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François Lehmann, Josef Gropper, Francis Carla, Nicolas Bonleux and Alex Vlieland (from left to right)

# Dear reader,

the trust that we have gained from our customers this past year – whether they are aircraft manufacturers, operators or service providers – has enabled us to continuously reach new heights. This trust is shown by the increasing number of contracts that we have been awarded this year, by the R&D projects we have launched, by participation in new aircraft programs and partnerships we have forged, new maintenance and overhaul capabilities we have developed, but also by the many performance awards that we proudly took home for our team!

Being recognized by our customers for excellence in the work we do is our goal. Customer satisfaction is the compass that guides us in our long-term strategy. We believe profitability is a natural and virtuous result of our customer-centric culture that is pervasive throughout our entire sister companies and instigated in each and every one of our employees. Being awarded the prestigious ‘Best Performance Award’ from Airbus, the ‘2018 Supplier of the Year Award’ from Boeing, the ‘Supplier of the Year 2018 – Win Win Cooperation Award’ from COMAC and Embraer’s ‘Best of the Best Award’ means that we are headed in the right direction and we are truly grateful for such recognitions.

We feel confident that our activities contributing to a greener and safer air transport, enhancing airline operations, reducing operating costs of aircraft, developing and delivering our systems and components for new aircraft programs with the highest quality and on-schedule, have been pivotal to achieving these recognitions. We will continue to set ambitious targets for the future in these areas so that we can continue to fulfil the promise to our customers with all of our efforts for excellence and innovation.

Going through the pages of the 2019/2020 edition of our magazine, you will get an overview of our unique range of products and technologies.

Our teams worldwide play a key role in shaping a bright future for our company and for our industry, and we warmly thank them as well as our global supply chain for their outstanding commitment.

Best regards,



François Lehmann  
Chief Financial Officer



Josef Gropper  
Chief Operating Officer



Francis Carla  
Chief Technology Officer



Nicolas Bonleux  
Chief Commercial Officer



Alex Vlieland  
Chief Services Officer



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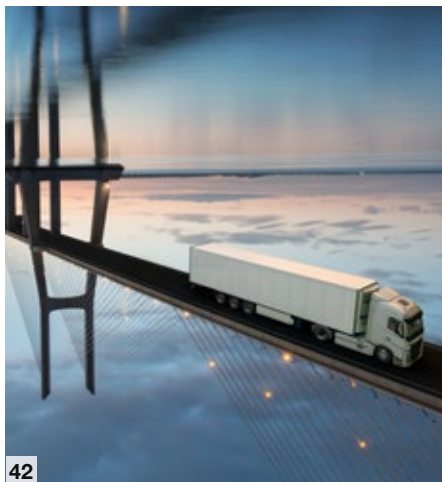
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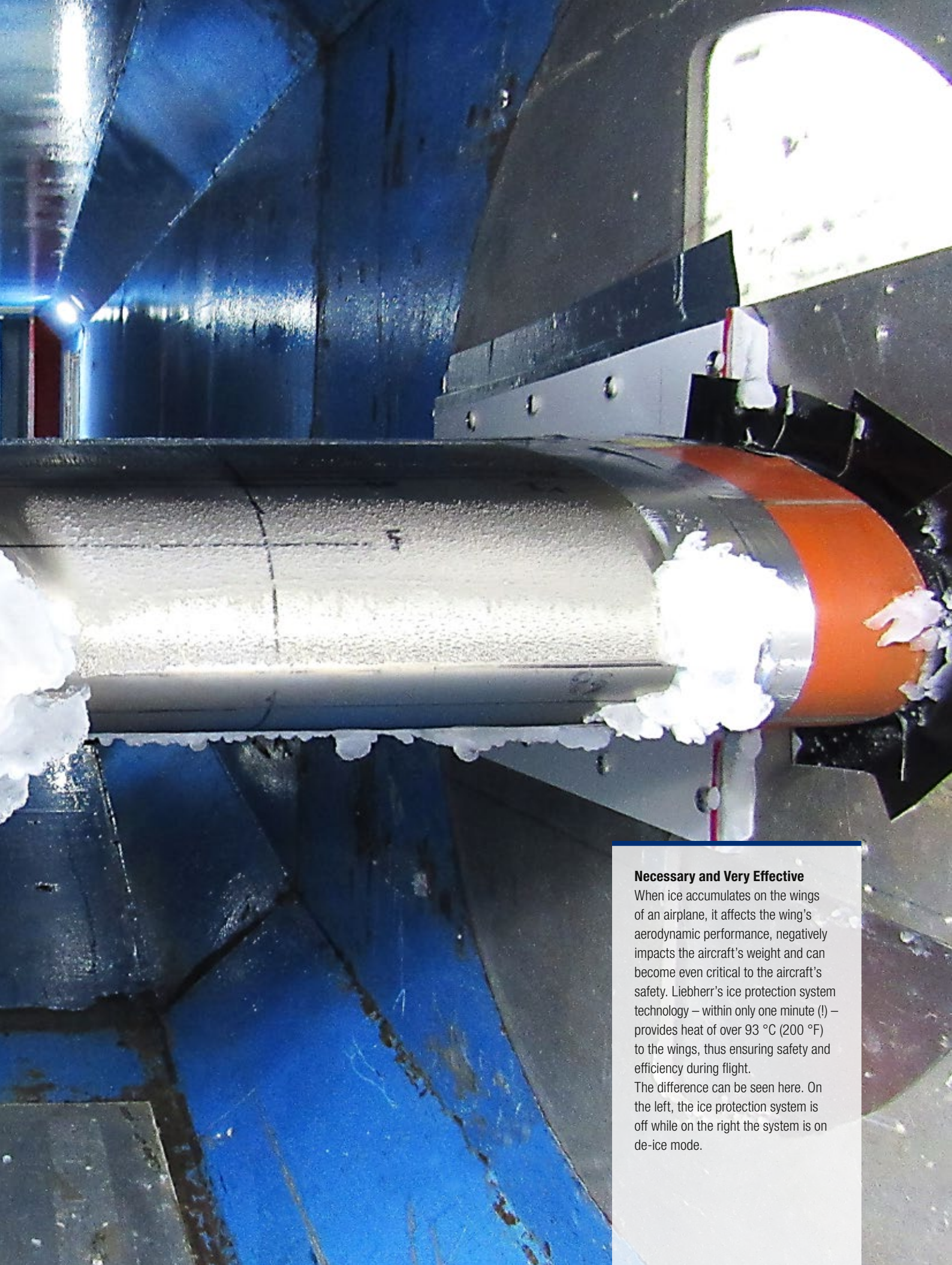
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# Impressions

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 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.







### **Necessary and Very Effective**

When ice accumulates on the wings of an airplane, it affects the wing's aerodynamic performance, negatively impacts the aircraft's weight and can become even critical to the aircraft's safety. Liebherr's ice protection system technology – within only one minute (!) – provides heat of over 93 °C (200 °F) to the wings, thus ensuring safety and efficiency during flight.

The difference can be seen here. On the left, the ice protection system is off while on the right the system is on de-ice mode.









< TRT - SCGAG >  
3000 Spindle Column Temperature Test Rig

Temperature  
Pressure  
Flow

Temperature  
Pressure  
Flow

Temperature  
Pressure  
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TRAUERS

Temperature  
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Temperature  
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Flow

### **Rigorous Testing in Russia**

At Liebherr-Aerospace's production facility in Nizhny Novgorod, various actuators for flight control systems are meticulously tested in order to prove their reliability. Each assembled unit runs for 16 hours during four so-called 'cycles' being exposed to temperatures ranging from 5 °C to 85 °C (41 °F to 185 °F), before they are delivered to the final assembly line of the aircraft manufacturer.





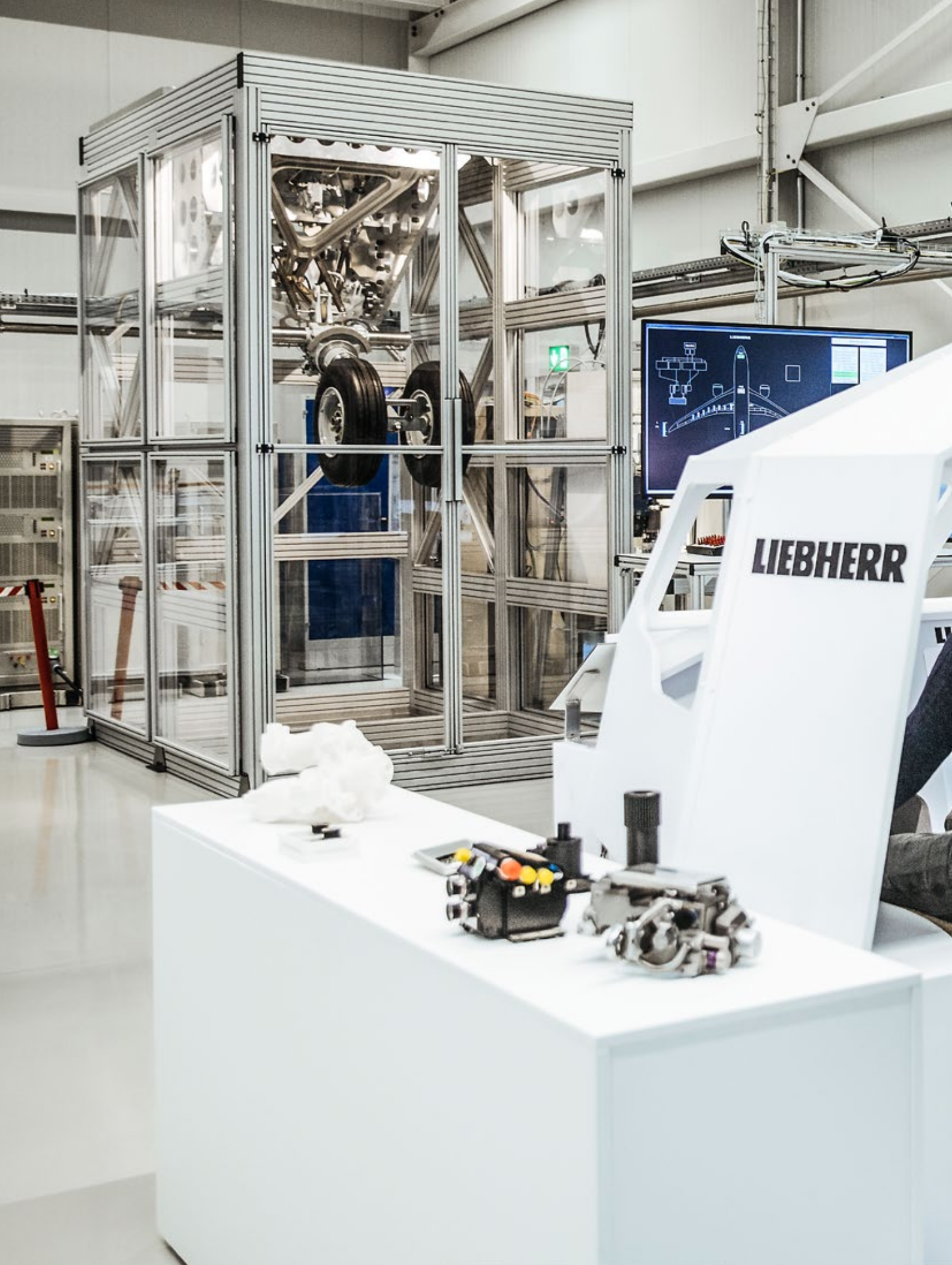




### Going Through Extremes

The Highly Accelerated Life Time (HALT) test chamber at Liebherr-Elektronik in Lindau (Germany) is used to submit a power-electronic product to combined strenuous temperature and vibration stress tests. The tests are performed several times during the development phase of a component to improve the maturity of the final product. By subjecting the parts to harsh environmental simulations from  $-55\text{ }^{\circ}\text{C}$  up to  $+125\text{ }^{\circ}\text{C}$  ( $-131\text{ }^{\circ}\text{F}$  up to  $+257\text{ }^{\circ}\text{F}$ ), the quality and reliability of the units can be analyzed and proven.





**LIEBHERR**





### **Ready for Take-off!**

Working in the cockpit requires utmost concentration. The aircraft accelerates and lifts off. At the push of a button, the landing gear retracts right in front of the pilots' eyes. That's because here, the nose landing gear is located directly in front of the cockpit window. The pilots are engineers, controlling a flight simulator at the Liebherr-Aerospace E-WING Research Center in Lindenberg (Germany). The Liebherr developers are working hard to find out how these kinds of hydraulic systems can be replaced by electro-mechanical or electro-hydrostatic systems in the future. They are steering a course that leads towards the next generation of aviation: the More Electric Aircraft.



# Industry Information

## A Closer Look: New Commercial Aviation Scene

Liebherr sat down with industry guru, Dr. Kevin Michaels, to discuss the future of the aviation industry and what it means for the equipment-manufacturing players as well as other suppliers in general.



### **Dr. Michaels, what are some of the major issues you see happening in the aviation industry today?**

One of the major issues that jumps to the forefront of any conversation about the aviation industry these days is, of course, the major consolidations that are taking place. We have rapidly moved from two duopolies (Boeing/Airbus in the larger jet segment, and Embraer/Bombardier in the regional jet market) into a super duopoly scenario with Boeing's proposed stake in Embraer and Airbus' stake in Bombardier's C Series program.

### **How do you see this change in the commercial aviation landscape affecting companies like Liebherr?**

This new and unique super duopoly will indeed create some challenges for suppliers. The two giants will have more purchasing leverage and negotiating power than ever before. We are going to have a downward pricing pressure on the supply chain – from Tier 1 suppliers, like Liebherr, all the way to smaller machine shops and raw material suppliers.

### **Can you give examples of the changes that are happening in the market?**

Sure, a couple of changes are taking place. First thing that comes to mind is that aircraft original equipment manufacturers (OEMs) are vertically integrating and developing items in house



that they were previously outsourcing. They are also redefining their relationships with suppliers regarding pricing, special programs, payment terms. A couple of examples are Boeing's "Partnering for Success" program and Airbus' "Scope+". Both are supplier cost-cutting initiatives, so we are going to see a lot more of that. And, finally, OEMs are also aggressively entering the lucrative aftermarket services arena, which is a whole new business model for them.

**Could this be a potential threat to organizations in the supply chain ecosystem?**

It depends. It could also be an opportunity if suppliers can swiftly adapt to the new pressures that will result from this scenario. Suppliers that can move forward with the cost-down pressures will do well, whereas suppliers that resist to the change will lose competitiveness.

**So how do you think OEM suppliers can not only adapt, but rather thrive in this new environment?**

There are a few strategies that can help them navigate the challenges ahead. Productivity improvement will be paramount. Firstly, automation and new production technologies (as well as traditional ones). Also, Lean and Six Sigma programs can enable them to succeed.

Secondly, they need to strengthen their supply chain capability, for example via supplier aggregation, low cost sourcing, and improved commercial terms. Selective vertical integration can also be used to enhance leverage with suppliers.

Thirdly, they can increase presence and improve performance in the aftermarket. Long-gone are the days where business just came to OEMs in the aftermarket.

Finally, they can revise their business portfolios to put greater emphasis on more attractive market segments and to purge underperforming businesses.

**Two new equipment super suppliers have been created with Safran and Zodiac as well as UTAS and Rockwell Collins mergers, what does this mean for Liebherr?**

This does not necessarily harm Liebherr's competitiveness; future aircraft programs will have more and smaller work packages. Suppliers like Liebherr that meet customer needs will hold their own versus the giants. Winners and losers will not be determined solely by size, being customer centered will be key.

**Dr. Michaels, thank you very much for sharing your insights with us.**

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**Dr. Kevin Michaels**

is an industry expert with over 33 years of experience in the Aviation/Aerospace arena and hundreds of consulting engagements under his belt. His insights and comprehensive knowledge are often featured in the most prominent industry publications, such as "Aviation Week & Space Technology", "Forbes" and many others. He is an avid speaker at industry events and currently holds the position of Managing Director at AeroDynamic Advisory, a specialty-consulting firm that focuses on the global aerospace and aviation industries.

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# More Customer Benefit

**A new organizational structure for new products: Liebherr-Elektronik GmbH created a new business unit: Aerospace Electronics. Ulrich Geier, Member of the Executive Board at Liebherr-Elektronik GmbH since 2018 and Manager of this new business unit, reports on how it will provide additional customer benefit.**



## **Why did Liebherr decide to create the new business unit Aerospace at Liebherr-Elektronik GmbH in Lindau (Germany)?**

The main reason was the concentration of electronics expertise within our Aerospace and Transportation Systems Division. We wanted to respond to the needs of our customers in a flexible and time-optimized manner. It would not have made sense to scatter the electronics expertise across various locations in our division, as this would have complicated communication and hindered dynamic responsiveness. One of the advantages of having the aerospace business unit at the Lindau location is the direct proximity to Liebherr's industrial electronics business unit, which is also stationed there.

The development and manufacturing expertise at the location in Lindau perfectly complements both business units, without having to set up separate organizational units for cross-divisional topics. Furthermore, the aerospace electronics business unit benefits from the large-scale knowledge of Liebherr's industrial electronics business unit and can therefore also feed cost-optimized approaches for design, testing and manufacturing into aerospace products.

## **What are the benefits of the restructuring for the customers?**

Our customers benefit from significantly faster response times, a very clear communication structure and a concentration of electronics expertise at one location. The minimization of non-productive organizational units and the use of synergies between the business units at the Lindau location is ultimately reflected in lower development and manufacturing costs for the customers. This is relevant across our entire service portfolio such as technological and product development, testing capabilities, production of our own products, customer services as well as electronic manufacturing services.

## **Lindenberg and Lindau are two different locations. Where and who are the points of contact?**

The point of contact for aerospace electronics is pooled via the marketing and sales organization of the two OEM companies Liebherr-Aerospace in Toulouse (France) and Liebherr-Aerospace in Lindenberg (Germany). Our colleagues there are in direct, daily contact with the aerospace electronics business unit in Lindau.



During acquisition phases, development projects as well as production and service business, we are usually also in direct contact with the customers, however, always under the umbrella of Liebherr's aerospace programs.

**What are the goals of the aerospace electronics business unit? And what are the next steps?**

We are currently working on several highly promising technological projects and platform products for the next generation of aircraft programs.

Together with Liebherr-Aerospace Lindenberg and Toulouse, we are developing system solutions for flight control, air management control, landing gear and stand-alone electronics products that will generate various benefits for our customers, including an increase in quality, lightweight construction, energy efficiency and cost reductions. In addition to those increased customer benefits, we are working towards supporting global climate goals with the new power electronics products. We consider the progressive electrification of typical aircraft systems as well as the support and replacement of conventional drive technology as our contribution to the 'green aircraft' of the future.

For today's aircraft programs, we offer continuously optimized products and service solutions, which help our customers to maintain the technical and commercial success in the market.

In addition, we are currently expanding our portfolio of Electronic Manufacturing Services (EMS) and are also enabling our customers to manufacture third-party designs with our quality standards. And last but not least, we offer further testing and qualification services at our modern, fully-equipped test center for electronic modules.



Slat actuation electronic control unit for the Airbus A350 program



Liebherr-Elektronik GmbH, Lindau (Germany) – home of the aerospace electronics and industrial electronics business unit of the Liebherr Group





# Research & Development

## The Future is Here

**The long-term advantages of additive manufacturing for the OEMs are many – leaner production with reduced waste, and the ability to produce parts with higher added value and more functionalities. Liebherr-Aerospace is making significant strides in the development of components through the use of additive manufacturing (AM) technology.**

The process of additive manufacturing allows OEMs to save money on logistics and warehouse storage space, since they no longer need to source and maintain inventory of piece parts for units that can be manufactured through this method. The raw resources – plastic or metal – can be easily stored in the form of powder.

Thus, the experts' outlook is unanimous: additive manufacturing is here to stay. This technology is being called 'disruptive' and many Original Equipment Manufacturers (OEMs) have now turned their attention to it. 'For us, this isn't something new', says Francis Carla, Chief Technology Officer at Liebherr-Aerospace & Transportation SAS. Liebherr discovered AM technology back in 2010 and since then, has continuously made significant investments evaluating and testing it. 'This makes Liebherr one of the pioneers in the aviation industry', adds Francis Carla.

For customers, this process proves to be superior over traditional manufacturing methods because, in the near future, the result will be increased availability of parts, due to shorter lead time for production, as well as lighter units than their traditionally manufactured counterparts. Weight and cost reductions are staple terms in every operator's strategic plans for the next few years.

But with all new developments, there are huge entry barriers: R&D costs are significant – not just for the printing machines, but also all the training and experimentation that take place before the precision and necessary reliability are achieved. However, Liebherr's long-term strategy has undoubtedly been pivotal to breaking through such barriers, and Liebherr-Aerospace remains committed to its long-term vision. For the past nine years, the team has been evaluating and testing AM with academic partners and a research institute. At first they start-



ed cautiously with smaller, simpler, and noncritical parts before moving on to components that are more complex.

At the beginning of 2019, Liebherr-Aerospace started the serial production of 3D printed components. The company had successfully certified and delivered a printed proximity sensor bracket for the A350 nose landing gear. This bracket is the first-ever introduced Airbus system part to be qualified for printed titanium. It is also proof of the commitment and partnership between Airbus and Liebherr-Aerospace. Further developments are being made on a positioning indicator that goes in a bleed valve. This non-critical part will most likely become airworthy and go into service later this year.

## Liebherr expects an exponential growth of additive manufactured parts in the next 25 years.

New investments are well under way, with new machines being purchased to further expand capabilities. Liebherr also plans to invest in next generation machines with bigger chambers, which will give the company the capability to produce larger and more critical parts.

Liebherr-Aerospace recognizes the potential and future benefits that AM technology will yield; therefore, it measures no effort to continue R&D in this area. Much research still needs to be done in this field. Years of experience will be necessary to perfect the process and to gain confidence in the quality and reliability of these units. However, the payoff will be well worth the effort, as significant efficiency gains as a result of a much lighter new generation of aircraft are just a few years ahead. AM yields weight reductions ranging from 20 to 60 percent, undeniably a game changer for the industry.

Liebherr expects an exponential growth of additive manufactured parts in the next 25 years. 'Our goal is to replace a large number of existing parts in the legacy programs in order to gain the expertise and feedback needed for confidently moving into new programs', explains Francis Carla.

Liebherr's facility in Lindenberg (Germany) handles the research and development of AM manufactured titanium components for landing gears, flight control and hydraulics systems, while the Toulouse (France) location focuses on nickel based and aluminum alloys for air management systems.

With hard work and a long-term vision, Liebherr's team of experts in design, technology, materials, production and manufacturing will continue to move forward in AM initiatives to remain on the leading edge of new technological developments in this new and exciting segment of the industry – a 'disruption' that will result in sustainability and efficiency gains for all stakeholders.



Two proximity sensor brackets for the Airbus A350 nose landing gear after the printing process

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Additive manufacturing, also referred to as AM, is a method of manufacturing that comprises of adding layers of material to create an object. Whereas traditionally, objects are created by subtracting excess materials (shaving and shaping) from a larger piece of material or block in order to obtain a desired form.

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# International Focus

## Digital Transformation – An Innovation Driver

**Liebherr-Aerospace is investing in the development of digital capabilities to gain leverage for reducing costs, streamline processes and increase its customer support experience. In this era of availability of data, information-driven decisions can be made to prevent issues and streamline operations.**

The company takes a holistic approach to digitization within three main domains: Digital Factory, Digital Workplace and Digital Services. These three domains engage ten key digital technologies. Digital transformation impacts the organization, the processes and certainly requires a shift in people's mindset.

'Digital transformation is ever evolving and continuous changes and innovations are crucial to success', says Fabien Petit, Vice President of Digital Transformation at Liebherr-Aerospace & Transportation SAS. He is in charge of accelerating the division's digital transformation and several projects have already been carried out to completion:

One of the first milestones for the digital transformation initiative was the creation of digital labs at Liebherr-Aerospace in Toulouse (France) and in Lindenberg (Germany). With the support of these labs, project ideas were launched, implemented, tested and deployed. On the **Digital Factory** domain, the teams have developed 3D Augmented Reality Glasses for product inspection, RFID tags to geo-locate containers or products, and are now currently testing autonomous ground vehicles to reduce non-added value time of workers in the shop. All these initiatives aim to support employees in their daily functions, allowing them to focus even more on their areas of expertise and valued added activities while technology eliminates the non-essential tasks.

Within the **Digital Workplace**, accounting and customer management tools are being enhanced to increase

automation resulting in streamlined processes with higher precision, minimizing human errors and with superior user interface capabilities. In addition, Liebherr is implementing a new generation of Enterprise Resource Planning (ERP), which will improve the efficiency of employees by eliminating manual tasks while simplifying the number of applications needed to run the processes.

Other initiatives that promise to transform business operations are also being developed within the concept of 'Model Based Enterprise'. This concept will profoundly change the interfaces from customers to the manufacturing and maintenance floor using 3D models and digital interfaces, eliminating manual transfer of information and creating a paperless environment in the machine shop.

'While we were working with one airline specifically, the data analysis performed by our team of roughly 24,000 flights resulted in reduced operating costs for our customer. This is something that we would like to scale and start offering for all of our customers', recalls Fabien Petit. 'The combination of airlines' data and our specific OEM knowledge create value for both parties. These **Digital Services** will enrich our offers to our customers.'

For Liebherr it is clear: At the end of the day digital technology is here to stay and it is indeed shifting the way customers expect companies to conduct their businesses. With data and information readily available, there is a need to be able to utilize them to compete and advance in an industry that is constantly demanding rapid innovation.



# Greetings from Toulouse

**Liebherr-Aerospace Toulouse SAS (France) is Liebherr's center of competence for air managements systems. Amongst others, two milestones have been reached during the past months: on one hand a partnership with the IoT Valley, an association that promotes the exchange between established companies and young start-ups, and on the other hand the successful NADCAP certification of its material testing laboratory.**



Aerial view of Liebherr-Aerospace Toulouse SAS

## Partnership with IoT Valley

IoT Valley is an association created by entrepreneurs from Toulouse dedicated to five main goals: (1) acculturate and train managers in companies on innovation; (2) accelerate innovative projects; (3) cooperate on innovative projects through partnerships; (4) operate/build the innovative projects; and (5) communicate by providing a platform for various start-up creators and established corporate executives to meet and exchange ideas.

The association was founded in 2009. Today it has grown into an eco-system comprising 37 start-ups and 18 partners from various industries. Liebherr-Aerospace Toulouse recognizes that having the opportunity to share ideas with fresh start-ups and other businesses that belong to completely different industries can be very valuable. It allows Liebherr to take a step back from day to day established operations and to be open to new perspectives. There are certain philosophies and concepts that apply to all businesses regardless of the industry, and when it comes to technological innovation, thinking outside of the box while looking beyond your own industry-specific challenges can yield great outcomes. Therefore, being part of an association such as IoT Valley is

beneficial. 'One of the benefits of this partnership is that it will solidify the companywide culture of innovation. Thus we will be able to offer customers new and competitive ideas', says Nicolas Perrier, Head of General Methods Department at Liebherr-Aerospace in Toulouse.

## Materials testing laboratory accredited by NADCAP

The accreditation of the National Aerospace and Defense Contractors Accreditation Program (NADCAP) is an important recognition for Liebherr-Aerospace Toulouse's Materials Testing Laboratory. This accreditation follows an audit conducted by highly qualified industry professionals with extensive knowledge and experience in the aerospace industry – the Performance Review Institute (PRI).

The audit focused on both the overall quality system of the laboratory and the practice of static and dynamic mechanical tests. The objective is to improve the quality of the products and processes while at the same time cut down on costs. This means that Liebherr-Aerospace Toulouse conforms to high industry-wide requirements and criteria for quality and safety.



Employees of Liebherr-Aerospace Toulouse are proud of the NADCAP accredited Materials Testing Laboratory

# Working Together We Can Achieve New Heights

**When two sister companies join forces, great innovations can be achieved. For example in the development of the skiving process for aerospace parts on a new LK500 machine by Liebherr-Verzahntechnik GmbH, Kempten, leading manufacturer of machine tools, and Liebherr-Aerospace Lindenberg GmbH – Plant Friedrichshafen – Liebherr’s competence center for the high-precision manufacturing of aerospace gear components.**

The new process on the new machine concept meets all requirements for the aerospace industry. For example the LK 500’s high cutting speed reduces cycle time and improves quality with razor sharp precision. Liebherr still utilizes shaping techniques when skiving is not viable, but since becoming operational in August 2018, the LK 500 machine brings skiving technology to the manufacturing process of aerospace gears.

With the LK 500 Liebherr-Aerospace implemented a new technology to an already existing production line. In 2017, the Friedrichshafen site had started to organize its production from production cells to different production lines (value-stream oriented production).

The first production line – for ring gears – was built in July 2017. About one year later, the line was completed with the new skiving machine LK 500. All ring-gears previously made by gear shaping can now be made by skiving, which is much more efficient. All employees working in the production line are specialized on ring gears and trained to work flexibly on the LK 500 and other machines in the production line. The buildup of the next lines has already started and the team will apply the lessons learned from implementing the first one.

## **Investing in skilled employees**

Liebherr-Aerospace foresees a steady growth of the aircraft industry, in line with the development of new manufacturing technologies, coupled with new contracts being awarded. As a result, the demand for skilled industrial mechanics is on the rise. In an effort to inspire and motivate workers entering the job market, Liebherr decided to invest in capabilities to offer an apprenticeship program for manufacturing of high-precision components and systems in Friedrichshafen – in addition to its apprenticeship program in Lindenberg. The expansion of the program to the Friedrichshafen facility eliminates the need for employees to commute back and forth between the two sites. Therefore, in the third quarter of 2019, the Friedrichshafen site will establish its own apprenticeship-department, offering a 3-year-apprenticeship program, enabling young students to gain hands-on-experience while still attending school. Liebherr-Aerospace believes that investing in its employees’ professional development and growth is invaluable.

The facility in Friedrichshafen plays a crucial role in the manufacturing of components for Boeing’s prestigious 777X program (read more on that on page 30). One example for the high precision gear-manufacturing competence are the extremely thin-walled gearbox-housings for the trailing edge high lift system of the 777X. Only a handful of manufacturers in the world have this capability and Liebherr-Aerospace is proud to be a manufacturing technology pioneer in this field. This competitive advantage would not have been possible without the synergies gained through the multiple Liebherr sites, sharing knowledge and resources to achieve remarkable results with finest quality in record time.





# There is Always Room for Improvement

**Liebherr-Canada Ltd. Aerospace and Transportation Division in Laval went through a stringent audit process in order to obtain certification for the Quality and Environmental Management Systems.**

Liebherr-Aerospace established a permanent presence in Canada in 1997 in order to provide its Canadian customers with improved support. This included the development of a quality management system and its certification in 2001, which continuously evolved to maintain alignment with emerging needs and expectations. Certification of the quality management system to the AS9100D standard was achieved and the certificate was granted on January 29, 2019. This revision was a result of months of dedication and hard work. AS9100D is a quality standard certification applicable to aviation, space and defense organizations. Obtaining it means that an organization has a process in place to ensure the highest level of quality in their operations covering areas such as production safety, risk mitigation, preventive actions, project management and counterfeit parts prevention, just to name a few. The main goal of a quality management system is to achieve customer satisfaction.

In addition to the quality management system, Liebherr's environmental management system also successfully passed the audit complying with the rigorous ISO14001:2015 standards in early February 2019. According to the International Organization for Standardization, the ISO 14001:2015 specifies the requirements for an environmental management system that an organization can use to enhance its environmental performance. This



certification is of paramount importance to Liebherr-Aerospace because it showcases the company's commitment to systematic practices that contribute to sustainability. Liebherr is determined to reducing the environmental impact of its products and services to the greatest possible extent.

Liebherr-Canada Ltd. Aerospace and Transportation Division began final assembly of the landing gear components for the Airbus A220 in 2017. The Liebherr site in Laval, Quebec is strategically located on Highway 13 between the aircraft assembly locations in Mirabel and Montreal. It offers Liebherr proximity to its customers in the Montreal area.

Additionally, a significant number of suppliers for such components are from North America. Therefore, adding the final assembly capabilities to the Laval facility brought notable logistics gains, ultimately contributing to increased customer satisfaction. Satisfied customers are the underlying driving force to all of Liebherr's strategic moves and there is a pervasive culture in the organization that there is always a way to continuously improve operations.



## China Taking the Lead

**According to the International Air Transport Association (IATA), China's air traffic will be the largest in the world by the mid-2020s – surpassing that of the US! The forecast highlights that more than half of the new passenger traffic worldwide will originate from this region. The growing Chinese economy is contributing to a significant increase in overall consumption, which includes demand for air travel. To keep up with this growth, Liebherr-Aerospace has also increased its presence in this region with a customer service center in Shanghai.**



The customer service center offers maintenance, repair and overhaul services on almost 4,000 square feet (370 square meters) to its customers for all systems supplied by Liebherr. These include, for example, inhouse repairs and dynamic testing of components for air conditioning and pneumatic systems (ATA 21, 36) for Airbus single aisle and long-range aircraft, Bombardier and Embraer aircraft and COMAC's ARJ21-700. Moreover, Liebherr-Aerospace China is also servicing flight control and hydraulic components (ATA 27, 29), and landing gears (ATA 32). The service center has developed expertise on site with a strong team, showing the company's commitment to contributing to the local economy by generating jobs in the areas of sales, customer service, and engineering.

Recently, new capabilities for the repair of COMAC's aircraft ARJ21 components were added to the facility. Furthermore, the technical support, engineering and flight test support teams were expanded to provide enhanced support for both COMAC's jetliners – for the day-to-day operation of the ARJ21 as well as for the C919 flight test program.

Over the last 16 years COMAC has awarded Liebherr several contracts, showing that the relationship is developing in a direction of prosperity and mutual trust, starting with the ARJ21 and continuing with the C919 covering the integrated air management systems, landing gear systems, as well as high and low pressure ducting.

The ARJ21 regional jet has been in service since 2015, and the C919 is scheduled to enter service in 2021. China Eastern Airlines will be the first carrier to operate the C919. With air travel on the rise, Chinese airlines are expected to purchase more than 7,000 new commercial aircraft in order to keep up with the growing demand in this region and Liebherr-Aerospace has positioned itself as a solid player in this market strategically partnering with key local leading companies forming win-win long-term relationships.

One example is the joint venture of Liebherr-Aerospace Lindenberg GmbH (Germany) and LAMC (AVIC Landing gear Advanced Manufacturing Corporation), called Liebherr LAMC Aviation (Changsha) Co., Ltd. It was founded in 2012 and it is doing very well. The experiences and knowhow, that are combined in the joint venture, have contributed to a successful transition of the assembly and testing activities of the C919 landing gears to move from Lindenberg to Changsha. The joint venture is responsible for the assembly and delivery of the landing gear system of COMAC's ARJ21 program as well. It is also working steadily towards expanding its supply chain network with local approved suppliers in the region and is engaging in direct procurement from the facility in Changsha. Thus, the joint venture can continue to remain internationally competitive with an increasingly independent location.

Additionally, Liebherr-Aerospace Toulouse SAS (France) cooperates with Nanjing Engineering Institute of Aircraft

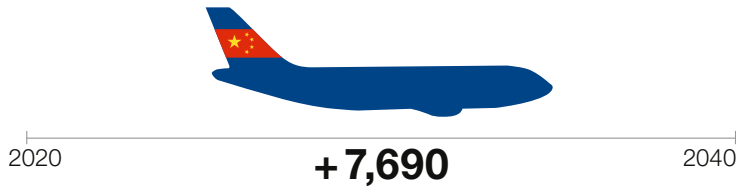


Systems (NEIAS) to design and produce components for the C919 air management system.

Overall, Liebherr-Aerospace sees the tremendous opportunity that the Chinese market presents with aviation growth projections being so robust. The company is prepared to

continue making local investments to better serve its customers, through not only infrastructure, partnerships and expansion of services offered, but also with the commitment to its people, sourcing local talent and growing organically within the region by utilizing the resources that this great country has to offer.

## The Aviation Market in China



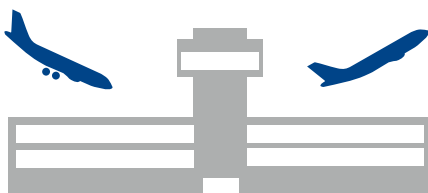
China will need to purchase **7,690** new airplanes over the **next 20 years.**



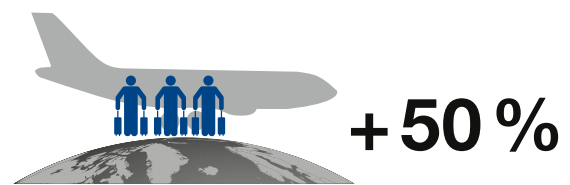
China has nine **state operated airlines.** Among them, Air China, China Eastern Airlines, China Southern Airlines and Hainan Airlines are the 'Big Four'.



China will **replace the US** as the world's largest aviation market by **2024.**



China will practically **double** the number of airports in the next **16 years**, building **216 new airports** by 2035, to keep up with increased air traffic.



The **Asia-Pacific region** will account for **more than half** the total worldwide number of new passengers over the next 20 years.

From 2017 to 2037 China will grow from **0.6 billion** to **1.6 billion new passengers.**



# 'I See the Future.'

## Three Questions to Vivian Yao, Planner at Liebherr-Aerospace China in Shanghai.

### What attracted you to Liebherr-Aerospace when you were ready to make your next career move?

I joined Liebherr-Aerospace in Shanghai in July 2012 because it is a leading manufacturer in many fields with an impeccable reputation. When I started, the team was very small. There were only 15 of us in total. So I knew that there would be plenty of opportunities for growth within the company. Our team's efforts were concentrated on hiring maintenance personnel. I was mainly responsible for administrative work within the customer service business unit, and was offered the opportunity to do purchasing work during the construction phase of the repair shop. I learned about the specific needs of a repair shop, as well as the many parts that Liebherr-Aerospace supplies to various aircraft programs.

### As one of the first few employees in this office, in hindsight, how would you describe the growth and development of Liebherr-Aerospace in Shanghai?

I feel that operations grew and developed very fast and that our business has become very diverse. We have been able

to provide Liebherr-Aerospace maintenance and technical support to the Greater China region, which has been growing very rapidly. To keep up with all the growth in the industry, there have been quite a few changes in the office. For example, my role has evolved so much over the years that it never gets old, and that is something I am very excited about. I am currently responsible for the production planning of the repair shop, and the monthly maintenance volume is growing steadily.

To enhance our customer satisfaction, we made many efforts. Last year, we were certified according to the AS9110 standard. We have a comprehensive quality system focused on product safety and reliability, including processes for continual improvement of the system and the assurance of conformity to customers' and applicable regulatory requirements. We are also developing more and more capabilities, and with the increasing supporting personnel, our on-time-delivery performance is continuously improving. We can therefore provide even better support to our customers in China.



### During all these years at Liebherr-Aerospace, is there something that impressed you the most?

One day, Eric Thévenot, Head of Customer Services, Didier Dubaele, our first Repair Shop Manager, and I were working overtime in the office cubicle in order to set up our repair shop, which was right next to it. It was very late and suddenly Didier pointed at the office window and asked me: 'What do you see?' I replied that I couldn't see anything, since it was dark and the lights were off. But then, he replied profoundly: 'I see the future'. He said that our work marked the foundation for the development of our future MRO shop. That moment touched me so much and has stayed in my memory until this day. I feel very proud to have been a key contributor to what we have here today.



Vivian Yao talking to one of her colleagues, Alan Huang, Logistic Executive



# Successful Lean Operations in Brazil

**As Embraer's presence in the global aviation market grew over the last 50 years, Liebherr-Aerospace's presence in its customer's home country, Brazil also expanded. With growth comes the need to improve and streamline processes, and that is when Liebherr-Aerospace embarked on the journey to implement Lean methodologies.**

Liebherr founded Liebherr-Aerospace Brasil Comércio e Indústria de Equipamentos Aeronáuticos Ltda. (LAB) in 2005. The decision to establish a strong presence in close proximity to its customers is in line with Liebherr-Aerospace's long-term vision of growing organically and providing world-class service. The company was able to benefit from the already existing infrastructure in the city of Guaratinguetá, where the Liebherr Group owns a total of roughly 54 acres. Today, LAB operates inside that space, specializing in machining, surface treatments and assemblies of high-tech precision parts for flight control and actuation systems, landing gear and air management systems that are on board a wide range of commercial aircraft programs. Furthermore, it manufactures, treats and pre-assembles complex medium-size structural parts made from aluminum, such as ribs, beams and brackets for aircraft wings and fuselage.

In 2014, LAB created a new department to overlook continuous improvement efforts, taking the first step towards incorporating the Lean methodology throughout the company. Additionally, the company brought in Kaizen consultants to formally develop and deploy methodically a holistic approach to Lean manufacturing and operations in four phases. First, top management and key strategic employees were fully trained and then applied their new skills in two pilot departments at LAB. Phase two included a workshop for all of LAB's employees em-

phasizing to everyone that the goal was not to reduce the number of employees, but instead, to increase efficiency, which in turn would allow the company to grow exponentially. Phases three and four focused on disseminating the new culture to the remaining departments and ensuring every single employee at LAB had received the training and was equipped with the knowledge and skills to perform everyday activities in the most efficient way, eliminating waste and increasing productivity.

The implementation of this program was a tremendous success. The company was able to significantly reduce costs as a result of efficiency gains in processes related to quality, environment and safety. But this financial win does not even compare to other non-financial key performance indicators that improved as a result of this initiative – from lead time to logistics, the entire company's operations benefited from Kaizen's methodology. And finally, the LAB-team is even more motivated to excel – to the benefit of its customers and the company.

---

## 97 %

less time waiting  
for tools from the  
warehouse

## 220 %

productivity increase  
on pilot project

## 91 %

reduction in lead time of the  
production of tool kits assembly  
(project pilot)

Biggest win of all: Change in culture –  
all employees evaluate their daily tasks  
to reduce waste.

Hence: Continuous Improvement.

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## Stronger Presence in India

**India's domestic aviation market is on the rise. By 2025, India will be the third largest domestic market worldwide according to the International Air Transport Association (IATA). Not surprisingly, Liebherr-Aerospace moves within the industry, opening a bigger office in Bangalore as well as forging a new partnership with a leading local player to solidify its presence in the region.**



The Liebherr-Aerospace team based in Bangalore is supporting Indian commercial and defense aircraft operators, manufacturers as well as suppliers. The team in Bangalore has a wealth of knowledge and expertise of over 50 years of combined experience in engineering and aviation.

‘Our growing team and this bigger office enable us to become a major player in India’

Nicolas Bonleux

The office also coordinates projects with the European-based OEM facilities Liebherr-Aerospace Lindenberg GmbH (Germany), Liebherr's center of excellence for flight control, actuation, gears, gearboxes and landing gear systems as well as electronics, and Liebherr-Aerospace Toulouse SAS (France), Liebherr's center of excellence for air management systems.

The office serves as a basis for the various strategic steps of Liebherr-Aerospace in the Indian aerospace market. ‘We are very pleased that we are progressing well with our plan to increase our footprint in India. Our growing team and this bigger office enable us to become a major player in India’, said Nicolas Bonleux, Chief Commercial Officer, Liebherr-Aerospace & Transportation SAS, during the inauguration ceremony at the beginning of this year.

In addition to the new and larger office, Liebherr-Aerospace is paving its way to become a strong player in the MRO market with the signing of a cooperation agreement with Max Aerospace – a leading Indian maintenance organization based in Mumbai. The cooperation agreement covers repairs, overhauls and maintenance of various components, including heat exchangers. The agreement was announced during Aero India 2019 held in Bangalore earlier this year in February. Under the terms of the agreement, Liebherr-Aerospace renews an existing repair license on Airbus components and supports Max Aerospace in developing industrial capabilities dedicated to heat exchangers manufactured by Liebherr for Airbus aircraft.



Thus, the agreement will expand Liebherr-Aerospace's world-wide network of heat exchanger maintenance facilities.

'We see India to evolve as one of the world's major aviation markets, including MRO activities', says Joël Cadaux, Director Business & Services – Customer Services, Liebherr-Aerospace & Transportation SAS. 'The partnership with Max Aerospace is key to locally support the Indian operators with Liebherr OEM quality, jointly with our Bangalore office and our Liebherr-Aerospace's regional service center in Singapore.'

Bharat Malkani, Chairman and Director of Max Aerospace & Aviation Ltd., added, 'The coming together of both organizations brings world-class service for Liebherr components to the doorstep of aircraft operators in India and the surrounding region. We see this as an opportunity for establishing a firm and sustainable footprint for support of Liebherr parts. Coupled with the encouraging growth in the aviation sector, we shall look to grow this partnership to include maintenance of many more Liebherr products.'

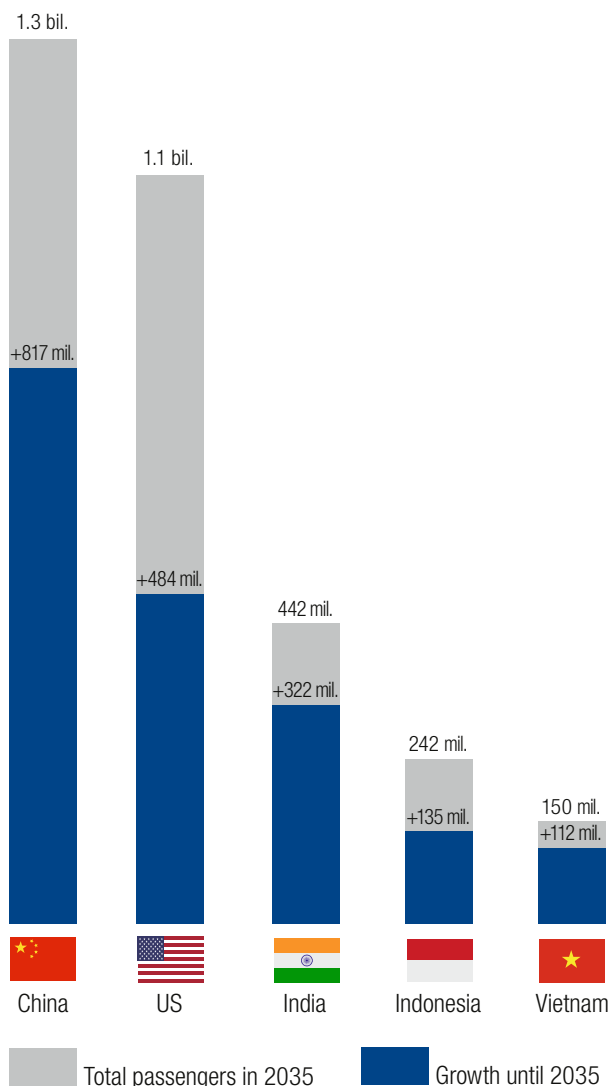
The news of this agreement was well-received by local operators, OEMs and suppliers at Aero India 2019, as it validates even further the robust aviation market outlook for this region. At the show, Liebherr-Aerospace highlighted its capabilities in its product fields and had the opportunity to meet and interact with customers in the region and to present its offers for lifecycle support and full range of customer services.

Liebherr-Aerospace offers Indian aircraft manufacturers highly integrated and engineered systems and components in its wide range of products for upcoming aircraft projects. In fact, Liebherr currently already supplies and maintains many components for aircraft that are built in India by the manufacturer Hindustan Aeronautics Limited (HAL). Among them are heating and ventilation system components for the Advanced Light Helicopter (ALH) program, the cabin pressure control system for the Jaguar, the Tejas as well as the Hindustan Jet Trainer (HJT) 36 and the flap actuation system, landing gear actuators and the nose wheel steering system for the Dornier 228. The products are maintained locally or within the Liebherr service center network.

### IATA's 20-Year Air Passenger Forecast

The International Air Transport Association (IATA) expects 7.2 billion passengers to travel in 2035, a near doubling of the 3.8 billion air travelers in 2016. Of the five fastest-growing markets in terms of additional passengers per year over the forecast period, four will be from Asia.

### Fastest-growing markets (in terms of additional passengers)



By 2035, an additional 1.8 billion annual passengers will be transported to, from and within Asia Pacific for an overall market size of 3.1 billion. The region will also grow by 4.7 percent annually.

# Earned Trust and a True Partnership

**Liebherr received the first contract from Boeing in 1979, when Liebherr-Aero-Technik GmbH (former name of Liebherr-Aerospace Lindenberg GmbH) designed and produced the truck positioner for the Boeing 767 main landing gear. Fast-forward into the next century: Today, Liebherr-Aerospace is a trusted partner for Boeing's two newest generations of aircraft, the 777 and 787 Dreamliner.**

In 2014, Liebherr-Aerospace celebrated a big win when it was selected to become the supplier for the first folding wing tip system in a commercial jet. Boeing's newest family of twin-aisle airplane, the 777X, set to enter service in 2020, will be equipped with Liebherr-Aerospace's technology for the folding wing tip system. It is the first time in history that a commercial airliner will be featuring a folding wing tip. The advantage of the folding wing tip is that the longer wingspan yields greater efficiency and fuel savings in flight, while the folding capability offers better airport accessibility and compatibility in the taxiway on the ground.

Another significant win, strengthening the relationship between Liebherr-Aerospace and Boeing, happened just a couple of months later in 2015, when Liebherr-Aerospace was awarded another contract to provide the actuators, hydraulic motor and power drive unit for the high lift leading edge and high lift trailing edge of the 777X as well. For the trailing edge actuators, Liebherr actually manufactures them based on Boeing's design (built to print), while for the leading edge actuators, Boeing entrusted Liebherr-Aerospace with the design and manufacturing of the units (built to spec).

When Liebherr-Aerospace was awarded the contract for the Iron Wing Test for the

777X, the company decided to make a major investment in a brand new building in which a system test rig was installed featuring one full size wing of the airplane. The facility was built from scratch and has been fully functional since 2017. Additionally, Liebherr-Aerospace adapted and harmonized a lot of design and production processes to comply to Boeing's requirements, showing flexibility and dedication to long-term client satisfaction.

The commitment and hard work paid off because in the last quarter of 2018, Liebherr-Aerospace was able to make yet another remarkable announcement: The company was selected by Boeing



The 777X introduces the latest technologies, including the most advanced commercial engine ever and an all-new high-efficiency composite wing that has a longer span than today's 777





The Boeing 777X will be equipped with Liebherr-Aerospace's technology for the folding wing tip system – making it the first commercial airliner in history with folding capabilities

to deliver the main landing gear steering control unit and the power control actuator with the steering position transducer for the 777 and 777X.

Today, the 777X aircraft program has 364 orders and commitments from eight airline customers around the globe. Liebherr-Aerospace works closely with Boeing. The company has a team in place in Seattle to provide full technical and assembly support 24/7 as needed.

The relationship between Boeing and Liebherr even extends beyond the 777 and 777 programs: Since 2003, Liebherr is on board the 777-300 program through the supply of fuel tank pressurization valves. A few years later, the complete air management system of the 747-8 followed, as well as fuel tank pressurization valves for the KC 46. And shortly after Boeing's 787th delivery of its 787 Dreamliner, which took place in the last quarter of 2018, Boeing announced that Liebherr would be the new supplier for the Nose Wheel Steering Remote Electronic Units for the midsize jetliner.

What started 40 years ago with a contract for the supply of a landing gear component has become over the years a trustful partnership between Boeing and Liebherr that is continuing to flourish with much commitment and dedication in the years to come.

### Supplier of the Year

Liebherr-Aerospace has been recognized as Supplier of the Year in the 'Excellence' category by Boeing. Liebherr was one of 13 companies honored on May 8, 2019 for distinguished performance in working with Boeing.

This year's recipients represent an elite group among more than 12,000 active Boeing suppliers around the world. This selection was based on stringent performance criteria for quality performance, delivery performance, cost, environmental initiatives, customer service and technical expertise. Liebherr received the 'Excellence' award for the contributions and engineering acumen at the award ceremony that took place in Los Angeles.

'Liebherr and Boeing have developed a very good, open and trustful relationship. Our team is very proud and grateful to receive this award. We have been learning a lot and we are very thankful for that.

We are looking forward to continuing our fruitful collaboration with Boeing', commented Josef Gropper, Chief Operations Officer of Liebherr-Aerospace & Transportation SAS.



## Busy Times Ahead with COMAC

**The Chinese aircraft manufacturer COMAC announced recently their ambitious goal of achieving one hundred deliveries of the ARJ21 by 2021. Liebherr stands by their side providing the integrated air management systems, landing gear systems (including breaking, wheels and tires) as well as the high and low pressure ducting for the twin-engine regional jet.**

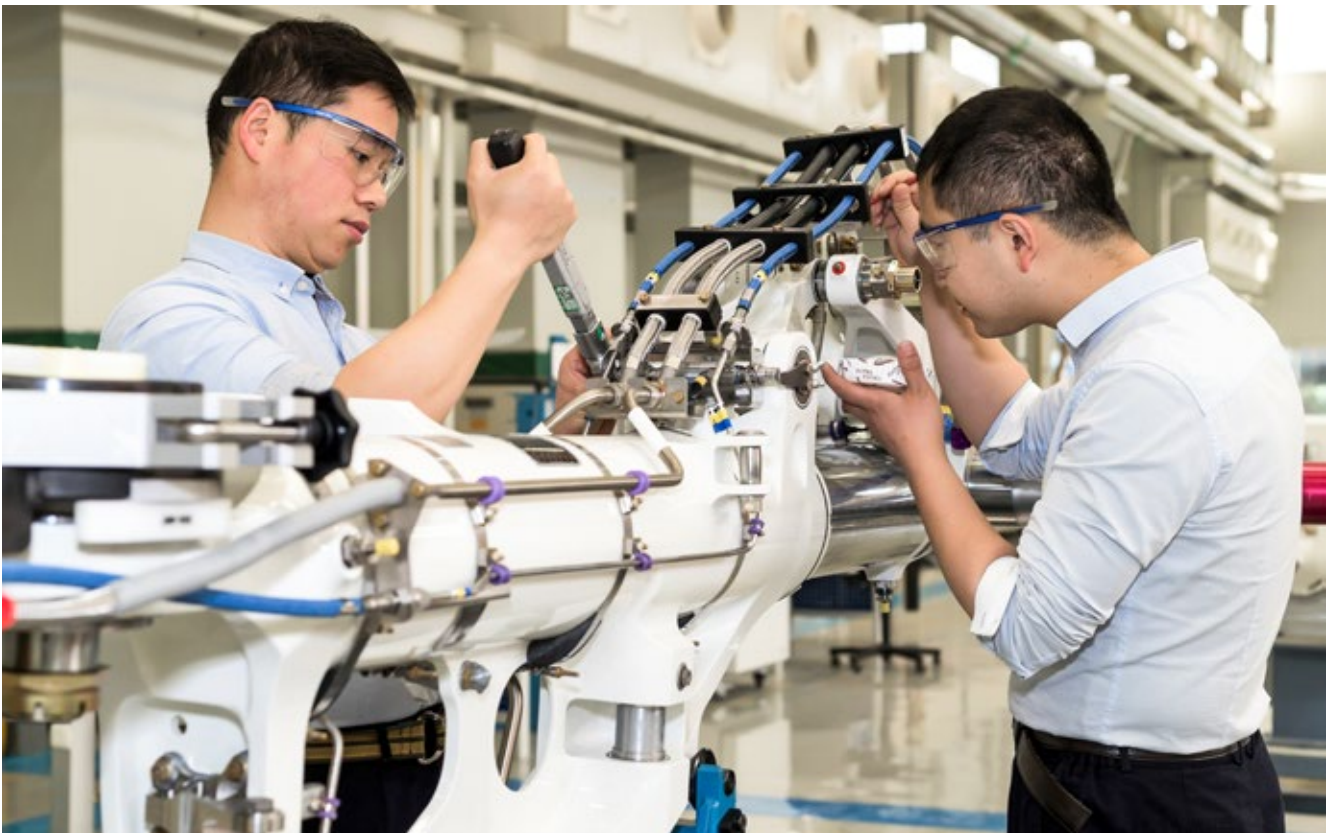
Liebherr-Aerospace has solidified its presence in China to support COMAC not only in its ramped up production and robust delivery schedule for the ARJ21, but also for the development of the C919. A very good example of Liebherr's commitment to supporting COMAC in the most efficient way is the joint venture named Liebherr LAMC Aviation (Changsha) Co., Ltd. – which oversees the final assembly and delivery of the landing gear systems for the ARJ21 and the C919. Additionally, Liebherr is focused on deploying a progressive strategy to increase its supply chain in the region by extending its network of approved suppliers.

The C919 is a narrow-body twin jet that was launched in 2008. Today, Liebherr is supporting flight tests at two major airports in China, Yanliang and Dongying, to support COMAC's efforts to obtain Type Certification (CAAC, EASA, FAA, etc.) in 2020. There are currently three test C919 aircraft in Shanghai with three more lined up to be flying in 2019. Entry into service is expected to happen in 2021.

Liebherr-Aerospace Toulouse SAS in France also recognized Nanjing Engineering Institute of Aircraft Systems (NEIAS) with the Best International Collaboration Award during the China 2018 Airshow in Zhuhai for their work per-

formed in the qualification of the C919's air management system. NEIAS was involved in the design and manufacturing of several components for the air management system at its facility at Nanjing. The collaboration is very promising for possible future projects.

Liebherr-Aerospace has been COMAC's trusted supplier for 16 years and is committed to continuing being the supplier of major systems for the ARJ21, C919 and for possible future platforms, as fostering long-term relationships and gaining the trust and honor of having repeat businesses from its customers is something Liebherr is striving for.



Assembly work on a landing gear in Changsha (China)



## Best of the Best

**In a ceremony with dozens of international suppliers and hundreds of guests, Embraer surprised Liebherr-Aerospace with not one, but three awards for ‘Best Suppliers’ earlier this year in São José dos Campos (Brazil) at its ‘2018 Suppliers Conference’.**

Liebherr-Aerospace received an award for ‘Best Program Development’ for the work the company had done on the E-Jets E2 high lift and air management systems, as well as the air management system for the multi-mission aircraft KC-390. It also received a second award for ‘Best Mechanical Systems’ for the landing gear system of the E-Jet E1 family.

But as if the two awards were not enough, Embraer surprised Liebherr with a third unprecedented award category named ‘Best of the Best’! It was the first time in the history of both companies that there has been a triple award recognition. The three awards are a testament of the true partnership between Liebherr-Aerospace and Embraer. It is undoubtedly the result of 40 years of continuous hard work and reciprocal dedication between both companies. These awards reflect the outstanding commitment and customer orientation of the Liebherr team worldwide.

Josef Gropper, Chief Operating Officer of Liebherr-Aerospace & Transportation SAS, thanked Embraer for the awards and recalled a meeting with the Brazilian aircraft manufacturer in the past: ‘During that discussion, we promised Embraer that Liebherr-Aerospace would become their best supplier – and we kept this promise.’

Francis Carla, Chief Technology Officer of Liebherr-Aerospace & Transportation SAS, added: ‘Meeting the development schedule set by Embraer was a challenge and we thank Embraer for having worked so intensively together with our team so that we made it together.’



In 2019, Embraer celebrates its 50th year anniversary and Liebherr-Aerospace is looking forward to at least another half a century of continuous cooperation with them. The company’s philosophy of fostering relationships with its customers as partners, rather than the typical supplier-customer relationship, has clearly been recognized.

## Global 7500: Comfort and Luxury Onboard

It is always a proud moment for Liebherr-Aerospace to see a new aircraft enter service and celebrate its success with all stakeholders. On December 20, 2018, Bombardier's ultra-long-range business jet, the Global 7500, officially entered service. This milestone was celebrated in

a grand ceremony held at Bombardier's headquarters in Dorval, Quebec.

In 2011, Liebherr-Aerospace was chosen to be the exclusive supplier of the integrated air management system for the Global 7500. The contract includes

the bleed air valve, cabin pressure control, air conditioning and wing anti-ice system. These components are manufactured by Liebherr-Aerospace Toulouse SAS.

The air management system is one of the most important factors contributing to comfort inside an airplane, as it controls the cabin temperature and airflow throughout the aircraft. And comfort is a key differentiator for the Global 7500, since it was designed from nose to tail to ensure a smooth flight for its high profile passengers on long distance routes. From New York to Hong Kong, for example, passengers and crew onboard the ultra-long-range Global 7500 will enjoy unparalleled comfort throughout their flight in its distinguishably spacious cabin.



## Long Lasting Customer Satisfaction

Liebherr-Aerospace Toulouse SAS was awarded with the 'Best Performer' recognition in 2018 by Airbus at their annual Supplier Awards ceremony held in Montreal. Liebherr attributes this achievement to a number of critical success factors, and firmly believes that customer satisfaction is not achieved by great products only. Another key element that contributes to the long-lasting relationship between Liebherr and its

customers is the fact that it has a strategically diverse network of suppliers and keeps costs at bay to meet the increasing requirements from aircraft manufacturers to cut down on costs. Moreover, Liebherr's logistics network contributes to a strong customer service. By expanding and opening facilities across the globe, the company is able to meet and exceed customers' expectations.



## A330neo: Ready to Take on the Sky

The last quarter of 2018 was an exciting one for Liebherr-Aerospace and Airbus, as they celebrated the entry into service of Airbus' new wide-body long-range airplane, the A330neo,



with TAP Portugal. The delivery took place in November 2018 at Airbus' headquarters in Toulouse (France).

Seeing a new aircraft being delivered to its very first customer and entering into service is indeed a proud moment for OEMs and, as a Tier 1 supplier of various systems and components for the long-range A330neo, Liebherr-Aerospace shares the pride and joy with Airbus about this milestone. Liebherr-Aerospace Toulouse SAS is the supplier for air conditioning, avionics cooling, the engine bleed air system, cargo heating system, the humidification system for the crew and rest area as well as the fuel tank inerting system of this aircraft. The high lift system, spoiler actuation, landing gear door actuation, the cargo door actuator as well as the spring strut are provided by Liebherr-Aerospace Lindenberg GmbH.

## Liebherr to Expand its Capability Beyond Airframe

In December 2018, Liebherr-Aerospace announced that the company will be the provider of anti-ice valves that will go into the engine build-up system designed by NORDAM for Airbus' A320neo aircraft.

The A320neo is a narrow-body jet equipped with Pratt & Whitney's PW1100G engines. It was introduced to the market in 2016 with delivery to Lufthansa airlines. Today, Airbus has over 6,000 orders of the aircraft in the books with about 700 deliveries so far. A healthy backlog that will certainly keep Liebherr and NORDAM busy for a few years to come.

The anti-ice valves, as the name explains it, prevents ice from forming in the engine cowls and will be manufactured at Liebherr's facility in Toulouse (France), the company's center of competence for air management systems. Ship-sets of two pneumatic valves per nacelle will be shipped to NORDAM to be installed.

'This contract marks a major milestone in our long-term strategy to offer technical solutions for aircraft-engine applications, and to continuously extend and consolidate our activities in this market', comments Nicolas Bonleux, Chief Commercial Officer,



Liebherr-Aerospace & Transportation SAS. 'We are happy to support NORDAM as we supply our products to a nacelle provider for the first time.'



# Customer Service

## MRO Worldwide Performance

**The global MRO (Maintenance, Repair and Overhaul) market is expected to grow by almost 5 percent per year in the next decade according to the International Air Transport Association (IATA). Evidently, it is no coincidence that Liebherr-Aerospace continues to make strides to maintain a strategic customer services network.**

The range of aviation equipment produced and serviced by Liebherr for the civil and military sectors includes flight control and actuation systems, landing gear, air management systems, as well as gears, gearboxes and electronics. These systems are deployed in wide-bodied aircraft, single aisle and regional aircraft, business jets, military aircraft (transporters and trainers) as well as helicopters.

Liebherr-Aerospace's worldwide footprint includes two aviation equipment production plants at Lindenberg (Germany) and Toulouse (France). These production sites offer a worldwide service with additional customer service centers in Saline (MI/USA), Dubai (UAE), Singapore and Shanghai (China). In addition to having their own stations, Liebherr works with an international network of highly qualified service providers for heat exchangers. One prime example of Liebherr's commitment to always improving its local presence for service is the collaboration for more than five years with Aviatechnik in the UK, as well as with SCS in Singapore.

Having a local presence in various markets with close proximity to its customers is crucial to developing close relationships that result in increased customer satisfaction. Liebherr-Aerospace's substantial spread out presence enables the company to optimize logistics to support its customers efficiently and cost-effectively – when they need it, where they need it. Liebherr holds itself accountable to strict turnaround time (TAT) goals that are widely accepted in the branch.

Liebherr-Aerospace's range of services are adapted to its customers' needs in each market: from simple testing and recertification to major repairs and overhauls. The company also offers AOG support 24/7 through an AOG hotline. The robust repair management system is the same in all of its sites maintaining the highest standard of quality, recognized by airworthiness authorities globally (EASA, FAA, CAAC, ANAC and others).



'We are constantly looking ahead and proactively making investments where we foresee customers' future needs', says Sven Dicke, Vice President of MRO Operation & Strategic Investment. Examples are the additional MRO capabilities for heat exchangers in the USA and in 2020 in Singapore, as well as for static and dynamic components for air management systems in China.

As a leader in customer services for legacy fleet, Liebherr-Aerospace constantly re-evaluates and improves its repair processes to meet market expectations and remain competitive. Being a flat organization is a tremendous competitive advantage, which allows the company to make adjustments very swiftly.

Liebherr's library of knowledge – also through decades of customer's feedback – paired with unparalleled OEM quality standards, enable it to make productivity wins by minimizing removals for its customers in the first place. However, when removals are necessary, customers know that they can count on customized and cost-effective solutions specifically tailored to their needs. Liebherr's flexibility, relying on a strong supply chain and the ability to carry large inventories, allows it to offer a wide portfolio of exchange units, test and repairs, Used Serviceable Materials (USM) as well as new parts. That is how Liebherr meets today more than 90 percent on time performance. Another example of tailored solutions is the possibility for Liebherr's customers to rely on its OEM pool, fit to their fleets and AOG coverage in order to keep costs at bay.

'Today we perform about 40,000 repairs per year and employ around 450 dedicated, highly trained professionals in our



Meticulous testing of a valve in Singapore

MRO facilities worldwide. We manage our supply chain closely, and make continuous improvements of processes and procedures along with the implementation of new technologies', summarizes Sven Dicke. 'Our top priority is to continue looking at opportunities to grow our network to support our customers and to exceed their expectations.'



A fusion welder in Saline (MI/USA) produces a weld seam on a heat exchanger



Overhaul of an air conditioning pack component in Lindenberg (Germany)

# USM by Liebherr: OEM Quality at Optimized Prices

**Liebherr-Aerospace's Dubai office focuses on sourcing materials from aircraft teardowns while also getting them back into the market with OEM fresh tags.**

In an effort to relieve its customers' concerns on ever increasing operating costs, Liebherr-Aerospace moves to strengthen its presence in the aftermarket of spare parts. In addition to repair services offered directly to operators and part suppliers around the world, today Liebherr actively sources available inventories through its Dubai center and efficiently distributes them to its worldwide network of service centers with Liebherr certification tags.

After recertification/repair or overhaul, the parts are made available for exchange or pooling programs – giving customers the flexibility they require to reduce operating cost. Used Serviceable Materials (USM) is the result of Liebherr's attention to customers' needs and the subsequent development of action to satisfy them.

This forward thinking and drive to innovate aims to adapt to changes and challenges in the market. The 'USM by Liebherr' initiative ensures that partner traders and brokers, have adequate access to OEM certified parts and services at the expected USM fair market value. It truly is the best of both worlds: quality with lower costs.

Liebherr recognizes that legacy fleet operators expect an array of solutions to address their spares and repairs needs. Timely availability of parts, efficiency in repair cost and reduction of inventories are legitimate expectations from customers with specific competitiveness targets. 'USM by Liebherr, amongst other Liebherr services, is available through our extensive network of service centers, providing proximity to and availability of Liebherr certified USM parts for our customers to service aircraft in a timely manner', explains Damon Seksaoui, General Manager of Liebherr-Aerospace in the Middle East. 'In addition to our OEM quality standards, our customers can enjoy optimum performance of services, cost efficiency and our continuous drive to innovate with privilege solutions to meet their expectations and ensure their success, which is also ours.'

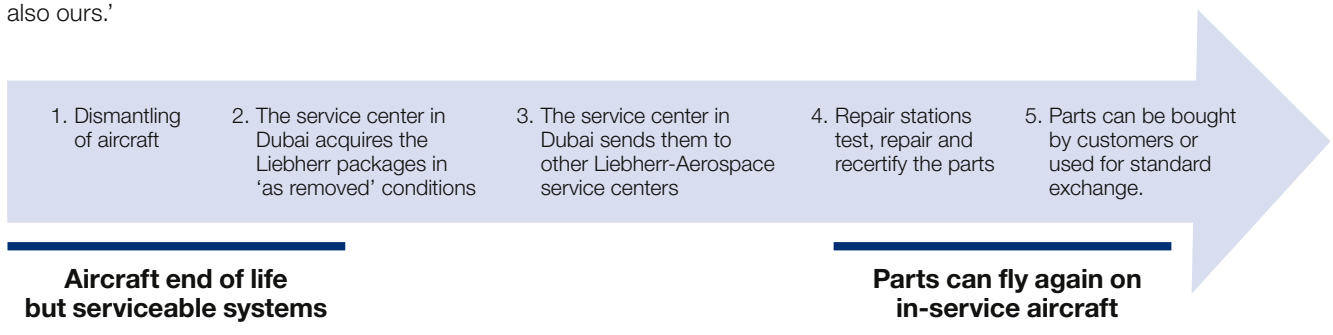
Additionally, having a procurement team consolidated in one location, constantly looking for large package opportunities helps Liebherr gain leverage in terms of pricing. The result is availability of serviceable units at significantly reduced prices while maintaining OEM quality standards for its customers.

Last year, three A320 packages of 'as removed' units were acquired by the team in Dubai, giving a new life and purpose to these torn down units. The Dubai office offers a neutral location with a start-up dynamic and logistics expertise to get parts in and out fast onto various service centers for repair work. Cost effectiveness, quick turnaround time and quality of work – the three key ingredients necessary to thrive in this highly competitive market – are the pillars that ensure smooth operations in the Dubai office.

The usage of serviceable materials is already a standard practice, widely accepted by operators who today rely on traders and brokers to fulfill their requirements with USM parts when quoted for repair work.

This additional service has also enabled Liebherr to develop new partnerships with teardown part suppliers, helping to map and understand the USM market in depth.

Finally, the industry is about to experience a significant influx of retired aircraft in the next decade or so. Legacy and mature fleets retirement are expected to continue growing with up to 8,000 aircraft estimated to come out of service within the next decade; as a result, an over-supply of USM is set to follow and affect the MRO sector.





# Growth Continues in Singapore

Singapore is undoubtedly seen as an MRO hub with continuous growth in the horizon. Over 130 aviation companies have set up offices and repair facilities in Singapore to service and support various aircraft components, and that number is only expected to grow in the next decade. An increasing number of aircraft are being delivered to the Asia Pacific Region (APAC). For example, about 50 percent of the current global A350 fleet is operated by airlines in APAC. Evidently, Liebherr-Aerospace recognizes the need and opportunity of having a strong presence in Singapore and the company continues to make strides to strengthen its presence and support for its customers in this region.

## Expansion of repair capabilities

A milestone reached for Liebherr-Singapore in line with this strategy is the certification of local rotor shaft balancing capability for air cycle machines (ACM). Rotor shafts must be re-balanced after any work is done in an ACM. Having the capability to do this in Singapore, as opposed to having to send units to the OEM-facility in Toulouse (France), has considerably reduced component repair down time for customers. Thanks to the great teamwork between the sites in Liebherr's Aerospace network, this project was completed successfully within schedule and budget; and Liebherr's customers in Asia Pacific can benefit from this further expansion of the company's regional repair capabilities.

The next goal is already in focus: further developments and investments are underway at Liebherr-Aerospace in Singapore to set up A350 components repair capabilities. With the A350 fleet increasing in APAC, the company is preparing its infrastructure thoroughly in order to meet its customers' requirements and to offer services for the whole life cycle of each aircraft.

## High level support solutions

In the last quarter of 2018, Liebherr and Singapore Component Solutions (SCS), a joint venture between AFI KLM E&M and Sabena technics (SNT) dedicated to component support for ATR and Airbus A320 aircraft fleets, signed a cooperation agreement. Under the terms of the agreement, Liebherr-Aerospace and SCS will collaborate in developing support solutions dedicated to the A320 heat exchangers manufactured by Liebherr. SCS will thus join the Liebherr worldwide network for heat exchanger maintenance. Through



this partnership agreement, SCS will be qualified to carry out servicing work on Liebherr-designed and manufactured heat exchangers – more precisely for cleaning and minor repairs. In return, the Air France-KLM Group will make use of Liebherr services for work requiring the overhaul or re-coring of defective heat exchangers.

In combining the know-how and expertise of Liebherr and SCS both companies are able to offer high level dedicated heat exchanger support solutions in terms of turn around time and cost, for the benefit of their clients. This agreement sets out the framework of a win-win partnership for both parties that will allow Liebherr in particular to further develop its repair network in Asia.

With its continuous growth, Liebherr-Aerospace in Singapore is on its way – always close to its customers.

# Participation in Programs

## 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 (Defence 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

### 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

## 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

## AVIC HAIG

### AC 312

- Air Conditioning System

## Boeing

### B747-8

- Air Conditioning System
- Engine Bleed Air System

### B777

- Fuel Tank Pressurization Valve

### B777-200LR

- Auxiliary Tank Pressurization System

### B777/B777X

- Main Gear Steering System

### B777X

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

### B787

- Nose Wheel Steering Remote Electronic Unit

### KC-46

- Fuel Tank Inerting Valves
- Refueling Hose Drum Drive System

### MH-139

- Environmental Control System
- Landing Gear System

## Bombardier Aerospace

### Challenger 300/350

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

### CRJ700/900

- Integrated Air Management System
- Low Pressure Ducting



#### **CRJ1000**

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

#### **Dash8-400**

- Cabin Pressure Control 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**

#### **ALX**

- Cabin Pressure Control System

#### **E-Jets E1**

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

#### **E-Jets 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

#### **KC-390**

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

### **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**

#### **Elta**

- Environmental Control Unit

#### **G200**

- Cabin Pressure Control System Components
- High-Lift System

### **Kamov**

#### **KA-226T**

- Air Conditioning System

### **Korean Aerospace Industries**

#### **KHP**

- Environmental Control System Components

#### **KT-1**

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

### **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**

#### **Trent 7000**

- High-Pressure Non-Return Valve

### **RUAG Aerospace**

#### **Dornier 228 New Generation**

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

### **Sukhoi Civil Aircraft Company**

#### **SuperJet 100**

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

### **Textron Beechcraft**

#### **750/850XP/900XP**

- Cabin Pressure Control System

### **Thales**

#### **Damocles**

- Environmental Control Unit for POD

#### **RECO NG**

- Environmental Control Unit for POD

#### **MELTEM II**

- Environmental Control Unit

### **TRJet**

#### **328 Series**

- Air Management System
- Flap and Spoiler Actuation Subsystem

### **Turkish Aerospace**

#### **Turkish Light Utility Helicopters (TLUH)**

- Air Conditioning System
- Oil Cooling System



# Liebherr-Transportation Systems

## CELSINEO – New Technology for Refrigerated Transport

**Krone and Liebherr have entered into a partnership for the development, sales and servicing of refrigeration units for trailers. Both companies have signed the relevant cooperation agreement. Under this agreement, Liebherr will develop, manufacture and supply refrigeration units for temperature-controlled road transport.**

Krone will install these in its refrigerated semi-trailers and offer them to its customers as a complete package. Krone's extensive European service network also allows it to offer expert maintenance and repair services as well as a fast supply of spare parts for all aspects of the new innovative CELSINEO cooling system.

Liebherr's patented system concept provides users with a modern and future-oriented solution. The entirely rethought modular design guarantees maximum availability, cost effectiveness as well as straightforward servicing. For Krone and Liebherr, the focus is on maximising customer benefits, and both partners contribute to the new cooling system with their extensive experience and knowledge.

'The two companies complement each other due to their strengths, technological leadership and market presence,' explains Josef Gropper, Chief Operating Officer at Liebherr Aerospace & Transportation SAS. 'In the case of the new product, we are able to apply our extensive know-how in refrigeration and air-conditioning systems for aircraft and rail vehicles to the specific requirements of road freight transport. The device's unique technology is also proof of Liebherr's innovative capabilities.'

Bernard Krone, Managing Partner of the Krone Group, emphasizes: 'The cooperation with Liebherr in the area of

transport refrigeration is a further step in extending the Krone Group's systematic focus on customer requirements and the demands of the international markets. Our company's strategy of increasing service intensity across Europe is a focus in this respect, as is the implementation of new business models for our customers.'



Josef Gropper, Chief Operating Officer at Liebherr Aerospace & Transportation SAS (left) and Bernard Krone, Owner and Managing Partner of the Krone Group (right) signed the cooperation agreement

© Stefan Schönig



# Modularity Provides the Perfect Solution

**CELSINEO** meets the demands of logistics companies for maximal reliability, while also getting economically efficient refrigerated transport. With its unique concept, **CELSINEO** represents a new generation of cooling systems for semi-trailers.



## **Service-friendly**

Refrigeration modules can be changed quickly, for example at the same time as a trailer service. A certified refrigeration engineer is not required.

## **Modules**

Three Plug & Play refrigeration modules with independent, hermetically sealed refrigerant circuit.

## **Energy-efficient**

The diesel motor is ideally dimensioned so that no exhaust gas aftertreatment is necessary.

# A New Company in China

**Liebherr is excited to announce an addition to its Transportation Systems footprint in China. On January 29, 2019, Liebherr representatives and officials of the Municipal Government and the National Level Pinghu Economic & Technological Development Zone (PEDZ) signed papers, officially launching a new company in the City of Pinghu, province of Zhejiang.**



Liebherr-Transportation Systems (China) Co., Ltd. will develop, produce and service components and systems for Liebherr's transportation business in China. The company will bring the most advanced technologies in its fields of business to the market, such as the environmentally friendly air cycle technology for air conditioning or the electro-hydraulic actuation technology for active lateral suspension or the high performance cooling technology for next generation on-board electronics. Liebherr-Transportation Systems will thus enable its customers and partners to offer comfortable and reliable public transportation means.

With the foundation of the new company, Liebherr aims to participate in and strengthen the Chinese 'Belt and

Road Initiative'. Liebherr-Transportation Systems (China) will provide one of the most eco-friendly technologies to improve the living conditions of tomorrow's generations.

### Reliable products of highest quality

'One of our main fundamentals for our business is to be where our market is', said Josef Gropper, Chief Operating Officer at Liebherr-Aerospace & Transportation SAS during the ceremony. 'The Chinese market is the largest railway transportation market in the world and

'One of our main fundamentals for our business is to be there where our market is.'

Josef Gropper

we reinforce our long-term commitment to China today by this investment. To develop and produce innovative, very reliable products of highest quality has always and will always be our mission.'

The facility in Pinghu (with a planned production area covering approximately 86,100 square feet) will be a very important base for Liebherr's further growth

in Asia and for the export of products developed and manufactured in China for the international railway market.

Liebherr will provide products out of Pinghu in line with the highest standards and requirements of its local and international customers. 'This was only possible in a good, trustful collaboration with local partners and authorities. We are looking forward to be part of the Sino-German development and production cluster and to contribute to the further development of China and

the Pinghu Economic and Technological Development Zone,' adds Josef Gropper.

'The settlement of Liebherr-Transportation Systems' China project will further expand and enrich our advanced equipment manufacturing industry, and it will also add new impetus to the further development of our Industrial Park,' commented Shen Bingxing, Secretary of the Party Working Committee of the Administration Committee of PEDZ.



### One Belt, One Road

is a project of the People's Republic of China to build and expand an infrastructure and trade network from Europe through Central Asia to the Middle East. With the revival of the antique silk road, China wants to expand its pioneering role in the global economy.



# Technology for the Next Generation of Fuel Cell Powered Automobile

**Liebherr is developing an electrical turbo-compressor and its power electronics for the next generation fuel cell-powered car. This car, that is being developed by a major automotive manufacturer based in China, will be able to transport up to five persons.**

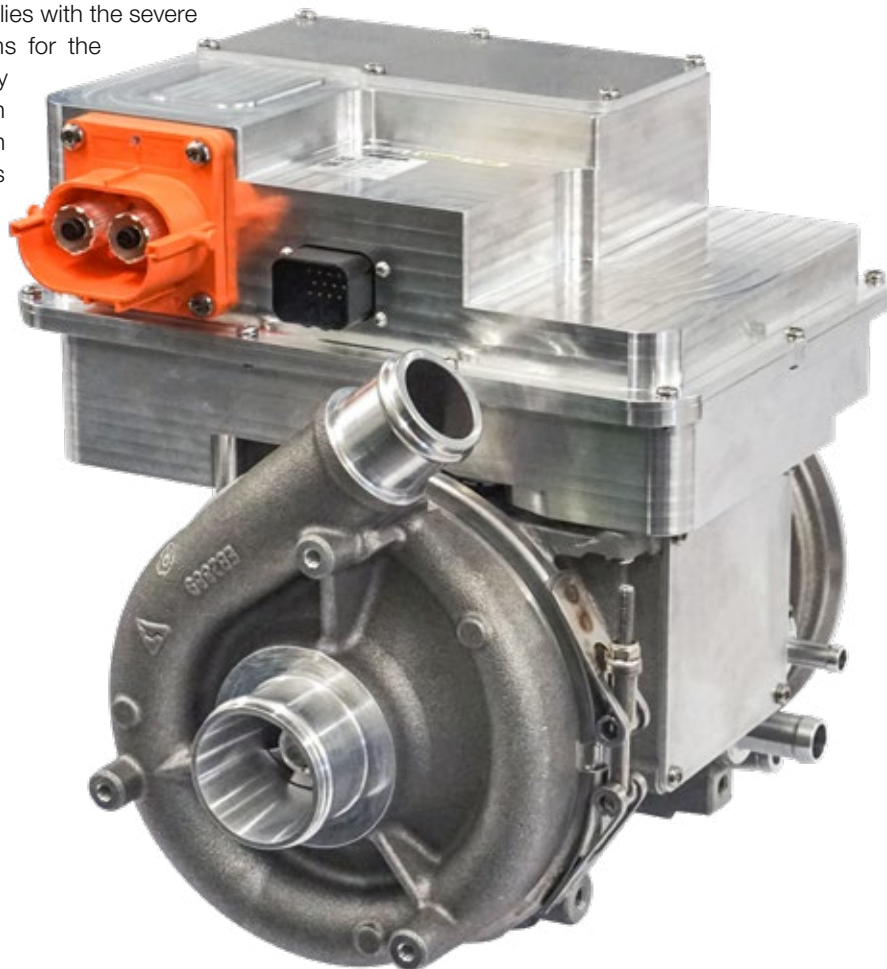
The selection of Liebherr illustrates the company's leading edge and experience in electrically-powered turbomachinery for on-board vehicle systems for aerospace, rail vehicles and automotive applications.

For more than one decade, Liebherr has been collaborating with major automotive manufacturers to develop the future generation of fuel cell vehicles. Liebherr air bearings technology for centrifugal compressor developed for aerospace activities powered by a high-speed electric motor has been identified as the best candidate to supply compressed and pressurized air to the fuel cell system.

The motorized compressor complies with the severe requirements of fuel cell systems for the automotive industry: it is very robust and reliable, compact in size, highly efficient, optimized in cost and noise emissions, it does not require oil, and it features a fast dynamic response.

This has been demonstrated in the field where more than one hundred vehicles using motorized turbo compressors by Liebherr have run millions of miles without any failure since 2007.

The contract with the Chinese car manufacturer is not only an agreement between two parties. It is living proof that Liebherr is enabling customers with its technology to produce the next generation of fuel cell powered automobiles in China. It also represents a significant milestone in Liebherr's long-term strategy to continuously enlarge its footprint in the country.





# The Liebherr Group

## Like Father, Like Son

**Building one of the biggest trade fair booths in the world is an enormous challenge. A great deal of experience, organisational skill and craftsmanship go into ensuring that Liebherr leaves the best possible impression on visitors from all around the world at Bauma. Having nerves of steel helps too. Head of Construction Werner Haas has all of these traits, but this year he's also brought in some very special help – his son.**

It's a tricky moment where everything has to fit with millimetre precision. Werner Haas directs the mobile crane with a circular wave of his hand. The cabin slowly descends and the men on the ground turn it until it is in position. Then things happen quickly. The cabin is mounted on the slewing platform in just a few steps. The young mechanic gets the presentation board out from inside. '1000 EC-H 50 Litronic', it reads. 'It's better if we leave the board down here', he says. 'When the crane is mounted, nobody will be able to read it 45 metres up.'

The man directing operations and the young mechanic obviously make a good team. And no wonder, since they are father and son. Werner Haas, 48, and his son Julian, 21, are both service mechanics at Liebherr-Werk Biberach GmbH. Werner Haas joined the company in 1991 and has been supervising the construction of one of the world's largest trade fair booths since 1998. His son Julian started an apprenticeship in mechatronic engineering at Liebherr in 2014 and is now a part of the construction team led by his father.

Both men like to roll up their sleeves. One is outside working with machine and crane assembly parts, whilst the other directs operations from his 'conductor's desk', a conference table in a small portacabin where Werner Haas has been orchestrating the various tasks since the beginning of November. This has included managing trade fair constructors, gas, water and electricians, garden designers and

landscapers, graphic designers and, of course, the builders of Liebherr's more than 60 machine exhibits.

'We can only succeed if we work together, combining age and youth, experience and a fresh attitude towards innovation.'

Werner Haas

'Approximately 60 Liebherr colleagues and 80 of the staff from the trade fair organisation are responsible for achieving the maximum impact for us at Bauma', explains Werner Haas. 'I am the interface, the man at the centre of the storm.' That said, he's only as good as the team around him. 'We can only succeed if we work together, combining age and youth, experience and a fresh attitude towards innovation.'

And it isn't just talk – this is the tenth time Werner Haas has been responsible for the Liebherr booth at Bauma, and he is putting this combination of experience and youthful curiosity and energy to the test. His eldest son Julian was integrated into the team.



'It was inevitable', the father says with a mischievous grin. In the past, he would always bring his children models from the trade fairs. They loved playing with them, particularly the eldest. 'My fascination with cranes, construction machines and Bauma began at a young age', confirms Julian. Therefore, it was 'pretty much a given' that he would choose to do an apprenticeship in mechatronic engineering at the Liebherr plant in Biberach in 2014.

## 'My fascination with cranes, construction machines and Bauma began at a young age.'

Julian Haas

An amateur handballer in his free time, he has since teamed up with Liebherr to work as a service assembly mechanic, working mostly with tower cranes. His responsibilities range from training and instruction to repair and maintenance work. 'A crane is a wonder in every possible sense', he says admiringly. 'It's incredible how much steel is used.' If he has time, he likes to pore over the statistical calculations to get a deeper understanding of the laws of physics. 'Curiosity and a hunger for knowledge can't hurt', says the father.

The pair have already worked together for Liebherr at the trade fair in Paris. 'That allowed us to get attuned to each other in preparation for Munich and practice particular processes', explains Werner Haas. But there's no question of the Head of Construction giving his son any preferential treatment and that's the way both would have it. 'It's a fantastic opportunity to be part of this unique project and work in a really hands-on way', Julian Haas enthuses. 'It's a special job where there's plenty of scope for me to learn.'

However, work is far from over for the Liebherr team once construction work for the trade fair is done. 'During Bauma, we are constantly on the go doing demonstrations and maintenance', explains Julian Haas, full of anticipation. 'And when the doors of the trade fair close and everyone goes home happily, it's time for us to get stuck in again', adds Werner Haas with satisfaction. What takes half a year to assemble has to be dismantled and completely removed in five weeks. 'And then all the teams have the whole mountain to climb again.'

'People often ask how we can actually work together as father and son and if there isn't constant family strife and stress', explains Werner Haas. 'Of course, there are occasional differences of opinion. That's completely normal. But in general, we get on just as well at work as we do at home', states



Julian. In fact, it's got to a point where the women in their lives tick them off at the weekend. 'When we talk about work at mealtimes, my wife says that there must be something else to talk about besides Bauma', Werner Haas explains. 'And she's probably right. But the trade fair is a special event that only comes around once every three years, so it's only right that everything else revolves around it. Well, almost everything.'



Find out more:  
[www.liebherr.com/fatherandson](http://www.liebherr.com/fatherandson)



## Aerospace

### The German Chancellor meets Liebherr

German Chancellor Angela Merkel and Federal Minister of Transportation Andreas Scheuer have visited the Liebherr Aerospace stand at the ILA Berlin Air Show, one of the largest international aerospace trade fairs in the world. Dr. h.c. Willi Liebherr showed them the Group's research on fully electrical components for the aircraft of the future.

## Domestic Appliances

### Domestic appliances production in India

The fast-growing Indian market: Liebherr has opened a 20-hectare production plant in Aurangabad. Liebherr Appliances India Private Limited specialises in the production of high-quality refrigerators and freezers for the Indian market. Due to the rapid transformation of living conditions there, India is expected to offer great sales opportunities in the future.



## Earthmoving

### World premieres and the project of the century

Construction machines in Paris: At Intermat, one of the construction industry's largest trade fairs, Liebherr presented innovative technologies and world premieres from its wide range of products. The theme of this year's fair was the project of the century: 'Grand Paris'. There are plans to build 200 kilometres of new metro lines to relieve the traffic situation in the French capital. Countless Liebherr construction machines are already in use on sites in and around Paris.





## Maritime Cranes

### New heavy-load crane in Rostock Harbour

Liebherr has started to install the world's most powerful land-based heavy-duty crane at the Port of Rostock. The 164-metre tall TCC 78000 will be used to load Liebherr's increasingly larger maritime cranes and external companies operating at the Port of Rostock will also be able to use it to lift heavy loads.

## Tower Cranes

### Tallest building in Europe

Breathtaking heights: The 462-metre tall Lakhta Tower was constructed in just three years using four Liebherr tower cranes. At the adjacent multi-purpose building, six more Liebherr cranes were in use. Liebherr service technicians are guiding the construction of the new building, even under difficult weather conditions.



## Hotels

### Award-winning chefs

The Gault&Millau restaurant guide has awarded the chefs at two Liebherr hotels. The Gault&Millau toque is one of the most prestigious awards in haute cuisine, alongside the Michelin star. Thomas Cavalho de Sousa (left) cooked up two toques for the Löwen Hotel Montafon in Schruns, Austria. And Mario Döring (right), head chef at the Interlpen Hotel in Tyrol, Austria, was awarded with three of the coveted toques.



Find out more:  
[www.liebherr.com/highlights](http://www.liebherr.com/highlights)

# In One Line

**In the design office truck mixers take shape. Working methods have changed in recent decades, but design engineers' enthusiasm for innovation remains the same today.**



Klaus Günther at his old workstation: the drawing board

It was no easy task getting hold of a drawing board. 'They'd simply all been tossed out at some point,' says Klaus Günther. So the 79-year-old was all the more surprised and delighted when one was set up specially for him in the training room at the Bad Schussenried plant. It was here that one of the first production companies of the Liebherr Group was founded in 1954, and where Günther joined the company as one of its first trainees the following year.

Today, Günther, who once headed the design office, is paying a visit to his former workplace to exchange ideas with the new generation. He has many stories to tell. In his heyday, he had been in charge of coordinating up to 30 design engineers at a time.

## The ink stain as a trademark

Back then, everything revolved around the drawing board. Rulers were attached to the drafting head at the end of a moveable scissor-type drafting machine – exactly like the one in the training room. Günther carefully places his hand on the drafting machine. 'With this, you could create a

precise design on A0 paper with exact angles,' he says. At that time, the design engineers usually worked standing up. 'The hallmarks of the design engineers were their ties, their white lab coats and the pens in their front pockets that often left ink stains,' he recalls with a smile.

'The truck mixer has not changed much in terms of its basic design. After all, the physics of mixing are exactly the same.'

Klaus Günther

By the time he retired in 2001, Günther had witnessed the department's transformation into the digital age. In the 1990s, the drawing board was gradually replaced by digital design tools. Today, computer-aided design (CAD) allows design engineers to create the most complex blueprints in 3D format, all within the confines of a computer screen – a far cry from the drawing board of the past.

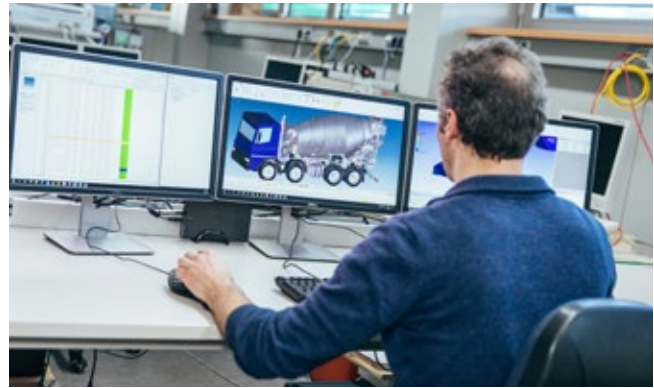
## Ideas from the top

Klaus Günther recalls that when they were designing on the drawing board, design engineers always had to have a clear view of the finished product in mind. 'There was always a moment of truth when we would test the design in the workshop.'

In the early years, the company's founder played a very hands-on role in coming up with new ideas. 'Hans Liebherr used to enjoy dropping by the office and saying, 'I have an idea.' Then we'd give him a pencil and paper and he'd start drawing,' recalls Günther.

'We had some lively debates with him. Many of his ideas were groundbreaking. Some led nowhere, and others were simply too far ahead of their time,' says Günther. 'The first hydraulic truck mixer, which we launched at the Hannover trade fair in 1968, was an idea that literally came all the way from the top.'





The construction workstation in transition: from the drawing board to the CAD program

### Topics, that stay current

'Tradition is very important,' says Berthold Ruf, who started working as a development engineer for Liebherr Mischtechnik GmbH in 2002, one year after the departure of Klaus Günther. By that time, the drawing board had long been superseded by digital design programmes. The white lab coat and mandatory tie that once comprised the design engineer's uniform were also long gone.

### Age-old debates

Ruf enjoys talking shop with a design engineer like Günther, who was around in the early days of the company. 'Even with our latest fifth-generation truck mixers, we're still dealing with many of the same issues as back then. It's all about the technicalities of optimising load capacity and axle load distribution, while keeping everything as safe and efficient as possible,' says Ruf.

'Of course,' he adds, 'we have it a bit easier now than the design engineers did back in the early days. 3D design enables us to integrate more and more

'Our goal is to lead from the front. At Liebherr, we have the freedom to think differently and try new things.'

Berthold Ruf

parameters, so we can simulate and model different kinds of load distributions and dimensions. This enables us to work more quickly, so we can focus more on the product and development process itself, without being too distracted by technical details.'

### The founder wishes you 'All the best'

Electrical drive trains, telematics, driver assistance systems, networking and

digitisation: 'The world of truck mixers keeps moving ahead and we're doing our part to keep the wheels turning,' Ruf tells his predecessor. So, it's just a question of more IT specialists then? 'On the contrary, it still comes down to classic engineering skills. Like when we're talking about designing steel components to weigh less but still offer the same load-bearing capacity and lifespan.'

And it's always been that way, as Klaus Günther points out. 'Every kilo of weight we can save on the truck is an extra kilo that the customer can transport on the road. For them, that's money in the bank.'

Even though the times and job descriptions have changed, the goals of the design engineers are the same as always. To prove this point, Klaus Günther brought along a promotional postcard from the early days of the company, written to stir up interest among customers for the HTM6 truck mixer. It contained a message that came straight from the top: 'Discover the HTM6's many advantages for yourself – and make them all yours. All the best, Hans Liebherr.'



Klaus Günther and Berthold Ruf exchange ideas and experiences



Find out more:  
[www.liebherr.com/drawing-board](http://www.liebherr.com/drawing-board)

# LIEBHERR



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