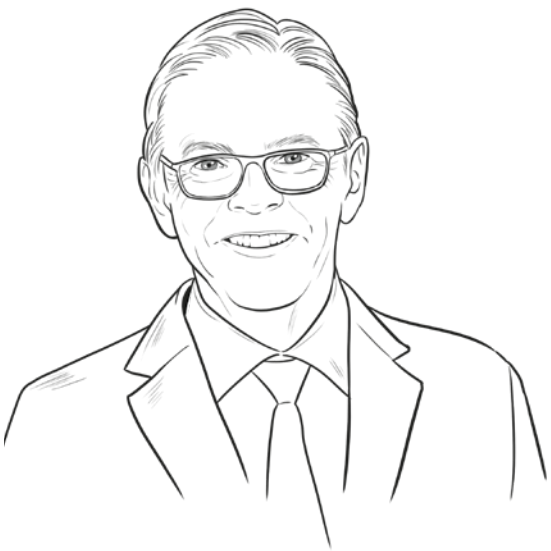
ECO

THE DÜRR GROUP MAGAZINE

SUSTAINABLE TRANSFORMATION

Every year, young people start vocational training in the Dürr Group. Whether they complete their training in mechatronics, computer science, or other professions – as experts, they will soon help shape the future of the company.

EDITORIAL



“Since change is part of our identity, we believe we are well-equipped for a future **that will be shaped by change more than ever before.”**

Dear Readers,

As a mechanical and plant engineering firm, we have repeatedly reinvented ourselves in the course of our 125-year history. With foresight and a pioneering spirit, we have succeeded in identifying the needs of our customers in order to bring the best solutions to the market at the right time. Securing promising technologies through acquisitions and cooperations and investing in new markets has long been part of the Group strategy. This approach has shaped us and ensured sustainable success. It is also one of the reasons why today the Dürr Group is among the global leaders in mechanical and plant engineering.

Since change is part of our identity, we believe we are well-equipped for a future that will be shaped by change more than ever before. In the process, aspects of sustainability will become increasingly important for us, our customers and our partners. Our automotive customers are undergoing a process of fundamental change, with electromobility being at its center. We offer the appropriate production technology, from coating technology for battery electrodes to the oven tunnel in the paint shop. In many manufacturing processes, we have to overcome old patterns of thinking and break new ground. One example is our paint shop of the future. It deviates from the principle of rigid line production. With modular painting boxes, car manufacturers are not only able to produce more flexibly, but also more efficiently and in a more environmentally friendly manner.

Things are changing in the construction industry as well. That sector is relying more and more on sustainable materials such as wood. Prefabricated components for timber houses can be produced quickly and easily – using high-tech plants offered by our subsidiary HOMAG Group with its Weinmann and System TM brands.

Digitalization is part of change and an accelerator at the same time. We are driving digitalization with determination. We are one of the pioneering partners of Volkswagen’s highly-regarded Industrial Cloud, which is impressive proof of the fact that we are at the forefront of digitalization.

Sustainability also involves social justice and good corporate governance: values that are part of our tradition. That is one of the reasons why we have employees whose parents and grandparents have worked in our company – and young people who rely on us when completing vocational training. We are also seeing an increasing focus on sustainability issues among investors. We were the first company worldwide to issue a Schuldschein loan, the interest on which is linked to our sustainability performance – thus proving that we are pioneers on the capital market as well.

Read on the following pages how we are shaping sustainable transformation in the Dürr Group – today and in the future.

Wishing you an engaging read,

Ralf W. Dieter
CEO of Dürr AG

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Pit stop

OUR SOLUTIONS

Innovative and sustainable

OUR EMPLOYEES

Dedicated to the job and geared to the future

ECO MAGAZINE ON THE WEB

You can find the Web version here:
www.durr-group.com/en/duerrmore/sustainable-transformation

2020

AT A GLANCE

FEBRUARY

Mourning for HOMAG co-founder Gerhard Schuler

Gerhard Schuler passes away at the age of 92. Born in the Black Forest, he was an outstanding entrepreneurial personality with excellent knowledge of the timber industry.

APRIL

EcoPaintJet wins German Innovation Award (Deutscher Innovationspreis)

Dürr receives the award for its groundbreaking process for painting without overspray. This means that two-color painting can be applied faster, in a more energy-efficient and resource-saving manner than before.

MAY

Takeover of HOMAG China Golden Field announced

With the complete takeover of the joint venture, HOMAG strengthens its sales and service presence in the world's largest furniture market.

AUGUST

Pioneering partner for Volkswagen Industrial Cloud

With its IIoT software applications, the Dürr Group is one of the pioneering partners of the new Industrial Cloud of Volkswagen and Amazon Web Services (AWS).

SEPTEMBER

Convertible bond of 150 million euros

Dürr AG issues a convertible bond for the first time, thereby achieving long-term financing security. Like other funding arrangements of Dürr AG, the convertible bond also includes a sustainability component.

A good start into professional life: The companies in the Dürr Group can count themselves among the best companies for vocational training.

New opportunities in battery manufacturing technology

By cooperating with Techno Smart, a leading Japanese manufacturer of coating systems, Dürr expands its range of products for battery cell production – a new growth market.

OCTOBER

UN Global Compact signed

The Dürr Group joins the world's largest and most important initiative for responsible corporate leadership.

HOMAG becomes a systems partner for timber house construction

HOMAG acquires the mechanical engineering company System TM in Denmark, which specializes in systems for solid wood processing. The Dürr subsidiary thus takes a major step towards becoming a systems partner for sustainable building with timber.

NOVEMBER

Among the best for vocational training

In 2020, Dürr Systems, Schenck and HOMAG once again hold top positions among Germany's best companies for vocational training as ranked by the business magazine Capital.

DECEMBER

Majority stake in Teamtechnik agreed

Strong augmentation in automation: The product range of the new subsidiary primarily includes test systems for electric and hybrid drives as well as production systems for medical products.

From workshop to world market leader

1896

A 125-year history with three generations of entrepreneurs

In the course of its existence, Dürr has reinvented itself several times and experienced some dramatic phases, yet it has continued to bring the best ideas to the market at the right time using its instinct and pioneering spirit. A chronicle of Dürr – and the opportunities for transformation.

2021

Find more information here:

Please open

125 YEARS

1896

Paul Dürr lays the foundation for today's Dürr Group. He founds a metal shop for roof flashing in Cannstatt near Stuttgart. The workshop carries out metal work on roofs and facades, soon gaining an excellent reputation.

1913

His work on the roof of the Stuttgart Arts Building leads to Paul Dürr's appointment as "Master Tinsmith to the Court of Württemberg".

1923

During the crisis year of the Weimar Republic, Paul's son Otto joins the business. Nine years later, he takes over management of the business from his father.

1939

The Second World War begins. Dürr becomes part of the Nazi arms industry and delivers, among other things, sheet metal parts for military vehicles. During the war, the company also uses forced laborers.

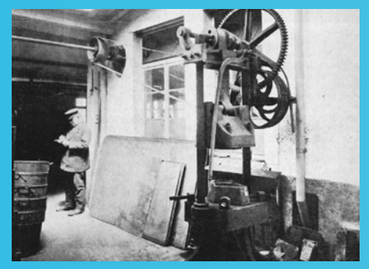
1943

The main plant in Bad Cannstatt is completely destroyed during an air raid. All activities are moved to Zuffenhausen.

1949

Otto Dürr realizes that there is little future for his company based on the metal shop for roof flashing and the sheet metal business alone. He toys with the idea of entering the plant engineering business. A fact-finding trip to the United States reaffirms his intention.

1890 1900 1910 1920 1930 1940 1950



1898

Even during the founding phase, the order books are well-filled, which is why the craft enterprise must move into larger premises after just two years. Paul Dürr buys a residential building with storerooms and sets up a workplace that is remarkably modern for its time.

1917

During the First World War, in times of extreme material shortage, necessity is the mother of invention. Paul Dürr buys iron sugarloaf molds in order to make many different household objects. This leads to the creation of a separate sheet metal processing business, independent of the metal shop for roof flashing. Dürr's new products include washing cauldrons and watering cans.

1920

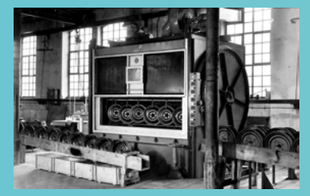
With the development of virtually vibration-free welded constructions, Paul Dürr and his team have found a lightweight yet robust substitute for heavy and expensive cast iron parts.

1929

By the late 1920s, the sheet metal business has become an independent branch. While the metal shop for roof flashing remains a "true" craft enterprise for a long time, the sheet metal business relies on the use of increasingly powerful machines and becomes more and more akin to industrial manufacturing, mainly due to the division of labor.

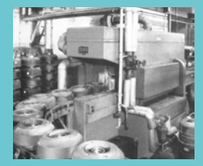
1937

The first engineer joins the business and a drawing board is purchased. This heralds the beginning of the engineering era at Dürr. A design office is established, now enabling more complex sheet metal products to be manufactured.



1950

Dürr creates its first self-built surface treatment plant: a phosphating plant for disk wheels.



1958

A clean solution: Dürr enters the industrial cleaning technology business by building a machine for cleaning crankcases and cylinder blocks. In the same year, the first pretreatment plant for car bodies is installed.

1964

Dürr follows VW to Brazil, where it establishes the firm's first foreign subsidiary. Later on, the company will expand into further countries, among them Mexico and the United States.

1960

Having entered into the family business three years earlier, Heinz Dürr joins his father at the helm of company management.

1969

Otto Dürr retires from management. Heinz Dürr takes over sole responsibility for the company.

1980

Heinz Dürr becomes head of electronics giant AEG, which is in need of restructuring. Later on, he will also sit on the board of Daimler and become head of the German Federal Railway after the reunification. But he retains close ties with "his" company, Dürr.

1989

Dürr goes public.

2000

Schenck becomes part of the Group. Dürr thus opens up new business fields, among them balancing and diagnostic technology.

2005

Shortly after the turn of the millennium, the company finds itself in financial difficulties. The FOCUS optimization program enables Dürr to get back onto the road to success and, in subsequent years, to expand its position in the future market of China.

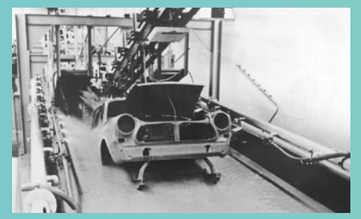
2014

The largest acquisition in the company's history attracts attention: The Dürr Group takes over the HOMAG Group, the world's leading supplier of woodworking technology.

2020

The Dürr Group expands its leading position through innovations and acquisitions, mainly focusing on digitalization, automation and sustainability.

1960 1970 1980 1990 2000 2010 2020



1963

Electrifying new development: With electrophoretic dip coating, Heinz Dürr and his engineers bring a new coating process to market maturity. This is Dürr's ticket to international business with paint shops for the automotive industry.

1973

Dürr installs the first immersion plant based on the VERTAK process. This involves car bodies being immersed vertically into a silo-shaped tank – an innovation that is spectacular but would ultimately have little success.

1982

Dürr focuses on automation and presents the "P 100" portal robot, a robot system for diverse handling tasks in vehicle assembly.

1989

Through the acquisition of application technology specialist Behr, the Dürr Group combines all key technologies for automotive painting under one roof.

1996

Dürr develops its own painting robot, thus setting new standards in flexibility, quality and environmental compatibility.

2001

The new RoDip process is deployed at Dürr. The car body performs a somersault while moving through the dip tank.

2010

Dürr lowers the energy consumption of paint booths through its innovative dry separation system, **Eco**DryScrubber.

2017

The ADAMOS IIoT alliance for the mechanical engineering industry is established. Dürr is among the founding companies and demonstrates its proactive approach to digitalization.

2019

Dürr introduces the **Eco**PaintJet. This robot system with a special applicator enables automated, razor-sharp, two-tone painting without generating any overspray.

2020

The "paint shop of the future" breaks with the traditional line layout in automotive construction. A modular concept provides greater flexibility and scalability.

125 YEARS

PILLARS OF SUCCESS

What was once a craftsman's workshop is today a group of companies selling industrial plants around the world: In the 125 years since its founding, Dürr has negotiated many an obstacle and reinvented itself several times. Team spirit, a passion for technology and true entrepreneurial spirit have made this success story possible.

TEXT: **HEIMO FISCHER**

When Paul Dürr founded his metal shop for roof flashing in 1896, he did not really need much to manufacture and assemble dormers, stove pipes, guttering or ornaments made of sheet metal and copper. But this was not enough for the entrepreneur. He invested in machines that were the best and most modern at the time and taught his four craftsmen how to use them. Word got around about the quality of his work. The company expanded, the first large orders came in, and new business fields emerged.

What applied 125 years ago is still valid today: The mindset and approach within the company are characterized by a thirst for knowledge, courage and innovative strength. It was mainly Heinz Dürr, the founder's grandson, who accelerated the transformation of the business from sheet metal processing firm to international technology group. He focused on plant engineering and ventured into the Brazilian market as early as 1964. Numerous painting technology innovations and complete reliability brought Dürr great success in its business with the automotive industry. The initial public offering in 1989, the acquisition of Schenck RoTec in 2000 as well as the consistent expansion of business in China in the early 2000s and the acquisition of HOMAG in 2014 are further important milestones, as is the digitalization of production processes, which the company is driving with determination.

Not resting on your laurels but looking to the future – this is part of Dürr's recipe for success. What needs will customers develop in the coming years? What solutions do they expect? Finding answers to these questions and having an entrepreneurial mindset and approach are part of the corporate culture – across all hierarchies. The employees have an understanding of reliability and quality, they respond quickly to changes and take decisive action, which is just what customers would expect from a mid-sized company. Even as a world market leader, Dürr has stayed true to its mid-sized roots. The hierarchies are flat, the paths are short – and everyone pitches in.

Not resting on your laurels but looking to the future – this is part of Dürr's recipe for success.

The European Union is issuing green and social bonds. Germany is spending billions on promoting electromobility, and the boss of the world's largest asset management firm is writing to listed companies around the world every year, reminding them of their responsibility toward the environment and society. Dr. Jochen Weyrauch, Deputy CEO of Dürr AG, and CFO Dietmar Heinrich explain how the Dürr Group is aligning its financing and business activities with the principles of sustainability.

PHOTOS: **PETER JÜLICH**

Mr. Heinrich, the EU is increasingly funding itself through "green" bonds. In 2019, Dürr AG was the first company to raise a Schuldschein loan with a sustainability component. What has happened since then?

DH In hindsight, the issue of a sustainability Schuldschein loan in 2019 was a clear cut. Since then, we have only issued financing instruments with a sustainability component. They include our credit line as well as two further Schuldschein loans and a convertible bond.

Let's look at the example of your Schuldschein loans – what makes them sustainable?

DH We conclude an additional agreement with the Schuldschein buyers: If we manage to improve our sustainability rating, we pay less interest. It's a win-win for all. If we reduce our resource consumption, for example, the environment benefits. Plus, it lowers the risk of our business model in the eyes of the Schuldschein buyer. The lower risk automatically

translates into lower interest rates, thanks to the additional agreement. This, in turn, benefits us as a company. By the way, the same also applies in reverse: If our sustainability ranking goes down, we have to pay more interest.

Who measures how sustainable the company is and how it has performed?

DH Our guideline is the development of our EcoVadis sustainability rating. The experts of this renowned agency assess us based on 21 criteria in the fields of the environment, labor laws and human rights as well as ethics and sustainable procurement. The result also takes into account not only our CO_2 emissions and energy consumption, but also how we promote sustainability in our supply chain. Dürr currently ranks well in the middle bracket. We have achieved 55 out of 100 possible points. If we reach 62, we will pay less interest.

Speaking of the supply chain, Dr. Weyrauch: What demands do customers place on you as a supplier when it comes to sustainability?

JW It is particularly the large automakers who ask us very formally how we organize ourselves, what rules we impose on ourselves and on our suppliers, and how we monitor their compliance, for example regarding health and safety at work. As a company, we are expected to commit fully to sustainable principles regarding human rights, labor standards, the environment and corruption prevention. This might sound obvious, but implementing these principles is often a complex undertaking. To underline our determination, we joined the UN Global Compact network last year. Our customers also want to see that we are reducing our own emissions and that we have a clear plan for this. It's one reason why we are currently developing a climate strategy in accordance with the Paris climate goals.

Dietmar Heinrich,
CFO of Dürr AG since August 2020

Automakers are under close watch from climate protectors. What effects does this have on Dürr as a supplier?

JW The management boards of automotive groups are showing a clear commitment to reducing their ecological footprint. For us, this is a huge opportunity. For many years now, the Dürr Group has been pursuing the goal of developing products with the highest resource efficiency within the industry. You could say this is part of Dürr's DNA. Through our technology and intelligent software, we can significantly help our customers make their businesses more sustainable and achieve their climate goals. That said, our customers' purchasing departments still look more at the price rather than the most sustainable solution. There is a lot of room for improvement.

Electric cars are seeing a rapid increase in sales. Is this reflected in the Dürr Group's order books?

JW Electromobility is a clear growth driver for us. We have gained new customers, many of them start-ups with high ambitions that appreciate our experience. They like to do business with us because we offer them high-quality,

flexible and efficient solutions in final assembly, production control and painting. And because Dürr is known for its strong track record for implementation. Thanks to the acquisition of Teamtechnik, we now also have this expertise for the power train of electric vehicles.

Does this mean the shift toward a CO_2-neutral society is more of an opportunity for the Dürr Group?

JW Yes, absolutely! Aside from resource-efficient systems, software solutions and production technology for electric cars, we offer, for instance, coating technology for the production of lithium-ion batteries. We also benefit from decreasing emission limits through our environmental technology. And finally, we are taking advantage of the megatrend of sustainable building by offering solutions for the construction of timber elements. In many of these growth markets, we have further strengthened our position through collaborations and acquisitions to address such opportunities in the best possible way.

Many thanks for the interview!

Dr. Jochen Weyrauch is the Deputy CEO of Dürr AG and responsible for sustainability within the Dürr Group.

SETTING THE COURSE

UN GLOBAL COMPACT

The UN Global Compact is the world's most important initiative for responsible corporate governance. The Dürr Group has been part of this network since October 2020 and, together with more than 15,000 companies and organizations, promotes a sustainable future.

ECOVADIS

The ratings provider evaluates companies' sustainability. It focuses on the environment, labor laws and human rights as well as integrity and procurement. The Dürr Group's new financing instruments are based on the principle "the better the rating, the lower the interest rates."

HUMAN RIGHTS POLICY

The Group-wide policy statement for the respect of human rights and fair working conditions underlines and substantiates corporate due diligence. The aim is to prevent any human rights violations by the Dürr Group and its suppliers. Its content covers, among other things, occupational health and safety, protection against discrimination and the fight against child labor.

CLIMATE STRATEGY

The climate strategy that has now been initiated will define the path toward reducing CO_2 emissions. It is based on measures in the company and in the supply chain – as well as on the huge savings potential in the operation of our products by our customers.

AWARD-WINNING IDEAS

TEXT: **HEIMO FISCHER**

A technology company must constantly reinvent itself. For the employees of the Dürr Group, developing pioneering ideas is therefore part of their daily work. The company encourages them in this – for example through the Heinz Dürr Award, which has been presented every year since 2001. The award is given in various categories, each receiving a cash prize of 7,500 euros, and recognizes outstanding achievements throughout the Group. While the focus is on technical innovations, it also extends to ideas for work organization and sustainability. The award is traditionally presented by the patron and Honorary Chairman of the Supervisory Board, Dr.-Ing. E. h. Heinz Dürr. For him, the award is an important part of the Group's culture of innovation. Here is a selection of interesting projects that have recently received the sought-after award.

The patron and Honorary Chairman of the Supervisory Board, Dr.-Ing. E. h. Heinz Dürr (center), at the award ceremony in 2018

“The heat generated through this process is enough to heat 100 single-family homes in Visby for a whole year.”

LISA LARSSON, GOTLAND ENERGY AB

IGNITED

WINNER IN THE NEWLY CREATED SUSTAINABILITY CATEGORY

Greenhouse gases are the main cause of climate change – they include methane and carbon dioxide. Both substances are also generated on landfill sites. In Sweden, landfill sites are responsible for 2 percent of all greenhouse gas emissions nationwide. This is why site operators burn the exhaust gases in purification systems, thereby feeding district heating networks. However, this process is reaching its limits since the proportion of organic waste is declining. As a result, the methane content is no longer sufficient to ignite a flame and trigger combustion. This means the operators must add fossil fuels – and this is both inefficient and harmful to the environment.

For the Swedish customer Gotland Energy (GEAB), Dürr Megtec has therefore developed a plant that is based on the principle of regenerative thermal oxidation (RTO). Here, ignition is triggered by an electrically powered heating coil. This means the plant requires less methane but can still achieve ignition and incinerate exhaust gases. Lisa Larsson, Waste Engineer at GEAB, explains that the heat generated through this process is enough to heat 100 single-family homes for a whole year. “The income from this even covers the operating costs of the plant.” Apart from Sweden, many other countries are looking for ways to use landfill gas sustainably. For them, Dürr’s innovation could be the solution.

THE WINNERS ARE

The award-winning ideas of the Heinz Dürr Award testify to the spirit of innovation and entrepreneurship at the Group's worldwide sites. The importance given to the award within the company reflects a culture deeply rooted in a passion for efficient and technologically outstanding solutions.

Spot on

Everyone is familiar with this effect: Not all paint from a spray can necessarily lands on the desired area; some of it misses the spot. This is inconvenient and wastes paint. A team at Dürr has therefore developed the **Eco**PaintJet painting robot system. Its applicator, with an intricately machined nozzle plate, works so precisely that even the smallest paint droplets land in exactly the right place. This saves material and enables, for example, contrast strips to be applied without prior masking of the remaining car body parts.

Simplified

A Drying ovens for paint shops are as big as several garages in a row, and their weight is huge. Producing them individually used to involve a great deal of manual work and was therefore very time-consuming. The members of an international Dürr team have now solved this problem: They have reworked the process to enable a semi-automatic flow production of compact and standardized modules. This simplifies production and lowers costs substantially.

Lit up

B Quality is key for automakers – especially when it comes to paint. However, monitoring the quality of the paint coat takes time. Therefore, a Dürr team has developed the **Eco**Reflect light tunnel. It helps to identify even the smallest defects in surfaces more easily and quickly. An additional advantage is that the LED technology employed requires less than half the energy consumed by conventional fluorescent tubes.

Taking a spin

© Spin test systems are used by technicians to test the load limit of rotors – at up to 240,000 revolutions per minute. This naturally leads to deformations, which must stay within defined limits. Schenck RoTec developers have enhanced the spin test systems even further: A measuring system now also records the expansion of the rotor surface during spinning. The information thus gained helps to improve the design of drives, for example, for electric vehicles.

Screened

Furniture factories use a number of different machines. This means: If production is interrupted, it is not immediately obvious where the cause lies. This issue has now been addressed in a project implemented by a team from the HOMAG Group. Every machine is equipped with sensors that collect production data. This information is used to screen – and easily optimize – all processes, from the delivery of raw materials through to dispatch.

Find more information here:

Three questions for DR.-ING. E. H. HEINZ DÜRR

1 Mr. Dürr, what does innovation mean for you?

The job of a company is to create products that society needs. This is what innovation must focus on. Many things are technically possible, but not everything is relevant. A good product developer therefore begins by studying the customer's requirements. At Dürr, practice-oriented innovation has always been a priority. This cements our position as a market leader. Seminal innovations in our markets, namely the automotive industry and furniture production, must come from us and not from our competitors.

2 20 years ago, you launched the Heinz Dürr Award. Why?

Innovation does not happen at the touch of a button, and it cannot be demanded. You need employees with good ideas. And you must encourage and support such employees. The award is designed to help us do so.

3 To this day, you present the awards personally. What characterizes the employees who receive them?

In your professional life, you always have to keep that curiosity alive and occasionally explore something unusual. I can sense this mindset in the award-winners I speak to. They are people who don't stop thinking when they clock out at the end of the day, but who want to keep improving their products.

Heinz Dürr is the anchor shareholder and Honorary Chairman of the Supervisory Board of Dürr AG.

PIT STOP

Rigid conveyor belts? Fixed cycle times? In the paint shop of the future, both will now be a thing of the past. Dürr's new concept relies on flexible painting boxes and automated guided vehicles, which are used to move the car bodies freely through the factory building. This also dispenses with the need for preset cycle times.

TEXT: **HEIMO FISCHER**
PHOTOS: **SASCHA FEUSTER, FRANK VAN GROEN, PETER JÜLICH**

“It’s a revolution.”

FRANK HERRE,
HEAD OF APPLICATION DEVELOPMENT

Pioneers of modular painting boxes: Dürr developers Frank Herre (left) and Jens Reiner (right)

There is dense traffic in the paint shop of the future. Automated guided vehicles (AGVs) continuously move car bodies from the high-bay warehouse to the working boxes located next to the transit routes. Shortly after the AGVs have dropped off their cargo, the robots begin the painting process. As soon as all paint coats have been applied and dried, a vehicle transports the colored car bodies onward. A digital manufacturing execution system controls the processes in the background.

This is what the paint shops of the automotive world could soon look like. For Frank Herre, it is only a question of time before this flexible concept replaces the rigid painting line. As much as 15 years ago, the head of application development at Dürr was wondering how the increasingly broad range of OEM vehicles might be painted even more efficiently. He sketched the first drawings on a napkin in a café in Tokyo while on a business trip. This was followed by many years of development work in cross-divisional teams. The result was the new concept for the paint shop of the future. “It’s a revolution,” says Herre.

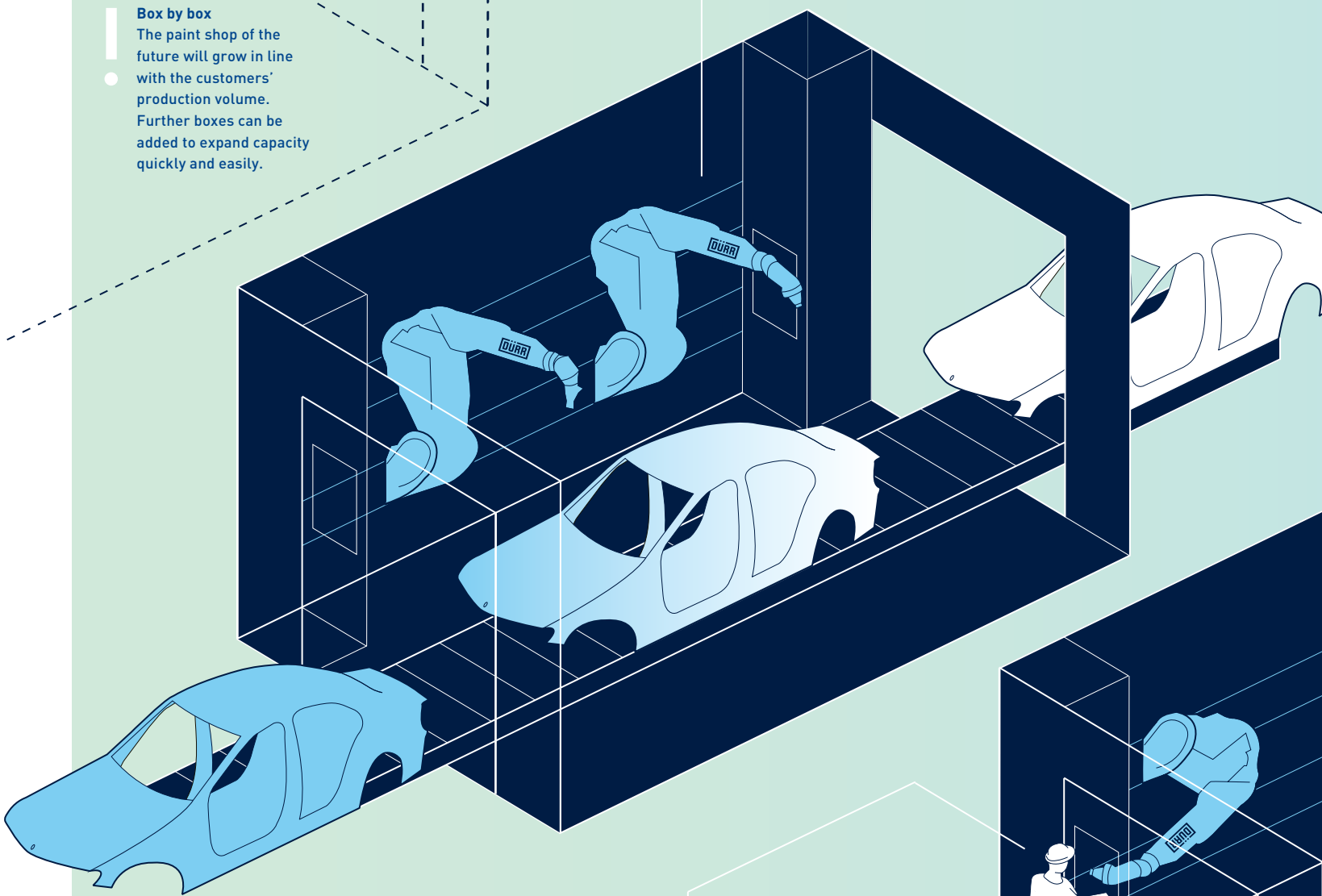
A break from tradition

Manufacturers are showing great interest since conventional in-line paint application is being pushed to its limits in meeting current demands. Using the conveyor belt principle, it involves car bodies being processed one after the other. Every work stage takes the same amount of time. “This kind of system is perfect when the painting line is used for producing a single model,” says Jens Reiner, Research and Development Director for Paint Shops at Dürr.

Box by box
The paint shop of the future will grow in line with the customers' production volume. Further boxes can be added to expand capacity quickly and easily.

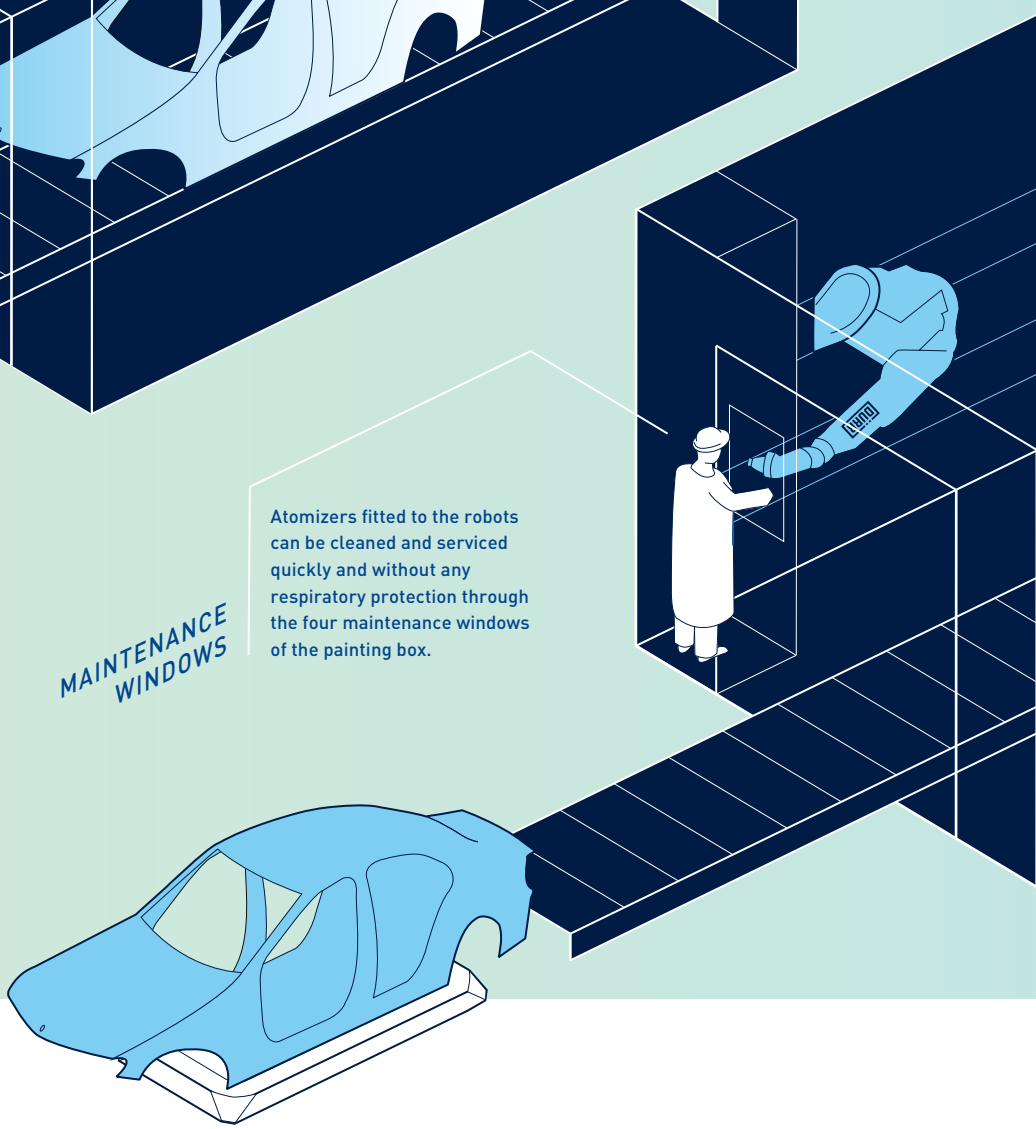
PAINTING ROBOTS

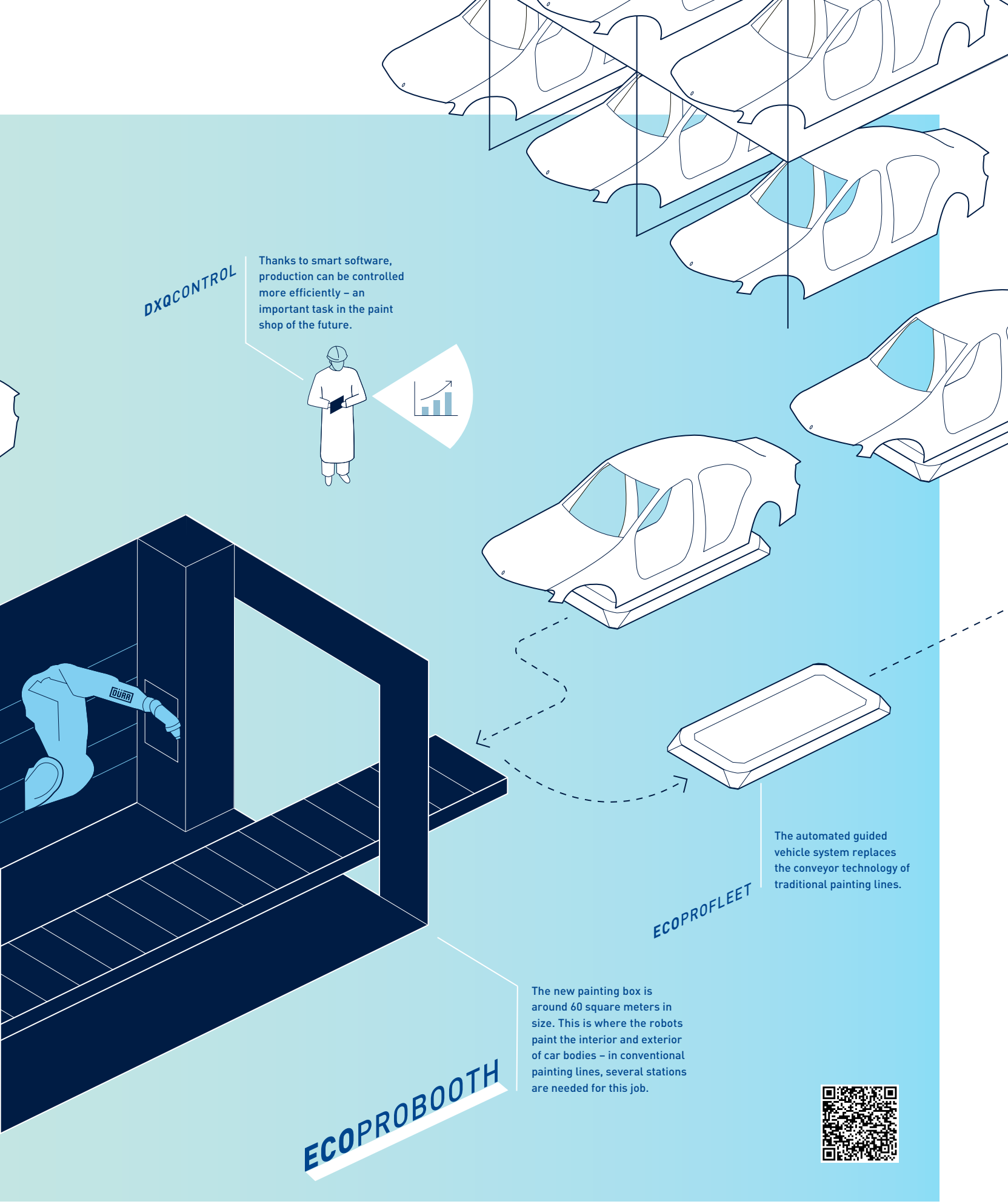
The new painting box can accommodate up to eight robots. The customer can equip it for certain types of painting work – such as the application of popular colors or decorative and contrasting colors.



MAINTENANCE WINDOWS

Atomizers fitted to the robots can be cleaned and serviced quickly and without any respiratory protection through the four maintenance windows of the painting box.





DXQCONTROL

Thanks to smart software, production can be controlled more efficiently – an important task in the paint shop of the future.

ECOPROFLEET

The automated guided vehicle system replaces the conveyor technology of traditional painting lines.

ECOPROBOOTH

The new painting box is around 60 square meters in size. This is where the robots paint the interior and exterior of car bodies – in conventional painting lines, several stations are needed for this job.

But this is hardly ever the case nowadays. The variety of models is growing and manufacturers are building their plants in close proximity to the customer in order to save transport costs and customs duties. This is why, in an ideal case, they need factories in which the entire range of models can roll off the production line – from the smallest car through to the SUV.

Small car bodies can be painted more quickly. "But it's the large car bodies that determine the duration of a work stage, although they often only make up 20 percent of total production," says Reiner. In the flexible paint shop of the future, this will no longer be the case. Just like in a car wash with self-service wash bays, every work stage only takes as long as necessary. As soon as a station becomes available, it is occupied by a new car body. This increases efficiency.

Boxes as a central component

The key component of this concept is the newly developed **Eco**ProBooth painting box. It is as large as two overseas shipping containers and works both flexibly and extremely quickly. In it, up to eight robots paint the interior and exterior of the car body. Until now, this has required two or sometimes three separate booths along the painting line, which means up to 30 seconds of transport time. That is now a thing of the past. It may not seem much but, with huge production volumes often exceeding 200,000 vehicles per year, it all adds up: The time saved is equivalent to that of several thousand painting processes.

Perfect route: Painted car body on automated guided vehicle

More time can be saved if boxes specialize in a single color such as white, which is ordered for every third vehicle worldwide. This dispenses with the need for colors to be changed and the paint atomizer to be cleaned which, in turn, saves time. The lower costs of materials also make a difference. Per factory, the cost benefit achieved through this alone could be around half a million euros per year, according to Herre's calculations. Due to the lower energy consumption and solvent use, the environmental impact is reduced as well. This is important for automakers, since they have set themselves the goal of becoming climate-neutral.

To increase efficiency further, it would also be possible to install boxes in which robots paint car bodies in rare colors or provide them with decorative stripes. These work stages are partly carried out manually and are currently very time-consuming.

Benefits for new entrants

The box concept offers even more advantages to those manufacturers who do not know how many vehicles they will be producing in the coming years. It is above all new electric vehicle manufacturers who find themselves in this position. "They can install more boxes straightaway, if required," says Jens Reiner. Rigid painting lines do not allow for the production capacity to be expanded that easily: Every modification involves a production standstill lasting several weeks – provided there is enough space.

The reverse is also possible: When their facilities are not fully utilized, the box concept gives manufacturers a high level of flexibility. "They can then leave one or several stations idle," says Reiner. This lowers operating costs. As soon as the number of orders increases again, production can be ramped up quickly.

Another key element in the paint shop of the future are the automated guided vehicles that transport the car bodies. A Dürr team has developed these vehicles itself. "There is no vehicle on the market that meets our requirements," explains Reiner. All existing models must go to a station each night to recharge their energy stores. This means they cannot operate around the clock. Dürr's vehicles, however, regularly connect to charging stations during their 24/7 operation.

Armed with hoses: A painting robot can apply up to 36 colors. But each color change takes time. In the box concept, individual robots can specialize in frequently ordered colors. This makes production quicker and more efficient.

“Automakers can install more boxes straightaway, if required.”

JENS REINER,
RESEARCH AND DEVELOPMENT
DIRECTOR FOR PAINT SHOPS

These stations are situated along their routes, at places where the vehicles stop anyway, for example, at an unloading point.

The paint shop as a lab of the future

The paint shop of the future is like a toolbox with space for further solutions on which Dürr experts work across different divisions. Maintenance windows in the painting boxes are one example. “They make it easier to clean or service the paint atomizer fitted to the robots,” says developer Herre. In the conventional paint application concept, the line has to be stopped to do that. A worker wearing respiratory protection enters the booth, perhaps bringing in contaminants that land on a freshly painted car body. From now on, the respective robot will be the only one interrupting its work to reach its arm through one of the four windows into a small maintenance cell. From this well-ventilated cell, the atomizer can be cleaned or repaired without any respiratory protection.

Paint shop expert Reiner is convinced: “Be it paint application, conveyor technology, sealing or exhaust-air purification – more innovations will soon follow.” The interdisciplinary development teams are working hard to also develop new software applications. These will make operations even more efficient. After all, Dürr’s paint shops are to remain ahead of their time, well into the future.

EFFICIENCY BOOST FROM THE CLOUD

The Volkswagen Group plans to continue digitalizing its production and, together with Amazon Web Services (AWS), is driving the “Volkswagen Industrial Cloud”. Gerhard Alonso Garcia, Vice President MES & Controls and one of the heads of the Dürr Digital Factory, explains why Dürr is one of the pioneering partners in this well-regarded alliance.

TEXT: **HEIMO FISCHER** — PHOTOS: **SASCHA FEUSTER, DÜRR AG**

Mr. Alonso, you have been accompanying the project with Volkswagen and AWS for some time now. What exactly does it involve?

Some VW plants already use software that helps them control their production and make it as efficient as possible. Together with AWS, Volkswagen is now setting up an app store. It is designed to make software solutions centrally accessible to all VW plants via the Internet. To this end, VW and AWS are expanding the cloud, adapted to the needs of the automotive industry. Dürr’s job in this is to provide software for certain production applications – in other words to stock the digital shop counter.

Can you give us an example of what Dürr provides?

In the initial stage, Dürr is delivering an application that analyzes paint defects in the current painting process, for example. This enables the customer to identify error patterns. Thanks to this information, the customer can then solve problems in the painting process before many quality defects and outages can occur. This, in turn, increases the “first pass rate”, which is to say the number of vehicles that roll straight off the production line without any defects. This is extremely important for automakers, because any reworking makes the production process complex and expensive and affects their ecological footprint.

Eleven partners are initially providing software for the project. Why is Dürr one of the first?

We have been working closely with VW for many years and equipping plants for the group. We have decades of experience in paint application,

Together with his team, he develops smart applications that make the operation of paint shops more efficient: Gerhard Alonso Garcia, one of the heads of the Dürr Digital Factory.

for example, plus we are very familiar with our customers' processes and requirements, and we help them improve production efficiency through innovations. We draw on this wealth of experience in developing our software products. We have an excellent team of software specialists in our Digital Factory who work closely with the paint business experts. This combination of programming expertise and practical experience sets us apart from many competitors and makes us a sought-after partner in the industry.

What makes the collaboration on the Volkswagen/Amazon project so special, from Dürr's point of view?

The collaboration allows us to gain valuable insights into production practice. That way we can tailor our software ever better to the industry's needs. Plus, our software is available to all plants worldwide via the Volkswagen Industrial Cloud.

Other companies are also working on cloud solutions for entire industrial sectors. Isn't Dürr tying itself down too much through its involvement in one single project?

No. Programming a customized solution for every manufacturer would be too expensive, anyway. That is why we are combining our expertise in one standardized architecture and creating interfaces with other systems. Our applications will therefore always be suitable for other cloud solutions too.

Many thanks for the interview.

TOTALLY DIGITAL – THE NEW VW PLANT IN ANTING

Dürr has built China's largest paint shop for the Volkswagen plant in the Chinese town of Anting. The plant is exemplary in demonstrating how important smart applications have become to automakers. "Never before have we planned a paint shop that comprises so many digital solutions," says Helena Rasp. The mechatronics engineer coordinated the software development during this large-scale project.

Despite travel restrictions due to the pandemic, Helena Rasp and the team from Germany and China stuck precisely to the timetable. This was helped by the fact that Dürr only had to tailor a small proportion of the software to Volkswagen's requirements. Most applications were already a perfect fit or had been included in the development roadmap. They come from the DXQ product family, which Dürr is using to drive digitalization in automotive factories.

One such example is the **DXQ**plant.analytics application. It provides performance metrics from the entire paint shop and uses artificial intelligence to identify error patterns. Thanks to this information, the customer can solve problems in the painting process before too many quality or technical defects can occur. "It was the first time that we used this application for the entire paint shop," says Rasp.

Another new feature used in Anting is a mobile app for accessing maintenance data. It complements an existing software solution that analyzes data for operation and servicing and can thus predict maintenance dates – and this goes not just for Dürr systems but also for other suppliers' components.

Helena Rasp holds a Master of Science degree in mechatronics and works in the Dürr Digital Factory.

REMOTE FIRST AID

Dürr subsidiary Schenck RoTec uses a new, web-based software for the commissioning and servicing of machines. This allows the company to support customers even faster and reduce the number of time-consuming trips. The digital tool is also used for training new employees and in sales.

TEXT: **HEIMO FISCHER** — PHOTOS: **RÜDIGER DUNKER, THOMAS HOPPE**

Virtually on the spot in seconds: Service expert at Schenck RoTec in Darmstadt

FIELDS OF APPLICATION FOR INTERACTIVE SUPPORT+:

- Troubleshooting
- Application engineering
- Commissioning
- Technicians' support for special topics
- Internal trainings
- Addition to the on-site seminars for customers
- Virtual company tours for customers
- Preliminary acceptance with customers
- Spin testing with customers

The customer is very satisfied with the balancing machine from Schenck RoTec. After the routine changeover to a new rotor type, the machine suddenly delivers conspicuous measurement results. The operator on site knows the machine well, but realizes that the help of a Schenck expert is needed.

Customer support is often confronted with situations like that. Up until recently, a Schenck expert traveled to the customer as quickly as possible in such cases – not only causing costs, but also upending schedules and increasing work pressure.

Since May 2020, it has been possible to solve even complicated service calls at Schenck RoTec right from the expert's desk – thanks to a digital tool called Interactive Support+. It allows the Darmstadt-based specialists to virtually look over the shoulder of machine operators and provide support as if they were standing right next to them.

The worker's video glasses transmit an image to the service expert, who can then display information in the worker's field of vision via the glasses.

"Support+ enables us to help customers even faster through optimized response times."

NADINE EGNER, DIRECTOR BUSINESS UNIT SERVICE AT SCHENK ROTEC

Interactive Support+ is based on a technology that has already proven its worth in a simplified form for remote maintenance via tablet or smartphone: Both parties connect via a web-based program, thus being able to view and discuss technical details by video.

Support via video glasses

However, Interactive Support+ can do much more. "Extracts from the technical documentation and operator instructions, for example, can be shown directly on the display," says Nadine Egner, Director Business Unit Service at Schenck RoTec. If the technician at the machine does not work with a tablet or smartphone, but rather wears data glasses equipped with a camera, he even has both hands free and is able to directly implement the instructions of the Schenck specialists.

Schenck RoTec expects to reduce the number of visits to the customer and on-site assignments thanks to the new system – thus also contributing to climate protection. In 2019 alone, employees of the company booked 771 flights, which is equivalent to 1,614 tons of CO_2 emissions. "We estimate that we will be able to save one tenth of air travel in the long run," says Nadine Egner.

This applies not only to the service unit, but also to other areas of responsibility, such as when a customer's employees need to familiarize themselves with a machine. They can take a close look at technical components while the trainer or inspector stands in front of an identically constructed machine explaining the details. A virtual tour of the company is also conceivable. Customers can also take part in a pre-inspection remotely – without having to travel for that purpose. A Schenck expert with data glasses can nonetheless explain the functions to them without any difficulty in the remote plant.

Needless to say, however, there will still be physical meetings at Schenck RoTec in the future, says Nadine Egner. "The goal is to make work easier in certain situations and to expand our product portfolio." Neither software nor data glasses can replace in-person conversations with the customer.

THREE QUESTIONS FOR NADINE EGNER

What role does the introduction of interactive support play for your company?
It is part of a cultural change that allows us to work faster and more flexibly at Schenck RoTec. Our experts can bring their experience to bear on a larger number of service cases. Fewer on-site assignments reduce our travel costs and emissions – and, of course, employees and their families benefit when they can spend more time together at home.

Did the Corona pandemic accelerate the roll-out?
Absolutely. Planning was already underway before 2020. However, when restrictions meant that many trips were no longer possible and important commissioning and service assignments could not be carried out, we pushed ahead with the implementation together with the entire team even faster than planned.

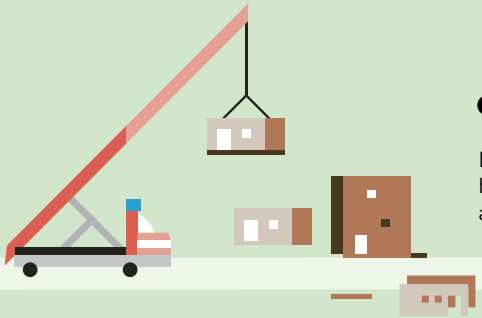
How has the new support been received by customers?
Very well. They are pleased that their machines are up and running again more quickly and that the effort required for servicing is reduced. Some customers even made clear to us that the costs were not that important to them. They simply want us to help them as quickly and effectively as possible.

FROM THE FOREST TO THE HOUSE

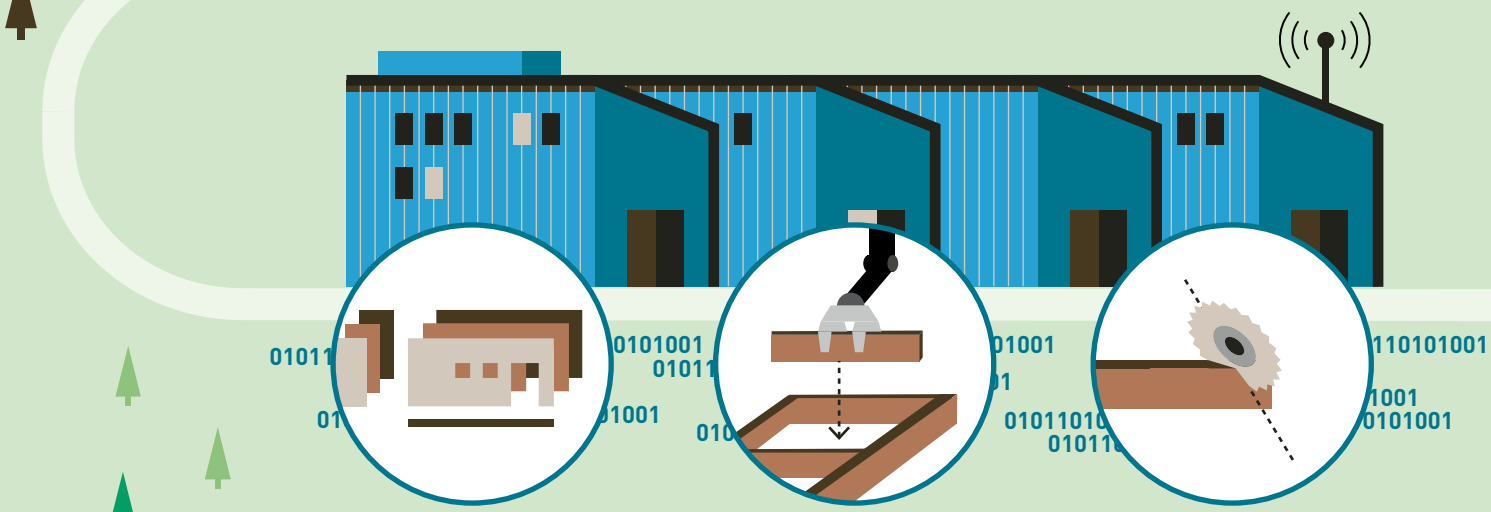
A house made of wood? For a long time, that seemed old-fashioned. Thanks to the trend towards sustainable building, this naturally grown material is once again very popular. With machines and systems such as those offered by the HOMAG Group, freshly felled trees can be turned into prefabricated houses in just a few days.

❶ FOREST
In the forest, forestry companies cut down the trees. The logs thus created are called round timber.

❷ SAWMILL
In the sawmill, the round timber is cut into boards, square timbers and beams, and dried.



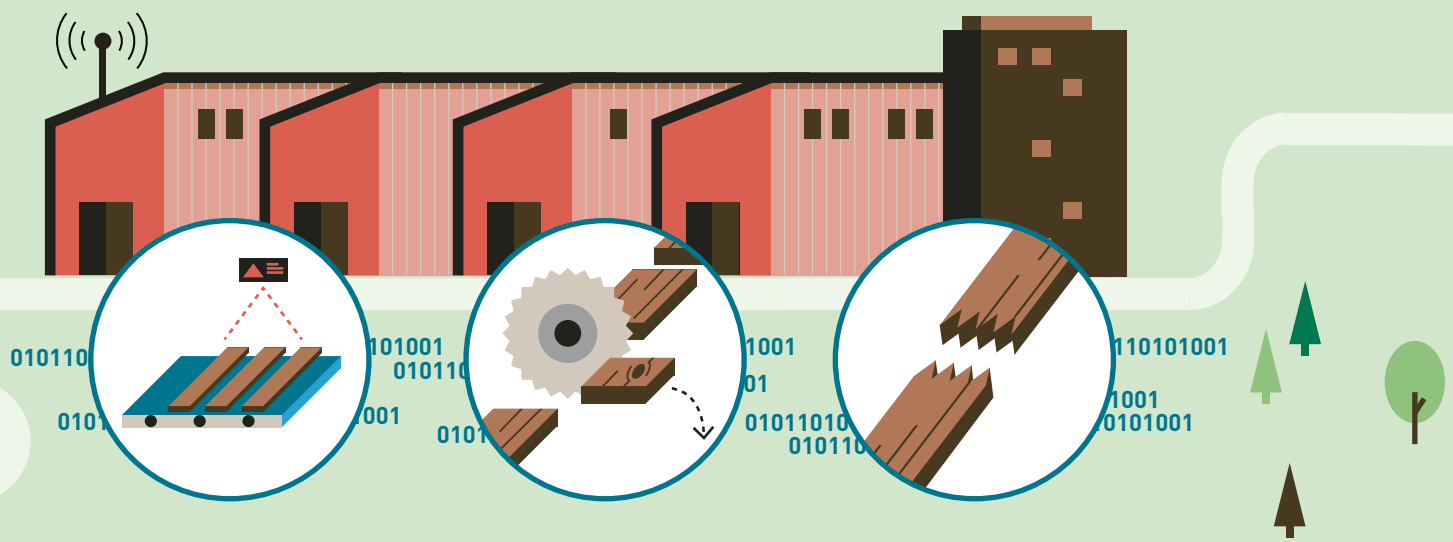
❾ LAST STOP: CONSTRUCTION SITE
In just 24 hours, the complete house is created from the elements and modules.



❽ CREATION OF ELEMENTS AND MODULES
Panels close the framework, and insulation material is placed in the gaps. The result: finished wall, roof and ceiling elements that are assembled into modules.

❼ FRAMEWORK
In modern manufacturing, robots assemble the framework – the skeleton of the house wall.

❻ TIMBER FRAMING
The beams must be cut and precisely prepared. This work is carried out by automated production lines.



❸ SCANNING
Sensors scan the wooden boards with high precision and speed. In this way, they find weaknesses, such as knotholes, cracks, resin deposits, discoloration and edges.

❹ SAWING OUT
The machine cuts out up to 420 flaws per minute.

❺ FINGER JOINTS
The now flawless – but short – boards are joined together with the help of "finger joints" to form a long, stable board.

78 m

SĂPÂNȚA PERI MONASTERY
The tallest wooden church in the world is located in Romania. It is 78 meters high and consists of 400 cubic meters of oak and spruce wood.

26 m

HEDDAL STAVE CHURCH
The stave church in Heddal, Norway, is 26 meters high and was probably built in the 13th century. More than a quarter of the original material has been preserved.

8th century

TODAIJI TEMPLE
The main hall of the Japanese temple is 57 meters wide, 50 meters deep and 49 meters high. It is the largest building in the world constructed entirely of wood.

Construction material with tradition

Houses, churches, bridges: Wood has been used as a building material for thousands of years. The material is sustainable and extremely durable. Architects are still inspired by it today.

HARTLAND COVERED BRIDGE
The Hartland Covered Bridge in New Brunswick, Canada, is more than 390 meters long, making it the longest covered wooden bridge in the world.

390 m

2041

PLYSCRAPER W350
It is to become the tallest skyscraper made of wood: A skyscraper with a height of 350 meters and 70 floors is being built in the heart of Tokyo – made of more than 90 percent wood. Completion is planned for the year 2041.

CONSTRUCTION MATERIAL WITH A PROMISING FUTURE

Wood as a natural resource offers enormous potential. That is the view of Heinrich Köster, Professor of Wood Technology and Construction at the Rosenheim Technical University of Applied Sciences. One important reason: Modern machines and plants are causing production costs to drop. A guest contribution.

TEXT: **PROF. DR. HEINRICH KÖSTER** — PHOTO: **TH ROSENHEIM**

PROFILE
Professor Heinrich Köster teaches wood technology at the Rosenheim Technical University of Applied Sciences. He is one of the most renowned experts in his field in Germany. Born in Münster, he completed an apprenticeship in carpentry in the family-owned business. Later, he studied wood technology and pursued an academic career. Köster is president of the Rosenheim Technical University of Applied Sciences and co-founder and president of the Forum Wood Building. Due to his work as a consultant, he is also familiar with the woodworking-machinery engineering field in practice.

Wood is the construction material with a promising future. This fact is not only reflected in the growing interest of students and mechanical engineers. The trend has long since arrived at the construction sites as well. One in five single-family homes and duplexes in Germany is now built using timber construction. It is estimated that in five years, it could be one in two.

One reason for this increase is growing environmental awareness. In fact, wood from sustainable forestry serves as an excellent means of storing CO_2. This is in stark contrast to cement, the production of which releases a large amount of greenhouse gas. Good timber lasts for centuries and is excellently suited for recycling.

One in five single-family homes and duplexes in Germany is built using timber construction today.

But there are also other good reasons for building with timber. Despite its low weight, it has an extremely high load-bearing capacity. Wood provides for a good indoor climate and protects against the cold. A 20-centimeter-thick prefabricated wooden wall filled with insulation material insulates just as well as a concrete wall five times as thick.

Timber construction is also attractive from a cost perspective. Wood is easy to work with and can be processed with utmost precision. That is why this building material is particularly suited for producing large quantities of prefabricated elements in factories. Thus, high-quality residential space can be built at reasonable prices.

Mechanical and plant engineering plays a key role in driving the trend towards timber construction. Companies rely on innovative solutions to construct buildings quickly and economically with prefabricated elements. With technology from companies such as the HOMAG subsidiary Weinmann, it is already possible to produce the walls and roof of an entire house in a single day. Whereas on a construction site, it often takes a year before even the shell of the building, made of cement and bricks, is finished – with considerably higher personnel costs!

The advancing digitalization of machinery and equipment will make timber construction with prefabricated modules even more efficient and cost-effective. It therefore offers the opportunity to provide homes and offices in sufficient quantities in a sustainable and cost-effective manner in the rapidly growing metropolitan areas around the world.

ROOMS FROM THE CONVEYOR BELT

Buildings made of wood are environmentally friendly, affordable and can be quickly constructed. Prefabricated elements are used to create, among other things, comfortable apartments and offices. Dürr subsidiary HOMAG supplies the required technology, for example, to the Swiss timber construction company, Blumer Lehmann.

TEXT: **HEIMO FISCHER** — PHOTOS: **LEHMANN GROUP**

CUSTOMER REPORT

Many hundreds of tree trunks are stored on the company's premises. Boards, square timbers and beams are piled up next to the workshops. Trucks are maneuvering, machines are humming, the smell of spruce and fir is in the air. Visitors notice immediately: It's all about wood at Blumer Lehmann in Gossau, a town near St. Gallen, about 25 kilometers south of Lake Constance.

The family business does not, however, build tables, chairs or cabinets. Blumer-Lehmann belongs to the Swiss Lehmann Group and is one of the leading timber construction companies

ABOUT THE PROJECT

The spectacular building on the Lattich site in St. Gallen: In the area around the freight railway station, 45 modules provide space for small businesses in the creative industries. Especially cities can really benefit from the advantages of modular construction. Obstacles to traffic caused by construction work are short-term. Blumer Lehmann was able to assemble the modules within a short period of time using the flexible modular system.

Katharina Lehmann runs the family business in the fifth generation.

"We take care of every step of the process – from the felled tree to the finished house."

KATHARINA LEHMANN,
LEHMANN GROUP CEO

in the country. "We are convinced that wood is the building material of the future," says Katharina Lehmann, who has been running the business for 24 years.

When the boss talks about wood, she is completely in her element. "I grew up in the company," she says. The business has been in her family for five generations. The former residential building with its pistachio green shutters now houses the cafeteria. Her ancestors started out in 1875 with a sawmill on a creek; later roof trusses, then barns for agriculture were added to the portfolio. "For about 20 years, we have been constructing complete buildings made of wood, including apartment buildings, school buildings, office buildings and industrial buildings," Lehmann says, adding: "We take care of every step of the process – from the felled tree to the finished house."

The portfolio not only comprises breathtaking arch constructions like the Swatch headquarters in Biel or the Apple store in Bangkok – "Free Form" is what the experts call it. A large part of the business consists of comfortable buildings made of wooden modules. "We manufacture the complete modules individually in our factory according to the customer's wishes," says Lehmann – with digitally controlled plants that produce the elements quickly and efficiently.

The process is much faster than spending months building brick walls or pouring concrete into steel frames. It also shifts work from the construction site to the shop floor. The premises are dry, kept at a constant temperature, and the professionals are permanently present, thus guaranteeing the consistently high quality of the modules.

The environment and climate also benefit from the trend to timber construction. "Wood is a raw material that is abundant here," Lehmann says.

Shop floor instead of construction site: There is no rain here, the temperature is just right, and the professionals are always present. These are the ideal prerequisites for high quality and maximum efficiency in element construction.

45 modules of 27 square meters each: The Lattich site offers creative minds room for their ideas and achievements.

One after the other: The modules are produced in the shop floor as if on a production line.

Swiss forests offer large quantities of wood that is used sustainably. What is processed in Gossau comes from within a radius of 80 kilometers of the company's headquarters.

Huge carbon reservoir

There is no doubt among experts that wood is a sustainable building material. Unlike in the production of steel and cement, hardly any climate-damaging CO_2 is produced. Today, the construction and maintenance of buildings account for almost 40 percent of global CO_2 emissions. The cement industry alone is responsible for approximately 8 percent of global greenhouse gas emissions.

A single-family house made of wood, on the other hand, stores up to 25 tons of CO_2. That is the amount emitted by two and a half average Germans per year. Extrapolated to entire conurbations, large volumes of CO_2 are thus removed from the carbon cycle and can no longer harm the climate. Modular buildings assembled from elements can even be moved and reassembled in a different location. Moreover, wooden houses can be recycled when disassembled. Consequently, administrations are already taking action: In France, for example, public buildings must consist of 50 percent wood starting from 2022.

It is reasons like these that led Katharina Lehmann to make timber construction the main pillar of the business. "Even my great-grandfather said that it was our job to find solutions to problems." She took this sentence to heart when her father suffered a stroke and she unexpectedly had to join the company at the age of 24 – alongside her business studies. "Fortunately, there were trusted and experienced people whose advice I benefited from," she says. Since then, turnover has increased fivefold and the number of employees has grown from 70 to 350.

Today, the company premises are the size of eleven soccer fields. The tour begins at the timber stacks, where a crane clamps logs in its gripper and places them on a conveyor belt. The logs disappear into the sawmill where they are cut up. The boards are then stored in the drying chamber for three to four days.

Troubleshooting with digital eyes

Houses must be stable. The wood used for them must be free from defects. Looking for individual knotholes, cracks or resin deposits and sawing them out takes far too long. "That is why we bought a machine sorting system in order to better refine the wood," Lehmann says.

The dried boards shoot through the planing machine on a conveyor belt. Watching over them are digital eyes, scanning the wood. Smart software detects errors immediately and reliably. But there is more: The machines from the Danish supplier System TM, which is part of the

1875

THE LEHMANN COMPANY LOOKS BACK ON A LONG HISTORY.

60%

OF A TREE CAN BE UTILIZED IN PRODUCTION.

25 tons

OF CO_2 ARE STORED BY A LARGE SINGLE-FAMILY HOUSE MADE OF WOOD.

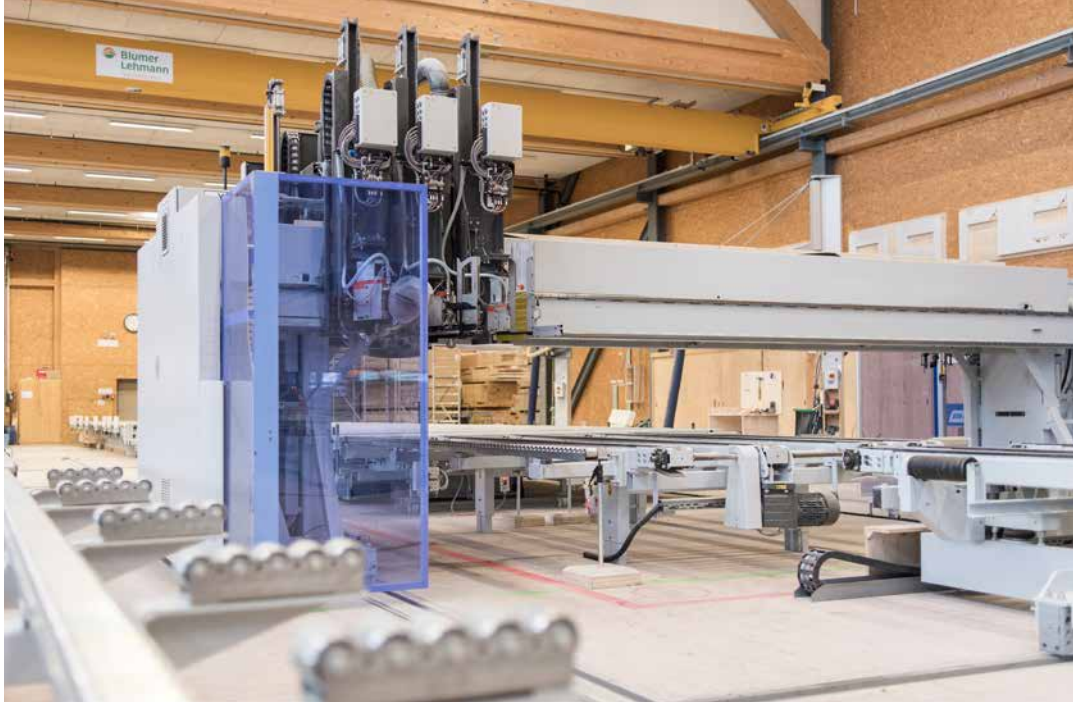
HOMAG Group, instantly saw out the flaws. The machine can eliminate more than seven defects per second.

Another System TM machine immediately glues the parts together again. To this end, it cuts serrations into both ends of the board, which perfectly fit together like a lock and key. This so-called finger-jointing process thus produces standardized boards – ideal for use where maximum stability or aesthetics are required.

In a further processing step, several of the pieces of wood joined together in this way are glued together in layers at right angles to the wood grain or nailed together in an environmentally friendly way with hard beechwood pins. This results in 20-centimeter-thick beams. Blumer Lehmann has this production step carried out by an external company.

Timber house elements from the conveyor belt

HOMAG subsidiary Weinmann has relied on the trend towards timber house construction for a long time. Among other things, the company offers machines and equipment for timber framing. That is what carpenters call the sawing and preparation of beams for roof trusses. Their portfolio also includes automated production lines for wooden construction elements for small carpentry companies, large prefabricated-house manufacturers and customers such as Blumer Lehmann.



Swift and reliable: The machines of the HOMAG Group perform many work steps fully automatically.

How this works can be observed in the next hall. Employees assemble the frame of a wooden element from beams of different lengths and cover it with a panel. Then the Weinmann multifunction bridge slides over the wall – and nails, drills, saws, mills, and marks. Within a few seconds, it affixes the panel and provides the openings for doors, windows and shafts. The semi-finished element is then turned and the cavities are filled with insulation material. A second panel closes the wall.

After a short finishing process, the wall is automatically erected and then transported to the intermediate storage. The carpenters in the

Visionary and down-to-earth: Katharina Lehmann has developed the sawmill into an internationally respected timber construction company.

“We even send the toilet brush along, if that is desired.”

KATHARINA LEHMANN, LEHMANN GROUP CEO, ON THE POSSIBLE RANGE OF FIXTURES AND FITTINGS OF THE FINISHED TIMBER HOUSE MODULES

40%

OF GLOBAL CO_2 EMISSIONS ARE CAUSED BY BUILDINGS.

20 cm

THAT IS HOW THICK THE BEAMS OF THE FRAMEWORK ARE.

factory assemble walls, ceilings and floors into finished modules or pack them individually. Then the journey to the construction site by truck begins. With the help of a crane, the fitters will erect the prefabricated elements there. It takes two to three days for the complete building to be erected – an advantage especially in narrow inner cities or when things have to move quickly for customers, for example in hotel extensions.

That is why Blumer Lehmann goes one step further. "We often deliver the individual modules already equipped with electrical wiring, water pipes, wallpaper, tiles and kitchen units," says Lehmann. Craftspeople commissioned by the company will take care of that while the modules are still in the factory. "We even send the toilet brush along, if that is desired," she says, laughing.

Making careful use of limited resources is very important for the company. Therefore, it ensures that nothing goes to waste. "We can only use about 60 percent of a complete tree in production," Lehmann says. What remains is residual wood. The tour leads past two towers that look like silos. "This is where we store the wood pellets that are produced at our plant." And what happens to the tree bark? That is also taken care of. It is shredded into mulch and goes into landscaping. Or it is processed into briquettes and, like the pellets, used in the company's own power plant. An ecosystem in which nothing is thrown away.

In the coming years, Katharina Lehmann plans to further digitalize her production. She will then be able to manufacture individual rooms in large quantities even more efficiently – in the long run, not only in Switzerland. Lehmann is receiving an increasing number of orders from abroad and is expanding – for example to Germany, where a second location for module production is to be built as early as this year.

Find more information here:

TIMBER CONSTRUCTION – THE ADVANTAGES IN BRIEF

1

Renewable raw material
Wood from sustainable forestry preserves the natural resources of the earth.

CO_2 reservoir
Wooden buildings store CO_2 for many decades. If construction timber is recycled, the greenhouse gas is permanently removed from the CO_2 cycle.

2

3

Speed
Finished modules can be set up in just a few hours. If required, they can simply be moved to a new location.

Nice and warm
A 20-centimeter-thick prefabricated wooden wall filled with insulation material insulates as well as a concrete wall five times as thick.

4

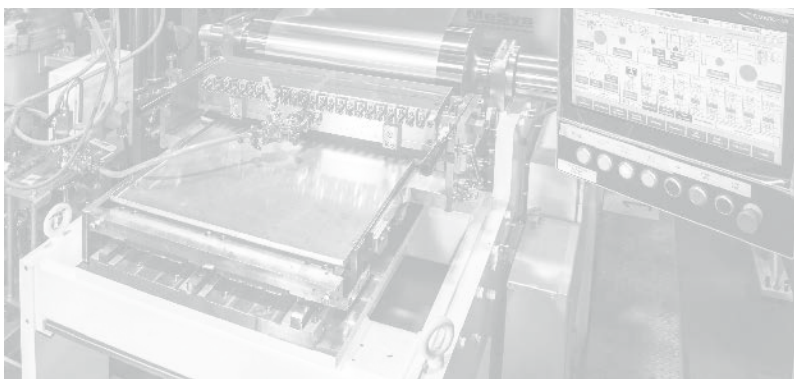
On the hook: A mobile crane puts the finished modules into the right place within minutes.

COATING FOR THE FUTURE

TEXT: **JOHANNES WINTERHAGEN** — PHOTOS: **CRAIG AUGUSTINE, ISTOCKPHOTO**

Demand for electric vehicles is increasing – and with it the production capacity for lithium-ion batteries. Battery cell production therefore plays a key role, since it determines the cost and longevity of the entire electric vehicle. Dürr provides the coating technology for battery electrodes from a single source – and much more.

In Europe, 460,000 electric cars were registered in 2020. Although this only corresponds to a market share of 4 percent, the proportion is twice as high as in the previous year. E-mobility is still in its infancy, but it will take hold. Battery manufacturers must significantly expand global production capacity for lithium-ion batteries. In Europe alone, it has to grow to 300 gigawatt hours per year by 2025 – equivalent to the batteries for around 6 million electric cars. More than half the factories required for them have not even been planned yet – a massive opportunity for the mechanical and plant engineering industry.



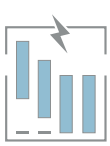
The wafer-thin layer of nickel, manganese, cobalt and lithium must be carefully applied to the copper foil.

Coating comes clean

Dozens of process stages are required to turn the raw materials into a battery that works safely and is long-lasting. Cell production and especially electrode coating play a key role. This is because each individual battery cell consists of two electrodes, extremely thin aluminum or copper foils that accommodate the lithium ions moving back and forth during charging and discharging. To this end, the foils must be provided with a 50- to 150-micrometer-thin coating – with graphite on the anode side and with a compound of nickel, manganese, cobalt and lithium in a precisely

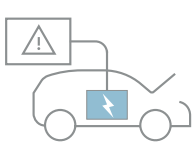
DÜRR'S RANGE FOR ELECTRIC CAR MANUFACTURERS INCLUDES

COOL DOWN!
Up to 60 liters of refrigerant is filled into the cooling system of batteries and electronics using Dürr technology.

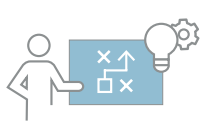


GLUING CELLS
The individual battery cells are arranged next to each other and – in simple terms – glued together to create a battery module. Dürr application technology applies a thermally conductive paste between battery module and cooling plate.

AT HIGH SPEED
The rotors of electric motors are tested and pushed to their limit using the spin test system of Dürr's subsidiary Schenck RoTec.



UNDER TENSION
Dürr's testing technology ensures that the high-voltage circuits in electric vehicles pose no risks.

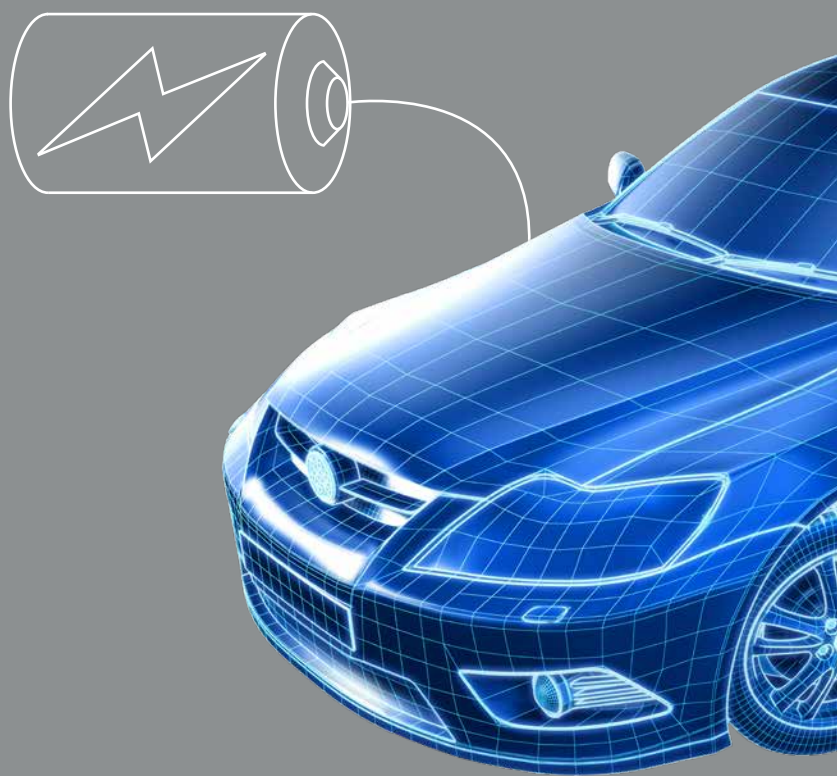


GOOD ADVICE
Dürr Consulting helps automakers plan and build their battery assembly plants.

30 MILLION

ELECTRIC VEHICLES

Many countries have policies that promote low-emission vehicles. The European Union anticipates that the number of electric vehicles will reach up to 30 million by 2030.



70

MODELS

The range of electric cars is growing rapidly. There are now 70 models on the market from German manufacturers alone.

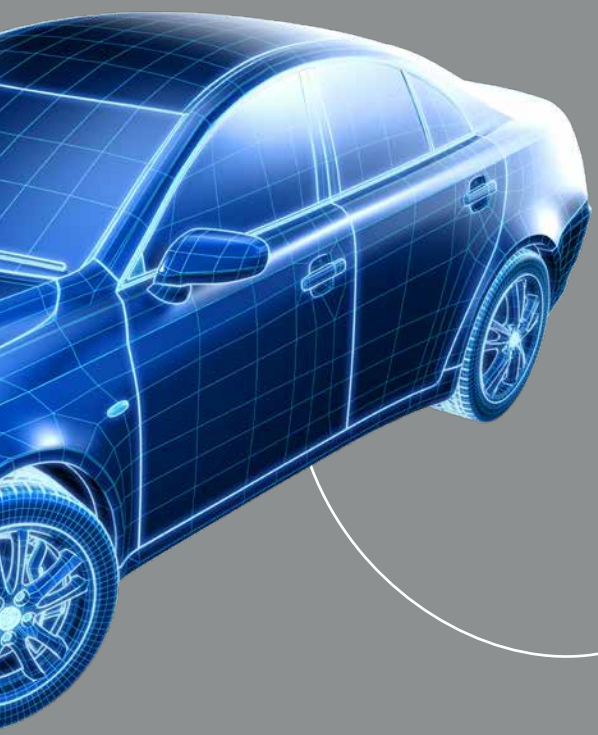
defined ratio on the cathode side. The electrodes account for around 80 percent of the material value of a modern battery.

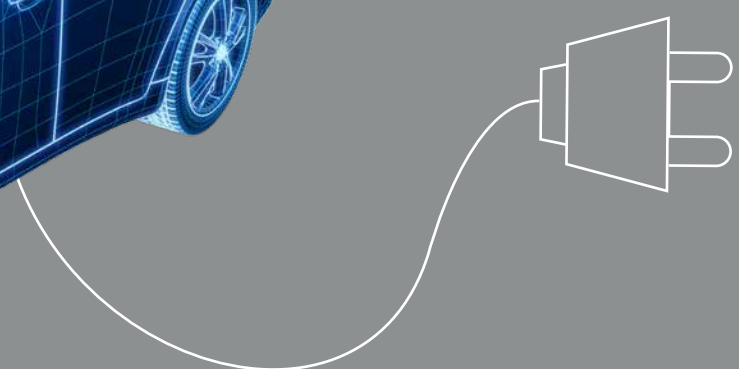
Cell production plays a pivotal role in the breakthrough of the electric car: Only if it becomes possible to produce a great many cells very quickly and fully automatically can the prices of batteries fall significantly. In addition, the production quality must be extremely high to prevent some of the valuable materials from having to be disposed of as waste later on, which would also negatively affect the environmental footprint of the electric car. Regardless of the type of battery, electrode production always takes place in two steps: The first step is the coating of the aluminum or copper foils, which are supplied on large rolls. In the second step, they pass through a drying oven. There, the solvent contained in the coating material escapes, requiring a laborious exhaust-air purification process. But solvent is expensive – so purifying the exhaust air is not the only issue. Thanks to a smart recovery system, it is possible to reuse a large amount of the solvent. This protects both the environment and the battery producers' budgets.

263%

MORE ELECTRIC CARS

In 2020, electric cars in Germany reached a market share of 13.5%, and 394,943 new electric cars were registered.





32,000

CHARGING POINTS

In Germany, there are now more than 32,000 public charging points. But 80% of all charging sessions take place at home or in the company parking lot.

$100

PER KILOWATT HOUR

Batteries are the most valuable component of electric cars. They are becoming increasingly cheaper. The cost of one kilowatt hour of storage capacity is soon set to come down to just 100 dollars.

Everything from a single source

In the automotive business, Dürr is known for its paint shops – customers receive them as turnkey systems; in other words: all-inclusive. Now, also battery manufacturers can order the necessary technology for electrode coating from a single source: from electrode coating through to exhaust-air purification and solvent recovery.

Most plants currently used by battery manufacturers coat one side of the electrode foil first before moving on to the other. A pioneer of this technology is coating specialist Techno

"Simultaneous coating not only achieves cost benefits but also improves quality."

ANDREAS KEIL,
DÜRR MEGTEC

THE DRYING OVEN THROUGH WHICH THE COPPER FOIL HAS TO PASS FLOATING FREELY MEASURES UP TO

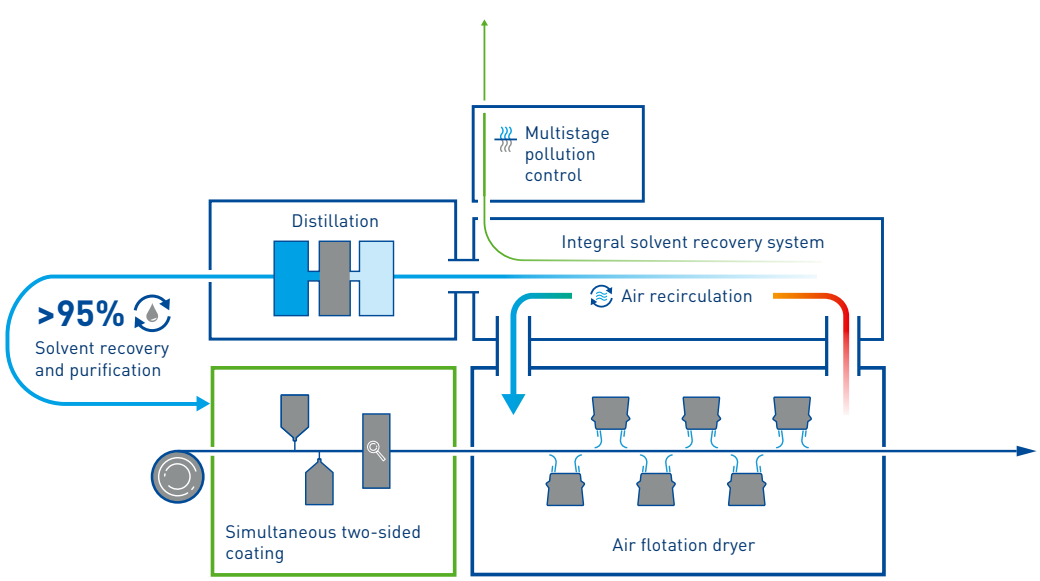
50 m long

Smart, which has been cooperating with Dürr since 2020. The company, which is based in the Japanese city of Osaka, was developing coating technologies for lithium-ion cells as early as the 1990s and supplies well-known manufacturers. Dürr Megtec, which has been part of the Dürr Group since 2018, has developed a new process that even enables electrode foils to be coated on both sides simultaneously. To this end, the foil must pass through a drying oven, measuring up to 50 meters long, suspended and without making the slightest contact with any of the machine parts. At Dürr Megtec, Andreas Keil is responsible for developing the Europe business within electrode production – and he is convinced that simultaneous coating not only achieves cost benefits but also improves quality. In the pilot production of a large European automaker, the process, which only Dürr Megtec can offer, is already in use. It is also particularly suitable for small battery cells, such as those found in hearing aids, for example.

Taking charge of battery technology

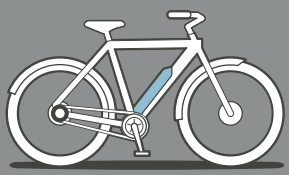
Dürr technologies are also used in many other stages of cell and battery system production. One such example is the coating of cells using the **Eco**PaintJet, a particularly accurate painting robot system that does not generate any overspray. This stage serves to provide not only electrical insulation of the battery cells but also thermal insulation. Dürr also has the right technology for gluing together battery cells to create modules and for applying thermally conductive paste between battery module and cooling plate. Filling the battery cooling system with refrigerant? Dürr can help here, too, as well as in the planning of battery assembly plants. The list goes on – and is getting even longer: Following the acquisition of a majority stake in Teamtechnik in February 2021, the portfolio now also includes technologies for assembling and testing battery modules.

SIMULTANEOUS TWO-SIDED COATING



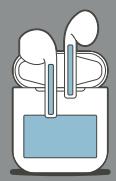
TYPICAL APPLICATIONS FOR LITHIUM-ION BATTERIES

Electric cars are the big growth driver in the global market for lithium-ion batteries, yet they are also used for many other devices. Users of wireless headphones, e-bikes and electricity storage facilities appreciate the high energy density of lithium-ion technology and the low weight of the batteries. These cells, too, are produced using Dürr technology.



REINVENTING THE WHEEL

Long-lasting lithium-ion batteries provide sufficient energy while keeping the weight low. This is one reason why the trend toward e-bikes is unstoppable.



ALL EARS

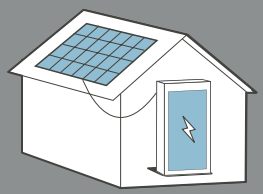
Used for videoconferencing, especially during lockdown: Small wireless headphones which play conversations and music – and cancel ambient noise. Their lithium-ion batteries are charged in small cases, for example.

UNTANGLED

They are putting an end to tangled cables and the laborious lifting of the vacuum cleaner from one step to the next: Cordless models are transforming the industry. Thanks to the powerful lithium-ion technology, some devices last for over an hour while in use – but they are still light.

UNHEARD-OF

From the ear trumpet to a tiny high-tech loudspeaker: Hearing aids have come a long way. Until now, they have mostly run on disposable batteries. Thanks to lithium-ion technology and chargers, rechargeable batteries are now revolutionizing the market.



BECAUSE THE SUN DOESN'T SHINE AT NIGHT

More and more homeowners are using photovoltaic systems to convert solar power into free electricity. This trend could see another boost following the spread of electric cars. But the sun does not shine at night – yet this is when the electric car is plugged in, when the washing machine, tumble dryer and other appliances are running. Energy storage systems are the solution. During the day they capture solar energy, while at night they release it. Another case for lithium-ion batteries: Thanks to their high energy density, they are small and thus fit into many basements.

LET'S GET STARTED

Every year, dozens of young people start vocational training in the Dürr Group. Whether they complete vocational training in mechatronics, computer science or in another profession: As experts, they will soon help shape the future of the company. There are currently over 200 apprentices at the major German locations of Dürr, Schenck and HOMAG alone.

TEXT: **HEIMO FISCHER**

It is particularly important for the company to train young people internally and bind them at an early stage. This makes it easier for them to start their career after completing the vocational training. "Those who were trained by the company have excellent skills in their field and are familiar with the processes within the company," says Hans-Uwe Klaiber, vocational training manager at Dürr Systems.

The whole spectrum of the industry can be experienced within the company. "We offer apprentices the opportunity to spend two to three months abroad," says Steffen Stippl, HOMAG vocational training manager at the Schopfloch site. Those who have experienced other cultures and ways of working far from home will find it easier to collaborate on international projects later on.

The Dürr Group is also working to offer thorough training to young people at its foreign locations – for example in the US. In Southfield, Michigan, Dürr is one of the few companies to offer dual training based on the German model. The apprentices even receive remuneration, which is not common in the US. Dürr won an award from the German American Chamber of Commerce for this special program.

Below, five employees tell us why they decided to learn their desired profession under the umbrella of the Dürr Group.

Philipp Tribble, 21, vocational training in mechatronics, Darmstadt

"I was already enthusiastic about technology when I was in school. I remember getting a construction kit at age 14. I was able to assemble a small electric motor from the parts, which I found exciting. Maybe that is why I wanted to start the vocational training as a mechatronics engineer after finishing vocational high school. Why at Schenck RoTec? Because I already knew the company. My mother works there, and I had jobs in production and warehouse during vacations when I was a student. The big machines and the friendly people – I really liked that. I spent the first year of my vocational training in the training workshop. Drilling, milling, metalworking – the basics of the trade. Now I work in the assembly hall. After completing my vocational training, I would like to continue working at Schenck or study electrical engineering."

"When I set foot on the Dürr Campus in Bietigheim-Bissingen for the first time, I was surprised: The modern architecture, the young and open-minded people – it was not at all what I had expected from a Swabian plant manufacturer. That is one of the reasons why I am absolutely sure that the vocational training as an IT specialist at Dürr Systems is the right thing to do. My father works for Deutsche Telekom, so I grew up with the internet. Computers and monitors have accompanied me throughout my life. After finishing vocational college, I worked for the German Armed Forces as an IT soldier for four years. Now I am curious to see what role digitalization plays in the corporate world. I'm currently working in digital support at Dürr. In the theoretical courses, I'm learning a lot about server technology and networks – future-oriented topics that fascinate me."

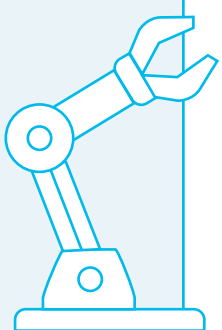
Leon Bentzien, 24, vocational training as an IT specialist, Bietigheim-Bissingen

"I am in vocational training to become a mechatronics engineer at Dürr Systems in Michigan. I spend half of the time in the company and get to know the practical sides of the job. In addition, theoretical courses provide me with the necessary background knowledge. I really like the combined program that the vocational training managers have put together. A stay abroad was also part of my vocational training: I spent four months at Dürr in Bietigheim-Bissingen, where I had a wonderful time. There was so much to learn, plus the friendly people and wonderful surrounding area. It may sound strange, but I felt at home right away. My goal now is to obtain a bachelor's degree in electrical engineering. Maybe there will be an opportunity to be employed on a regular basis at Dürr in Germany for a while afterwards."

←

Kaitlin Bowen, 20,
vocational training in mechatronics,
Southfield, MI, USA

"Electronics is a significant part of our lives, so I wanted to know more about it and completed an internship at the HOMAG Group. I immediately liked my colleagues. They answered my questions and assigned me smaller tasks. For example, I learned how to wire terminals. I found it particularly impressive to look inside a robot arm and understand how individual parts work together with the help of electrical impulses. Since September 2020, I have been learning the profession of an electronics technician for industrial engineering. When the vocational training is finished after three and a half years, I would like to study for a bachelor's degree and then continue to work for the HOMAG Group. Maybe even in my home country of China, which is a very important market for the company."



Siyu Chen, 21,
vocational training as an electronics technician for industrial engineering, Schopfloch

→

"I admit that I have chosen a very rare profession. In fact, vocational training as a production technologist has only been offered for a few years now. What I like is the variety of topics: Automation technology, process optimization, programming – an interesting mixture. A few months ago, I completed the three-year vocational training. I currently work in quality development at the HOMAG Group, looking for weaknesses in our processes in order to make them even better.

I am happy that I have found a job that perfectly suits me. After graduating from technical high school, I first wanted to become a teacher. Then I came across the profession of production technologist at an information event held by the HOMAG Group and quickly decided to do my vocational training at precisely this company."

Christopher Kübler, 33,
vocational training as a production technologist,
Schopfloch

Vocational training in the Dürr Group

First steps with international perspectives: We offer great opportunities for vocational training or a cooperative state university program.

Find more information here:

A FAMILY AFFAIR

Dürr is a family business in its third generation. Some employees are also the third generation to work at Dürr. We introduce two families who want to continue to play an active role in the future of the 125-year-old company.

TEXT: **HEIMO FISCHER**

Dianna Thomas (front row left) with her sons Kevin (back row left) and Brandon (back row right) and father-in-law James

Thomas family, Southfield, MI, USA

Dianna Thomas has never regretted joining Dürr Systems as a payroll clerk. She currently heads the department and sometimes can hardly believe that she has been working for the US subsidiary of the German company for 36 years. So why did she start working at Dürr? "One reason is my father-in-law," she says. He did on-site assembly work for Dürr, installing paint shops in the region's large car factories. Together with her family, she accompanied him every year to the large picnic that Dürr still organizes for their employees today. "At these events, I got to talk to a lot of people from Dürr families," the manager remembers. That is how she learned that the company was looking for a payroll clerk. She applied for the job and was accepted. Today, her son also works for Dürr, building paint booths. She smiles. He was two years old when she first took him to a Dürr picnic. "Today, he is 39 and still attends them." Dianna Thomas and her family are looking forward to keep up this family tradition for many years to come.

> "From my father-in-law I heard many stories about his work at Dürr."
>
> DIANNA THOMAS

SOUTHFIELD

Michigan, USA

Carolina Silva with her grandfather José and her father Valdy

Silva family, São Paulo, Brazil

For Carolina Silva, Dürr is an integral part of her life. Even as a toddler, she listened to her grandfather talking about the company – about the times he was away on assembly work, which 40 years ago was very different from today. Later, her father told her about how the processes changed and the company developed. He described new products and explained their functions. “These stories made me get more and more curious. I wanted to find out exactly what it was all about,” says the 25-year-old. She had the opportunity to do so at an open house day for employees and their families. Seeing the big machines and plants fascinated her, she remembers. “At that moment I decided that I wanted to work at Dürr.” She studied hard to get a good degree and was eventually hired by Dürr – in the third generation. “I immersed myself again in the stories my father and grandfather had told me.” The company is now also part of the biography of Carolina Silva, who works as a documentation coordinator. “I am grateful that Dürr has given me and my family the opportunity to achieve professional success and prosperity.”

> “When Dürr opened the doors for employees and their families, I was fascinated.”
>
> CAROLINA SILVA

THE DÜRR GROUP AT A GLANCE

KEY FIGURES[1]

		2020	2019	2018	2020/2019 Change in %
Incoming orders	€ million	3,283.2	4,076.5	3,930.9	–19.5
Orders on hand (Dec. 31)	€ million	2,556.7	2,742.8	2,577.2	–6.8
Sales revenues	€ million	3,324.8	3,921.5	3,869.8	–15.2
of which abroad	%	83.1	82.9	84.3	0.2 pp
Gross profit	€ million	604.2	838.2	855.5	–27.9
EBITDA	€ million	125.3	308.5	326.9	–59.4
EBIT	€ million	11.1	195.9	233.5	–94.3
EBIT before extraordinary effects[2]	€ million	99.5	263.1	274.9	–62.2
EBT	€ million	–18.5	174.7	219.7	–
Net loss/profit	€ million	–13.9	129.8	163.5	–
Earnings per share	€	–0.23	1.79	2.27	–
Dividend per share	€	0.30[3]	0.80	1.00	–62.5
Cash flow from operating activities	€ million	215.0	171.9	162.3	25.0
Cash flow from investing activities	€ million	–119.2	–231.8	–30.1	–
Cash flow from financing activities	€ million	27.4	60.8	–134.0	–54.9
Free cash flow	€ million	110.7	44.9	78.4	146.7
Equity (with non-controlling interests) (Dec. 31)	€ million	908.1	1,043.4	992.2	–13.0
Net financial status (Dec. 31)	€ million	–49.0	–99.3	32.3	–
Net working capital (Dec. 31)	€ million	382.6	502.7	441.4	–23.9
Employees (Dec. 31)		16,525	16,493	16,312	0.2
of which abroad	%	52.0	50.4	50.0	1.6 pp
Gearing (Dec. 31)	%	5.1	8.7	–3.4	–3.6 pp
Equity ratio (Dec. 31)	%	23.4	26.9	27.4	–3.5 pp
Gross margin	%	18.2	21.4	22.1	–3.2 pp
EBITDA margin	%	3.8	7.9	8.4	–4.1 pp
EBIT margin	%	0.3	5.0	6.0	–4.7 pp
EBIT margin before extraordinary effects[2]	%	3.0	6.7	7.1	–3.7 pp
Net financial debt / EBITDA		0.4	0.3	–	–
ROCE	%	1.1	16.9	24.0	–15.8 pp
EVA	€ million	–66.0	39.4	76.0	–

[1] Please note the information on page 68 concerning the figures in the 2020 annual report.
[2] Extraordinary effects: €–88.4 million (2020), €–67.2 million (2019), €–41.4 million (2018).
[3] Dividend proposal for the annual general meeting.

COMPANY PROFILE

The Dürr Group is one of the world's leading mechanical and plant engineering firms with extensive expertise in automation and digitalization/Industry 4.0. Its products, systems and services enable highly efficient and resource-saving manufacturing processes in different industries. The Dürr Group supplies sectors like the automotive industry, mechanical engineering, chemical, pharmaceutical, medical technology and woodworking industries. It generated sales of €3.32 billion in 2020. The company has more than 17,000 employees and 120 business locations in 33 countries. Since February 2021, the majority-owned automation specialist Teamtechnik has also been part of the Group. The Group operates in the market with the brands Dürr, Schenck and HOMAG and with five divisions.

OUR FIVE DIVISIONS

Paint and Final Assembly Systems

- Paint shops
- Final assembly systems
- Testing and filling technology for the automotive industry
- Assembly and test systems for medical devices

€1,173.8 M
SALES

€36.9 M
OPERATING EBIT

4,383
EMPLOYEES

Application Technology

- Paint application technology
- Gluing technology
- Sealing technology

€459.4 M
SALES

€19.0 M
OPERATING EBIT

2,162
EMPLOYEES

Clean Technology Systems

- Air pollution control
- Noise abatement systems
- Coating systems for battery electrodes

€386.2 M
SALES

€20.6 M
OPERATING EBIT

1,348
EMPLOYEES

Measuring and Process Systems

- Balancing equipment
- Diagnostic technology
- Industrial filling technology

€193.5 M
SALES

€0.2 M
OPERATING EBIT

1,407
EMPLOYEES

Woodworking Machinery and Systems

- Machinery and equipment for the woodworking industry

€1,111.9 M
SALES

€27.0 M
OPERATING EBIT

6,942
EMPLOYEES

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Corporate Communications & Investor Relations
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74321 Bietigheim-Bissingen
Germany

Tel +49 7142 78 - 1785
Fax +49 7142 78 - 1716
corpcom@durr.com
www.durr-group.com

CHIEF EDITOR
Andreas Schaller

EDITORS
Stefan Tobias Burkhardt, Claire Busche, Mathias Christen, Heimo Fischer, Andreas Schaller, Anna Waibel, Johannes Winterhagen

PHOTOGRAPHY AND ILLUSTRATIONS
Craig Augustine, Silas Bubser, Rüdiger Dunker, Sascha Feuster, Frank van Groen, Thomas Hoppe, iStockphoto, Luisa Just, Peter Jülich, Lehmann Group, Martin Poulsen, TH Rosenheim

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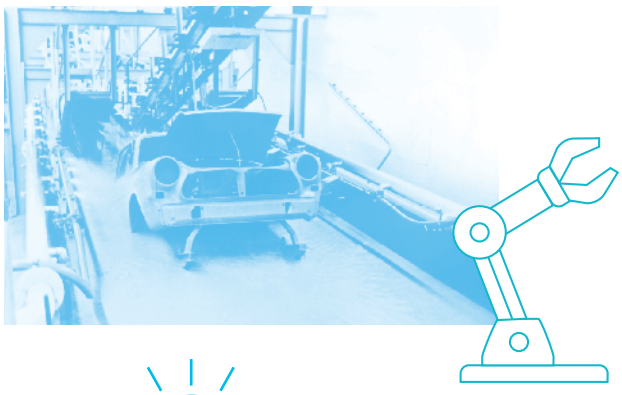

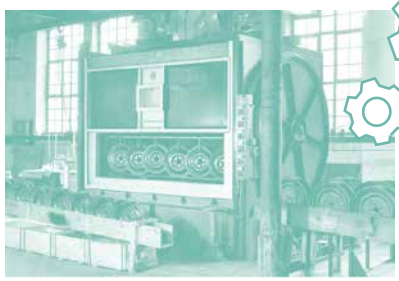

125 YEARS

From workshop
to world market leader