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The Liebherr Group When Ideas Take Shape | **p. 46**





Nicolas Bonleux, Francis Carla, Alex Vlieland, Martin Wandel, François Lehmann (from left to right)

Dear reader,

While browsing through this magazine, you will gain an impression of the fascinating projects with which we support our customers and which we realize together: We are proud of our ability to contribute to designing and building higher performance and more environmentally friendly aircraft.

Despite the many successes that we would like to share here, we must also take into account what happened in the earlier months of 2020 while producing this magazine. Our world is faced with an unprecedented challenge through COVID-19. This challenge has impacted, and will further impact, the health of many people, the daily and professional lives of all of us, and the worldwide economy. The aviation industry is one of those sectors most affected by the pandemic.

Due to the tireless dedication of our employees worldwide, we have been able to protect the health and safety of our workforce as much as possible, while also being able to continue supporting our customers and partners throughout the past months. In order to weather the turbulences, we had to revise our plans: Like everyone in the industry, we have taken the necessary steps to get through the coming period, and have adjusted our costs in order to maintain our liquidity.

Nevertheless, we have reasons to be convinced that our industry will regain the path of growth in the foreseeable future. As we tackle the short-term actions that will lead us through the next phase, we are also preparing for the long-term – our journey post-COVID-19. With the right framework, this crisis offers us the opportunity to make a significant contribution to sustainable aviation, in particular by accelerating the deployment of highly efficient models with drastically lower CO₂ emissions and with modern technologies.

We have always been focused on long-term success, and we will continue to play our role as a major system supplier by contributing to the future of the aerospace industry with our technologies, our operations, and our teams worldwide. Our company has shown much resilience in countering this exceptional crisis, while at the same time shaping a robust future.

We wish our customers success, and would like to thank all our employees and our business partners for this joint achievement.

With best wishes,



Nicolas Bonleux
Chief Commercial Officer



Francis Carla
Chief Technology Officer



François Lehmann
Chief Financial Officer



Alex Vlieland
Chief Services Officer



Martin Wandel
Chief Operating Officer



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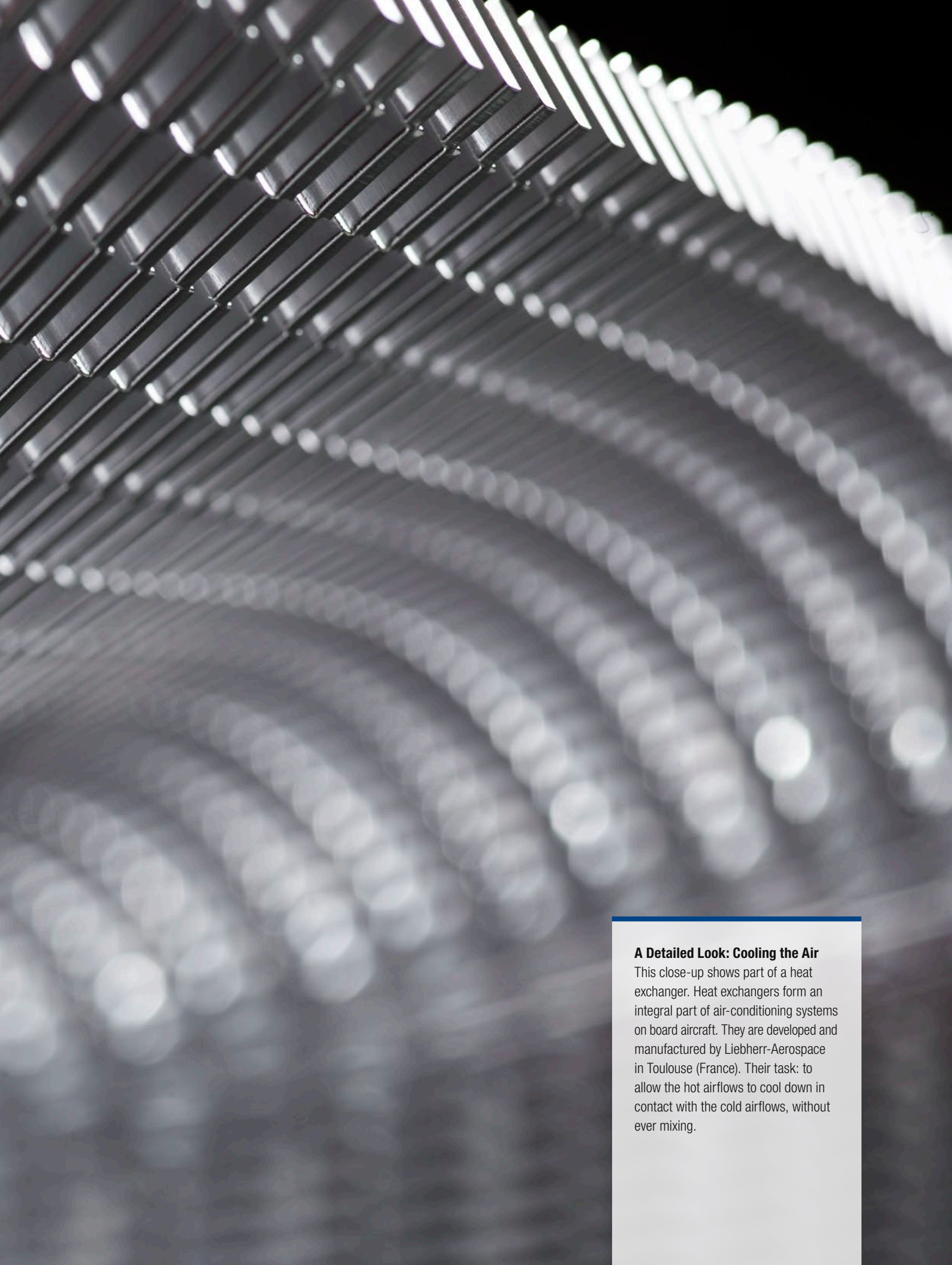
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Impressions

Know-how, sensitivity, and precision are crucial for maintaining high standards of quality. With its highly skilled workers and a wide range of cutting-edge production technologies, logistics, and testing methods, Liebherr-Aerospace is able to ensure that all the aviation components that it develops, manufactures, and maintains function reliably and exactly as required.



A Detailed Look: Cooling the Air

This close-up shows part of a heat exchanger. Heat exchangers form an integral part of air-conditioning systems on board aircraft. They are developed and manufactured by Liebherr-Aerospace in Toulouse (France). Their task: to allow the hot airflows to cool down in contact with the cold airflows, without ever mixing.





Small and Fast

Aircraft components are constantly exposed to extreme stress. Surface treatment makes sure that these components can withstand these forces. Shot peening is one of the most important processes: 11 million small steel balls with a diameter of 0.2 to 0.6 mm each are accelerated and shot with compressed air at 50 m/s (180 km/h) at the targeted surface of the component. Where it is hit with the steel balls, the surface is compressed by the kinetic energy of the steel balls, increasing the product life of the component. Here, an employee is checking the housing of a landing gear in a shot peening cabin at Liebherr-Aerospace in Lindenberg (Germany).





Maximum Efficiency

At Liebherr-Aerospace in Lindenberg (Germany), automatic material handling equipment and the warehouse management system called WAMAS enable the company to store up to 70,000 boxes on the narrowest of spaces, while complying with numerous storage rules and regulations. On a length of around 1,000 m, a material handling system and a forklift control system can thus transport individual storage boxes quickly and on time to their destination. This automation is the basis for more efficient and more economical internal logistics processes.



Industry Information

Innovation Through Digitalization

There is great value in digitalization as it enables real-time exchange in the different processes for better efficiency. Liebherr-Aerospace has embraced this digital journey for all of its product lines and has started several key initiatives in order to facilitate it.

The perhaps most innovative and game-changing initiative addresses the product development process starting with customers' product requirements being sent to Liebherr by way of digital models. This first step is the beginning of a digital journey that includes systems and product simulation, intensive usage of virtual testing, and digital continuity with the manufacturing and customer support activities. Liebherr's capability of

additive manufacturing is fully integrated into this digital process as well, with parts already flying on aircraft.

On the supply chain side, Liebherr-Aerospace adopted the use of AirSupply, a robust global logistics system utilized by many major players in the aviation ecosystem. AirSupply meets all the functional requirements for transparent collaboration processes, and it enhances supplier delivery performance. The system significantly improves demand forecasting and coordination between suppliers.

Additionally, Liebherr has implemented several digital improvements in the manufacturing area. Several initiatives are already apparent, such as cobots ("light" robots), automated ground vehicles, indoor and outdoor geolocation of parts, and the use of augmented reality technology for inspection of the products prior to delivery to the customers.

Another major initiative implemented is the predictive maintenance capability – the process of gathering technical data from the aircraft and using data analysis

to determine accurately and in almost real time when parts should be replaced before they fail in service. This predictive maintenance approach uses a product "digital twin" – a digital model, which allows the simulation of the real product in terms of functionalities but also the potential failures. Thus, Liebherr is taking steps to invest in cutting-edge technology that will enable the company to better plan and schedule repairs and overhauls for components installed in thousands of aircraft flying across the globe.

Last but definitely not least, after implementing its own customer relation management tool, Liebherr is developing a state-of-the-art customer web portal to facilitate data exchange with its customers with the goal of developing its activity and to improve customers' experience.

The digital journey at Liebherr-Aerospace has indeed started, and the company is at the beginning of a new era, with tremendous opportunity for growth and lessons to learn along the way.



An automated ground vehicle transports goods at Liebherr-Aerospace in Toulouse (France)

QRQC: Modern Quality Management

No discipline has undergone such a change as quality management in the past 100 years. From pure quality control, through Q-measures in all areas of a company, to customer- and result-oriented excellence models, modern quality work is more integrated. QRQC means Quick Response Quality Control, and means that teams from all hierarchy levels are integrated in all company areas, who solve Q-problems quickly, in a structured and permanent manner. The word “control” does not refer here to “checking” as in, for example, a product inspection, but to “steering” or “managing.” The control focuses on the cause analysis of the problem and on avoiding that the same problem reappears.

Through a five-year project that reached its maturity in 2019, Liebherr reached significant reductions in the rejection rates of manufactured components. The project resulted in a network of 950 employees trained in two of its operations sites. The initiative, dubbed Quick Response Quality Control (QRQC), began in Toulouse (France) in 2014, and, after three years of successful implementation, was deployed in the Lindenberg (Germany) facility as well.

At Liebherr’s Toulouse site, the groundwork for implementation of QRQC was made with the goal of reducing the rejection rate of serialized units by 80%. Some problems are so complex that they cannot be solved quickly. This is where the CPS (complex problem-solving) approach comes in, which methodically extends QRQC. The objective set for quality improvement was achieved within the schedule through the hard work of 500 employees challenged and supported by five committees. For 2025, the company expects to reduce the rejection rate even further.

In Lindenberg, 450 employees are at present methodically involved in achieving the quality objectives, continuously supported by specialists and management. And more and more are joining the initiative. QRQC has helped to bring the

ejection rate down by even 90% for various customers. The implementation of the CPS methodology was also introduced in the facility in Germany. QRQC and CPS are important elements of Liebherr-Aerospace’s quality road map. For 2025, the company expects a stable level of rejection rate of serial units and a reduced number of notifications of quality escape towards the customer.

QRQC and CPS are complemented by the introduction of APQP (advanced product quality planning) within Liebherr-Aerospace, which, unlike QRQC and CPS, is preventive. The aim of APQP is to identify changes during development, to avoid errors and to reliably meet customer requirements before a product goes into series production.

The project won great recognition not only internally but also from clients. It is a great success due to the unwavering commitment of all team members involved. The level of collaboration between both Liebherr-Aerospace sites in France and Germany shows how much can be learned and achieved when team members are committed and motivated to foster a culture of continuous improvement for the customers’ benefit as well as for safety in aviation.



Shop floor meetings play an important part in Liebherr-Aerospace’s QRQC management

Clean Sky: Promoting New Mobility Solutions

The Clean Sky research program, part of the EU's Horizon 2020 program, was established in 2008 as a public-private partnership between the European Commission and the European aerospace industry aimed at developing and maturing innovative technologies to reduce CO₂, gas emissions, and noise produced by aircraft. Liebherr-Aerospace sat down with Mr. Axel Krein, Executive Director of the undertaking, to discuss its goals.



Mr. Krein, what were the key factors that led to this initiative being launched and how has it evolved since then?

The Clean Sky Joint Technology Initiative took off 12 years ago, but the groundwork that led to it actually started in 2001 with the report “European Aeronautics: A Vision for 2020.” The report identified the main challenges for the future of the European aviation industry. Clean Sky was designed to address two of these main challenges: reducing the impact of air transport on the environment while promoting competitiveness and sustainable economic growth. It stems from the recognition that there is an increased demand for capacity and efficiency in the aviation industry, and at the same time a growing concern with strategies to mitigate the climatic impacts of this activity.

Our goals are essentially to promote solutions for improved mobility benefiting travelers and lower emissions and noise pollution that benefit the environment at the same time, while also improving the competitiveness of the European aeronautics industry and allowing the scientific community to have an active role in this development.

In the meantime, Clean Sky 2 is already underway. 23 aeronautics industry leaders, research organizations, and university associations signed a Joint Declaration of European Aviation Research Stakeholders in June of 2019 to express their strong commitment.

What are the goals of Clean Sky 2?

Our goals under Clean Sky 2 are simple: to reduce CO₂ emissions by 75 %, NO_x by 90 %, and noise emissions by 65 % compared to the aircraft which entered into service in 2014.

This requires a large network of involved players, in addition to a sizeable budget. How is the Clean Sky project structured and funded?

As a public-private partnership, we want to assure that pioneering new products can go through their whole life cycle – from research and conceptualization to development and manufacturing. We want to ensure that the projects can thrive with appropriate support to benefit all involved. We have over 1,400 participants: 334 industry members, 420 small and medium enterprises, 373 research centers and 350 universities. Our budget of 4 billion euros comes from contributions by the European Union, the 16 founding members of Clean Sky 2 Joint Undertaking, and six so-called Core Partners.

Can you give some examples of these projects and their results?

We are actively investing in several areas within our scope to benefit both the public and the industry. We expect delivery of three very interesting projects this year: Firstly, a semi-morphing wing concept that uses lower weight thermoplastics and liquid resin. Secondly, a new compound helicopter architecture that allows low-noise flight procedures and mission capability. Thirdly, a complete redesign of existing cargo doors that will allow for more than 5 % weight reduction, 50 % cost reduction, as well as an environmentally friendly manufacturing process that uses 20 % less organic solvents in paint, and is safer and easier to operate.

Liebherr is also a great example as one of the major partners of Clean Sky, making great strides in the development of the next generation of electric actuators, taxiing, electric wing, electric environmental control systems, auxiliary power generation systems, hydraulic power supplies, and thermal and power management systems.

Mr. Krein, during the preparation of the magazine in spring 2020, the coronavirus pandemic has spread over the world. From your point of view, how is the SARS-CoV-2/ COVID-19 crisis likely to affect Clean Sky and aviation in general?

For this question, it is very important to bear in mind: We can only make our forecasts based on the current state of knowledge – developments in the course of the year depend on a number of factors. The COVID-19 pandemic has a massive impact on the aviation industry in general. Airlines worldwide are experiencing a sharp and sudden decline in revenues. There have been immediate repercussions for the aeronautical industry. The big unknown for everyone is the duration of this crisis and this, of course, compounds the sense of uncertainty.

Assuming a short-term slowdown and quick recovery after a few months, we do not anticipate significant impact to the delivery of the Clean Sky 2 projects because our members and partners should be in a position to continue the delivery of project results with an acceptable delay.

We will continue to monitor this situation very closely and make updates as needed so that we can be sure we are doing everything we can to support all of our stakeholders.

Mr. Krein, thank you very much for your time and this interview.



Axel Krein

Since February 1, 2019, Axel Krein has been Executive Director of Clean Sky 2 Joint Undertaking, the European public-private partnership between the European Commission and the European aerospace industry for research in aeronautics, part of the European Union's Horizon 2020 research and innovation program. Mr. Krein has extensive experience in the aviation

sector, having served as Senior Vice President Research & Technology at Airbus from 2007 to 2014, and most recently as Airbus Senior Vice President Cyber Security Program.



334

Industry members



420

SMEs



373

Research centers



350

Universities



28

Countries



110

Regions

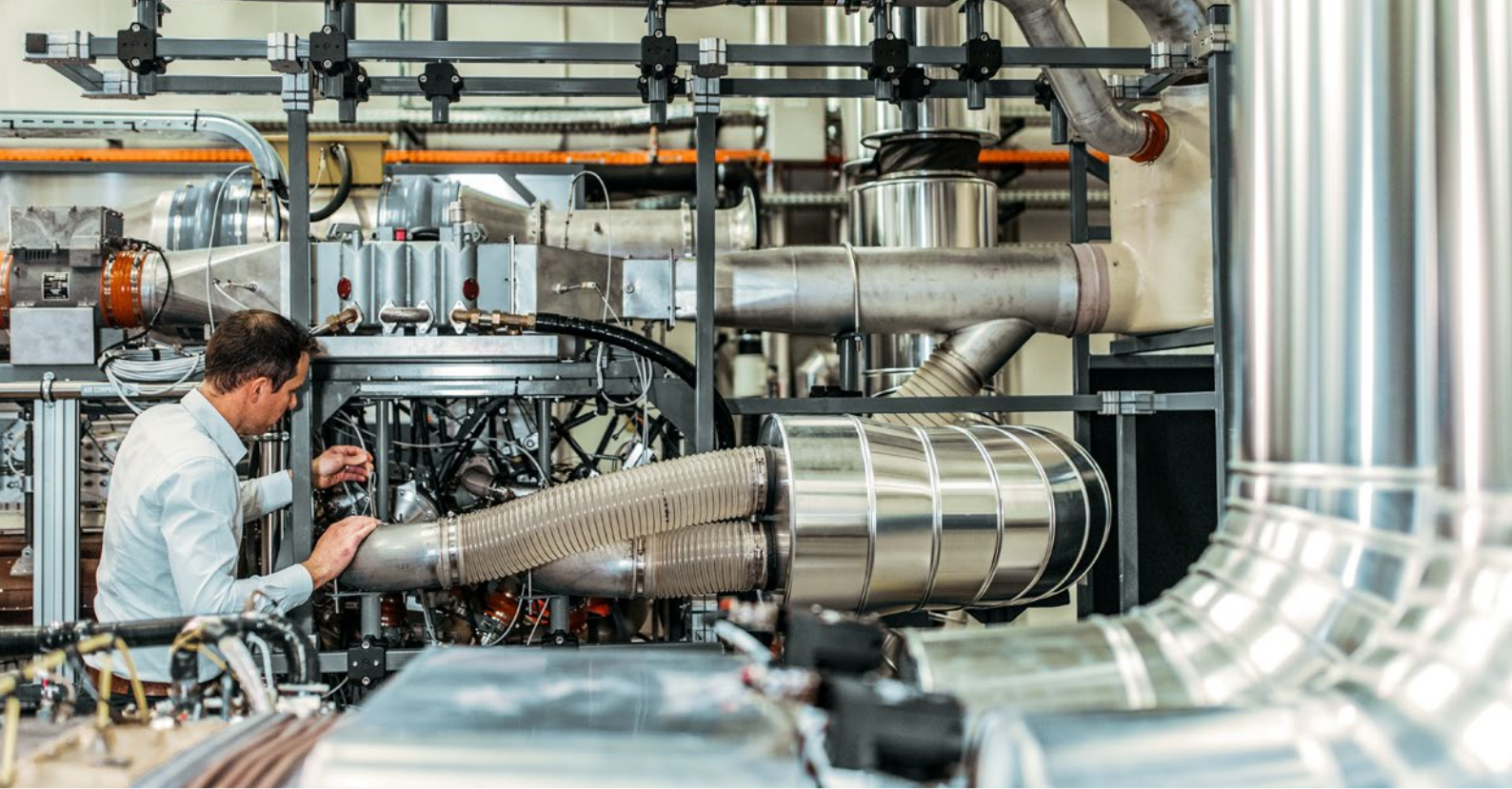


+466

Grants



Find out more about the research program at:
<https://www.cleansky.eu/>



Research & Development

The Future is Near – More Electric Aircraft

Less weight, higher efficiency, and cleaner skies: there are many advantages of a More Electric Aircraft. Liebherr is taking the lead to invest heavily on research in the field of electric systems to revolutionize aviation and leap into the frontline of advancements in moving towards a More Electric Aircraft (MEA). The focus of this research is creating solutions that will allow reduction of CO₂ emissions, NOx emissions, and lower noise pollution. Three different sites are involved in the research. Teams of engineers and developers in Lindenberg (Germany), Toulouse (France) and Lindau (Germany) are working hard to pave the way to new breakthroughs.

In late 2018, Liebherr unveiled the test module of the ESTER project (Electrohydraulic Steering, Extension and Retraction System), at its Lindenberg (Germany) site. The project is aimed at improving the aircrafts' landing gears using components known as electrohydraulic actuators (EHAs) in the retraction/extension and steering functions.

Instead of using constant hydraulic pressure powered by the central hydraulic system as energy supply to the landing

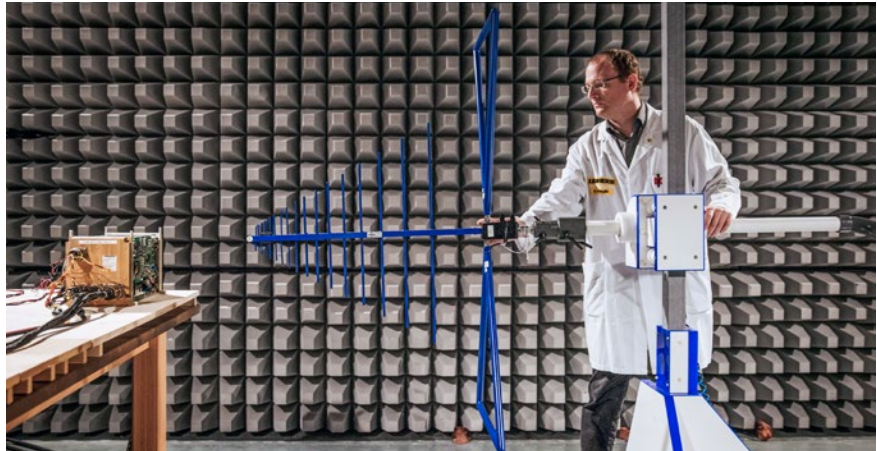
gear, the EHAs draw power from the aircraft's electrical system in a controlled manner. The system consists of a high efficiency motor pump and power electronics that only provide the power instantaneously needed by the landing gear, reducing the losses to the absolute minimum. By switching from the central line to these decentralized systems, the solution allows for aircraft weight reduction that impacts fuel consumption and generates less heat. In addition to being lighter and more energy-efficient, they

are easier to install, which is an important characteristic for high production rate aircraft such as today's single-aisle aircraft.

Liebherr also completed the second phase of the E-WING demonstrator platform that incorporates the system concept of MEA, with the setup of a laboratory that includes a control room, a flight control system rig, and the ESTER rig.

For the air systems and anti-ice systems, developed at Liebherr's site in Toulouse (France), the approach is different. The goal here is to totally suppress the air bled from the engines and to transform these from the present pneumatic systems into electrical systems, reducing the fuel burn and thus directly reducing the associated emissions.

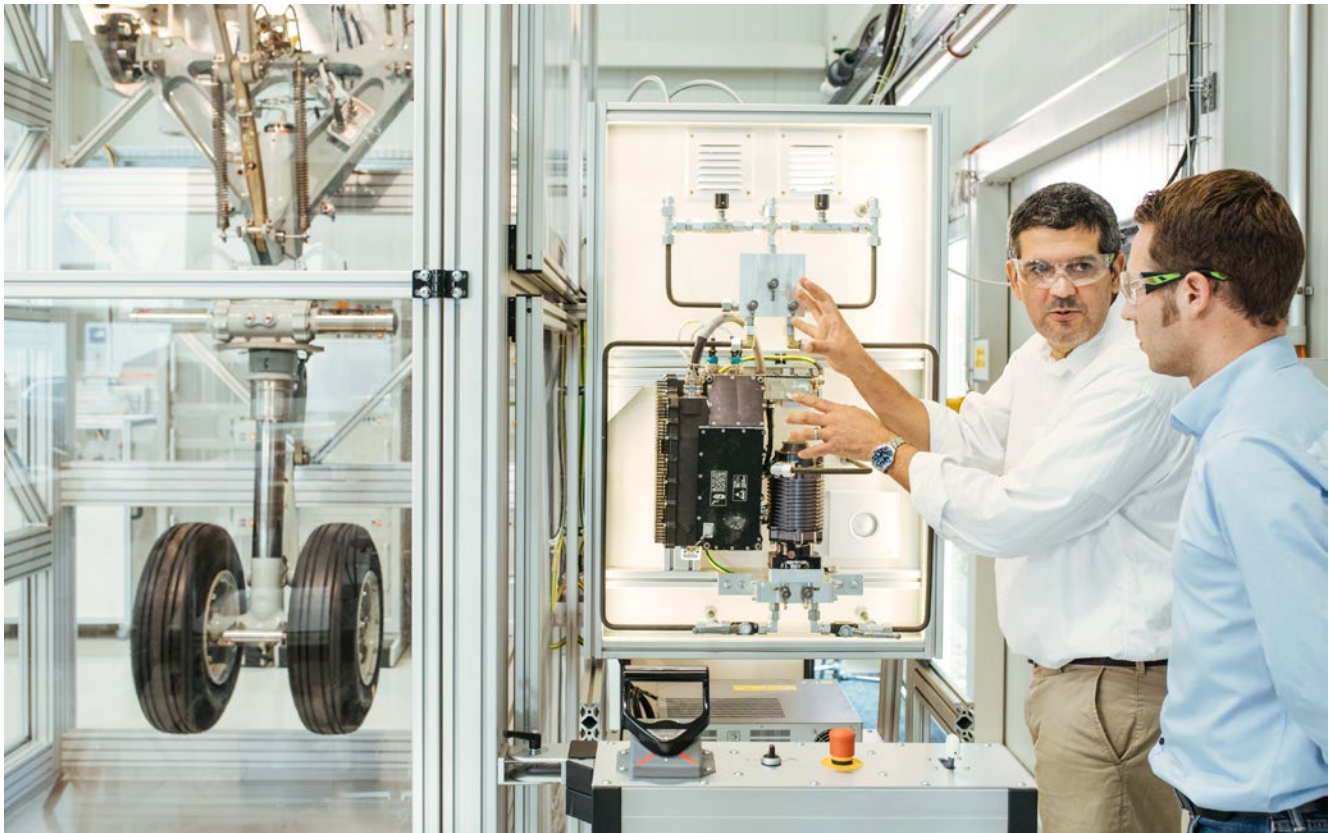
As a leader in paving the way to an MEA, Liebherr has developed two major electrical environmental control systems (E-ECS), one for regional aircraft and one for single-aisle aircraft, which have both flown successfully, on an ATR72 and an A320 flying test bed, respectively. The flight tests, as well as the intensive internal tests, have fully validated the robustness and stability of the air pressurization and air-conditioning systems.



Before any electric aircraft component takes to the skies, it is subjected to numerous tests. Here, for example, at Liebherr-Elektronik in Lindau (Germany)

The results of years of research have been very encouraging. The technological advances obtained from moving towards an MEA are important steps

in the direction of higher efficiency, weight reductions, enhanced passenger comfort, and, most importantly, greener operations.



ESTER test rig at Liebherr-Aerospace in Lindenberg (Germany)



Learn more and see the research up close here:
www.liebherr.com/moreelectricaircraft



International Focus

A Small but Mighty Team

The new facility of Liebherr's Aerospace and Transportation Systems Division in Laval, near Montreal, has been quite busy since its inauguration on October 12, 2017, ramping up efficiencies in the assembly line. Just over a year since the official opening ceremony, the team celebrated the milestone of 100 completed side- and drag-brace assemblies for the A220-100 and A220-300 aircraft.

For each aircraft, one drag-brace and two side-brace assemblies are required. With over 650 aircraft ordered to date, the Laval (Canada) facility quickly ramped up production to keep up with customer demand. In February 2020, yet another remarkable milestone was achieved: another 100 completions done in just eight months, marking the site's 300th completion of brace assemblies.

The assembly area is equipped with Liebherr's state-of-the-art technology and, most importantly, staffed with multi-talented and highly motivated employees. As a family-owned company at its core, Liebherr's most precious and valued resource is its people. At Laval, the

Aerospace and Transportation Systems division was built to be lean – with only 24 employees ranging from warehouse personnel, logistics experts, and product quality inspectors all the way to assembly line workers, engineers, technical writers, and administrative staff. With such a small and flexible team, the site has been able to achieve a high level of efficiency and cross-functionality – pivotal factors that enabled them to reach such extraordinary results.

The team will also soon start to assemble the nose landing gears for the A220 program in addition to the side- and drag-brace assemblies. Currently, the nose gear is being assembled at Liebherr's

Lindenberg (Germany) location. This transfer across national borders will significantly improve the logistics flow to better support Airbus. The closer proximity to the customer will optimize response time and improve service levels.

The team in Laval also certifies and distributes various components for air management systems for many applications on Airbus, Boeing, Bombardier, and Embraer aircraft. The total volume of parts delivered experienced a drastic increase of 132% between 2018 and 2019. Proving, once again, that the team may be small, but it is mighty.

Liebherr Aerospace Brasil Enters US Market

Liebherr Aerospace Brasil Ltda. entered a new partnership with PTI Technologies Inc., based in Oxnard, California (USA). The company signed a contract to become the supplier of hydraulic manifolds for Embraer's latest aircraft.

The company welcomed several PTI senior leaders to its facility in Guaratinguetá (Brazil) in the fall of 2019 for the celebration of the first strategic collaboration between the two companies.

Liebherr Aerospace Brasil is honored to become a supplier for PTI because the partnership helps the Brazilian company enter the American market, putting it one step closer to realizing its long-term vision of a diversified customer base.

With no non-conformities found during the product audit, the team in Guaratinguetá demonstrated its commitment to

excellence, and PTI places confidence in the arrangement with Liebherr: "Liebherr Aerospace Brasil's lean initiatives, process controls, and cutting-edge technologies will allow them to be competitive on PTI programs. We are looking forward to a successful partnership with Liebherr to improve our overall customer satisfaction," states PTI's Senior Director of Supply Chain Management, Larry Abel.

PTI has begun placing orders with Liebherr for three different kinds of manifolds to support the Embraer E2 during the first quarter of 2020.



At the contract signing ceremony, the following company leaders were in attendance (seated in front row, from left to right): Ray Lopez, Quality Director (PTI); Eduardo Giroto, Senior Director, Manufacturing (PTI); Tadeu Coelho, Financial and Administrative Director (Liebherr Aerospace Brasil); and Rogério Gimenez, Managing Director Operations (Liebherr Aerospace Brasil)

Growing Engineering Capabilities in China

Liebherr focuses on customer proximity in the Chinese market and wants to expand its engineering capacities in the aerospace and transportation systems sector, but also in the automotive sector. Océane Liu has worked as an Air Management System Engineer in Liebherr's Aerospace Division in Shanghai since 2014 and reports on this development.



Océane Liu at her desk in the Liebherr office in Shanghai (China)

Mrs. Liu, what are your responsibilities?

As a System Engineer, I have been mainly engaged in liaison engineering during the development phases of the Chinese aircraft programs COMAC ARJ21, C919, and the helicopter program HAIC, called AC312E/C, as well as in fuel cell electrical compressor projects like SHPT PROME390. My main tasks are liaising with customers and with our original equipment manufacturers (OEMs), i.e. Liebherr-Aerospace in Lindenberg (Germany) and in Toulouse (France). My tasks include supporting technical discussion, integrating systems with aircraft/vehicles, writing engineering documents, supporting tests at customers' integrated test benches, and flight tests. In January 2019, I was promoted to Air Management System Supervisor. I am therefore responsible for developing engineering capabilities of the engineering team here in Shanghai.

What are the goals of this engineering team?

Following the strategy of Liebherr to build long-term relationships with customers and using the benefits of our proximity with Chinese customers, our goals are to ease the communication and to enhance our engineering capabilities to provide efficient support for both customers and our OEMs during acquisition and development phases. Our aim is to enhance customers' satisfaction and our company's reputation, together with our OEMs in Europe, and thus to enlarge our footprint in China.

What was one of the most impressive moments so far in your career?

I think one of the most impressive moments for me was seeing the C919's first flight. I would say not only for me but especially for many people who work in this industry. I still remember the first time when I supported the C919 ground tests before the maiden flight: our system test started at 3 a.m., the cabin door had to remain closed during the whole test, and everyone stayed in the unfurnished cabin for five hours. Our system worked faultlessly, and later on I was much honored to receive the "First Flight Contribution Medal" issued by COMAC, which of course belongs to our whole team.

How do you see the future of the aerospace and new energy automobile markets in China?

I think China is a growing aerospace market which requires a lot of aircraft. This is a big opportunity and at the same time a big challenge for our Chinese customers who are going to reach historical milestones. I am very honored, being a part of the Liebherr team, to contribute to this important phase.

The same positive outlook applies to the automotive market. I believe that the research of Liebherr into new technologies such as fuel cells and e-mobility will allow us to reach further technological advancements for the benefit of our environment.



Successful Joint Venture in China

Liebherr LAMC Aviation (Changsha) Co., Ltd. was granted official approval in spring 2019 by COMAC to be a supplier of the Chinese aircraft manufacturer. This joint venture of Liebherr-Aerospace and LAMC is based in Changsha and specializes in aircraft landing gear.



It's all thumbs up: members of the Liebherr LAMC Aviation (Changsha) team celebrate the delivery of the 100th ARJ21 landing gear strut

This approval recognizes the intensive work done by LAMC and Liebherr's teams in order to further develop the capabilities of Liebherr LAMC Aviation (LLA). It illustrates the results achieved regarding the assembly, testing, and delivery of localized landing gears within a short period of time through the high-quality collaboration between both companies. LLA supplies landing gears for two of COMAC's aircraft programs: the ARJ21 and the C919.

In the ARJ21 program, LLA achieved one major milestone in November 2019: the 100th landing gear strut was delivered from Changsha for this twin-engine regional jet. This happened only three years after the delivery of the first ARJ21's landing gear in 2016.

LLA is also home to the assembly line for COMAC's narrow-body twinjet C919 landing gear struts. The first delivery of the C919 landing gear strut for flight test aircraft 104 occurred in 2018. The company is set to ramp up production to 145 landing gear struts per year by 2025, and its first delivery of two shipsets (or six struts) for series production is scheduled for the second quarter of 2020. COMAC plans to deliver the first C919 to its customer in 2021.

The LLA campus comprises an almost 54,000-square-foot, state-of-the-art facility, equipped with two separate assembly lines – one for each program: ARJ21 and C919. Its new and robust ERP system allows LLA to gain full logistics responsibility, streamlining planning, procurement, and inventory turnover. Having logistics autonomy will significantly and positively impact operations, as the plan is to grow not only deliveries of new final shipset assemblies but also the maintenance and repair of existing landing gears from established operators in the region.

Because Chinese air traffic is anticipated to grow, LLA is committed to making strides toward strategic investments in the market. The company is preparing its engineering capabilities to support both assembly and service lines for the ARJ21 and C919 programs. By fully supporting both programs in-house, LLA can reduce costs to regional customers.



Customer Service

Close Alignment with the Customer

Liebherr-Aerospace organizes interactive Regional Technical Workshops (RTW), providing its customers the perfect platform to share their experiences and to learn about how they can optimize their MRO activities with the latest innovations made by Liebherr. They support airlines through workshops, demonstrations, technical sessions, and presentations.

RTWs are, for example, centered exclusively on Airbus aircraft. They usually take place in various locations globally to reach operators in their nearest markets – Saline, Toulouse, Lindenberg, Shanghai, and Singapore.

Bombardier's exit from the commercial aerospace industry means a meaningful shift for Liebherr-Aerospace, whose customer portfolio is now slightly more consolidated. The departure presents an opportunity for Liebherr to align even more closely with Airbus on the A220 program with a customer focus no longer split between two different aircraft manufacturers. Since Liebherr is steadfastly dedicated to

complete customer satisfaction, the company continues to demonstrate its allegiance to Airbus, which it supports by supplying a variety of systems for over 20 different aircraft programs, and now the addition of the A220.

The last Airbus-centric RTW was held in 2018 and attracted more than 220 workshop attendees, including airlines, MROs, and Airbus representatives. Future RTWs will celebrate the success of Airbus and Liebherr's cooperation, giving the companies the opportunity to work even more closely together to make process enhancements that will further strengthen the partnership and its output.

Winning Contracts in Japan

Liebherr-Aerospace has signed two long-term service agreements in Japan: The original equipment manufacturer will cover the overhaul of the landing gear systems of the ten Embraer E170 family aircraft from Fuji Dream Airlines and for 15 of the Embraer E170 from J-Air.



Kojiro Yamashita, VP Procurement of Japan Airlines (right) and Ekkehard Pracht, General Manager Aerospace of Liebherr Singapore, at the contract signing ceremony

Fuji Dream Airlines, with its main bases in Shizuoka and Nagoya, is an independent regional Japanese carrier that began operating in July 2009. And J-Air, with its main bases in Tokyo and Osaka, is a wholly owned subsidiary of Japan Airlines (JAL), a member of the oneworld alliance.

Customized solutions were successfully agreed following close collaboration between the teams. These new contracts highlight the continuous effort Liebherr has been employing towards extending its support services in Asia-Pacific. The contracts are important milestones in the company's successful pursuit of landing gear overhaul campaigns.

A Success Beyond Expectations

Recently, Liebherr-Aerospace celebrated the delivery of its 5,000th heat transfer component by its dedicated Center of Excellence in Saline, Michigan (USA). This milestone was reached only 30 months after Liebherr-Aerospace entered the heat exchanger maintenance market with the opening of the 35,000-square-foot building. This milestone is a testament to the success of the Saline facility, which has progressed far beyond expectations since it opened.

With initial capabilities on the Airbus A320 family, Mitsubishi CRJ family, and the A380, the heat exchanger staff are working diligently to add capabilities for other Liebherr equipment installed on the Airbus A330 family, Airbus A220, Boeing 747-8, and Falcon 7X business jet. By utilizing OEM parts and procedures, non-contact metrology, custom-built cleaning and non-destructive testing setups, wire-EDM (electrical discharge machining) cutting, and adapted fixturing, Liebherr-Aerospace is continuing to be more efficient while maintaining superior OEM quality. Furthermore, Liebherr is exploring more time-saving techniques, such as CMT (cold metal transfer) robotic welding.

The staff in Saline now comprises 40 employees, and the facility is delivering over 340 units in peak months while upholding the quality standards and timely delivery Liebherr is known for.

In addition to expanding capabilities in the US facility, Liebherr also deployed a worldwide network of selected partners to service heat exchangers under a licensing agreement. This initiative was created to shorten service times and optimize spares inventory even further, as these partners were scattered throughout the world in closer proximity to operators. The partners must meet stringent technical qualification criteria and are positioned in key locations, such as Europe, Singapore, India, South America, and the Middle East.



Proud of their work: Liebherr-Aerospace team members in Saline, Michigan (USA)

Maintenance of Heat Exchangers

Every four years, or approximately every 12,000 flying hours, the heat exchangers, which are part of the air management system, must be inspected, cleaned, and maintained. To avoid pollution clogging, the intervals must even be reduced sometimes, depending on the environmental conditions, the routes, and the frequency of use of the aircraft.

Generally, a thorough cleaning of the components using high-pressure, ultrasonic, and immersion-bath cleaning processes is sufficient. This is followed by a leakage-and-pressure test and minor repairs done locally. Afterward, the heat exchanger is ready for reuse. If the inspection reveals major cracks or irreversible clogging, the heat exchanger is completely overhauled by the specialists at Liebherr-Aerospace in Saline.

Taking MRO Services to the Next Level

Liebherr-Aerospace offers its clients a worldwide service network for maintenance, repair, and overhaul activities (MRO). In 2019, the company managed 40,000 component repairs and 130 landing gear overhauls. It is undeniable that with the advancements in digitalization, MRO operations are going through a transformative stage at the moment. Liebherr is taking the leap into the current digital age.

The company is strongly engaged in defining a framework that enables exploration, adaptation, and in some cases the development of technologies that will streamline operations and improve efficiencies across functions, leveraging the power of digital tools that are certainly going to become game-changers in the near future.

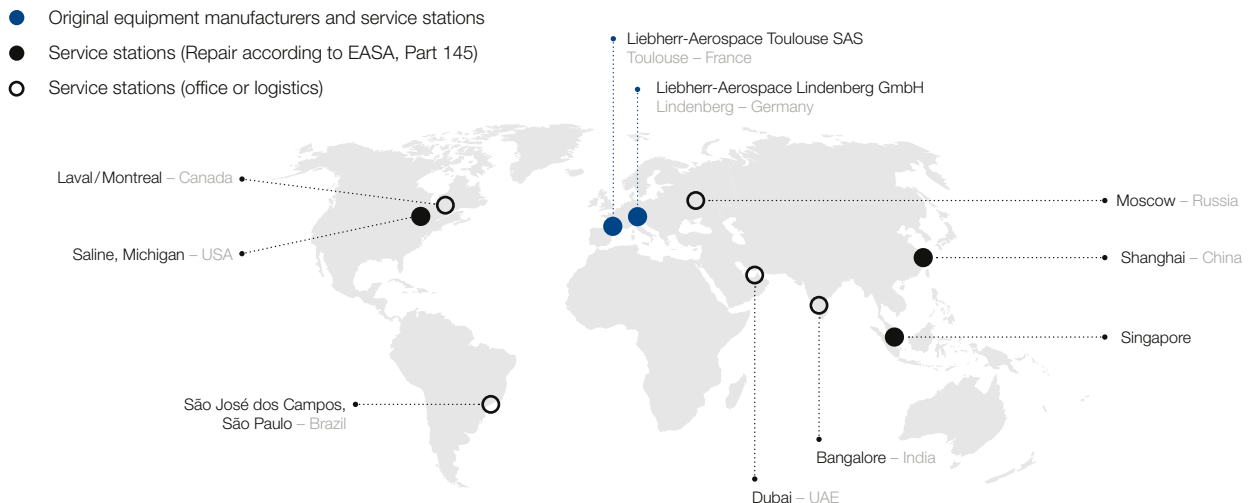
Liebherr has developed and implemented the eLirom software for its service center network. The software is dedicated to process all repair activities from the incoming inspection to the final acceptance test. With this new software, the company is creating a new level of standard, which has the potential to increase process efficiency by 30 % by minimizing the efforts during work scope selection, ordering parts, documentation of work performed, and other process steps.

The fully digitalized workflow follows the approach of “no more paper in the shop.” It empowers Liebherr shop personnel to make use of digital data during shop floor management and illustrate it in various visual management applications. eLirom supports collecting as well as analyzing MRO activities in each Liebherr-Aerospace service center across the whole network, and all of this in real-time. This newly gained transparency allows both the identification and exchange of best process practices. Benchmarks can be set to provide more time- and cost-efficient MRO services to the customers.

In addition to this smart MRO software, Liebherr-Aerospace is implementing, together with a partner, a highly advanced planning and prognosis software, which aims to improve on-time delivery performance by 10–15 %. With this new software application, customers can apply scenario techniques into the MRO planning process, thus being able to make even better and faster predictions of which materials are needed and in which quality, quantity, and region – this will be a huge advantage. As a side product, inventory holding costs can be optimized as well. Liebherr also offers its services for MRO services and asset management to yet more competitive conditions.

Data analytics has played and will play an even bigger role in the near future. In aircraft operation, it will increase availability and reliability through predictive maintenance. In the MRO shop environment, it will improve capacity planning of workforce, test benches, and machines. It will help to optimize the level of inventories and set triggers for the development of repair solutions. Additionally it will provide detailed information of normal and abnormal wear and tear, which will in turn support the future development of modifications up to new designs for components and systems.

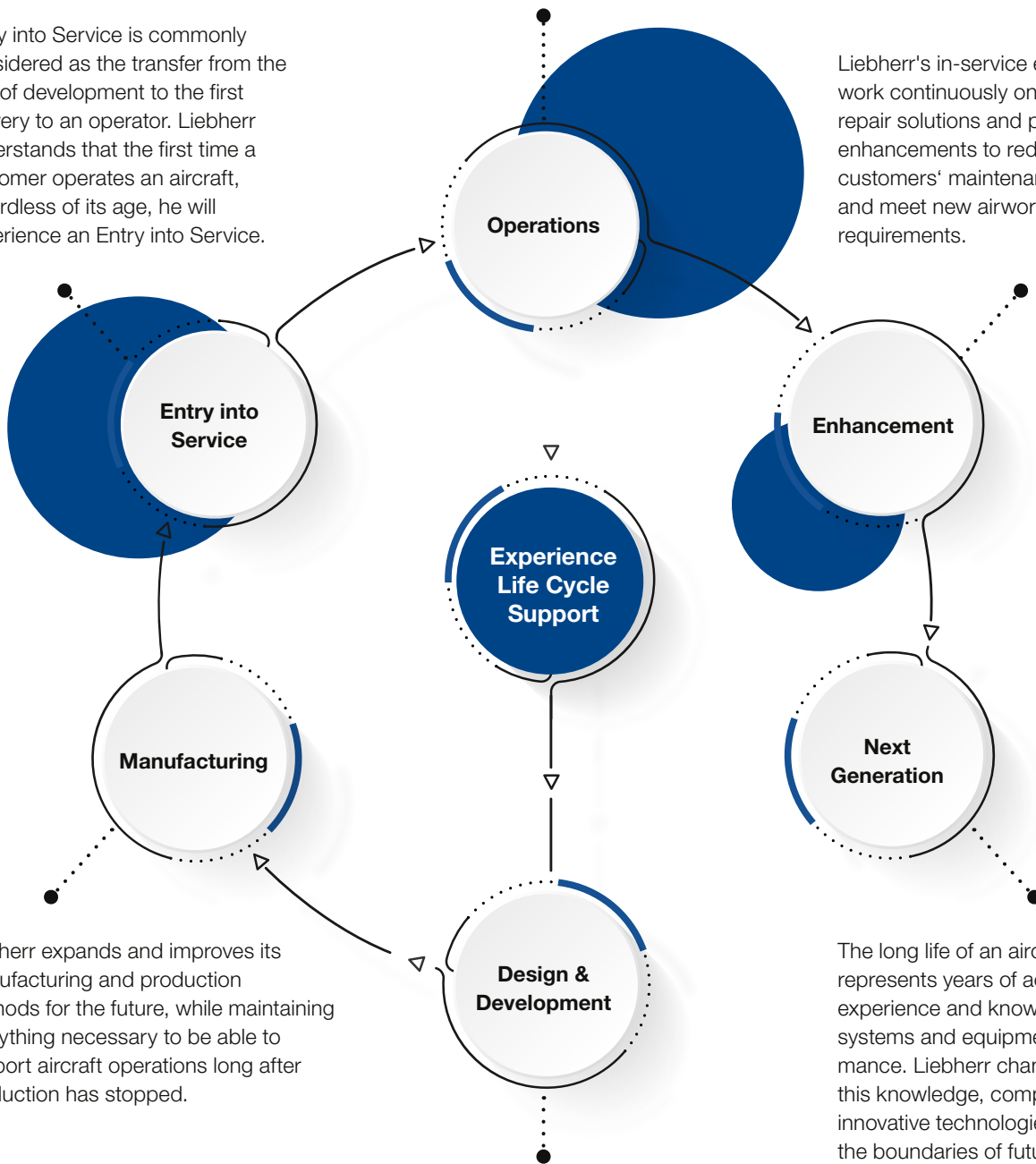
Liebherr has no doubt that the aviation MRO business needs to transform its operations to solidify its presence in the digital ecosystem. That is why Liebherr has invested in digitalization of its MRO processes in the past few years, and is prepared to make further investments.



More than 600 employees in Customer Service in the Liebherr global network are dedicated to support customers locally with services, material solutions, and technical support.

Entry into Service is commonly considered as the transfer from the end of development to the first delivery to an operator. Liebherr understands that the first time a customer operates an aircraft, regardless of its age, he will experience an Entry into Service.

Liebherr's in-service engineers work continuously on innovative repair solutions and product enhancements to reduce customers' maintenance costs and meet new airworthiness requirements.



Liebherr expands and improves its manufacturing and production methods for the future, while maintaining everything necessary to be able to support aircraft operations long after production has stopped.

The long life of an aircraft represents years of accumulated experience and knowledge of systems and equipment performance. Liebherr channels this knowledge, compiled with innovative technologies, to push the boundaries of future services.

Liebherr strives to design the next generation of services using system knowledge, gathered through millions of hours of real-life data.

Flexibility and Customer-centricity

Liebherr-Aerospace Lindenberg (Germany) has been the exclusive supplier for Embraer's E-Jet landing gear components since 1999. Today, Embraer's active fleet of E-Jets comprises around 1,600 aircraft with a diverse portfolio of operators. Liebherr's landing gears are on board each and every one of those aircraft.



Upon arrival in the MRO shop at Liebherr-Aerospace every landing gear is disassembled

OEMs, like Liebherr, are not only in the business of designing and manufacturing components for aircraft, they also support these products in the aftermarket. In the case of landing gears, a great deal of effort is put into providing customers with a high level of logistics and MRO services.

With the maintenance parameters determined far ahead of time, each structural component has its specific restoration interval, known to all parties as the time between overhauls (TBO). It is reasonably safe to say that with the right planning tools, maintenance and overhaul slots can be planned and accommodated well in advance.

Each landing gear overhaul is a complex project that takes on average about 45 calendar days to be completed. Thus, it becomes imperative that the MRO facility plans accordingly to be able to service aging equipment with as little downtime as possible. Minimizing aircraft downtime is a top priority.

When the E170 and E190 originally entered into service, Embraer and the authorities agreed to set the restoration interval for both aircraft family types to a TBO of 30,000 flight cycles, or 12 years – whichever occurs first. At the time, this was considered to be the maximum possible limit. However, with more new operators joining the customer base along with their associated airworthiness authorities, the E190 family had its TBO reduced to just 20,000 flight cycles, or eight years – after only being in service for a few years.

Over the following years, the E190 TBO saw incremental increases following positive results achieved through sampling. The sampling program, which investigates the condition of landing gears operating in different environments, provided the necessary evidence to justify the restoration interval threshold.

In general, gearing up to be ready for each overhaul requires a great deal of planning. It has to be ensured that an adequate level of landing gear rotables and spare parts are available, so that the aircraft can keep on flying while the overhaul takes place.



Assembly of an overhauled landing gear at the Liebherr-Aerospace facility in Lindenberg (Germany)

In 2017, Liebherr's Lindenberg (Germany) facility experienced an unprecedented spike in its repair shop activity, overhauling 35 shipsets of landing gear for Embraer customers. It was a huge undertaking that would not have been possible without the unwavering commitment of each person involved in the venture at every level of the organization.

Liebherr was already planning the induction of many E190 family landing gears into the repair shop when, at the end of 2017, Embraer and the authorities officially approved an extension of the TBO from ten years or 20,000 flight cycles to 12 years or 25,000 flight cycles. Such a seemingly subtle change can have major consequences in the operations of an MRO facility.

Subsequently, in 2018, the Liebherr shop was underutilized as the operators followed the TBO extension for the E190 family. Nevertheless, the agility and flexibility required to sustain operations and adapt to unforeseen changes and challenges is something that Liebherr is very proud of. Having a customer-centric focus and the flexibility to swiftly adapt to changes are the two main driving forces behind Liebherr's long history of fruitful partnerships and exceptional customer satisfaction.



© VR-Technologies

Programs & Contracts

Aboard the VRT-500 Helicopter

Liebherr-Aerospace has signed an agreement with VR-Technologies, a subsidiary of Russian Helicopters, to supply the environmental control system for their new civil helicopter, the VRT-500. Included in this agreement is the cooling system as well.

VR-Technologies anticipates the VRT-500's breadth of application to be quite diverse – from private use, taxiing, tourism, news and media, as well as logistics, all the way to rescue and ambulance services. The forecast for deliveries of the VRT-500 is quite solid. The helicopter was first revealed to the world in 2018 and will prove VR-Technologies' vast experience in developing helicopters with today's market demands in mind. "We are thrilled to have been awarded this contract," says Nicolas Bonleux, Chief Commercial Officer of Liebherr-Aerospace & Transportation SAS. "We have built a solid reputation in the helicopter market by supplying various systems to our customers. The addition of VR-Technologies to our portfolio is an honor, and we look forward to serving them."

"Liebherr-Aerospace's know-how, reputation, and customer-centric approach were decisive factors to bring them on board our VRT-500 program," comments Alexander Okhonko, General Manager of VR-Technologies, at the start of this partnership. "This is a new milestone for us and we are happy to join hands with an industry leader such as Liebherr-Aerospace. We are paving our way to a new development, reaching a broader global customer network; thus, having a strong and well respected supplier network by our side is of the utmost importance to us."

The VRT-500 is a five-passenger, light, single-engined, multipurpose helicopter expected to be highly successful in Europe with EASA certification on the horizon. With a cruising speed of 225 km/h (approximately 140 miles per hour) and a maximum range of 860 km (approximately 534 miles), this helicopter is poised to become a versatile solution in a multitude of industries.



Alexander Okhonko, General Manager of VR-Technologies (left), and Nicolas Bonleux, Chief Commercial Officer of Liebherr-Aerospace & Transportation SAS, shake hands after the contract signing at Moscow Airshow MAKS 2019

Pneumatic Valves for Business Jet Engine

Liebherr-Aerospace has been selected to supply the pneumatic component package for Rolls-Royce's next-generation business jet engine, Pearl 700. Both the pneumatic valves and the actuation devices that control pneumatic power around the engine have been designed by Liebherr-Aerospace Toulouse SAS in France and are also being manufactured and serviced there.

Liebherr-Aerospace Toulouse SAS provides Rolls-Royce with lightweight, high-reliability valves and actuation devices that match the requirements of the Pearl 700 engine program, the most powerful in the Rolls-Royce business jet propulsion portfolio. The Pearl 700 is the latest member of Rolls-Royce's Pearl® engine family and the exclusive power plant for the new Gulfstream G700.

The new contract is another important step in the relationship between Rolls-Royce and Liebherr-Aerospace. In 2015, both companies established a 50:50 joint venture called Aerospace Transmission Technologies GmbH. It is based in Friedrichshafen (Germany), and develops manufacturing capability and capacity for the power gearbox for Rolls-Royce's new UltraFan® engine.

In addition, the engine manufacturer has selected Liebherr-Aerospace to supply a pneumatic valve for the Trent 7000 engine.

Liebherr's worldwide center of excellence for air management systems in Toulouse (France) can rely on extensive experience in the development, manufacture, integration, and service of engine bleed air valves and nacelle pneumatic valves.



© Rolls-Royce plc 2019

Assembly of the Pearl 700 engine at Rolls-Royce

Working Hand-in-Hand with Boeing

In 2007, the Liebherr-Aerospace office in Seattle, Washington (USA) started out with a core team of three people to support the Environmental Control System developed and manufactured by Liebherr for the Boeing 747-8. Today the team counts 11 highly specialized and motivated team members. In 2020, they celebrated the first flight of Boeing's latest aircraft, the Boeing 777X.

Despite the fact that the office is called Liebherr Seattle office, the location is de facto in Everett, WA. Since 2009, the team has been led by General Manager Dietmar Klauber. "Our liaison office functions as an interface between Boeing and Liebherr-Aerospace OEM sites in Lindenberg and Toulouse", explains Klauber about the mission and vision of the office. "We are thus ensuring a high proximity between both companies during ongoing as well as possible future aircraft programs. We are able to provide Boeing with a high level of support and reactivity, meeting the requirements of all present programs."

The 11 employees interact daily with Boeing. Bernhard Bauer has worked for Liebherr since 1999 and in Seattle since 2009. He is one of the liaison engineers and leads the engineering team in the office. "Not only do we need to have the necessary technical and product knowledge, we also need to master soft skills – such as understanding cultural differences, effective problem-solving, ability to prioritize tasks, and interact with all levels of stakeholders," states Bauer. With each product having its own dedicated liaison engineer, this office structure yields vast product knowledge



1979
Contract
Boeing 767 main landing gear truck positioner

2003
Contract
Boeing 777-300 fuel tank pressure regulating valves

2007
Contract
Boeing 747-8 air-conditioning system and engine bleed air system

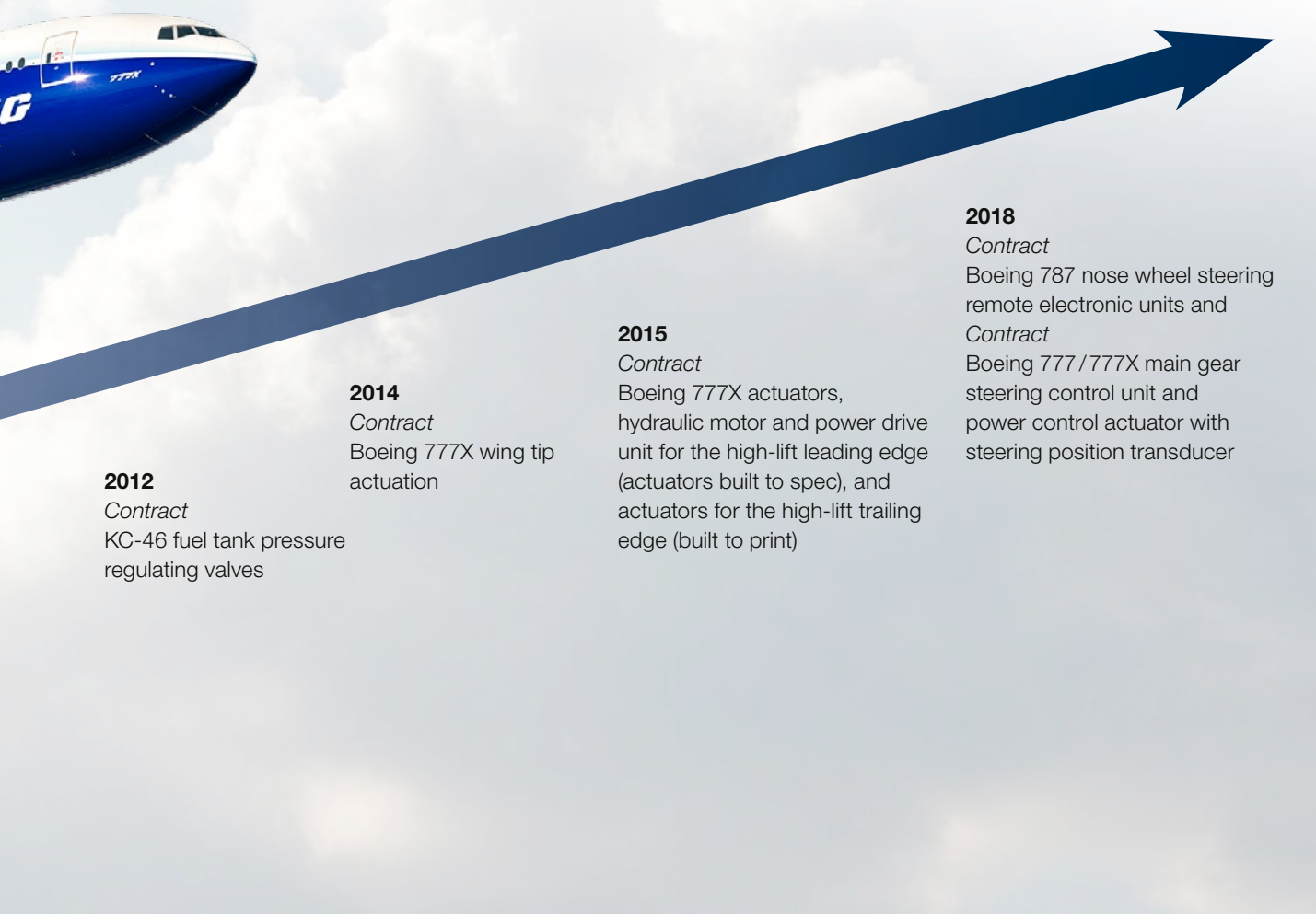
2007
Opening
Liebherr-Aerospace's liaison office in Everett

and expertise. For example, there is a dedicated engineer to the 747-8 air-conditioning and engine bleed air system, there is another engineer dedicated for the 777X folding wing tip, and the list goes on. With each engineer responsible for specific systems, accountability, problem resolution and communications between Boeing’s staff and Liebherr-Aerospace’s OEM facilities staff become very effective and streamlined.

While having the future in mind, the team is preparing to master the latest quality methodologies, such as APQP (advanced

product quality planning) and MBSE (model based systems engineering). “Our aim is to constantly strive to even better support our customers and meet their expectations,” comments Dietmar Klauber. “Expanding our business from the civil aviation sector into the military arena could be a possibility.”

This close-knit team has accomplished great results and stellar customer satisfaction levels working side by side with Boeing’s staff. Proof that a small group of talented and hard-working individuals can truly make a successful impact in not one, but two large organizations.



2012
Contract
 KC-46 fuel tank pressure regulating valves

2014
Contract
 Boeing 777X wing tip actuation

2015
Contract
 Boeing 777X actuators, hydraulic motor and power drive unit for the high-lift leading edge (actuators built to spec), and actuators for the high-lift trailing edge (built to print)

2018
Contract
 Boeing 787 nose wheel steering remote electronic units and
Contract
 Boeing 777/777X main gear steering control unit and power control actuator with steering position transducer

Partners for Over 40 Years: Embraer and Liebherr

The relationship began over 40 years ago when Liebherr began providing Embraer with air system components for the Tucano. A lot has happened over the years, and 2019 ended on a real high note for the partnership. Embraer celebrated its 50th anniversary and Liebherr-Aerospace is looking forward to at least another half a century of continued success and partnership with Embraer. The following few paragraphs highlight some of the most recent major accomplishments.

Triple certification of the new Praetor 600 executive jet

Embraer's latest super-midsize business jet, the Praetor 600, was certified by FAA and EASA in May 2019 following certification by the Brazilian Civil Aviation Authority, ANAC, the month before. Liebherr-Aerospace is responsible for the fuel tank pressurization valve of the additional fuel tank system, which enables the aircraft to fly 4,018 nautical miles (7,441 km).

The Praetor 600's new fuel system was engineered by Embraer to meet the highest regulatory requirements, thus significantly reducing fuel flammability. The valve, an integral component of the new fuel system, has been developed and manufactured by Liebherr-Aerospace Toulouse (France).

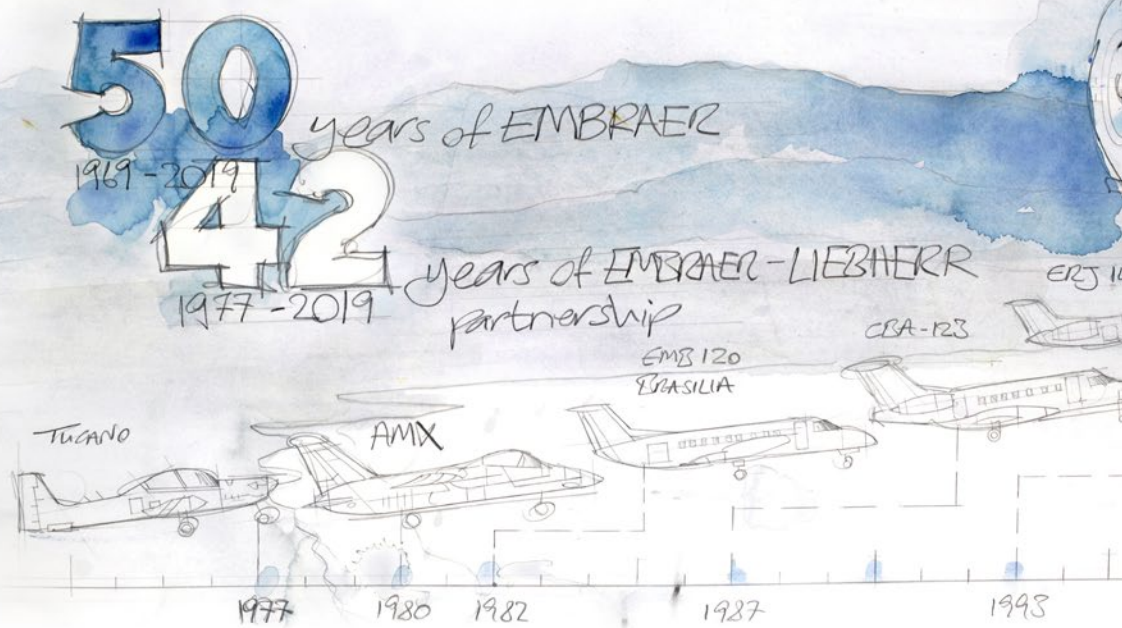
Thanks to the additional fuel capacities, the Praetor is capable of achieving intercontinental nonstop flights, such as from London (UK) to New York (USA). Seating up to 12 passengers, it is the farthest-flying super-midsize business jet in the world.

Entry into service of the C-390 Millennium

The new Embraer C-390 Millennium military transport and aerial refueling aircraft celebrated its entry into service in September 2019 with its first customer, the Brazilian Air Force.

Liebherr-Aerospace is responsible for the integrated air management system (IAMS) of the C-390. This system includes a next-generation air-conditioning and a cabin pressure control system. Engine bleed system components and wing anti-ice system components as well as the integrated air management system controller complete the IAMS.

Even under the aircraft's extreme operating conditions, the IAMS provides enhanced safety and comfort conditions for both troops and crew. Additionally, the latest-generation bleed valves feature advanced compact electro-pneumatic bleed technology.



Entry into service of the E195-E2

In September 2019, Embraer delivered its first E195-E2 to its launch operator, Azul Linhas Aéreas, in Brazil. Liebherr supplies the advanced, full fly-by-wire high-lift system with integrated computers, the IAMS with lightweight electro-pneumatic and mechanical components, as well as the nose wheel steering control module for the E2 aircraft family.

Delivery of Embraer 170 main landing gear serial no. 1,000

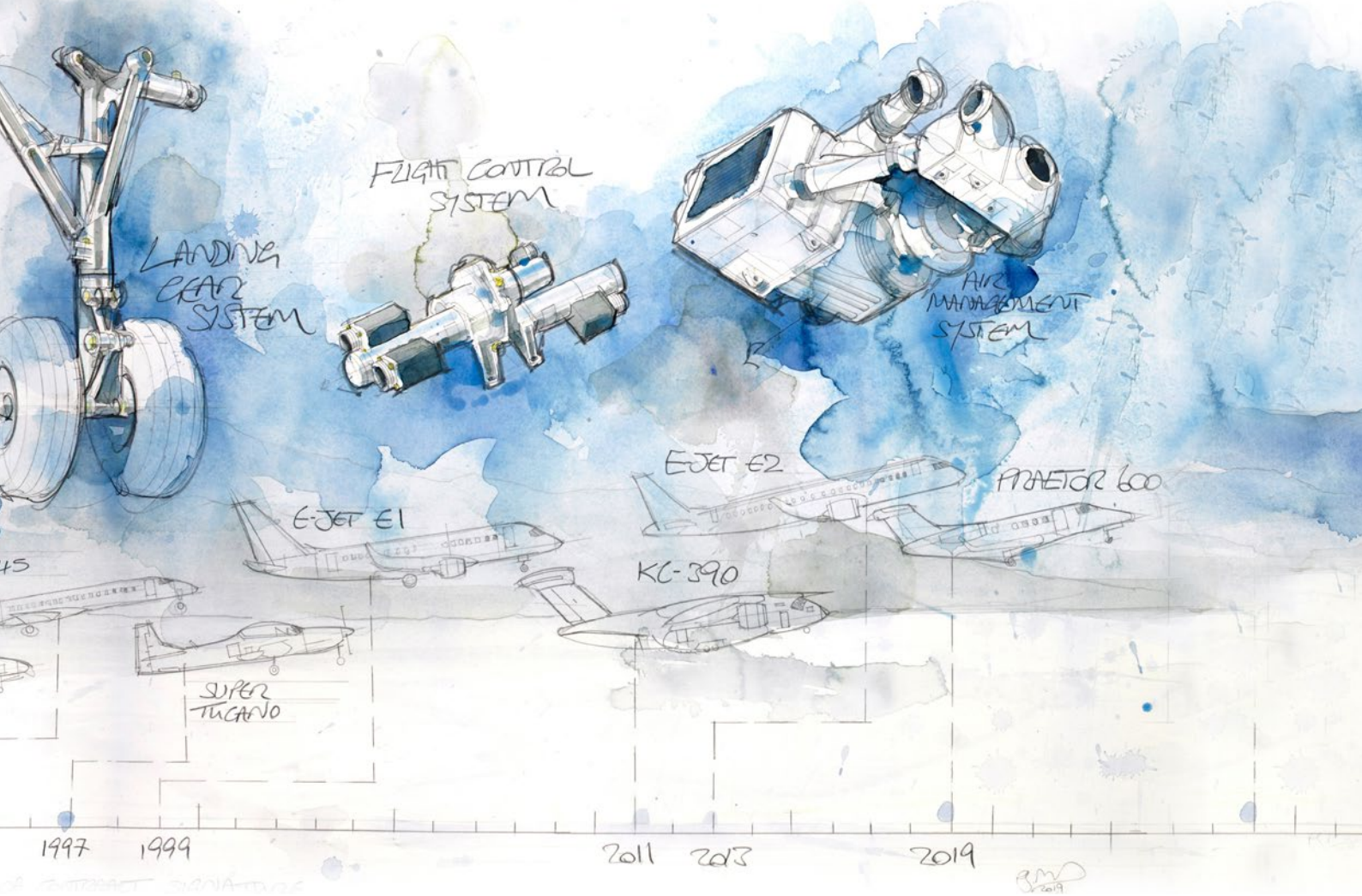
In October 2019, Liebherr proudly delivered the main landing gear with serial number 1,000 to the final assembly line of the Embraer 170/175 in São José dos Campos (Brazil). Embraer started the series delivery of the Embraer 170/175, the first version of the E-Jet family, in March 2004. The regional jet has a seating capacity of 66–78 passengers and can carry a full load of passengers up to 3,982 km (2,150 nautical miles).

First flight of the E175-E2 with Liebherr technology onboard

Just about two months later, in December 2019, the E175-E2 touched down in São José dos Campos after its successful first flight, and was received by the proud team of the aircraft manufacturer as well as representatives from several supplier companies.

The jet features key technology developed by Liebherr: the advanced, full fly-by-wire high-lift system with integrated computers, the IAMS with lightweight electro-pneumatic and mechanical components, and the nose wheel steering control module. Liebherr also manufactures the main landing gear for this aircraft version.

With Liebherr working so closely, supplying and supporting Embraer’s aircraft, it was no coincidence that during its 2019 Suppliers Conference in São José dos Campos, Embraer presented an unprecedented three awards to one supplier at the same time: Liebherr received the three Embraer Best Supplier Awards in the categories “Best of the Best,” “Program Development,” and “Mechanical Systems.”





At 63 meters in length, the “smiling” BelugaXL is about seven meters longer than its predecessor, the BelugaST

Liebherr-Aerospace Aboard the BelugaXL

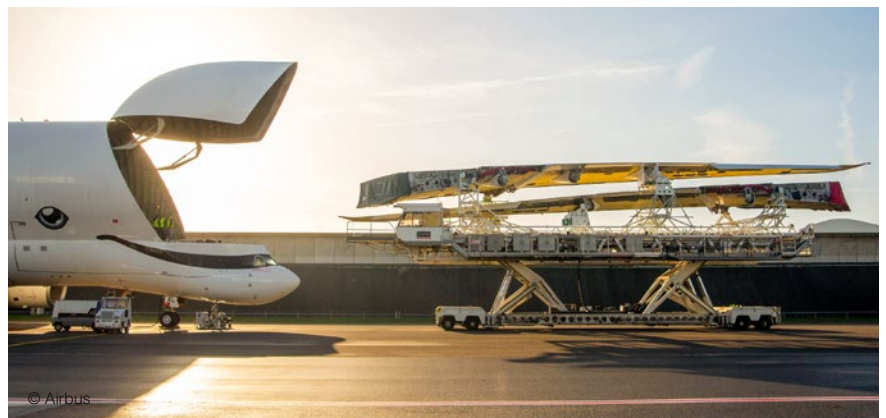
Liebherr-Aerospace systems and components entered into-service on board the Airbus BelugaXL extra-large transport aircraft on January 9, 2020.

Liebherr supplies the air-conditioning system, several components for the engine bleed air system, and the conditioned air supply system (a subsystem of the fuel tank inerting system), as well as the high-lift system, the landing gear door actuation, and the spoiler actuation for the BelugaXL program.

Liebherr-Aerospace offers support solutions for its components and systems on board the BelugaXL during the aircraft’s entire life cycle. Thanks to its international

network of maintenance, repair, and overhaul stations and spares distribution facilities, the company’s customer service

organization ensures customer proximity and high-level performance for aircraft operators across the world.



Airbus marked an important achievement with the first flight of its next-generation BelugaXL carrying a set of A350 XWB wings

First Flight of the G700

Recently, the business jet G700™ made its successful first flight. Liebherr supplies components for the Pearl 700 engine that powers the aircraft.

On February 14, 2020, the all-new business jet G700™ manufactured by Gulfstream Aerospace Corporation took off for its first flight and landed safely after two and a half hours at Savannah/Hilton Head International Airport, Savannah, Georgia (USA).

According to Gulfstream, the G700 can fly at its high cruising speed of Mach 0.90 for 11,853 km (6,400 nautical miles), which equals a route for example from London (UK) to Cape Town (South Africa), or at its long-range cruising speed of Mach 0.85 for 13,890 km

(7,500 nautical miles), for example from London (UK) to Buenos Aires (Argentina).

The entry-into-service is expected during 2022.

Liebherr supplies the pneumatic component package for the Rolls-Royce Pearl 700 engines of the aircraft. The lightweight, high-reliability pneumatic valves and the actuation devices that control pneumatic power around the engine have been designed, manufactured, and serviced by Liebherr-Aerospace Toulouse (France), Liebherr's center of competence for air management systems.



Gulfstream G700 during its first flight

No Chance of Ice

Liebherr's expertise in nacelle anti-ice valves for commercial and military transport aircraft is built upon a foundation of many years supplying high-reliability, lightweight, high-pressure, and high-temperature valves to the aviation industry.

The valves are on board various aircraft. For example, a fleet of 133 Boeing B747-8 aircraft, the latest in the prestigious 747 family, is in service and has accumulated 2.5 million flight hours. Four Liebherr nacelle anti-ice valves are on board each aircraft, and there have been no in-service issues so far – the

valves have even exceeded reliability expectations.

Anti-ice valves are also on board Airbus' military transport four-engine turbo-prop A400M. Eighty aircraft have been delivered so far, and the A400M fleet has accumulated close to 40,000 flight

hours. In an operating environment with particularly severe vibration, Liebherr's valve can be counted on to work exceptionally well.

Nacelle anti-ice valves will be used in an engine build-up system for A320neos equipped with the Pratt & Whitney PW1100G engine. The valves are packaged into shipsets of two pneumatic valves per nacelle. They are not only developed and manufactured by Liebherr, but also tested and certified by the company.



A400M at Colmar (France) airport with Liebherr-France facilities in the background



People & Community

When Change is the One Constant

A career spanning nearly 30 years that still allows for frequent changes and the possibility to satisfy curiosity: Mireille Lemasson, Quality Safety Environment Director of Liebherr-Aerospace Toulouse (France) can look back on an impressive professional background.



Mrs. Lemasson, you have worked for Liebherr since 1992 when you were finishing your PhD in aerodynamics. What inspired you more than 28 years ago to pursue this degree?

I was always very studious, but I was a bit lost about what I ultimately wanted to do. I knew I enjoyed physics and mathematics, so I went to an engineering school for my bachelor degree in Aeronautical Engineering. Then I dug

deeper and found that I was really drawn to fluid mechanics and aerodynamics. I decided to pursue my masters in this field and after that, I wanted to explore the topic even further with a PhD.

How has your role at Liebherr evolved over time?

When I arrived, Liebherr had just started researching activities in the field of aerodynamics – it was a completely new department! Our goal was to improve the performance of air-conditioning systems, and I mostly worked alone. In time, the team grew to include three researchers in aerodynamics.

In the many years since, I have been fortunate enough to be able to manage teams of experts in many other fields as well, including thermodynamics, acoustics, materials, and mechanics/ stress calculations. Furthermore, I managed in-development systems engineers, and in 2014 I became Head of Research, Development, Qualification, and Test Service.

What do you enjoy most about working at Liebherr?

I really like working for a family-owned group. Liebherr-Aerospace Toulouse feels like a small company within a big group, so I can get a lot done without having to go through too many hierarchy levels to make things happen.

I also like that the company is always looking forward and makes heavy investments in transformation into new technologies and research so that our work can be applied to other markets, such as railroad and automotive.

Why do you think you have stayed at Liebherr for such a long time?

I really enjoy professional change, and Liebherr has allowed my career to stay fluid. Each of my career moves has allowed me to gain new knowledge and to adapt, reconsider, and reevaluate my skills. I am a very curious person, so there is only one constant in my professional life – and that is change.

The Perfect Job

Meet Alexander Baldauf, a young and driven apprentice at Liebherr-Aerospace in Lindenberg (Germany), who has been able to experience the joy of being extremely passionate about work.

Mr. Baldauf how did you hear about Liebherr?

Liebherr-Aerospace Lindenberg runs a vocational training program where they reach out to high schools to recruit top students to join the program. I was 17 years old finishing my high school program back in 2018 and I was not quite sure what I wanted to do next. But I knew one thing: I really enjoyed biotechnology and chemistry. So when I saw the flyer for an apprenticeship program at Liebherr, I just knew I had to apply as I really wanted to do something with sciences.

How long have you been with the company? What does your job entail?

I have been part of the program for one and a half years now and my position is “surface coater.” My job, in a nutshell, is to protect metal parts through a process called electroplating so that they don’t corrode.

What do you like the most about your job?

Learning about physics, chemistry, and other natural sciences is actually one of my favorite things to do – even when I am not working. This job is really perfect for me because I must understand how chemistry, ions, metals, and other substances in the electrolytes work. No other company that I know of uses so many different procedures for electroplating. I talk to other students in my class and they only work with one procedure while I am learning about eloxal (electrolytic oxidation of aluminum), coppering, cadmium plating, silver plating, chromium plating, chemical nickel plating, zinc nickel plating, and passivation.

How long is the apprenticeship and how hard was it to get in?

The program lasts three years, so I am halfway through it. Liebherr brings on about four to five surface coaters per year. Therefore, in order to be accepted, students must have specific interests in math, physics, and chemistry. Organizational and planning skills are also required.

How do you see your career evolving? What would you like to do after the apprenticeship is over?

I think there is still so much to be learned. I would like to continue in this field and become an expert. I will graduate from technical school in 2021, and I would like to become an electroplating engineer.

What advice would you give other high school students who might be considering getting into an apprenticeship program like yours?

If you want to land an apprenticeship program at a global company with lots of opportunities for growth like Liebherr, you just need to focus on getting good grades, demonstrate responsibility, and good work ethics. Most importantly, I think that finding a field to work in that is related to the subjects that you enjoy the most at school is crucial to being successful and happy. That way, work does not become a chore, but rather a very fun and important part of your life.



Find out more about open positions here:
www.liebherr.com/career

Participation in Programs –

Fixed Wing Aircraft

Airbus

Airbus A220

- Integrated Air Management System
- Landing Gear System

Airbus A300-600

- Cabin Pressure Control System
- High-Lift System
- Krüger Actuator
- Latching Actuator
- Landing Gear Door Actuators
- Nose Landing Gear
- Upper Cargo Door Actuator

Airbus A310

- Cabin Pressure Control System
- High-Lift System
- Krüger Actuator
- Nose Landing Gear

Airbus Single Aisle Family ceo / neo

- Air Chillers
- Air-conditioning System
- Avionics Cooling System
- Cargo Heating System
- Engine Bleed Air System
- Fuel Tank Inerting System – CSAS (except A319CJ)
- High-Lift System
- High Pressure/Power Transfer Unit Manifolds
- Rudder Servo Control
- Safety Valve

Airbus Long-Range Family ceo / neo

- Air Chillers
- Air-conditioning System
- Auxiliary Power Unit Gearbox (Long-Range)
- Avionics Cooling System
- Engine Bleed Air System
- Cargo Heating System
- Cargo Door Actuator
- Crew Rest Humidification System
- Fuel Tank Inerting System – CSAS
- High-Lift System
- Landing Gear Door Actuation
- Rudder Servo Control (Airbus A340 Enhanced)
- Spoiler Actuation
- Spring Strut

Airbus A350 XWB

- Flap Active Differential Gearbox
- Load Sensing Drive Strut
- Moving Damper
- Nose Landing Gear
- Slat Actuation

Airbus A380

- Air/Hydraulics Cooling System
- Cargo Heating System
- Engine Bleed Air System
- High-Lift System
- Pneumatic Distribution System
- Reservoir Air Supply Cooler
- Spoiler Actuation
- Supplemental Cooling System

Airbus BelugaXL

- Air-conditioning System
- Conditioned Air Supply System (a subsystem of the fuel tank inerting system)
- Engine Bleed Air System Components
- High-Lift System
- Landing Gear Door Actuation
- Spoiler Actuation

Airbus (Defense and Space)

A400M

- Aileron, Elevator, Rudder Servo Control
- Air-conditioning System
- Cabin Pressure Control System
- Door Ramp Actuation System
- Engine Bleed Air System
- Fuel Tank Inerting System – CSAS Components
- Nacelle Anti-Ice System
- Power Control Unit
- Spoiler Servo Control
- Ventilation Control System
- Wing Anti-Ice Valves
- Wing Tip Brake

Eurofighter/Typhoon

- Airbrake Actuator Servo Control
- AMAD Gearbox
- Engine-Driven Hydraulic Pump
- Filter Package Units
- Nose Landing Gear
- Nose Landing Gear Retraction Actuator
- Main Landing Gear Side Stays
- Primary Flight Control Actuators – Fly-by-Wire Technology

Antonov

AN-74/AN-140

- Cabin Pressure Control System

AN-132/AN-148/AN-158/AN-178-Prototype

- Integrated Air Management System

ATR

ATR 42/72

- Integrated Air Management System

AVIC

MA700

- Valve Actuator

Boeing

B747-8

- Air-conditioning System
- Engine Bleed Air System

B777-200LR

- Fuel Tank Pressure Regulating Valves

B777/B777X

- Main Gear Steering System

B777X

- Folding Wing Tip Actuation
- High-Lift Actuators
- Power Drive Unit and Hydraulic Motor for Leading Edge Actuation System

B787

- Nose Wheel Steering Remote Electronic Unit

KC-46

- Fuel Pressure Regulating Valves
- Refueling Hose Drum Drive System

Bombardier Aerospace

Challenger 300/350

- Flap System
- High- and Low-Pressure Ducting
- Integrated Air Management System

Global Express/G5000/G5500

- Cabin Air Humidification System
- Integrated Air Management System
- Nose Landing Gear Shock Strut

G6000/G6500/G7500/G8000

- Integrated Air Management System

COMAC

ARJ21

- Integrated Air Management System
- Landing Gear System incl. Braking System, Wheels, and Tires
- High- and Low-Pressure Ducting

C919

- Integrated Air Management System
- Landing Gear System
- High- and Low-Pressure Ducting

Daher-Socata

TBM850/900

- Air-conditioning System
- Cabin Pressure Control System
- Engine Bleed Air System

Dassault Aviation**Falcon 50EX/900/2000/2000EX**

- Air-conditioning System
- Cabin Pressure Control System
- Engine Bleed Air System

Falcon 6X

- Integrated Air Management System
- Cabin Air Humidification System

Falcon 7X/8X

- Cabin Air Humidification System
- Engine Bleed Air System

Mirage 2000

- Air-conditioning System
- Cabin Pressure Control System
- Engine Bleed Air System

Rafale

- Air-conditioning Components
- Cabin Pressure Control System
- Engine Bleed Air System

Embraer**AMX**

- Cabin Pressure Control System

C-390 Millennium

- Air-conditioning System
- Cabin Pressure Control System
- Engine Bleed Air Valves
- Refueling Hose Drum Drive System
- Wing Anti-Ice Valves

E-Jet E1

- Landing Gear System incl. Braking System, Wheels, and Tires

E-Jet E2

- Nose Wheel Steering Control Module
- High-Lift System
- Integrated Air Management System
- Machining of Main Landing Gear (E175 E2)

Embraer 135/145/Legacy 650

- Cabin Pressure Control System
- Flap System
- Nose Landing Gear

Legacy L500ER

- Fuel Tank Pressurization System

Lineage

- Landing Gear System incl. Braking System, Wheels, and Tires

Praetor 600

- Fuel Tank Pressurization Valve

Super Tucano

- Air System Components

Tucano

- Air System Components

FAdeA**IA-63 Pampa III**

- Air-conditioning, Heating and Ventilation Components
- High-Lift Actuation Components
- Primary Flight Control Components
- Landing Gear Components

HAL**ALH**

- Heating and Ventilation Systems

Dornier 228

- Flap System
- Landing Gear Actuators
- Nose Wheel Steering System

HJT 36

- Cabin Pressure Control System

Jaguar

- Cabin Pressure Control System

Tejas

- Cabin Pressure Control System

IAI**G200**

- Cabin Pressure Control System Components
- High-Lift System

Irkut – Regional Aircraft**SuperJet 100**

- Fly-by-Wire Flight Control System
- Integrated Air Management System

Leonardo (Aircraft)**C27-J**

- MELTEM III-MMI Auxiliary Cooling System
- MELTEM III-MMI Environmental Control Unit

M-346

- Main Landing Gear System
- Nose Landing Gear System
- Nose Wheel Steering System

Longview/De Havilland Canada**Q400**

- Cabin Pressure Control System

Mitsubishi Heavy Industries**CRJ700/900**

- Integrated Air Management System
- Low-Pressure Ducting

CRJ1000

- Command-by-Wire Rudder Control System
- Integrated Air Management System
- Low-Pressure Ducting

RUAG Aerospace**Dornier 228 New Generation**

- Flap System
- Landing Gear Actuators
- Nose Wheel Steering System

Textron Beechcraft**750/850XP/900XP**

- Cabin Pressure Control System

TRJet**328 Series**

- Air Management System
- Flap and Spoiler Actuation Subsystem

Participation in Programs –

Rotor Wing Aircraft – Engines – Actuation – Pods

Airbus (Defense and Space)

MRTT ARBS

- Ruddervator Control System

Cobham

Cobham Mission Equipment

POD

- Hose Drum Drive System

Airbus (Helicopters)

AS350/355 Ecureuil

- Environmental Control System Components
- Gears for Main Gearbox

AS365

- Environmental Control System

BK117

- Gears for Power Transmission Gearboxes
- Hydraulic Power Supply
- Main and Tail Rotor Servo Controls

H120

- Environmental Control System Components

H130

- Air-conditioning System

H135/H135M

- Gears for Power Transmission Gearboxes
- Hydraulic Power Supply
- Main and Tail Rotor Servo Controls

H145

- Gears for Power Transmission Gearboxes
- Hydraulic Power Supply
- Main and Tail Rotor Servo Controls
- Tail Gearbox

H160

- Environmental Control System Components
- Main Rotor Servo Controls
- Heating Valve
- Tail Rotor Gearbox

H175

- Environmental Control System Components

H225/H225M

- Environmental Control System Components
- Heating System

NH90

- Actuation Control Computer
- Auxiliary Power Unit Gearbox
- Fly-by-Wire Main and Tail Rotor Servo Controls
- Environmental Control System Components

Tiger

- Gears for Tail Gearbox
- Air-conditioning System
- Main and Tail Rotor Servo Controls
- Tail Landing Gear

UH-72A Lakota LUH

- Gears for Power Transmission Gearboxes
- Hydraulic Valveblock/Reservoir
- Main and Tail Rotor Servo Controls

AVIC HAIG

AC 312

- Air-conditioning System

Boeing

MH-139

- Environmental Control System
- Landing Gear System

IAI

Elta

- Environmental Control Unit

Kamov

KA-226T

- Air-conditioning System

Kopter

SH09

- Main Rotor Actuator

Korean Aerospace Industries

KHP

- Environmental Control System Components

KT-1

- Cabin Pressure Control System
- Engine Bleed Air System
- Ventilation Control System

Leonardo (Helicopters)

AW109

- Environmental Control System

AW139

- Environmental Control System
- Landing Gear System

AW149/AW189

- Environmental Control System
- Fly-by-Wire Main and Tail Rotor Actuators
- Landing Gear System

AW169

- Environmental Control System

T129

- Environmental Control System

NORDAM

A320neo Nacelle

- Anti-Ice Valve

Northrop Grumman

Litening

- Environmental Control Unit for POD

Rafael

Litening

- Environmental Control Unit for POD

Rolls-Royce

Pearl 700

- Pneumatic Component Package

Trent 7000

- High-Pressure Non-Return Valve

UltraFan®

- Power Gearbox*
- Temperature Control Valve

*In cooperation with Aerospace Transmission Technologies GmbH – A Joint Company of Liebherr-Aerospace and Rolls-Royce

Thales

Damocles

- Environmental Control Unit for POD

RECO NG

- Environmental Control Unit for POD

MELTEM II

- Environmental Control Unit

Turkish Aerospace

Turkish Light Utility Helicopters (TLUH)

- Air-conditioning System
- Oil Cooling System

VR-Technologies

VRT-500

- Environmental Control System



Liebherr-Transportation Systems

Applying Experience to Automotive Application

Liebherr is making great strides towards clean and efficient alternative power sources. Whether it is hydrogen fuel cell systems or electric systems, the bottom line is the organization as a whole is paving the way to smarter and greener global mobility – in the air, on railroad tracks, and even on the streets in automotive applications. Recently, two applications have made headway: electric turbocompressors for fuel cell vehicles and cooling units for e-mobility charging stations.

Liebherr-Aerospace has vast experience in the development of electrically powered turbomachinery for aerospace and rail vehicles. For more than a decade, the company has also been collaborating with major automotive manufacturers to apply this experience to automotive applications and to develop the future generation of fuel cell vehicles. This research has lately paid off with several contracts being awarded to the company.

New electric turbocompressor

In 2018 Liebherr-Aerospace was selected by a major automotive manufacturer in China to develop an electric turbocompressor and its power

electronics for the next generation of a fuel cell-powered car.

In 2019, Liebherr secured a strategic partnership with a Swiss fuel cell power train specialist to integrate Liebherr-Aerospace electric-powered turbomachinery with a heavy-duty truck platform. The equipment will be on board fuel cell systems for application in the food-and-beverage logistics industry for two giant supermarket chains in Europe. This agreement plays a pivotal role in opening the door to an additional application of Liebherr's turbocompressors: commercial food-and-beverage transportation.

The uniqueness of the design of Liebherr's turbocompressor is that both the power electronics and the compressor were developed at the same time as one system. The result is optimization in various areas – weight, integration, compact dimensions, and ultimately efficiency.

Cool charging for e-vehicles

Liebherr-Transportation is also a pioneer provider of thermal conditioning units for batteries used in various platforms such as trains, buses, and cars. The cooling systems ensure that batteries are operated under optimal thermal conditions, improving the lifetime of the batteries. This is an environmentally friendly



“We continue to work relentlessly to remain at the forefront of new developments in greener energy sources. Constantly looking forward to the next generation of green technology initiatives is a priority when it comes to our long-term strategy.”

Francis Carla, Chief Technology Officer, Liebherr-Aerospace & Transportation SAS

solution that significantly reduces CO₂ emissions, ideal for urban transportation. This type of system even offers passengers a quieter and more comfortable transport experience – a technology that is not only great for the environment, but also more appealing to consumers.

Furthermore, Liebherr-Transportation Systems is proud to have been selected by ITT Cannon to supply active cooling units for its liquid-cooled DC high-power charging (HPC) solution. This contract

enables Liebherr to contribute significantly to the further development of electromobility. Initial units of the cooling units, cables, and connectors have already been delivered for assembly in EV ultrafast charging stations in the USA and Europe.

Prototypes of the active cooling units – also known as thermal conditioning units (TCU) – have been developed by Liebherr-Transportation Systems specifically for e-mobility charging stations

and were extensively and successfully tested beforehand by ITT Cannon, together with Efacec’s Electric Mobility division, one of the world leaders in fast and superfast charging. Liebherr’s technology cools the innovative high-performance ITT Cannon HPC charging cable and connector to reliably limit a rise in temperature during the charging process.



An efficient alternative power source: Liebherr’s electric turbocompressor for fuel cell vehicles



Liebherr technology cools the ITT Cannon HPC charging cable and connector during the charging process

Air-Conditioning Systems for Railjet ČD

Liebherr-Transportation Systems signed a new contract with Siemens Mobility Austria GmbH, based in Vienna (Austria): the company will provide 50 air-conditioning systems for the Czech Railjet ČD.

They are being manufactured in Liebherr's center of competence for air-conditioning and hydraulic actuation systems for railway vehicles in Korneuburg (Austria).

Liebherr plans to deliver the air-conditioning systems by 2021 because the Czech operator, České Dráhy, will start operating the coaches on the Budapest-Bratislava-Prague route that year. The scope of delivery includes compact air-conditioning units, which are installed in the underfloor area of the cars, as well as the associated peripheral devices and parts. This contract marks the successful continuation of the fruitful collaboration between Siemens and Liebherr.



Czech Railjet ČD train

Successful Commissioning of New Load Leveling System

Liebherr-Transportation Systems successfully completed the commissioning of its new hydraulic level control systems for the new 7000 series light-rail vehicles for Chicago Transit Authority (CTA) (USA). The vehicles are built and supplied by China Railway Rolling Stock Corporation (CRRC) (China), the world's biggest railway vehicle manufacturer.



Prototype car of the CTA 7000 series

The leveling system was commissioned in fall of 2019 at the CRRC Sifang site in Qingdao (China), on a near-series prototype. Liebherr-Transportation's development team thus made a significant contribution to the successful and on-time delivery of the vehicles to CRRC's customer.

Level control systems for the first ten carriages have already been delivered to CRRC for final assembly. The vehicles must prove their flawless function and reliability in a one-year test phase in Chicago, Illinois (USA) before series delivery starts at the end of 2020.

The level control system adapts the level of the vehicle floor to exactly that of the respective platform: When the car arrives at the station, sensors detect the platform height. Based on this height measurement, four hydraulic actuators are activated per carriage, which, with six tons each, pull steel springs together to lower the vehicle until the exit edge exactly matches the height of the platform. This will enable barrier-free transfer and improve accessibility of public transport.

New Technology for Air-Conditioning Systems

Siemens Mobility Austria GmbH commissioned Liebherr-Transportation Systems to equip 21 Viaggio intercity passenger trains for the Austrian Federal Railways (ÖBB) with air-conditioning systems for the passenger compartments.

An option for air-conditioning systems for more than 500 further carriages was also agreed. Delivery is due to commence in 2020 and will be completed by December 2022.

The air-conditioning systems under this option are to be run using natural refrigerant (CO₂). This is new technology for the rail sector and has been developed to series-production readiness at Liebherr over recent years. The intercity passenger carriages are to be used in passenger operations and shall run predominantly in cross-border operations, including to Germany and Italy.

The order further underscores the trust Siemens places in Liebherr's ability to master new technologies in the industry and successfully introduce them to market.



Liebherr supplies air-conditioning units for Siemens' Viaggio intercity trains

Ridin' on the Tracks in Texas

Liebherr-Transportation Systems has received an order from Stadler US Inc., based in Salt Lake City, Utah (USA), for the supply of 72 dampers with an integrated displacement sensor for multiple FLIRT diesel-electric low-floor units.

Trinity Metro operates these on the TEXRail commuter rail line in Tarrant County, Texas, along a 43 km route between downtown Fort Worth and Dallas/Fort Worth International Airport.

For the TEXRail project, a new pneumatic leveling system has been developed by Stadler, which includes vertical dampers with displacement sensors developed and manufactured by Liebherr. The damper design has already been deployed successfully in many hydraulic leveling systems.

Two of these special dampers are arranged vertically on each bogie. Each damper signals the piston position over the entire stroke. The train control unit takes the signal from the damper, and by two magnet valves, regulates the air volume required in order to reliably adjust the required car level.

This new technology not only reduces energy consumption on the vehicle – with significantly less compressed air having to be generated – but it also guarantees reliable position monitoring of the vehicle body. A further advantage is that a mechanical shift linkage for regulating the compressed air volume, which might also have been damaged by icing or stone chipping, is no longer required.



Dampers developed by Liebherr will be on board FLIRT diesel-electric low-floor multiple units operated in Texas (USA)



The Liebherr Group

When Ideas Take Shape

Complex data calculations, digital simulations, and hundreds of hours driving and digging on challenging test sites all add up to one thing: in Kirchdorf an der Iller (Germany), Liebherr is working hard to perfect its next generation of earthmoving and material-handling machines.

The shovel cuts deep into the gravel. The A 913 Compact Litronic is able to turn in a remarkably tight space in order to load the enormous articulated dump truck that is waiting. Manuel Wirthensohn is at the controls of the wheeled excavator. His interest in the actual freight is secondary – what he's really fascinated by is the machine itself and how the new hydraulic excavator maneuvers and balances loads.

Wirthensohn is a test engineer. As Head of Testing and Validation for the product line hydraulic excavators, he is responsible for earthmoving machines from 10 to 24 t. He and his team have been working for weeks to test every aspect of the A 913 Compact Litronic, a new, extremely compact hydraulic excavator, in realistic conditions, deploying a wide range of measurement technology. "Anything that isn't perfect is immediately improved – while testing continues," explains Wirthensohn with a wink.



"Throughout the product development process, we work very closely with the design engineers and all the departments involved – the shorter communication paths are a real benefit."

Manuel Wirthensohn, Head of Testing and Validation,
Product Line Hydraulic Excavator

Time is limited. Batch production is due to start. It won't be long before the A 913 Compact will be proving its qualities on city-center construction sites – and there's no room for teething troubles. Manuel Wirthensohn and his team are using the new development and demonstration center in Kirchdorf an der Iller to ensure their machine is perfectly tuned. The facility, operated by Liebherr-Hydraulikbagger GmbH, is unique in Europe. Development, design, and test engineers all work closely together, pooling their various skills in a single location.



Manuel Wirthensohn and Mathias Graf discuss test results frequently

When working together like that, the engineers here rely on their torque wrenches and screwdrivers just as much as their measurement technology, laptop connections, and digital analysis tools. “We measure the entire machine and all its attachments, in order to obtain as much knowledge as possible directly in the field,” Manuel Wirthensohn tells us.

The A 913 Compact has more than 60 measurement points, which the engineers use to model the hydraulic pressure system and the range of movement on the prototypes during deployments. “It takes two days to configure the machine. The actual tests then take months. We implement the improvements while testing continues, and take them into account for the tests,” explains Wirthensohn.

Design and testing go hand in hand

When the motor of the new prototype was started for the first time, the development engineer Mathias Graf came right over. “It was a fantastic moment,” recalls Graf. “As the development engineer, it’s great to participate at these times.” After all, he and his colleagues from the development-engineering department have followed the machine’s progress from the first sketches on a sheet of paper through to a completed product – and on to testing with the customer.

Futuristic with virtual reality

Developing a product like the A 913 Compact takes around 36 months. In order to keep development times short and still produce the best results, the design engineers have recently started using virtual reality. “We can carry out tests of the field of vision at the virtual prototype stage for example,” says Graf. These ensure that there is sufficient visibility in all directions under any driving or working conditions. The virtual reality systems can also be used to test the accessibility of service and maintenance points in advance.

Mathias Graf details the advantages of the new technology: “We can use the 3D simulations to test components and assemblies that don’t actually exist yet. That means that we can eliminate errors before we even start to build the prototypes.”

Still, however closely the digital solutions are able to model or create reality, driving real excavators on the testing site remains an essential part of the process. “The feel of a wheeled excavator and its power as it works is – and always will be – something quite unique,” explains Graf. The new development and demonstration center therefore combines the best of both worlds, virtual and real.



“VR gives us all kinds of new possibilities for optimizing components and processes in future,” says Development Engineer Mathias Graf



Learn more and see the videos to this story here:
www.liebherr.com/development-testing



Mobile Cranes

Half a century of mobile cranes made in Echingen (Germany)

Liebherr-Werk Echingen GmbH has celebrated its 50th anniversary. Since the factory opened its doors on 22 February 1969, it has become a success story of German engineering. Today, Liebherr leads the global market for mobile cranes. On average, one out of two all-terrain mobile cranes worldwide is manufactured at Echingen. Each year, the 3,600 employees produce more than 1,800 mobile cranes and crawler cranes.

Transportation Systems

Celsineo reinvents refrigerated transport

Liebherr joins forces with Krone to develop, market, and service cooling systems for trailers under the new Celsineo brand. The newly developed modular design of the patented cooling system maximizes flexibility and efficiency in temperature-controlled road freight transport. Celsineo offers a winning combination of Liebherr's cooling systems know-how and Krone's expertise in refrigerated semi-trailers.



Construction Machinery

14,000 m² of Liebherr at Bauma

“Together. Now & Tomorrow”: at Bauma 2019, Liebherr amazed its visitors with innovations of today and work-site solutions of the future. The 14,000 m² Liebherr stand offered plenty of space for around 100 exhibits, including 60 construction machines and cranes, making it one of the largest trade show exhibitions in the world. This time, the emphasis was on digitalization, connectivity, efficiency, and product responsibility.



Deep Foundation

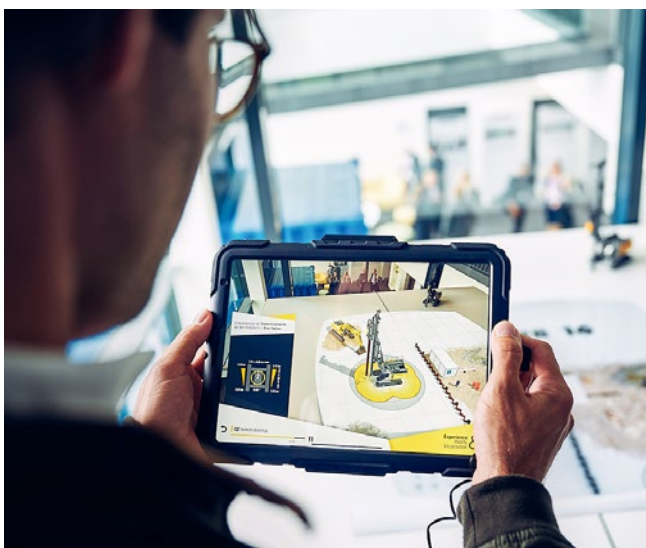
Going electric

The world's first battery-powered drilling rig, the LB 16 Unplugged, makes its inaugural run during junction improvement works on the A14 motorway in Austria. The deep foundation rig produced by Liebherr-Werk Nenzing is powered by an electro-hydraulic drive system and can be battery-operated for use without a cable. And sustainability does not stop with the drilling rigs. New Liebherr concrete mixers, powered by an electric drum drive, supply the concrete on the work site as well.

Maritime Cranes

A crane of epic proportions for the port of Rostock (Germany)

"Three, two, one ... go." These four words mark the inauguration of the TCC 78000, one of the world's most powerful heavy-duty gantry cranes, in the port of Rostock. Members of the Liebherr family stand alongside ministers from the German state of Mecklenburg-Vorpommern to celebrate the dawn of a new era. The crane is a game-changer for heavy-duty cargo handling on the Baltic Sea coast.



Construction Machinery

The desktop construction site

The first Liebherr augmented reality (AR) app is available for download via app stores. The AR app lets users explore virtual construction sites from the comfort of their own office or home, or even on the go. Using a tablet or smartphone, they can explore Liebherr crawler cranes, duty cycle crawler cranes, and deep foundation machines operating in different construction scenarios.



Find out more:
www.liebherr.com/highlights

The Rostock Giant

The TCC 78000 Liebherr gantry crane is taking maritime crane technology in the port of Rostock (Germany) to a whole new level. This colossus of a crane has the capacity to perform extremely large-scale heavy-duty lifting operations. Its installation represents a major infrastructure enhancement for the Baltic Sea port and offers huge potential for the future.

Gently does it

The people of Rostock are well accustomed to reports from the German Meteorological Service warning of extremely changeable weather. The forecaster on December 12, 2019 describes “a continuous stream of areas of low pressure which will blow both mild and cold sea air across the region.” This would not normally concern native East Frisian Keno Dirks a great deal. Keno was born and bred by the Baltic Sea and loves its harsh climate.

However, this morning is different – even the gentlest breeze is too much for the Project Manager from Liebherr-MCCtec Rostock GmbH. Wind, rain, and fog are not welcome the day Keno is responsible for overseeing the maneuver of the upper section of a 1,400 t HLC slewing platform. The platform must be lifted



40 m in the air and positioned with millimeter precision on top of the column of one of the largest offshore cranes in the world. This is the very first lift performed by the TCC 78000. Today, it is going to move a huge maritime crane onto the offshore installation vessel Orion. Liebherr's new gantry crane has a maximum lifting capacity of 1,600 t and a height of 164 m. Its double bogeys, which are each powered by ten motors, are breaking new ground in maritime crane technology.

The lift is scheduled to start at 5 a.m. Everyone is ready, but it is raining and the wind is blowing swathes of mist in every direction. “We need to wait. We'll get started in three hours' time,” states a voice over the radio link. The message gives the men permission to take things easy for a while. Keno Dirks looks up at the TCC. “I've built a lot of very large cranes, but the TCC is bigger than anything I've ever seen. It makes me feel quite proud to think that I've been part of the whole build process from the very beginning.” At around 8 a.m. it's time to get started. Dirk and the Liebherr team are good to go.



“The TCC doesn't just assemble Liebherr cranes, it can also load all types of products and heavy goods directly at the dockside.”

Keno Dirks, Project Manager at Liebherr-MCCtec Rostock GmbH

A huge team effort

The TCC 78000 has a maximum lifting capacity of 1,600 t and moves along two double rails with a track gauge of 30 m. This presents a challenge not just for the crane's statics but also in terms of the section of the docks between the Liebherr factory site and the adjacent quayside that the cargo crane must move along.



“Offshore cranes are getting bigger because the components they help to install are getting bigger and heavier.”

Udo Wosar, Head of Cargo Management at Liebherr Maritime Cranes

maritime crane construction needs to meet now and will also have to in the future,” explains Udo Wosar, Head of Cargo Management at Liebherr Maritime Cranes. Udo and his team are responsible for loading all kinds of maritime cranes. “In the past, we had to use external handling technology and expensive floating cranes to transport large cranes by sea. The TCC 78000 provides us with completely new options for assembling and shipping complete, preassembled, and pretested machines,” he explains enthusiastically.

The TCC 78000 will be regularly used by Liebherr and it will also be available to other companies that handle heavy-duty loads at the Rostock deep-water port. “It feels good to be able to use all our Liebherr expertise to help create a promising future here in Rostock, whatever the weather has to throw at us,” he explains.

Extensive excavation work had to be carried out at the Liebherr works and harbor site before the crane could become operational.

It was necessary to draw on resources from a number of divisions when constructing and producing the new prototype. As Keno Dirks explains, “We had to pull together teams from both Rostock and our plant in Nenzing (Austria). We have never manufactured and assembled components on this massive scale before. We are breaking completely new ground with our steel construction processes when we produce these components.”

Thinking big

Later that day, the job is completed when the Liebherr fitters screw the upper and lower slewing sections together on the column of the HLC295000. There is more than one maritime crane record being broken this morning. The special offshore installation ship Orion represents a significant milestone for Liebherr-MCCtec Rostock GmbH.

The HLC 295000 heavy-duty crane installed on the ship is the most powerful offshore crane Liebherr has ever built. “Bigger, more powerful, and more versatile: these are the challenges that



Learn more and watch the lift in our video here: www.liebherr.com/rostock-giants



LIEBHERR



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www.liebherr.com