-how. Today, this translates to an industry-leading range of SCARA and 6-axis robots.

In 2017 we introduced the mobile robot HelMo, which combines robotics expertise with the motion and fleet management capabilities of WFT, which became part of Stäubli in 2018. This added industry-leading compact, precise and heavy payload AGVs, opening up new avenues for innovation.

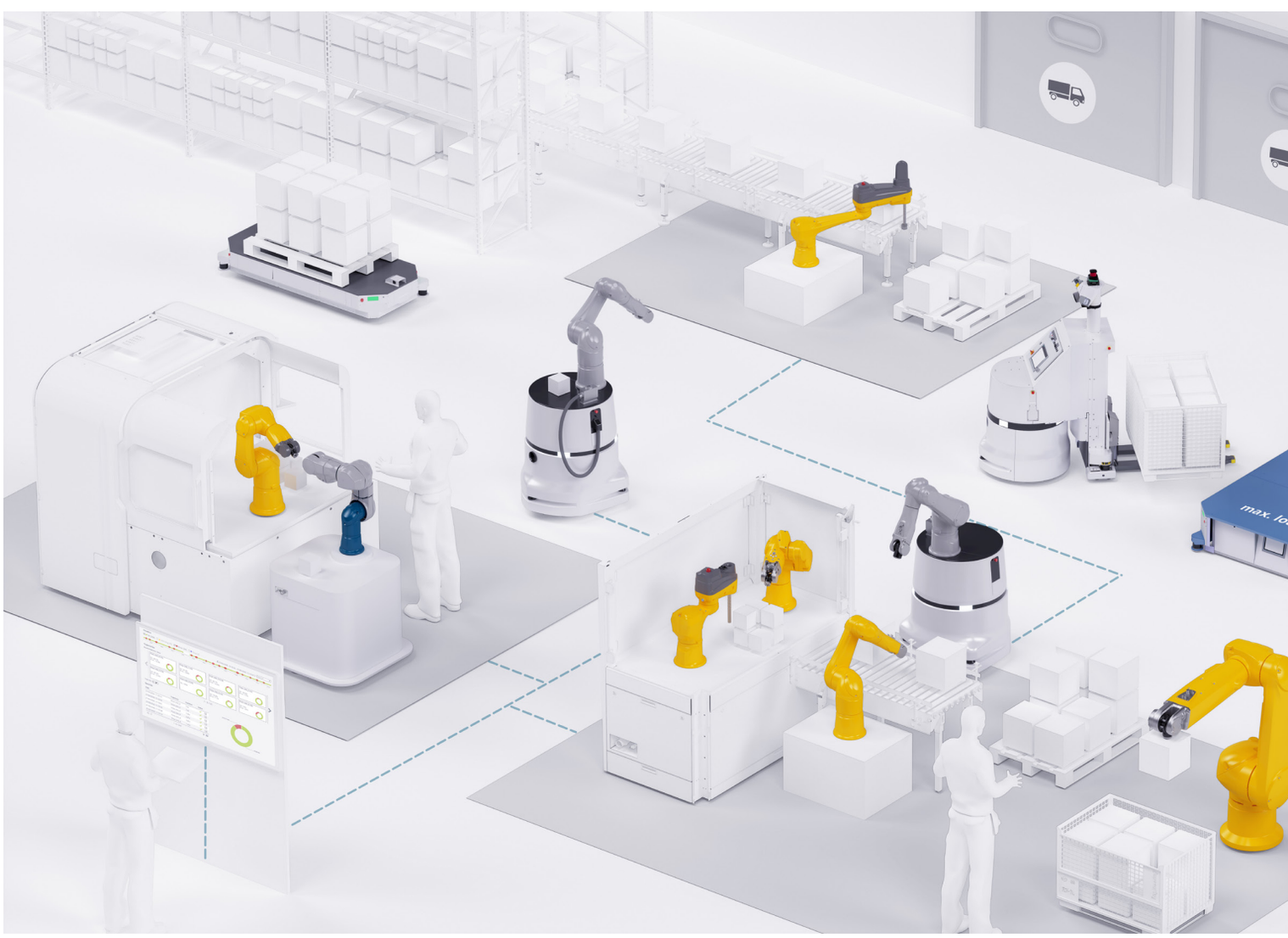
The third point is the unmatched performance and reliability that our robots are known for. We focus on developing technologies that enable our robots to operate in ever more demanding environments. We make no compromises on performance, precision and reliability in standard, harsh and sterile environments. This results in best-in-class total cost of ownership [TCO] throughout the lifecycle.

Our people are also a key differentiator. They are the driving engine of our growth and success, so we hire highly qualified people who want to make an impact in a family business and are willing to grow in a fast-growing and demanding market. I believe this shows in the quality of our people, who are all customer centric, from interns to the CEO.

Goodbye conveyor belt – hello smart factory

Author: Ralf Högel | Photos: Stäubli

For the past century, industrial production has been dominated by the assembly line, an inflexible sequence of machine stations for the cost-effective manufacturing process of products in enormous quantities and generally to the same design specifications. In an age in which consumers increasingly demand individualized products, it is a technology that appears to have reached its natural limits. Modern production is geared towards smaller batch sizes, an ever-higher number of variants and constant retooling. This calls for future-oriented intralogistics and production concepts that offer maximum flexibility. And thanks to the quantum leaps that have taken place in the development of robotics and AGVs, these criteria can now be met without any problems, as our look at matrix production shows here.



In the “Smart Factory”, the classic linear structure has disappeared, and fixed conveyor technology has been replaced with highly flexible transport solutions involving the use of AGVs (Automated Guided Vehicles). The digital networking of stationary and mobile robots, cobots, AGVs, autonomous forklifts and HRC (Human Robot Collaboration) workstations bring unprecedented flexibility to production.

The parts to be assembled are delivered to the production area by heavy-duty AGVs. Here, they are received by compact, unmanned forklifts and distributed to the relevant assembly stations. Within the smart factory, the partially assembled components are then conveyed by smaller AGVs or mobile robots which independently navigate their way to the assembly stations where predefined work content is performed.

These assembly stations are configured differently depending on the degree of flexibility required; in many cases, a combination of classic stationary robot stations and highly flexible HRC workstations proves to be the best solution. Mobile robot systems are also the first choice as flexible production assistants. With this process, individually equipped variants and derivatives can be assembled, and in the case of complete product changes, it is not necessary to strip out entire production lines, but only to reprogram robots and AGVs.

Smart solutions from a single provider

A look at the smart factory shown here reveals a rather special feature: the entire workflow is dependent throughout on robots and vehicles supplied by Stäubli. The Robotics and Connectors divisions of the Stäubli Group have the distinction of being the world’s only suppliers able to offer digitally networked production solutions of this complexity from a single source.

At Stäubli today, producers can find everything they need to set up a smart factory, from high-performance four-axis and six-axis robots, mobile robot systems, POWER Cobots, AGVs of various types, collaborative AMRs (Autonomous Mobile Robots) and unmanned forklifts through to key components such as fully automated tool change systems for robots.

SCOPE: Digital production at a glance

To ensure that users have full transparency over their smart production, Stäubli has developed a platform called SCOPE. The acronym stands for “Stäubli Connect, Optimize, Prevent and Enable”, which neatly summarizes the nature of this digital solution for the networking of robots. Implemented as an on-site solution, the platform aggregates, processes and visualizes the robot-specific data.

Users can view a wide range of relevant operating data for each individual robot system on a central dashboard and thus have an overview of the status of all robots at all times (“Condition Monitoring”). This creates the prerequisite for detecting irregularities and taking appropriate preventive action before quality fluctuations or even failures become imminent. Machine evaluations allow predictive maintenance, with the future option for users also to run their own AI-controlled optimization processes.

All in all, these highly flexible intralogistics and production logistics offer the perfect solution for today’s production engineering challenges. Ever smaller batch sizes, individualized products, frequent model changes or the assembly of different products at the same time present no problem at all for the modern smart factory.

Innovation as a driving force

Interview Jan Louwen, Global Head of AGV | Photos: Stäubli

Jan Louwen is the new Managing Director at Stäubli WFT. As Global Head of AGV, the AGV expert is already responsible for the worldwide AGV business. During this time, he has oriented himself and set the course for the future. But what is his strategy for the further development of the company and what goals has he set for himself? The answers can be found here in this interview.

Mr. Louwen, you have been observing as well as shaping the AGV (automated guided vehicle) market for the past 10 years or so. What do you see as the most striking changes taking place today?
Louwen: The AGV market has been undergoing major changes in recent years. The pace has been particularly dynamic in software development, where the focus is on navigation and fleet management systems. We are also seeing great demand for automated guided vehicles in almost all industry segments, a development that is naturally also attracting new competitors into the market.

At Stäubli WFT, we're very well equipped to face the growing challenges, and customers are inspired by the solutions we offer. Our product portfolio covers AGV platforms for heavy-duty applications, AGV forklifts and mobile robot systems.

What particularly attracted you to your new role as Global Head of AGV Robotics at Stäubli Robotics?
Louwen: Stäubli is a family-run multinational business with an impressive record and an exemplary corporate culture. I was immediately won over by the values held by the company and by its long-term corporate strategy. The technology of automated guided vehicles has fascinated me since I embarked on my career, and I am convinced of the enormous potential of our solutions.

What is the top item on your agenda for the future of Stäubli WFT?
Louwen: Stäubli WFT is positioning itself in the field of heavy-duty AGVs with the clear objective of becoming the market leader. In doing so, we are focusing on the highest possible modularity of our vehicles, and on making the transition from a special solutions provider to a series manufacturer. To achieve our ambitious goals, we need a product mix in our portfolio that includes standard AGVs as well as vehicles for high-end applications. To this end, we will continue to develop our own expertise and work with strategic partners on certain technologies.

Our sales strategy is focused on select target industries and applications where we have the expertise and can generate repeat business. We will gradually activate our sales channels through the Stäubli Business Units and empower integrators to offer our solutions.

Let's look specifically at fiscal year 2022. What goals have you set for yourself?
Louwen: In 2022, we will be concentrating on three core areas, namely the expansion of the customer base in our strategic target industries while simultaneously extending our service offerings, the expansion of our global distribution channels, and diversification of our product portfolio. We will meanwhile be pushing ahead with further training and education of our employees and continuously optimizing our structures and processes.

One area in which WFT specializes is heavy-duty AGVs. What importance will this have under your leadership, especially in comparison to standard vehicles? Where do you expect to see the most growth in the next few years?
Louwen: Our core competence and technology lies in the area of heavy-duty AGVs. We are also further diversifying our portfolio to include standard vehicles as well as AGVs for high-end applications such as cleanroom and outdoor applications. We expect similar growth rates in these different areas, with the highest volume coming from standard AGVs.

In the past two years, Stäubli WFT has invested in a production facility for cleanroom-compatible AGVs. Which markets are you tapping into with this specialized offering, and how do you see this segment developing?
Louwen: We have already been able to successfully supply international customers with cleanroom AGVs. Our production facility in Sulzbach-Rosenberg plays a central role in meeting the high quality standards. In the meantime, we have been developing a high level of expertise in this area. We see great potential in the semiconductor, pharmaceutical and food industries, and will explore this together with our robotics colleagues and their first-rate customer contacts.

Do you expect to see the trend toward so-called "free" navigation continue, more specifically simultaneous local-

ization and mapping (SLAM)? Are there other innovation drivers at play here, for example industrial 5G networks?
Louwen: I cannot see fully autonomous navigation being feasible in an industrial environment. Instead, our customers want their AGVs to move along virtual tracks without having to install additional infrastructure such as reflectors. We enable this with our laser-based navigation system. However, the most appropriate navigation solution always depends on the customer's specific application. Stäubli WFT is able to respond flexibly to customer needs.

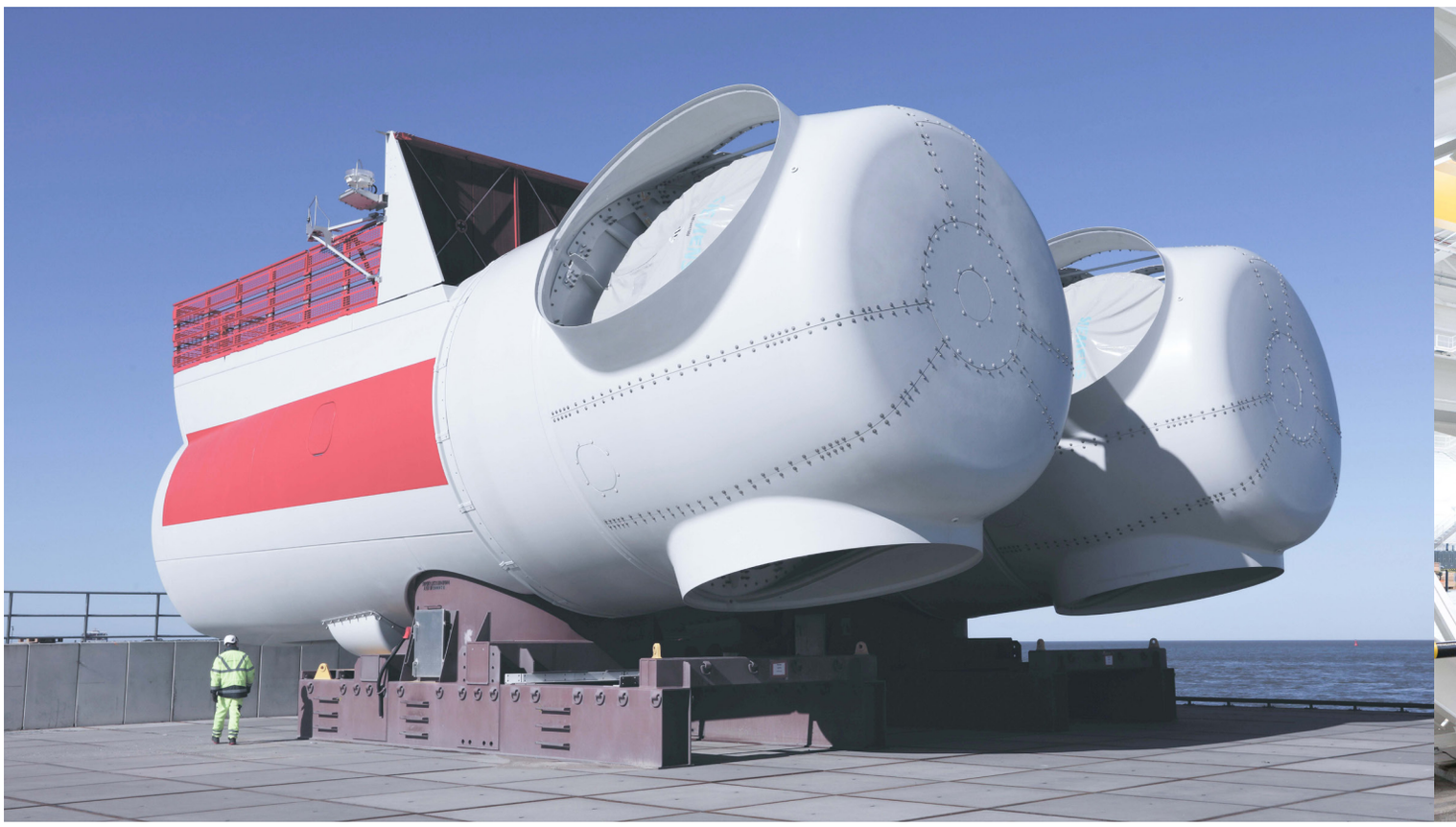
We are involved in various research projects with industry partners with the aim of always being at the forefront of the latest technological developments. We are currently focusing on GPS navigation in the outdoor sector, on 5G as a replacement for Wi-Fi, and on the VDA5050 standard interface.

Where do you see further innovation potential at the technology level?
Louwen: I still see a lot of innovation potential in the areas of software and sensors. Our customers expect intuitive operation and reliable performance of their system controlled by our software.
Our vehicles are already equipped with a lot of sensors, especially for safety reasons, for navigation and detection of pallets and barcodes. Developments toward 3D object recognition or direct communication with robot cells will create completely new possibilities for us.

What developments or new products can be expected in the near future?
Louwen: In the coming year, we will focus on our own in-vehicle control architecture as well as the new generation of our smallest platform, the PF100, and the FL090 forklift. We place great emphasis on customer-oriented development with the involvement of our international Stäubli AGV team.

"I've been passionate about automated guided vehicles technology since the beginning of my career, and I'm convinced of the enormous potential of these solutions."

Jan Louwen,
Global Head of AGV



450-ton AGVs in action at Siemens Gamesa

Author: Ralf Högel | Photos: Siemens Gamesa

Flexible flow production on a mega scale – Every working day, a 350-ton nacelle for an 8MW offshore wind turbine leaves the Siemens Gamesa factory in Cuxhaven. In the ultra-modern flow production environment, four heavy-duty AGVs supplied by Stäubli WFT assist in transportation from station to station within the factory.

The manufacture of wind turbines for offshore installations is on a completely different scale from standard mass production. The rotor blades of the 8MW SG 8.0-167 DD turbines that Siemens Gamesa builds for offshore wind farms are 81.4 meters in length, the total turbine height is 167 meters (ten meters higher than Cologne Cathedral) and the nacelles weigh around 350 tons. These machines for sustainable energy production are in demand all over the world. The nacelles are built at the Cuxhaven plant, which was newly constructed in 2018 for this very task. The rotor blades come from other sister plants of the Siemens Gamesa Group.

Just as impressive as the dimensions of the turbines are the workflow and the capacity of the plant in Cuxhaven. More than 250 nacelles are produced each year and loaded directly onto specially built transporter ships. In other words, the 600-strong workforce builds a complete wind turbine nacelle every working day. This is flow production on a mega scale.

Clearly structured, highly flexible flow production

The three main components – the hub, the

Photo left:
Mega dimensions: Two 8MW nacelles present an impressive sight: The frames bearing components weighing many tons are maneuvered by AGV.

Photo right:
Stäubli WFT's heavy-duty platform AGVs perform an important function in transporting components around the factory in which wind turbine nacelles are assembled.

two-story "backend" machine house and the generator itself – are assembled on three parallel production lines. The magnets that go into the generator are also manufactured at the Cuxhaven plant, likewise with a high degree of vertical integration. These three massive components are brought together to form the complete nacelle, which is then comprehensively tested at an inspection station.

Assembly takes place in cycles at individual stations, and the components, which weigh many tons, are placed on frames that allow them to be transported from station to station. This is mainly done by crane, but in order to ensure maximum flexibility, driverless heavy-duty transport systems (AGVs) from Stäubli WFT are also used for transport around the factory. The AGVs maneuver themselves into position underneath the frames, lift them up and move them on to the next assembly station.

Three high-precision AGVs with 200-ton load capacity

Three heavy-duty platform AGVs from the Stäubli WFT range with a load capacity of 200 tons are in service. They move about with the help of eight omnidirectional drive units – a patented in-house development by Stäubli WFT. Eight fixed rollers provide support when transporting the load.

The human operator moves the 8.00 x 2.62 meters platform under the frame by radio remote control and raises the platform by 200 mm at the push of a button. At a maximum speed of 1.2 km/h (2.1 km/h when unloaded), the operator transfers the component to the next assembly station. This ensures smooth travel and is gentle on tires as well as floors – thanks to the patented Stäubli WFT drive technology, rotary movements cause minimal abrasion.

RFID tags sunk into the floor create the right conditions for semi-automatic operation. The AGVs then move between pre-programmed positions. And this is only the first stage in the integration of heavy-duty AGVs into automated material flow concepts. The control system also allows integration into Industry 4.0 environments and warehouse management systems. In addition, Stäubli WFT can provide AGV data for process optimization.

A highly efficient material flow concept

The combination of transport by crane and/or AGV has been adding value since the start of production in Cuxhaven. Ample proof of the unique advantages this confers was given during the first model changeover. Nils Schattenmann, in charge of rolling equipment at the plant, explains: "Production started with our 7MW offshore turbines. Later, and without any interruption to production, we switched to the current much larger 8MW turbines. The time and effort involved was minimal, with the AGVs only having to be reprogrammed."

Senior management are also totally satisfied with the vehicles supplied by Stäubli WFT in more conventional operations. Nils Schattenmann: “The AGVs work reliably and with high precision. Because these vehicles are an integral part of the internal material flow, we cannot afford any downtime here.”

Transport to the test stand with 450-ton AGVs

The reliability criterion applies all the more to the fourth heavy-duty AGV supplied by Stäubli WFT. Its load-bearing capacity of 450 tons is more than twice that of its predecessor, and with a platform dimension of 10.5 x 3.02 meters, it is also significantly larger. Here, 16 drive units, supported by 19 fixed castors, ensure mobility.

This AGV is essentially reserved for the final process step – the transport of the finished nacelles to the test stand. It therefore also has a fixed role in the mega-scale flow production.

The vehicle can lift and transport more than eleven times its own tare weight of around 40 tons, bringing a total weight of more than 400 tons to the weigh station. There are very few AGV manufacturers in the world that can compete in this payload class, but Stäubli WFT goes one better: for loads of 500 tons and over, multiple vehicles can be hitched together. AGV control systems are basically set up for this.

Future prospects: Two 450-ton AGVs in synchronous operation

Siemens Gamesa plans to purchase a fifth heavy-duty AGV from Stäubli WFT for the Cuxhaven plant in the near future. Nils Schattenmann: “We are currently setting up production for the next generation of offshore wind turbines, which will be significantly larger and also deliver an enhanced 11 MW of power.” In concrete terms, this means that the SG 11.0-200 DD will have a rotor diameter of an incredible 200 meters, and the nacelles will weigh a third more. They will also be equipped with a helicopter landing platform.

Flexibility again played a central role in the planning of the in-plant heavy-load material flow. For this reason, the system designers at Siemens Gamesa opted for a second model of the existing 450 ton platform rather than a single, even larger AGV. Nils Schattenmann: “We will then transport the finished nacelles of the new turbines from final assembly to the test stand on the two 450 ton vehicles operating in tandem. The fact that Stäubli WFT has the technical expertise to enable synchronous operation of vehicles of this size is a great advantage for us. It allows us to use the vehicles individually or paired up for maximum flexibility.”

Photo up:
Neatly lined up: Flow production of the hub components. The AGVs supplied by Stäubli WFT can be seen on the right.

Photo down:
The generator is the central and heaviest component of the wind turbine nacelle.

Automotive production: Unprecedented changes ahead

Author: Ralf Högel | Photos: Stäubli

The automotive industry has embarked on a major shift towards e-mobility. This is having an impact on the automated production of vehicles, most notably of drive units. The tasks performed by robots are set to change dramatically.

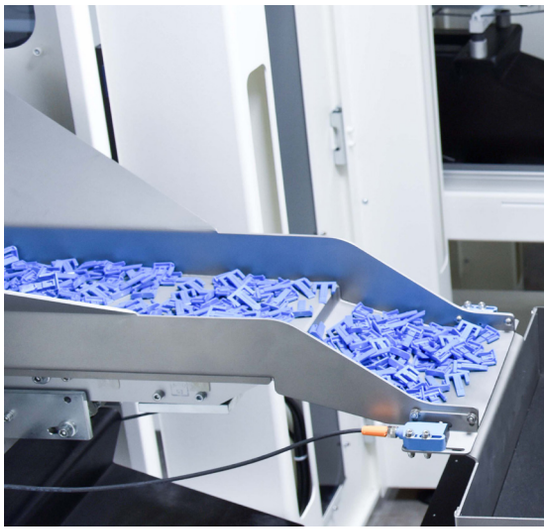
The automotive industry is undergoing one of the greatest transformations since 1886, the year Carl Benz filed a patent for his "Motorwagen." There are multiple challenges to be met, and each one imposes its own unique demands.

The acronym CASE gives a good idea of what is involved: Connected, Autonomous, Shared, Electric. The "E" element is the most important of the four. It signifies the change from internal combustion engines to exclusively electric power units. Manufacturers such as Volvo have already halted the development of new combustion engines, while others including Daimler, Fiat, Ford and Nissan have announced that they will no longer be producing "gas guzzlers" from 2030 onwards. Audi, General Motors and Volkswagen will follow suit in 2035.

The new drive technology will have a massive impact on automotive production and consequently on automation in automotive plants. This includes the types of tasks assigned to robots. Gone are the days of merely handling cylinder heads, conveying pistons to honing and grinding stations, and assembling fuel injection systems and catalytic converters. And because the entire powertrain – including the transmission – now has a much simpler layout, other traditional robotic tasks such as automatic deburring of gears are also becoming less relevant.

One thousand robots for battery production

Does this mean robots in automotive production will soon be out of a job? Most de-



finitely not; only the nature of the work they do is changing. This reorientation of applications is commercially beneficial to Stäubli Robotics. Processes in battery production, for example, require ultra-fast, high-precision robots.

"These are precisely the areas in which our robots excel," says Adrien Brouillard, Global Business Head General Industry & Customer Services at Stäubli Robotics. "We were already able to supply the one-thousandth robot to be used in the production of lithium-ion batteries for electromobility to a single customer just a few months ago. From our perspective, we're only at the beginning." Brouillard sees an immensely profitable market emerging for Stäubli's most reliable robots due to the transformation taking place in the automotive industry.

Market forecasts support this optimism. Around 6.5 million e-vehicles (EVs), not counting hybrids, were sold worldwide in 2021. That's a 9.5% share of total volume and an increase of more than 100% over the previous year. Market studies all confirm that this rapid growth will continue. By 2030, at least 40% of all new cars are expected to be electrically powered, with some forecasts even predicting a 50:50 split by then.

The tasks that Stäubli robots perform in battery production could not be more varied. For example, they assemble the "stacks" in prismatic cells and put together rectangular or cylindrical cells to form battery packs. Other jobs include applying conductive paste, bolting the units together and handling them during inspection, as well as delivery to and retrieval from the charging station. The robots enable flexible production, allowing manufacturers to follow product design trends and stay in full compliance with new requirements for sensitive production environments.

Focus on China, rollout in the West

The use of Stäubli robots in battery manufacturing is happening predominantly in China, which is logical considering the Asian giant is the world's largest producer of lithium-ion batteries. But the U.S. and Europe are catching up at a phenomenal pace. In Europe alone, 20 to 30 "gigafactories" – plants with a production capacity of more than one terawatt hour per year – are under construction to meet Europe's demand for batteries to power electric cars. To cite one example, Volkswagen has signed agreements with partners to build six gigafactories with a total capacity of 240 GWh by 2030.

A hotly debated issue at the moment is the extent to which European engineering companies have the skills and capacity to serve this colossal new market. Each gigafactory requires investments the magnitude of one billion euros. There are a number of compelling reasons why Stäubli robots have already established a presence in the first projects to get off the ground.

"Battery assembly requires the shortest cycle times and maximum precision," explains Lionel Schaal, Market Leader Auto-

„By playing our part in the automation of battery production, we are helping to open up a new and highly attractive market. In doing so, we are applying our traditional strengths of innovation and customer service."

Lionel Schaal,
Market Leader Automotive/E-Battery , Stäubli Robotics

Image left:
With its processing head, the robot can complete four welds in a row while in a static state, before repositioning and continuing its works. The Stäubli TX2-90 was the only six-axis robot on the market that was able to meet the requirements in terms of load capacity, range, and precision in such a compact design.

Image right:
The Stäubli six-axis robot picks up a connector lock from a vibration platform and mounts it on the connector housing.

motive/E-Battery at Stäubli Robotics. “Our robots are ideally suited to this task. By playing our part in the automation of battery production, we are helping to open up a new and highly attractive market. In doing so, we are applying our traditional strengths of innovation and customer service.”

Remote laser welding of battery packs

A prime example of the use of Stäubli robots in electromobility is remote laser welding of cylindrical cells to make ready-to-install battery packs. SWS Laser GmbH, a startup that designs and builds special machinery, has developed plug-and-play robotic cells for this specific task, centered on a Stäubli TX2-90 six-axis robot with a specially designed processing head.

In selecting the robot, SWS Laser GmbH specified process reliability and precision as their top priorities – characteristics for which Stäubli robots have acquired an excellent reputation. In this context they are absolutely essential, because any weld that burns through the connecting plates would inevitably lead to short circuiting in the battery. Therefore the welding depth has to have process reliability within the micrometer range.

For these reasons, Stäubli robots are also used in a fully integrated cell for the assembly of lithium-ion battery modules. The cell, called Voltjet, is a joint development by Austrian specialists Nordfels and Voltlabor and can process a battery capacity of up to 100 kWh per hour. Stäubli‘s new TS2 generation four-axis robots are used to assemble and test the cylindrical battery cells. They offer high performance and repeatability and use proprietary laser welding technology to complete the cells into battery modules.

E-mobility is not the end of the road

The electrification of vehicles requires the production of batteries, but also special e-components. Here, too, suppliers as well as manufacturers of automated systems for component production rely on Stäubli‘s robotics expertise. For example Eberhard AG, a German manufacturer of specialized machinery, was commissioned by a major automotive supplier to design and build a system for the assembly of high-voltage connectors in Mexico. In the plant, six ceiling-mounted Stäubli robots will handle five million connectors per year. Their tasks include optical inspection and leak testing as well as tray packing.

As far-reaching as the transformation of automotive production and Stäubli’s role within it may be, not everything is destined for change. An estimated 40% to 50% market share for EVs in 2030 also means that internal combustion engines will still be in production for the remaining 50% to 60% of vehicles. And every car, regardless of its drive system, needs an interior with operating elements, lights, locking systems and air conditioning – components and modules which will require highly automated and robot-supported production systems. Stäubli is well prepared for the post-2030 era.

Six ceiling-mounted Stäubli six-axis machines work on the assembly and testing line. Five million high-voltage connectors will be assembled annually on the highly structured assembly line.

The biggest obstacle to automating pharmaceutical processes is microscopically small

Author: Kerstin Jarosch | Photos: Stäubli

One key challenge for robot manufacturers today: contamination control strategy (CCS)

At the end of 2021, it was estimated that nearly 3.2 million robotic units were deployed in industrial settings worldwide. What makes this number all the more remarkable is that it has doubled since 2015 and is set to continue growing at a similarly rapid pace, meaning a double-digit increase over the next five years.

The reasons for this are as varied as they are familiar: Pandemic-related supply bottlenecks must be compensated for, the shortage of skilled workers is becoming more acute, and technological progress is exhibiting dynamics that no longer require Moore's Law to visualize!

The International Federation of Robotics (IFR) predicts: "The future belongs to the networked interaction of robots and autonomous vehicles – or rather autonomous mobile robots (AMR)." Developments that are still considered cutting edge in some industries are already standard in others. Despite or perhaps precisely because of its intense regulatory landscape, the pharmaceutical industry, too, will have to face up to these future demands in a timely manner, as demonstrated not only by the past two pandemic-dominated years.

From the standpoint of the pharmaceutical industry's highest regulatory agency in the United States, the Food and Drug Administration (FDA), it is only logical to update the relevant regulations. The same goes for Annex 1 of the EU Good Manufacturing Practice (GMP) Guidelines.

No automation without more stringent risk controls

Annex 1 focuses on the monitoring of contamination risks, referred to in the original as contamination control strategy (CCS). In doing so, it obliges manufacturers of robots of all sizes to address the principles of quality risk management (QRM) intensively, with the aim of excluding particulate,

Saving time and raising hygienic standards: Robot-based loading and unloading of freeze dryers under sterile or aseptic conditions.

microbial and pyrogenic contamination of the end product during the manufacture of sterile products. As a robot manufacturer with many years of experience in the pharmaceutical market, Stäubli is familiar with prevalent conditions in the regulatory environment. Ongoing dialog with the pharmaceutical industry and its machinery suppliers results in innovative new CSS-compliant products.

Stäubli's high level of expertise in connectivity and interface management facilitates automation across the entire process chain of pharmaceutical production. The complexity of this process should not be underestimated, as it involves a balancing act between maximizing output (and therefore profitability) on the one hand and maintaining exceptionally high quality standards on the other.

Fully automated – that's the way of the future

At the behest of the European Medicines Agency (EMA), both highly potent as well as non-potent active ingredients are to be manufactured exclusively in enclosed process systems in the future. This elevates robots to the status of core elements – provided they meet the new Annex 1 requirements.

The International Society for Pharmaceutical Engineering (ISPE) has called for open process equipment to be replaced by enclosed equipment wherever possible. This creates a need for new and more flexible concepts. The right choice of robotics solves this dilemma. It is now at a level of development at companies such as Stäubli that goes far beyond laboratory scale and has the functional maturity for use in series production.

Today, in addition to autonomous mobile robots (AMR) and automated guided vehicles (AGV), there are solutions that enable pharmaceutical companies to automate a large number of laboratory applications. Examples include the automated cultivation of cells, sample handling, the preparation of cells for flow cytometry, the filling of culture bottles, handling processes within enclosed isolators and supporting activities during freeze-drying and autoclaving.

Robotic applications also already exist in the field of biotherapy and the processing of personalized cell cultures, as well as for API research and production and the manufacturing of liquids and solids. The indispensable components for such a broad range of applications are not only more modern hardware but always up-to-date control mechanisms.

The Stäubli robot precisely stoppers a tray of nested vials after filling. Changing over seamlessly to different formats, Vers-A-Tech™ can process up to 1,200 nested vials or syringes per hour.

„New developments like tele-manipulation, force detection and controls, aseptic tool changers, haptic remote control devices and other technologies are needed to set up gloveless systems in the future, supporting tasks that need to be carried out inside the cell."

Rudolf M. Weiss,
Global Head of Pharma

40 years of Stäubli Robotics

Author: Cindy L'Esperance | Photos: Stäubli

Stäubli's long history is distinguished by a number of world firsts. Using its tremendous innovative strength to great effect, the company continues to focus on making industrial applications faster, safer, more reliable, and more productive across all sectors of the economy.

Stäubli Robotics, a division of the Swiss-owned Stäubli Group, first ventured into robotics in 1982. It all started with a partnership forged with U.S.-based Unimation, the world's first acknowledged manufacturer of articulated robots. Later that same year, the two collaborated on their first range of SCARA robots.

Unimation merged with Stäubli in 1989, and in 1993 Stäubli launched its first fully robot designed and built entirely in-house, the six-axis RX90. This development marked a milestone in robotics as the world's first fully enclosed six-axis robot, the RX90, vastly expanded the potential of robots for applications in clean or harsh environments. It also marked the introduction of Stäubli's patented JCS drive technology.

In the years that followed, Stäubli Robotics expanded through acquisitions, bolstering its capabilities and expertise as it continued on a path of innovation. The foundational RX series evolved into the TX six-axis series. These robots would be the first to feature Stäubli's proprietary CS8C PC-based controller, which greatly simplified robot programming for all types of users.

New generations of TX2 six-axis and TS2 four-axis machines have since made their debut. The robots have proved their versa-

tility and scalability with the incorporation of special kinematics and the introduction of models for particularly sensitive environments in the pharmaceutical and medical sectors, for humid environments in the food industry where cleaning with high powered water jets takes place, and for the harsh conditions that prevail in the automotive industry.

The rise of the AMR, AGV and cobot

In 2018, Stäubli developed its first mobile robot system in collaboration with AGV manufacturer WFT. The company merged with Stäubli shortly thereafter to form Stäubli WFT. This move put Stäubli in a position to vigorously pursue the development of autonomous mobile robots (AMRs) and automated guided vehicles (AGVs).

Also in 2018, the company launched the TX2touch POWER Cobot series for HRC (Human Robot Collaboration) applications, which features advanced safety technology. TX2touch is the first cobot to qualify for SIL3/PLe safety certification and has been proven to work safely with humans in all sorts of industrial environments.

“With our acquisitions, continuous product innovation and expansion of the global Stäubli presence, we have been able to pave the way for flexible solutions for the smart factory of tomorrow,” says Gerald Vogt, CEO of the Stäubli Group. In addition to celebrating the 40th anniversary of the Stäubli Robotics Division, there are many other causes for satisfaction, including the recent record levels of incoming orders and the expansion of production across multiple manufacturing sites.

Gerald Vogt,
CEO Stäubli Gruppe

40 years of passion for innovation

1982

Creation of Division „Automation and Robotics“

1989

Acquisition of Unimation, industrial Robotics pionner

1993

RX 6 axis robot with CS7 controller

1995

Faverges Robotics building, France

1997

Hangzhou creation, China

2001

Stäubli Robotics Suite

2004

Acquisition of Bosch Rexroth‘s SCARA activity

TX 6 axis robots with CS8C controller

2007

HE robot range

2008

TX Stericlean
6 axis robots for
VHP environments

2011

TX200 6 axis
heavy payload

2016

TX2-40/60/90
6 axis robot series
with CS9 controller

2017

HelMo
mobile robot
system

2018

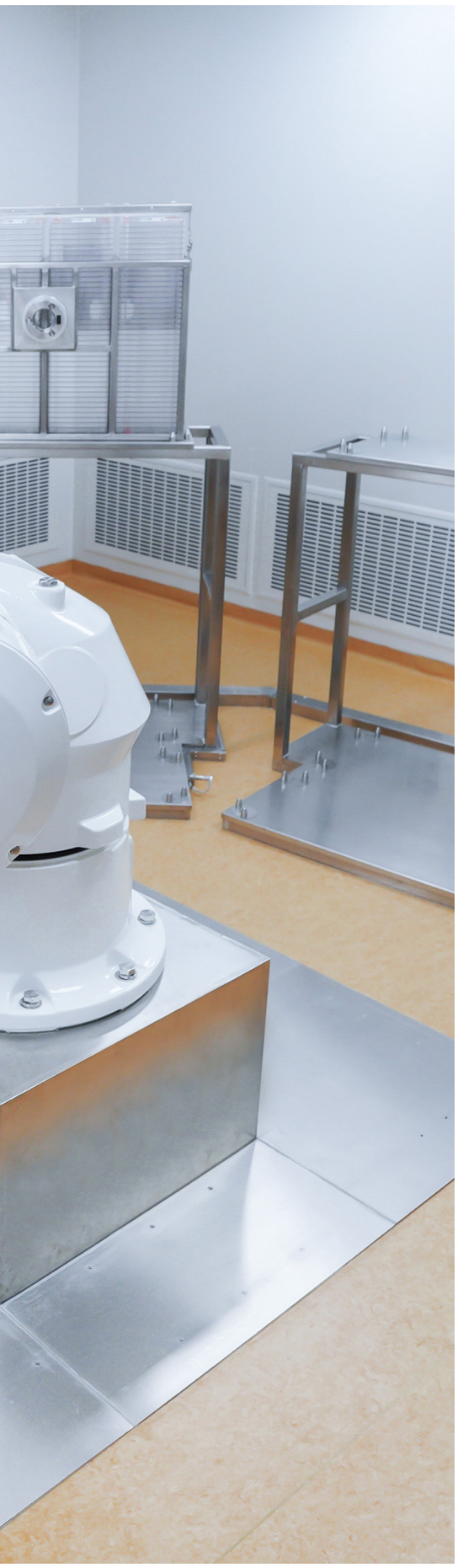
Acquisition of WFT,
Sulzbach-Rosenberg,
Germany

TS2 SCARA series
replace TS

2021

Red Dot Award
for TS2

TX2-140/160
robots series



How robotics creates a better and more sustainable future

Author: Karolin Kluesener | Photos: Stäubli

As the global population grows and resources dwindle, we have a greater responsibility than ever to make our actions more sustainable. With internationally defined goals, the United Nations wants to create humane living conditions worldwide and preserve our natural resources. Here, robotics makes a decisive contribution as an enabler technology for various fields of development.

The 17 Sustainable Development Goals (SDGs, see info box) were launched by the United Nations in 2015 to fulfill our responsibility towards future generations. In the meantime, many governments, associations and organizations are using the SDGs as a global reference framework to align their actions with these goals and work together to achieve a certain level of prosperity and a peaceful world for all by 2030.

Towards a healthier society

One goal where robotics is making an important contribution is the improvement of global health care and individual well-being (SDG 3). Here, advancements in medical technology are driving societal progress, with robots performing complex microsurgical procedures with even greater precision and safety. For example, doctors use their own head movement to control a surgical robot with an integrated camera via so-called head-mounted display (HMD) and can operate on the affected area with a high-resolution all-round view and without any jittering.

At the same time, robots for aseptic environments simplify and accelerate the sterile and automated production of cell and gene therapies or vaccines, paving the way from laboratory research to series production. While their use significantly reduces the risk of contamination, this form of production also brings significant cost reductions and facilitates access to these sometimes vital therapies.

For a long time, robotic systems have helped relieve employees of monotonous or physically demanding tasks. Examples of improved working conditions range from handling heavy wheels of cheese in the food industry to welding and polishing operations in manufacturing. In recent years, collaborative robots are now making their way into various industrial sectors and taking over monotonous or unhealthy work steps interacting directly with employees: Particularly in assembly, these cobots contribute to greater safety and relief.

Responsible use of resources

In the long run, however, robots not only reduce intensive labor, but also the resources used in the sense of SDG 12, „Sustainable consumption and production“. Their use in food and drug production, for example, en-

sures that ingredients processed with minimal losses and that the packaged portions or filling quantities can be precisely dosed.

Thanks to extensive research and development, also the robotic systems themselves are becoming ever more precise and efficient, which reduces energy consumption. Their high-quality workmanship also extends service life – and if a robot does reach the end of its life cycle, it is not simply disposed of and replaced, but refurbished and reused again. This not only saves time but also noticeably reduces CO2 emissions and raw material consumption that would be generated by producing new machines.

Accompanying the energy transition

In times of climate change, independence from fossil fuels and affordable access to renewable energy are becoming increasingly important. In terms of SDG 7, „Affordable and Clean Energy“, automated guided vehicles (AGVs) built for heavy-duty transport can significantly facilitate the construction of wind turbines. This can be achieved, because they transport components for offshore wind turbines weighing several tons every day and contribute to flow production on an XXL scale through the synchronized operation of several vehicles.

The production of solar panels can also be carried out much more efficiently and on a larger scale, and thus more cost-effectively, using cleanroom robots: They cover all steps of module production or assembly and ensure safer handling, resulting in less material breakage, for example. In addition, as in many other areas, they guarantee less machine downtime and high-quality output in large quantities for a market where demand is growing strongly.

In summary, robotics, as a relatively young industry, also enables and accelerates the development of other future technologies, contributing to a more sustainable development of our planet. Be it the series production of sophisticated medical therapies, an easing of difficult work steps, or the assembly of PV modules. Today, the focus often lies on harmonious cooperation between man and machine. All these advances are not detached from each other – improvements in one area in turn facilitate the development of other applications. Thereby also robotics is incrementally contributing to a more sustainable future for all of us.

Sustainable Development Goals

The Sustainable Development Goals (SDGs) are part of the United Nations 2030 Agenda for Sustainable Development. They are a global call to action to protect our planet and provide a decent life for all its inhabitants. The 17 goals can be roughly assigned to five core areas: Social aspects target better health care and the fight against poverty, among other things; the economic area covers humane working conditions; and the governance goals aim to promote global peace through strong institutions. Environmental protection also plays a major role as the goals promote clean energy and sustainable forms of production. However, the individual areas of action are closely interlinked - development in one area simultaneously promotes further social progress. For example, responsible and efficient use of resources goes hand in hand with climate protection goals.

Robotics in precision surgery:
State-of-the-art robots make complex microsurgical procedures easier and safer.

Food processing:
Thanks to their high precision, robots contribute to efficient food processing with minimal losses.

Solar panel production:
In the manufacture of solar panels, robots allow for largely automated series production, thus ensuring a high output of the highly demanded technology.

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