

**More than just gear skiving** New additional functions such as chamfering and tool change | **P. 12**

**Combined for greater efficiency** Bin picking at line inputs and outputs | **P. 30**

**Liebherr and MTU Aero Engines** Automation increases productivity tenfold | **P. 38**



50 years  
connecting  
forward



# 50 years connecting forward



**LIEBHERR**

The Managing Directors of Liebherr-Verzahntechnik GmbH (from left to right): Michael Schuster, Dr. Christian Lang, Michael Messer and Dr. Hans Gronbach

## Dear readers,

Liebherr-Verzahntechnik GmbH is celebrating its 50th anniversary. It goes without saying that this proud number is also a topic in our magazine. We talk about our history and our future, because we live in exciting times and are already preparing ourselves for changing markets.

Connectivity is one of the key concepts of the future, which is why you will encounter a variety of connections in our magazine. Gear technology connects skiving processes with chamfering during the machining process, including additional options such as turning, milling, drilling and measuring. It integrates generating grinding with centrifugation and, with the aid of ChamferCut technology, worm milling with chamfering.

The same applies to automation. It combines bin picking and stacking cells with an automated guided vehicle and reveals new and faster pallet handling systems for modern and universal manufacturing. We are driving digital networking forward and incorporating service issues to a greater extent. Because our most important connection is with our customers.

Immerse yourself in the increasingly networked world of Liebherr, which showcases many new ideas and solutions in this issue, too. Never before have we demonstrated in so many ways how capable our technologies are of integration. After 50 years, Liebherr-Verzahntechnik GmbH is more innovative than ever before. Discover the possibilities!

Michael Schuster

Dr. Christian Lang

Michael Messer

Dr. Hans Gronbach



14 16



24



## Anniversary

### Traditionally innovative

Retrospective and vision ..... 6

## Gear Technology

### More than just gear skiving

New additional functions such as chamfering or tool change integrated ..... 12

### “A chamfer for every gear”

ChamferCut plus tapered end mill ..... 14

### New at Liebherr: worm milling

Milling, chamfering and brushing in one machine ..... 16

### Chamfering despite interference contours

Considerable increase in the number of possible applications ..... 18

### CBN generating grinding – a thoroughly economic alternative

Stable processes with a long cycle and tool life ..... 19

### Bigger, better, faster: the new LHStation control panel

Two control surfaces in matrimony ..... 22

### Integration of metrology

Welcome to the Liebherr-Family: Wenzel GearTec ..... 24

### Top gear cutting tools, in-stock

With new material and coating ..... 26

## Automation Systems

### Combined for greater efficiency

Bin picking provides automation of line inputs and outputs ..... 30

### Autonomous travel through the factory

AGVs take over intralogistics tasks ..... 33

### PHS Allround: twice as good

The new twin loader opens up new possibilities ..... 34



30



45



58

## Practice

### Liebherr and MTU Aero Engines: partners in automated machining of turbine blades

Automation increases productivity tenfold ... 38

### In the fast lane

Gear hobbing and generating gear grinding machines for silent e-bike drives by Morat Swoboda Motion GmbH ..... 41

## Liebherr World

### Ring in the future together

The great anniversary celebration ..... 44

### Experiencing the future for 50 years

On Family Day, employees celebrated with their loved ones ..... 45

### From prototype to series production

Process design à la Liebherr ..... 46

### Focus on customer productivity

Liebherr restructures service portfolio ..... 48

### As flexible as our own range

The Robotics department introduces itself ..... 50

### Liebherr Academy „Gear Technology“: local presence

Customer training as a guarantor of success ..... 52

### Future challenge

Training 4.0 ..... 54

### Only the best

Quality management at Liebherr ..... 56

### Expansion in China

New plant in Yongchuan, China ..... 57

### Strong cooperation

Partner Level Award by John Deere ..... 57

### Interactive machine experience with Virtual Reality

The LGG 280 with VR glasses ..... 57

### At icy altitude

Revolving tower crane in action during construction of the Lakhta Towers ..... 58

## Imprint

### Publisher / Responsible for content:

Liebherr-Verzahntechnik GmbH  
Kaufbeurer Strasse 141  
87437 Kempten / Allgäu, Germany

### Issue:

2019/2020

### Layout/Editorial control:

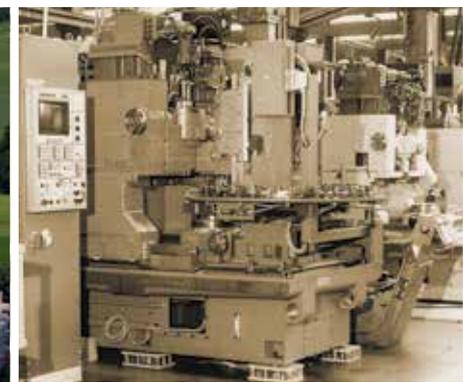
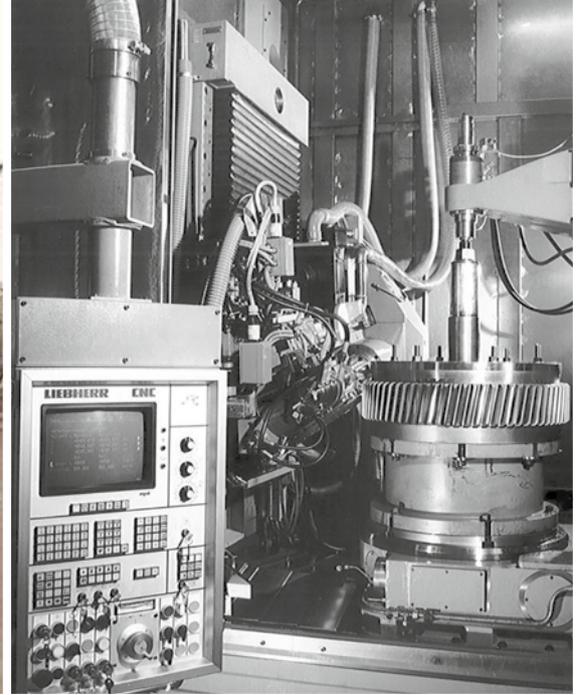
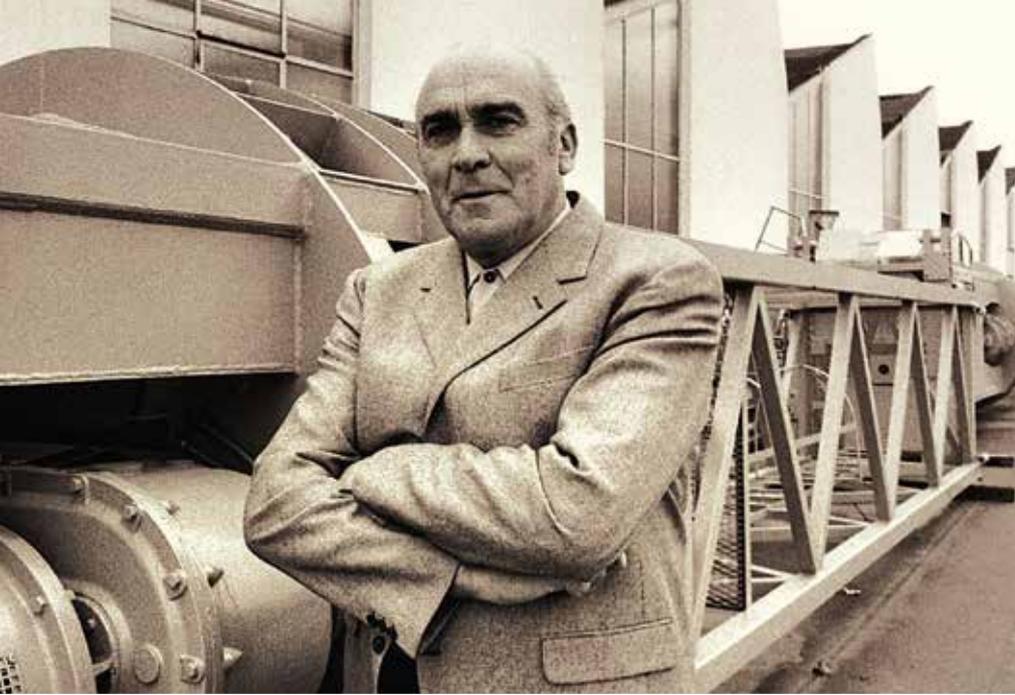
C&G: Strategische Kommunikation GmbH,  
Overath, Germany  
www.wir-verstehen-technik.de

### Photo credits:

Liebherr-Verzahntechnik GmbH

### © Liebherr-Verzahntechnik GmbH

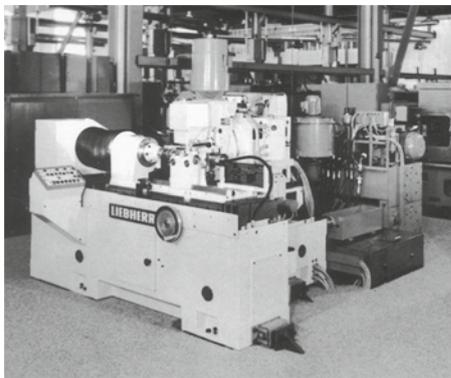
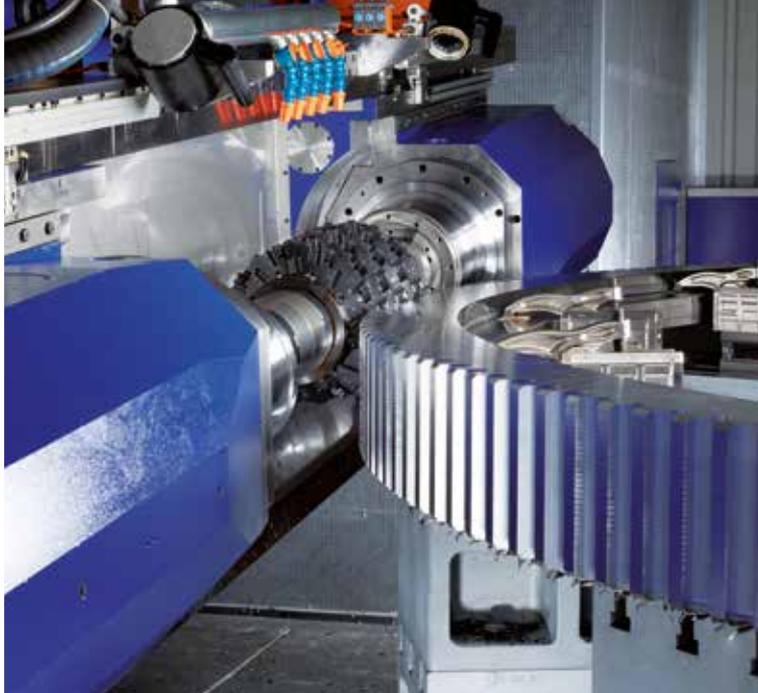
No part of the contents of this magazine may be reproduced or published in any form or by any means without the consent of the publisher.



# Anniversary - 50 years connected

## Traditionally innovative

Half a century of Liebherr-Verzahntechnik GmbH means 50 years of commitment to the machinery and plant engineering industry. Gear technology originates in the technology of the revolving tower crane. Hans Liebherr wanted to buy a gear hobbing machine for gear manufacturing, but could not find what he wanted – so he simply built it himself. It's a typical Liebherr story, since many sectors in the company group have emerged in this or in a similar way. Taking things into one's own hands: an attitude that can still be found at Liebherr today.



# ting forward

## Pioneers in gear manufacturing

Pioneering achievements in gear technology include the first shaping machine with a hydrostatic guide in 1967 and the first gear grinding machine with CBN grinding discs in 1989. Both technologies set standards in their industry. Three years later, Liebherr took over the machine factory Lorenz, a renowned manu-

facturer of gear shaping machines and gear cutting tools located in Ettlingen. Liebherr Verzahntechnik GmbH still has a factory for gear cutting tools there today. The product range offered by the traditional company was a perfect fit for the Liebherr-Verzahntechnik GmbH product portfolio.



In the late 1990s and 2000s, the trend in gear technology was towards size: The wind turbine boom increased the demand for large toothed gears and therefore for machines to make them. Gears with a diameter of six metres required special technologies, which Liebherr successfully developed.

### At the pulse of technological progress

In the last ten years, increased quality and precision of toothed gears finally came more sharply into focus, driven by avi-



ation technology and the desire for increasingly quiet gearboxes. Gear technologies such as ChamferCut were able to score highly here. Gear skiving, a process that had been developed at an earlier date, finally caught on in a modern design and is having a considerable effect on productivity: skiving<sup>3</sup> completes the product range of gear manufacturing (see also the article "More than just gear skiving" on page 12).

### From individual machines to a connected production park

From an early date, Liebherr relied on machine automation, founding a second business segment in this area. The company entered automation and plant engineering back in the late 1970s, by planning a production hall for a customer. At the start of the 1980s, Liebherr planned the "factory of the future": the first fully automated plant with a high-bay warehouse and automatic machine loading.

Automation developed considerably over the next 20 years, particularly in the area of loading gantries and palletising cells. Finally, in 2007, the first pallet handling system (PHS) was installed; this became a great success story for Liebherr and still impresses with its flexible possibilities.

Liebherr completed its automation range with bin-picking solutions and successfully entered robotics with vision systems. This was the company's response to the increasing need for flexible production processes. Batch sizes are becoming smaller, with lines processing a larger number of different components. Thus, Liebherr became a full-service provider for automation systems and enjoyed success in many industries in this capacity.

In the last few years, automation and gearing have increasingly converged. Liebherr's extensive range now enables it to build, for example, gear cutting

machines with cage automation, robot loading, integrated additional services such as measuring or de-oiling, which is increasingly in demand. From individual machines to the complete machining line with automated line input and output, Liebherr can offer everything from the same source.

### ... connecting forward

Over time, both gear technology and automation continued to face new challenges, for which Liebherr developed suitable solutions. For 50 years, the engineers at Liebherr have provided innovative guidance for many industries and played a part in shaping the future.

Because the future needs origins. "We are constantly developing", Dr. Hans Gronbach observes. "Since momentum and globalisation are continuing to increase, we have to ask ourselves this question: How does a traditional company react to technological change?" adds Michael Messer. For the Managing Directors of Liebherr-Verzahn-technik GmbH, an important issue here is the human factor.

### Networking means building bridges

One aspect of this, according to Dr. Hans Gronbach, is that "Modern technology increasingly uncouples people from machines. Previously, gears were set; now, everything is done through the digital NC control system. Perhaps our machines will be controlled from the office in future." Direct feedback from the machine to human interventions is increasingly omitted. The operator cannot observe so directly and has to fill this gap by making inferences – a demanding task.

For Liebherr, this means a different way of interacting with employees. Michael Messer says: "We have to guide our people and train them appropriately. We therefore also see ourselves as bridge-builders for our employees towards globalisation and high technology."

As Michael Schuster shows, this path already starts during training. "All trainees go abroad. Every industrial mechanic learns

“The topics of the future are increased connectivity as well as needs-based and local production with the least possible waste, because resources are limited. We are preparing ourselves for these trends.”

Dr. Christian Lang, Managing Director Sales and Marketing



English and deals with control technology. This is an investment in the future. Interdisciplinary work is trained from the start, in order to encourage common understanding when working in teams.”

#### **Intensive customer understanding**

Intact and trust-based customer relationships have top priority for Dr. Christian Lang. “We succeed because of our deep understanding of applications. Gear technology is now established, which means that the competition has become tougher. In this setting, trust in the ability to solve problems becomes increasingly important, because customer technological challenges are becoming ever more demanding.”

Quality is therefore the constant factor underlying Liebherr's self-image. “This applies both to mechanical and digital products”, emphasises Dr. Hans Gronbach. “Our daily routine and our development are becoming more and more software-dependent. That's why we are increasingly building up expertise in this field and deciding where we should be active ourselves and where we should buy services.”

#### **Increasing complexity and individuality**

At the same time, digitalisation has become the driver of growing complexity and customer individuality. Michael Messer is convinced: “This trend towards maximum flexibility will continue to occupy us. This applies especially to us as mechanical engineers: both during manufacturing and during the use of our products, both for gear technology and for automation. We will achieve a level of self-governing control loops that can't even be imagined today.”

All CEOs are observing a massive change due to the new digital possibilities. Dr. Hans Gronbach outlines tomorrow's modern production as follows: “We will see self-organising supply chains that are supplied by autonomous production centres as

much as possible. We will plan manufacturing very differently, on the basis of qualified and digitally optimised predictions.”

#### **Data-based business models**

Data represents a critical factor in these future scenarios. Who will have the rights to what data in future? The business models of the future are based on this information, which means that connection with customers and suppliers is critical for success. Dr. Christian Lang says: “There will be competition for data, because it is increasingly being used as goods.”

This goes hand in hand with the topic of data security: who will have access to what knowledge? Michael Messer points out that business relationships will become considerably more data-centric in future and that new pay-per-use models will also establish themselves in mechanical engineering. “Our task will be to keep the customer benefit in mind within this setting and to find suitable solutions.”

#### **Needs-orientated and local production**

Despite globalisation and digitalisation, however, Dr. Christian Lang also sees a trend back towards local production. “We will experience a reversal. On the one hand, transport will be more expensive, and on the other hand, the modern factory requires fewer people – and those that are needed must be well trained. Thus, much of production will return from low-wage countries. The topics of the future are increased connectivity as well as needs-based and local production with the least possible waste, because resources are limited. We are preparing ourselves for these trends.” To ensure that Liebherr gear technology and automation systems continue to be future-orientated, innovative and successful for the next 50 years to come.

A close-up photograph of a mechanical gear assembly. The image shows several parallel metal shafts or gear teeth, with a prominent one in the foreground showing fine details of its surface. A white banner is overlaid across the top portion of the image, containing the text 'Gear Technology'.

# **Gear Technology**





## More than just gear skiving

**The constantly rising demands from the markets, such as higher accuracy, more effective processes and increased flexibility, require sophisticated machine concepts. For this reason, the new gear skiving machine generation has been equipped among other things with a tool changing system integrated in the machine, multi-machining functions, an integrated measurement device for tools and the option of chamfering during the machining process.**

Liebherr-Verzahntechnik GmbH has established targets for the new series of gear skiving machines: With the LK 180/280, a gear skiving machine is launched on the market that enables chamfering during the machining process. "With this machine, you can also produce internal gears with a defined chamfer", explains Dr. Oliver Winkel, Head of Applied Technology at Liebherr-Verzahntechnik GmbH. "This is a world first." The advantages are obvious: The 90 degree positioned chamfering device does not influence the cycle time and delivers deburred and chamfered workpieces – an absolute advantage for any customer.

### **New additional functions for maximum flexibility**

"For us as gear specialists, it was important to be able to offer our customers new additional functions", proclaims Oliver

Winkel. "Our tool changer can accommodate up to twelve tools for different operations." Gear skiving tools for roughing and finishing, drilling, and turning tools allow machining in a single workpiece clamping fixture. This is of particular interest with position-orientated gears, explains Thomas Breith, Head of Product Management. "Beyond mass production, we can very clearly see a trend towards the integration of various work steps. The aim here is to reduce the set-up times of associated or adjacent machines, as well as the influence on workers."

If re-clamping is dispensed with, many operations become faster and more reliable. Holes can be drilled, for example, exactly at the position of the gear without the need for a reference point marking or renewed measurement. Particularly on ring gears for

### Highlights of LK 180/280

- Small machine, space-saving and fast
- Skiving and chamfering in one machine
- Tool changer integrated in the machine
- Roughing and finishing tools
- Additional functions such as turning, drilling, hobbing and measuring
- Integrated measuring of skiving tools

planetary gear sets, the reference journal (or reference hole) can be precision turned to match the gear so that one step of the operation can be dispensed with. “The quality and accuracy of our gears are increasing because they always relate to the reference surfaces”, adds Oliver Winkel.

### Integrated tool measurement in the machine

Quality is also the main argument for tool measurement in the machine. “The gear skiving machine was developed with a view to the highest precision in all aspects”, emphasises Winkel. By performing tool measurement in a clamped state in the spindle, a higher process reliability and constant quality are achieved. External tool pre-settings are dispensed with and also the multiple administration of tool data becomes superfluous. This helps to avoid faults and eliminates inefficient procedures.

“Our larger LK 500 gear skiving machine was received very well by the market”, reports Thomas Breith. “We are extending the portfolio downwards with the new machine because many

parts can also be machined on a smaller model. At the same time, we offer a package with additional options such as tool changing system, multi-machining functions, tool measurement and chamfering during the machining process, that doesn’t exist anywhere else and we can promise great interest in it. This small machine leaves almost nothing to be desired and is also of interest to customers who have so far not discovered the benefits of gear skiving for themselves.”

Liebherr-Verzahntechnik GmbH offers the new gear skiving machine generation variably with various table and head variations – in the trusted modular system. The new series is set to cover the maximum workpiece diameters of 80, 180 and 280 in future and will be extended gradually.

### Skiving<sup>3</sup>: machine, tool, technology

The process of gear skiving depends heavily on the tool. “Successful skiving depends on many details and we know our setting screws”, reports Arroum Haider, Team Leader of Tool Sales at the Ettlingen factory. “Instead of taking an empirical approach during configuration, we prefer our calculation models that are becoming more and more accurate.” A deep knowledge of the kinematics of skiving is required, particularly at the limits of operation. “This process is not forgiving of inaccuracies or even faults. On the contrary: It punishes incredibly, and severely.” Customers have discovered the procedure for themselves and welcome the design and manufacture of skiving tools from a single source.



## “A chamfer for every gear”

**Johannes Weixler has developed a new universal chamfering application – with the dynamic mathematical assistance of colleagues.**

Johannes Weixler has been employed at Liebherr-Verzahntechnik GmbH for 20 years and is responsible for technical offering. He listens to the problems and imaginations of customers and finds solutions – “That is my job.” In one area, however, he had to wave aside many years unfortunately: “The chamfer has become a significant factor in both gear design and manufacturing. By implementing the ChamferCut technology, we are very well set up at Liebherr in the area of chamfering, too. When it comes to chamfering internal gears on ring gears or cluster gears with interfering contour, however, the procedure often reaches its limits.” Customers and Liebherr sales personnel had identified an urgent need for a solution – and Johannes Weixler had an inspiring idea.

### **Simply enhance ChamferCut**

Where the ChamferCut unit cannot reach, a tapered end mill can be used for deburring. “The idea is to mount the tool directly on the machining head of the ChamferCut with its own drive and own swivel axis. The tapered end mill can then be controlled via the NC axes – and this is where our mathematicians came in”, explained Johannes Weixler.

What initially appeared quite simple became a challenging mathematical task from the perspective of his colleagues, Robert Würfel and Johannes van Hauth. Robert Würfel remembers: “Johannes Weixler came to us with a request to convert his idea into a mathematical description and to solve it numerically. He wanted a constant feed, which can only be achieved through an uneven rotating speed of the workpiece. We originally wanted to use just one axis and faced



the question: How do we achieve a nice chamfer that looks even from tip to foot?"

### Significance of chamfer growing

A mathematical model was created that Johannes van Hauth implemented in a test program for calculations. Since then, not only has a patent been registered for the concept of the end mill on the NC axis but also for the axial movements during milling. The reason: "This method is of interest for practically any customer with difficult geometries and, as far as we are aware, is the only available solution on the market", says Johannes Weixler in estimating the potential of the invention. The background: The number of gears in gearboxes is growing, but at the same time the amount of space available is decreasing. Where space had to be allocated for four gears in the past, these days it is often seven gears. The gears are therefore becoming smaller and they are required to perform at a higher level, particularly at the edges, which is only possible with perfect chamfering. "Chamfering therefore extends the limits of possibility."

To satisfy the requirements, difficult geometries are dealt with by hand or spring-loaded guided end mills. Example based on cluster gears (see image): With the new method, the ChamferCut unit can machine the upper and the lower gear. However, it cannot reach the middle one. "A tapered end mill is used for deburring here: first, a meshing sensor finds the tooth space and then the travel is calculated. Our milling tool only moves from the top down so there is no risk of collision. The swivel option enables it to reach all edges: tilted downwards, it can machine the bottom contour, while tilted upwards it is able to machine the top one", says the engineer to explain the method. Internal gears from ring gears can also be machined in the same way – even if there are contours on the inside. "This means that a chamfer is possible on practically any gear", says Johannes Weixler in summarising the potential of the application.

"Chamfering therefore extends the limits of possibility."

Johannes Weixler, Head of Portfolio Management, Technical Offer

### Enormous scope thanks to a completely normal tool

Tapered end mill deburring is possible alongside the main tasks of gear hobbing, gashing, shaping, and skiving. A standalone solution – e.g. for retrofitting – is also feasible. For manufacturers with small batch sizes, a tapered end mill without the ChamferCut tools could also be of interest: "ChamferCut tools are workpiece-specific and are only worth the investment for higher batch-size volumes", explains Johannes Weixler. "The tapered end mill is a completely normal tool, made of carbide, a catalogue part. We offer a tool changer for the machine that can also exchange tapered end mill cutters. In addition, the tapered end mill is able to



Problem solved by teamwork: Johannes Weixler, Johannes van Hauth and Robert Würfel



The tapered end mill gets to difficult-to-reach spots

### Highlights

- Flexible solution especially for internal gears or interfering contours
- Consistent chamfer width from tip to foot
- Chamfering alongside main task of gear cutting, slotting and skiving
- Creation of variable chamfer shapes

create variable chamfer shapes. With this broad range of possibilities, completely new perspectives are presented for many applications."

## New at Liebherr: worm milling

**“A worm is actually a gear with very few teeth.” And for this reason there is now a solution from Liebherr that can machine components of this kind economically: the LC 80 WD milling machine.**

In the production of electronic steering systems, the cycle time means everything. But a customer's existing system was already optimised to the hilt, which meant that further improvements could only be realised with new machine technology. “At this point, the company turned to us because our machines are already employed there: They machine the steering segment while other machines make the worm”, reports Johannes Weixler from the technical quotations department at Liebherr-Verzahntechnik GmbH.

Worms have to be made with very high precision for electronic steering. “Electronic steering is becoming more popular because it offers some advantages over hydraulic power-assisted steering”, says Johannes Weixler to explain the market significance. “It only operates when actual steering movements are carried out and thereby saves a considerable amount of energy. Furthermore, it is very quiet and therefore particularly ideal

for electric cars.” New vehicles are almost exclusively equipped with this technology. As such, this is real mass production.

### **Swivelled cutter head, no steady rest**

“In actual fact, a worm of this kind is a gear with two teeth and this is why it should generally be made on gear hobbing machines”, says Johannes Weixler in explaining the rationale. The swivelling range of the cutter head of the customer's LC machine on which it is based was extended for this special task. A significant advantage of the Liebherr solution compared with conventional worm milling is the elimination of the steady rest. “We solved this problem with an intelligent clamping fixture that is extremely rigid”, reports Johannes Weixler.

While adapting the machine to worm milling, requirements of the machine table were taken into account – as well as the ap-





Source: Robert Bosch Automotive Steering

“Electronic steering is becoming more popular because it offers some advantages over hydraulic power-assisted steering.”

Johannes Weixler, Head of Portfolio Management, Technical Offer

plied cutting forces – to facilitate a stable process. Tool life tests indicate that it was possible to increase the cutter life by more than 40 percent. Since the price of the tools makes up a large part of the machining costs, big savings can be realised here.

#### Chamfering and brushing included

Because the gear cutter can produce razor sharp burrs, the machine is equipped with a multi-station ring loader and an additional chamfering unit. Conventional side milling cutters are used for chamfering, which are significantly cheaper than the worm cutters otherwise used. A brush is also installed in the same position, which removes any micro-burrs after chamfering and is readjusted automatically as it begins to wear.

“We were able to provide added value for our customers in several aspects”, says Johannes Weixler in summarising the results of the project. “The customer can now cut, chamfer and brush parts on one machine. Chamfering during the machining process means that a faster cycle time can be realised and the tool

costs are also lower. This is a major saving, particularly with the customer’s high volume.”

#### Advantages

- Shorter cycle time
- Long tool life
- Lower tool costs
- Workpiece exits the machine without burrs
- Chamfering and brushing during the machining process



In electromobility, noise reduction means everything

# Chamfering despite interference contours

**As before, ChamferCut is a technology with a great deal of development potential. A new upgrade is now pushing the limits of the impossible.**

On components such as shafts or idle gears, it was often not possible to use the ChamferCut method for chamfering until now. "Interfering contours, like shoulders, or shaft-work, pose a risk of collision that had restricted the potential use of the tool", explains Dr. Oliver Winkel, Head of the Technology Application. "By tilting the tool, it is now possible to machine gears that had not been possible before."

## A tool for every side

Left and right tooth flanks are machined separately from each other with different tools. "A cutter arbor can easily handle four tools so this is not a problem. For small gears and shafts, the range of application is great." Oliver Winkel has series production facilities, the automotive industry and suppliers, truck manufacturers and industrial applications with repetitive series production in mind that can all profit from the technology.

"We consider this to be an extremely important subject. After all, about half of the gears and shafts in a gearbox have interference contours. This is an extremely high number of parts for which the ChamferCut CG technology (collision gear) can prove its worth", says Oliver Winkel in his estimation of the value of the development. Since the use of classic ChamferCut tools is limited on account of interfering contours, this type of chamfering is usually employed on disc-shaped or simple component geometries.



## Highlights

- Chamfering of shafts or gears with interfering contours
- Chamfering of internal gears
- Up to four ChamferCuts on one arbor

tries. "We now see a dramatic increase in the application possibilities, so ChamferCut will be of interest to a new range of customers as well."

## Same technology, further opportunities

Based on the principle of ChamferCut, it is now possible to cut chamfers in internal gears provided the faces lie on the edges of the component. For the ChamferCut IG tools (internal gear), the tool profile is changed to the concave shape of the internal gear and positioned accordingly within the workpiece. Apart from the use of tapered end mill tools, there are not very many chamfering solutions for internal gears as yet (for more information, read the article "A chamfer for every gear" on page 14). ChamferCut is a very fast and precise method, though until now it was not considered at all for internal gears. "As yet, we are unable to estimate the demand in this area", Oliver Winkel reports. "We are therefore looking forward to the reactions, and speaking with customers about this subject, which will no doubt provide further impetus for the development."



# CBN generating grinding – a thoroughly economic alternative

**The demand for high quality gear teeth in areas such as electric mobility, for example, come with great challenges. Liebherr is working on the development of solutions for economic manufacturing.**



For many applications, generating grinding with corundum is a good solution, but this abrasive also has certain disadvantages for some applications. Grinding special geometrical modifications could, for example, have a negative effect: The modifications would then have to be integrated in the tool completely or partially via the dressing process in the machine. On one hand, however, profiling a grinding worm needs time and, on the other, it alters the geometry of the tool. Depending on the choice of grinding process, it has to be repeated in very short intervals in order to guarantee the production at the same level of quality. This is just where Liebherr comes in, offering a CBN tool with an implemented modification and demonstrating on an example workpiece that extremely economic production is possible with these tools.

CBN stands for cubic boron nitride. Next to diamond, it is the second hardest cutting material in the world. It consists of a three-dimensional matrix made of boron and nitrogen atoms that can develop a broader spectrum of crystal forms than diamond. It has high thermal conductivity and a low coefficient of friction. In this way, the workpiece heats up much less than grinding with corundum, for example. It is possible to machine very hard materials reliably with CBN. CBN grinding worms can also be smaller, which means that the range of applications is greater than with corundum.

CBN tools are currently experiencing a comeback. They may be expensive to procure but make gains with the unit costs on modifications. Dr. Andreas Mehr, the leading grinding technology expert at Liebherr-Verzahntechnik GmbH with a

## Advantages of CBN tools

- Tool mounting, pre-profiling and dressing are dispensed with
- No adjustment of profile angle necessary
- Easy operation
- Significantly reduced measuring and testing effort

PhD in engineering, explains the differences of the grinding materials: “We have been using galvanically coated CBN since 1988. It is a highly durable grinding material. A significant increase in the grinding performance of modern corundum has been achieved in recent years but, compared with CBN, it comes with the disadvantage of the amount of effort required for dressing, which is encountered most prominently on topological grinding processes.” With these processes, the num-



ber of workpieces per dressing cycle is significantly reduced due to the limited shift possibility, which in turn raises tool costs and also cycle times. It may be possible on corundum tools (e.g. for distortion-free generating grinding) to increase the workpiece number for each dressing interval through new mathematical solutions but this also applies in the same way to the use of CBN tools.

With CBN, the dressing times can be dispensed with completely, which means that cycle times and thereby manufacturing costs can be reduced. CBN is highly machinable and generates an extremely low measuring complexity. A CBN grinding worm is clamped in and the grinding process begins straightaway – with there being no need at all to make corrections beforehand. The unit costs of a test work-

---

#### **LGG 180 with integrated centrifuge**

In most cases, the new generation of electric cars is built in new factories where the focus is on reliable and clean processes. At EMO 2019, therefore, Liebherr is exhibiting a generating gear grinding machine that meets the requirements of a clean factory in full: The LGG 180 with integrated centrifuge. The centrifuge station for the removal of burrs and coolants is located at the pocket of the ring loader pointing towards the operator side. It is mounted decoupled from the machine so that oscillations or vibrations from the centrifugation process do not have any effect on the gear quality. Spinning during the machining process is therefore possible. There is no loss of oil, the media remain in the machine and the cleaned components can be transported further in any automation system.

---

piece ( $m = 1.53 \text{ mm}$ ,  $z = 81$ ) included a special width modification with corundum at 4.25 Euros with a cycle time of 114.6 seconds, while the same grinding process with CBN was 3.38 euros cheaper and considerably faster with a cycle time of 78 seconds. Where the number of producible

workpieces per dressing cycle with corundum is in the two figure range, it can occasionally reach well into the four figure range with a CBN coating. “Each situation needs to be assessed individually to determine which grinding worm is the most viable. We are happy to advise our customers on

### Advantages of integrated centrifuge unit:

- Clean factory thanks to integrated centrifuge: dry workpieces, no oil loss, reliable production
- Decoupled centrifuge unit with no transfer of vibrations to grinding machine
- Can be connected to any conventional automation solution

whether CBN is the better alternative for their numbers and application scenarios”, offers Andreas Mehr.

### A robust process

In a dressing-free CBN process, all parameters are predefined and “frozen”. This is a crucial difference between corundum and CBN processes: All corundum processes are subject to changes through dressing, which can impair the grinding worm quality. Examples are wear of the dressing tool or diminishing worm diameter: As the worm diameter diminishes, the length of the active worm spirals are shorter, which reduces the number of active abrasive grains. A consequence of this is an increase in the roughness factor on the tooth flank, which should remain constant throughout the worm tool life. “There is a limit to which this can be counteracted through finer dressing processes,” explains Andreas Mehr.

Additional processes, such as dressing, present fault sources that simply cannot occur with CBN. CBN processes are extremely robust and quality assured, which makes them particularly interest-

ing for the economic production of high quality gear teeth, such as in the area of electric mobility. “Attempts are being made to reduce noise, particularly on the very sophisticated electric gears in the automotive sector, by changing the macro and micro geometry,” explains the expert.

Liebherr manufactures CBN tools at the Ettlingen factory. “Our aims in production are high performance and top quality in a very sturdy process”, explains Haider Arroum, Team Leader of Tool Sales Ettlingen. The production of CBN grinding worms and discs is therefore carried out in a closed loop process in which measurement results flow immediately back into the production parameters as corrections. “We have to carry over the configuration accuracy to manufacture as close to 1:1 as possible”, says Haider Arroum in substantiating the complicated procedure.

### Peter Wiedemann

Head of Sales Gear Cutting Machines

Kaufbeurer Strasse 141,  
87437 Kempten, Germany  
Phone: +49 (831) 786 1472  
peter.wiedemann@liebherr.com



# Bigger, better, faster: the new LHStation control panel

**More than a new control panel: Under a 24 inch monitor, the LHStation combines the new Sinumerik One system line with the new LHGearTec software for all gear engineering equipment. This constellation makes complete machining of a gear workpiece possible.**



When Peter Pruschek, Head of Electronic and Control System Development at Liebherr-Verzahntechnik GmbH, presents the new LHGearTec control system, he first highlights the striking new features: “We are entering the market with a 24 inch touchscreen monitor – an above-average size for machine tools. The monitor is flanked by an additional number pad for fast numeric input because we have learnt that inputting data on a touch basis is not suitable for workshop applications. Moreover, the control panel is supplemented by a removable handheld unit with a second touchscreen display, the LHMobile. The handheld unit – the first of its kind in this form – is an integral part of machine operation.”

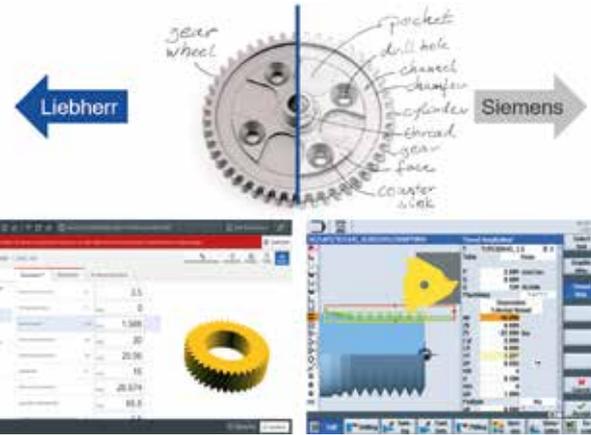
Not only does it simply mirror the view of the large screen, there are also operator functions and displays between the fixed main screen and the removable handheld unit. “The LHGearTec display on the main screen guides the user through the programming and set-up procedures. The LHStation offers the operator the present handling functions that are currently required, while the large screen provides more clarity and further details and data.”

### Two control surfaces in matrimony

The LHGearTec software from Liebherr benefits from a completely new design and more intuitive user guidance. All gear engineering equipment can be shown on the screen. Furthermore, it is also possible to use all functionality of the “Sinumerik Operate” control system interface that underpins it. Peter Pruschek explains the advantages: “We are able to cover a broader workpiece spectrum and machine gear workpieces completely with the aid of machining cycles – including additional processes such

**Advantages**

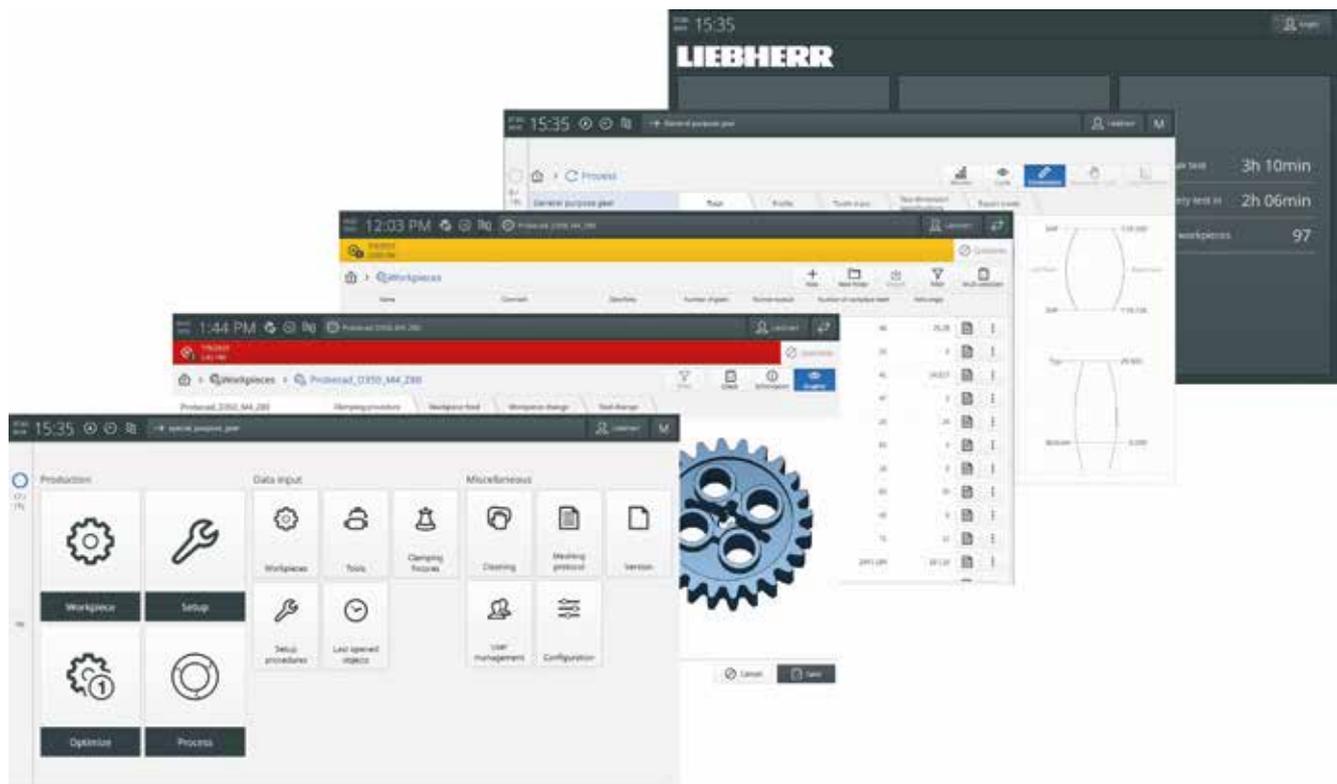
- Broader range of parts possible
- All gear engineering equipment
- Complete machining of gears saves time and improves accuracy
- Higher operating speed
- Context-sensitive user guidance
- Tool changing system
- Use of Siemens cycles
- Can be changed between electronic gearbox and interpolation
- 24 inch display
- Separate operating unit with own screen



LHGearTec and the Siemens user interface are both available on one screen

as drilling, hobbing or turning. With special applications and small batch sizes, this saves the user time. Complete machining in a workpiece clamping fixture can also increase accuracy and reduce the amount of effort required for handling.” The LK 280 DC will fully utilise these functions as the first Liebherr machine (read the article on page 12 to discover more).

The display on the screen changes between LHGearTec and the Siemens interface depending on the machining process. For actuation, Liebherr will rely on the new Siemens control system generation Sinumerik One in future.



The user is guided intuitively through various context menus

# Integration of metrology

**Wenzel GearTec GmbH, a successful manufacturer of gear inspection machines, has been part of Liebherr-Verzahntechnik GmbH since May 2019. The Karlsruhe-based company has specialised in the measurement of gears, gear cutting tools and other rotationally symmetrical workpieces since 2004 and has an innovative product range that perfectly complements Liebherr's own.**

Gears are in continuous contact with each other under high load, with fast movement. Therefore, it is immensely important that they comply with predetermined quality standards, to keep noise generation as low as possible, for example. Their quality is also a significant factor in the prevention of premature wear and, as a result, the prevention of gearbox failure. Machines for gear inspection, such as the successful WGT series from Wenzel GearTec, are predominantly used in gear manufacturing for gearboxes in the auto, truck, rail vehicle and aerospace industries as well as in mechanical engineering, where they ensure high precision.

## **The star: the WGT series**

The 4-axis measuring instruments of the WGT series have high-precision mechanics and electronics, which are controlled by smart software. Machines for gear inspection must fulfil even stricter specifications than machines for gear manufacturing: they comply with the VDI guideline VDI/VDE 2613, group 1.

The WGT machine is not the solution – it is part of the solution. The application team examines the specific requirements and then configures a system that fulfils them. Gear inspection machine options include travel ranges on the Z-axis adapt-

ed to customer requests, longer tailstocks for mounting longer shafts and various rotary tables for the right load capacity. An automatic probe change system ensures uninterrupted measurement of the workpieces. Thanks to its wide range of accessories, a WGT machine can be perfectly adapted to meet customer requirements and individually configured. It is suitable for all types of gears, such as cylindrical gears, bevel gears, worms, worm wheels, shafts, gear cutting tools and other rotationally symmetric parts.

All machines are equipped with Renishaw probes. They offer the highest precision



Wenzel Geartec becomes part of Liebherr (from left to right): Heinrich Brüderle, Dr. Christian Lang, Frank Wenzel and Dr. Hans Gronbach

### This is what sets WGT machines apart

- Lasting precision through lapped granite guides and air bearings, constant thermal profile, precision rotary tables and Renishaw probe systems
- Low operating costs due to contactless guides (as a result of the air bearings), reliable probes and cost-effective spare parts
- Flexible for all kinds of gears and can be configured for other tasks
- User-friendly interface and ergonomic design



“Liebherr is renowned around the world as a trusted employer and we are proud to be part of a global company.”

Heinrich Brüderle, Sales Manager Liebherr-metrology, former Wenzel GearTec GmbH

at low operating costs. The international Renishaw team supports customers and Liebherr and is responsible for the global supply of spare parts, probes and accessories as needed.

#### An option for the future

Nothing will change for existing customers and staff at Wenzel GearTec because of the acquisition. “Liebherr is renowned around the world as a trusted employer and we are proud to be part of a global company,” Heinrich Brüderle, divisional manager at Wenzel GearTec GmbH, states. Wenzel and Liebherr have been

partners since 2015. The goal of this year’s acquisition was to be able to offer closed-loop system solutions from a single source.

The General Manager of Sales and Marketing at Liebherr-Verzahntechnik GmbH, Dr. Christian Lang, is positive about the acquisition: “We are delighted that we were able to finalise the negotiations in an efficient and constructive manner. Now we are able to include gear cutting measurement technology in our range of products and work together on technological development.” Former managing part-

ner Frank Wenzel agrees: “We know our company is in safe and reliable hands.”

### Heinrich Brüderle

Sales Manager Liebherr-metrology

Dieselstr. 1,  
76316 Malsch, Germany  
Phone: +49 721 17087 110  
heinrich.bruederle@liebherr.com

## Top gear cutting tools, in-stock – with new material and coating

**Simply order from the catalogue and two days later the new shaping tool will arrive: Liebherr makes the process as straightforward as this for customers and offers a broad range of stock tools available for immediate delivery. New: Instead of cutting material ASP2030 with a titanium nitride (TiN) coating, stock tools are now made as standard from ASP2052 with Alcrona Pro.**

“This is essentially a performance upgrade”, confirms Haider Arroum, Team Leader of Tool Sales at the Ettlingen factory. “The reason is that our customers have to machine increasingly harder materials, such as 42CrMo4 (900 to 1200 N/mm<sup>2</sup>), for example, and need a higher tool performance as a result. These

new materials were seen as somewhat exotic in the past, while these days they are pretty widespread. We opted for this development to ensure that our stock tools offer more flexibility for our customers.”



“Our stock tools catalogue enables a delivery speed that, particularly in Europe, few other suppliers can match.”

Haider Arroum, Team Leader of Tool Sales Ettlingen

Thanks to the new material and coating combination, the tool life can be significantly extended. It also facilitates higher cutting speeds in wet and dry machining without negatively-affecting tool life.

**Higher cutting speed, longer tool life**

The changes are the potential cutting speed and the tool life whose quality is markedly improved by the new coating. “We already employ this cutting material and coating combination in other technologies, such as gear skiving. The technology is tried and tested and reliable”, reports Haider Arroum. Other coatings and cutting materials are still available of course.

“Our stock tools catalogue enables a delivery speed that, particularly in Europe, few other suppliers can match”, the tool expert explains. At Liebherr, standard-compliant tools can be ordered from stock – via an order form or the online catalogue. Both were revised and updated this year.



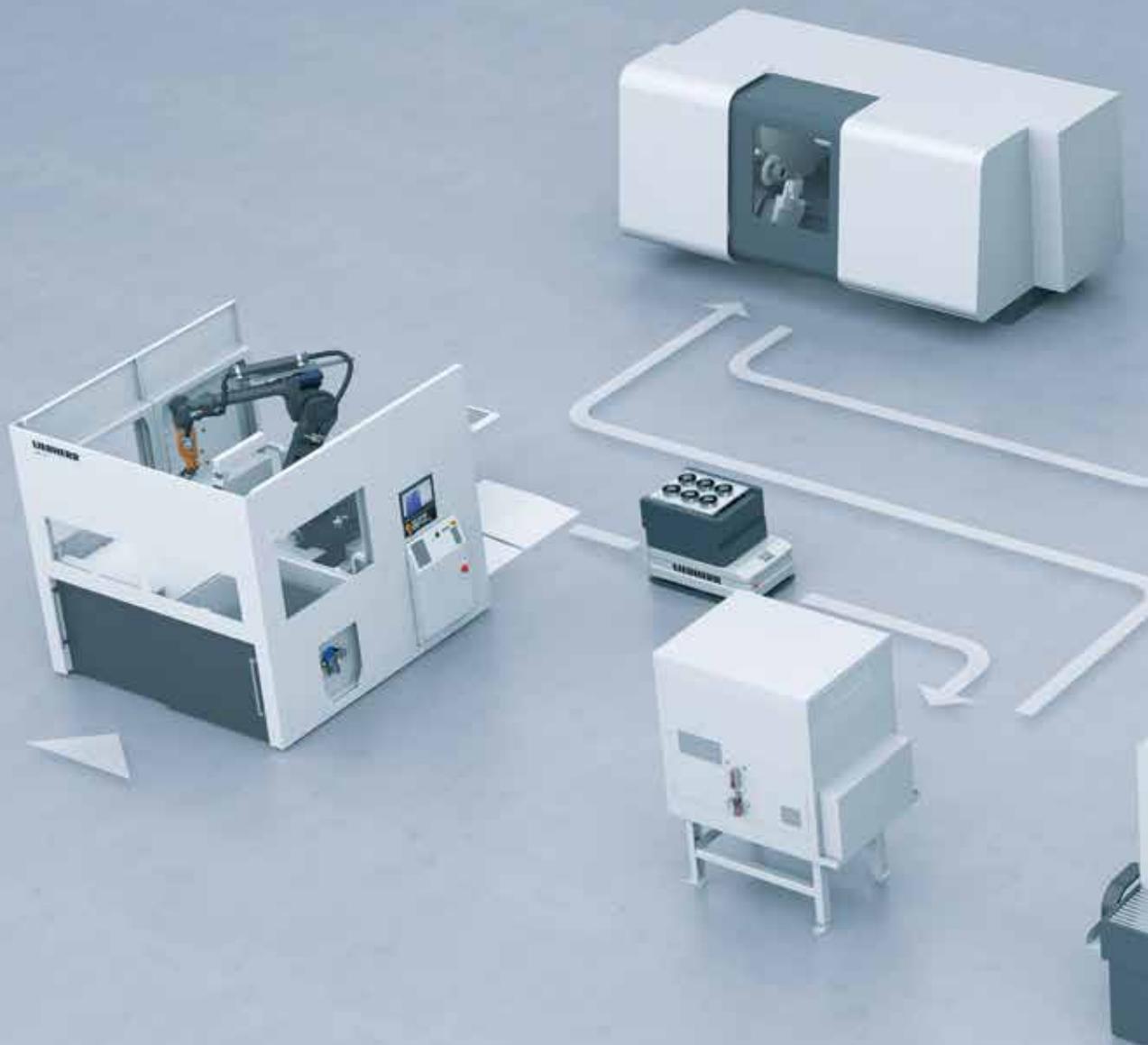
**Haider Arroum**

Team Leader of Tool Sales Ettlingen

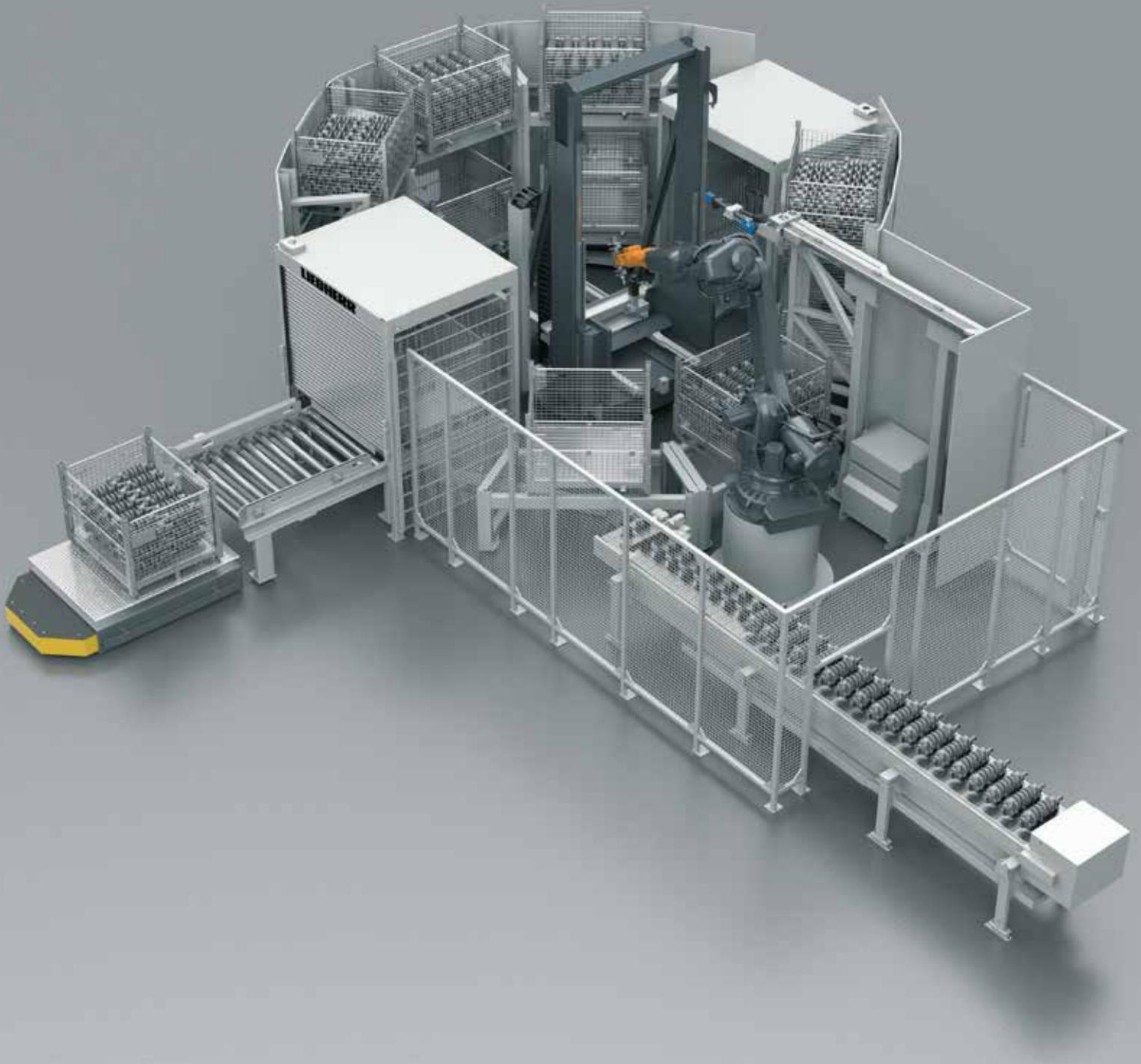
Hertzstrasse 9 - 15,  
76275 Ettlingen, Germany  
Phone: +49 (7243) 708 673  
haider.arroum@liebherr.com



# Automation Systems







## Combined for greater efficiency

**Rotary loading systems and bin picking are a permanent feature in the Liebherr automation division. Together, they**

**form a good team in automating inputs and outputs from production lines.**



“The more precise workpiece placement is to be, the more challenging the task is for the vision system, the picking technology and the alignment station.”

Uwe Radigk, Head of Global Key Account

In many modern production facilities, manufacturing lines with numerous machines work through various processing steps in an automated manner. Uwe Radigk, Head of Global Key Account Management in the automation division of Liebherr-Verzahrtechnik GmbH, knows that automation often stops at the end of the line: “Loading components on these production lines still often takes place by hand. Blanks are supplied to the bins in chaotic order and positioned for machining by workers. The aim here is to provide sensible automation solutions for the inputs and outputs of these kinds of production lines as well that make the production process easier and more reliable.” The smaller the batch size and the more diverse the components and workpieces that are produced on the line, the more challenging this task becomes.

Liebherr has developed highly flexible intralogistics for a customer in the automotive industry. “In this particular example, a manufacturing line with about

30 machines processes and machines crank shaft blanks of different types from an unfinished to a finished part”, reports Uwe Radigk who supervised the project. “These arrive in random order in bins at the start of the line. Production is not meant to be controlled through complete emptying of each bin, though, rather via the specified number from the customer’s main computer. If only half of the blanks in a bin are required, the remainder is stored for an interim period and processing continues on new bins with different component types.”

#### Perfectly positioned for machining

This problem has been solved by Liebherr using a rotary loading system (RLS) with bin picking. The individual workpieces lie in these bins in chaotic order. The core of the Liebherr bin picking system is an intelligent piece of software that compares data from 3D visualization of the bin contents with the actual CAD data of the workpieces being searched for and detects the correct parts. Potential picking

points are determined in the process and a collision-free withdrawal path is calculated. “This means that the robot is capable of picking the optimally positioned workpiece precisely from a depth of up to one metre,” explains Uwe Radigk. Since the components have many different picking positions, an intermediate storage area is used as a re-grip station on which the components can be realigned before transfer to the manufacturing line. With tasks such as these, “the more precise workpiece placement is to be, the more challenging the task is for the vision system, the picking technology and the alignment station. The typical cycle time for this process is roughly 30 seconds.”

This procedure enables a high variance of parts as well as very flexible production. The feed station features a rotary loading system (RLS) with eight storage locations for intermediate storage of the workpiece bins, two workstations, a loading station and an outfeed position. In this way, orders can be worked through in a varia-

## Technical Data

		RLS 800		RLS 1500	
Transport weight in kg		800		1,500	
Height of workpiece	2 levels	2 x 1,100		2 x 1,400	
Including pallet	3 levels	2 x 700 + 1 x 1,100		2 x 600 + 1 x 1,300	
Workpiece – Ø in mm		600	800	900	1,300
Number of storage locations	2 levels	16	14	14	10
	3 levels	24	21	21	15
	2 levels with RST*	24	22	22	16
	3 levels with RST*	36	33	33	24
Maximum height in mm		4,130	4,130	4,130	4,130

\*Rotary storage tower



ble manner. The cell retools itself and checks the workpieces. A special weight sensor detects workpieces that are wedged together. Through a comparison with CAD data, the vision system also detects parts that should not be in the bin and will not pick them. In this way, process reliability is increased due to the fact that an inspection is directly integrated in the logistics process.

### Orderly depositing at line output

Finished machined parts are usually very sensitive. Most components arrive at the commissioning station in batches and are correctly sorted on a conveyor belt, another solution provided by Liebherr. The parts are picked by a robot arm and placed in suitable blisters which, in turn, are stacked in bins. The picking system therefore features two tools equipped with an automatic changeover system. It handles workpieces with a mechanical parallel gripper and blisters with a vacuum gripper.

A pallet handling system (PHS 1500) with a large number of storage positions is capable of receiving full or partially full bins at any time. Once the bins are filled with finished parts, they exit the line automatically on a conveyor and are then picked up again by unmanned tools. At the same time, empty bins with blisters are fed into the system via a second conveyor.

“We were able to successfully bring the system into operation for our customer in March 2019. It is operating reliably and they are

very satisfied with their new system,” reports Uwe Radigk from the field. The potential for savings that they had hoped for is already evident. The company is saving material costs and reduces the burden on the environment through the efficient automated process. Staff can focus fully on the productivity of the line because manual loading is no longer necessary. “We have been able to elevate production to a new level while decreasing potential hazards with this system.”



**Discover more:**

<https://go.liebherr.com/ndyAtx>



## Jürgen Groß

Sales Director Cells and Flexible  
Manufacturing Systems

Kaufbeurer Strasse 141,  
87437 Kempten, Germany  
Phone: +49 831 786-3072  
[juergen.gross@liebherr.com](mailto:juergen.gross@liebherr.com)



# Autonomous travel through the factory

**While we still have some way to go to achieve autonomous driving on the road, factories are miles ahead: AGVs (automatic guided vehicles) are already being used in the area of production. They are responsible for intralogistical tasks in production and in doing so transport workpieces from unfinished parts to finished parts between the respective stages of production. But how does the raw material make it into a fully automated production system and how do finished parts make it out of the system?**

Liebherr-Verzahntechnik GmbH combines driverless transport systems with the tried and tested bin picking concept. Reliable 3D vision systems optically scan the workpiece environment and evaluate it. A robot with patented auxiliary axes can use this information to reliably unload chaotically stored parts from a container with a depth of up to one metre and position them on an AGV. Picking from the box is more complicated the less order there is when the workpieces are delivered, which means that more precision is needed to place them.

Similar rules apply for the production outlet: The robot arm of a pallet cell can pick the machined workpieces from

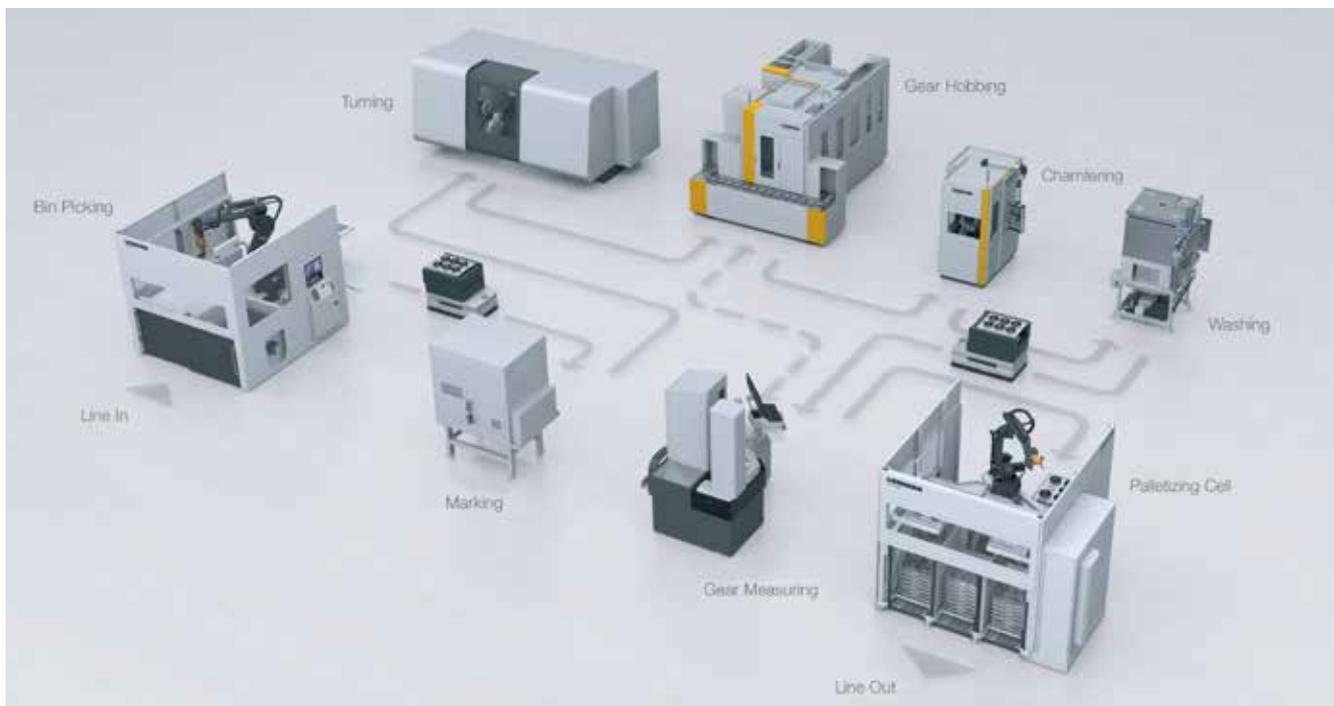
the AGV here as well and then palletise them in workpiece carriers such as wire crates or blisters. "Multi-layered storage in crates or blisters during which the robot restacks the crates and blisters in addition to workpiece handling as an intermediate step is also not a problem", explains Thomas Mattern, Head of Automation System Development. "Since the grippers can be changed flexibly, many options are available to us."

At EMO 2019, Liebherr-Verzahntechnik GmbH shows a possible automation solution for production input and output coupled with an autonomous AGV. "This is the step that has been missing in automation technology: individual production



More flexibility thanks to AGV

processes are already heavily automated, and now they are connected flexibly to each other." A system like this can be of great interest for standalone production as well. Thomas Mattern sees a clear necessity for systems such as these: "The more flexible production becomes, the more important intralogistics is. More diverse parts also means more movement in production. Smaller batch sizes have to take different paths in the factory. With our combination of AGVs and bin picking we are addressing a very topical subject here."



Automated guided vehicles open up new possibilities for connecting up machines and systems

# PHS Allround: twice as good

**PHS Allround has become a bestseller of Liebherr Automation Systems. The modular pallet handling system appeals to a wide range of different areas of industry with a main selling point being its scalability. It has now been made even more flexible with the new twin loader.**

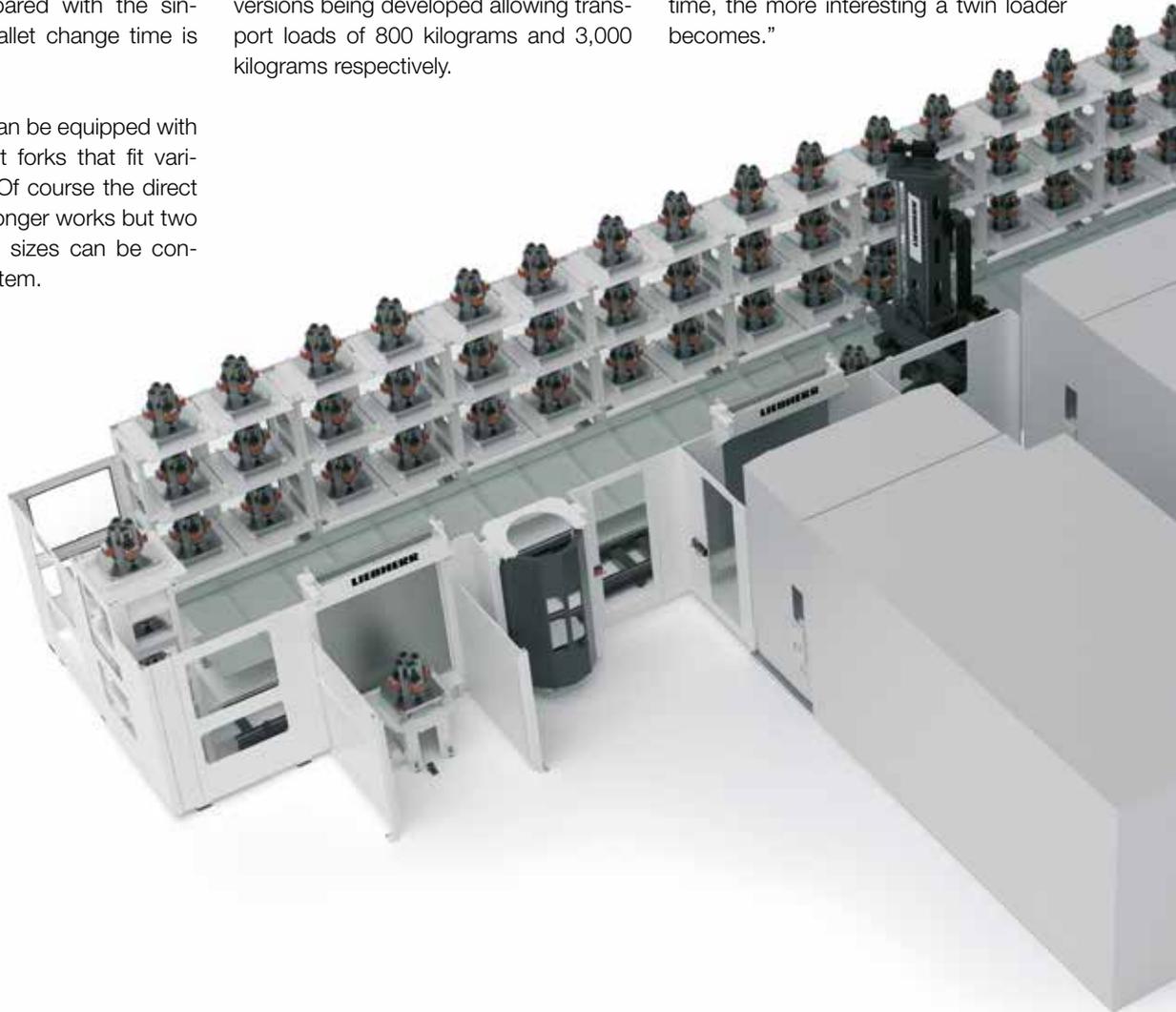
The version with twin loader features a moving turret with second telescopic fork. This is offset by 90 degrees and is able to fulfill two different functions:

1. The telescopic fork can carry an unfinished part in one motion and reload the machine straight after unloading the machined workpiece. This is of particular interest for direct-loading processing centres without pallet changer or systems with multiple machines. Compared with the single loader, the pallet change time is halved.
2. The twin loader can be equipped with different transport forks that fit various pallet sizes. Of course the direct change then no longer works but two different machine sizes can be connected to the system.

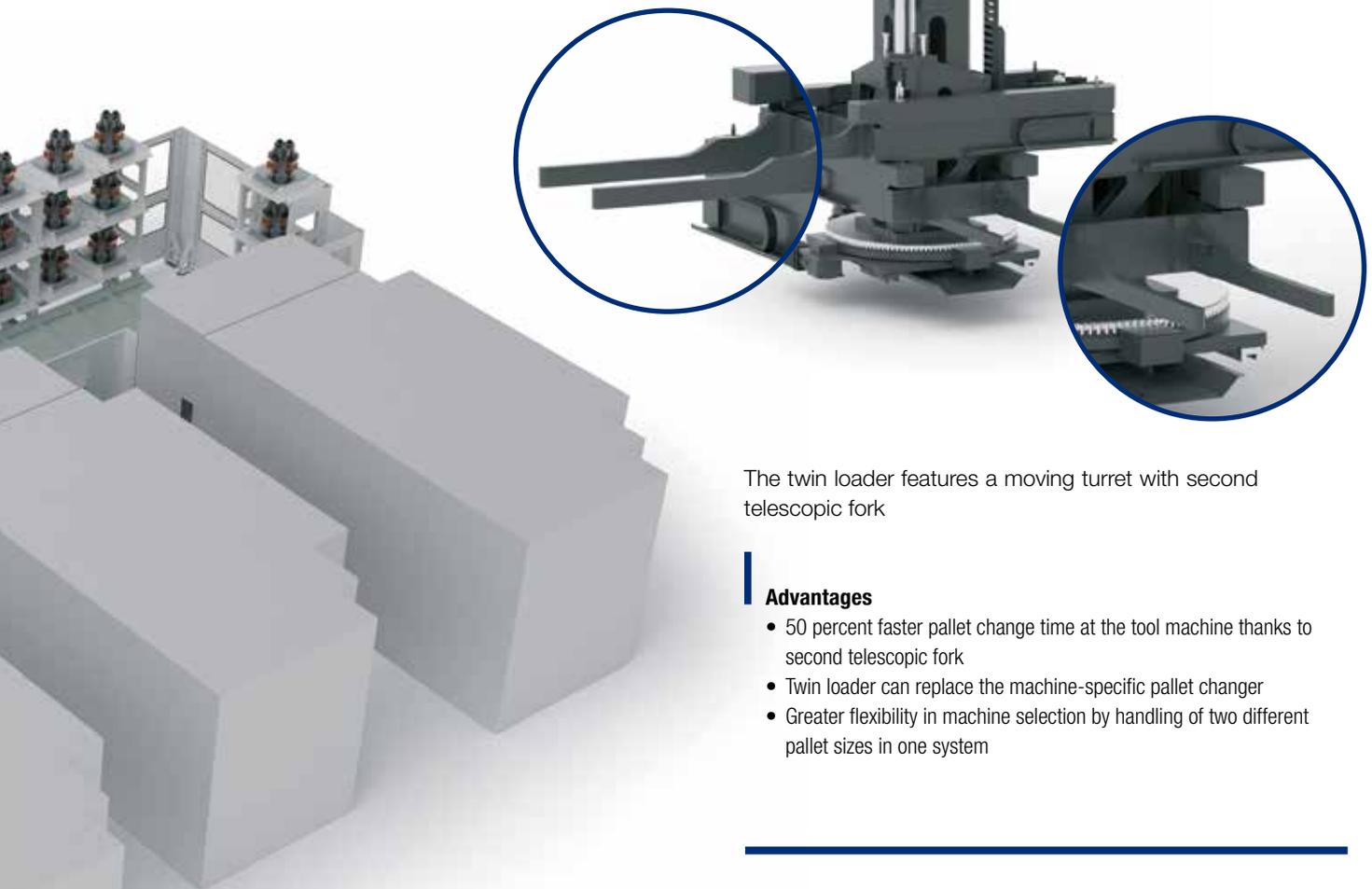
“A PHS Allround can supply up to four machines with workpieces clamped on pallets”, explains Thomas Mattern, Head of Automation System Development. “It consists of one modular system and can be set-up with completely different configurations and also easily extended at a later date. It is this modularity in particular that makes it so popular in the market.” Currently on the market, the PHS 1500 can allow a workpiece and pallet up to 1,500 kilograms. There are also two new versions being developed allowing transport loads of 800 kilograms and 3,000 kilograms respectively.

## Reduced processing cycle

“We have already increased our resources due to the high demand”, reports Knut Jendrok, Regional Sales Manager of Automation Systems. He promises a further push forward from the twin loader: “This is a prime-time-relevant feature: loading is faster, which thereby reduces the processing cycle. With shorter processing times, in particular, and frequent pallet changes as a result there are significant advantages: the shorter the processing time, the more interesting a twin loader becomes.”



A popular advantage of the PHS Allround is not impaired by the twin loader: The long telescopic stroke of the single loader remains unchanged in this version and as such offers the opportunity of integrating frontal access. Individual machines can be decoupled from the system through the secure intermediate spaces between the machine and PHS, while the remaining processing centres can continue to operate without restriction in automatic mode. "This is unique in this constellation", remarks Knut Jendrok.



The twin loader features a moving turret with second telescopic fork

#### Advantages

- 50 percent faster pallet change time at the tool machine thanks to second telescopic fork
- Twin loader can replace the machine-specific pallet changer
- Greater flexibility in machine selection by handling of two different pallet sizes in one system



**Discover more:**  
<https://go.liebherr.com/6eTn6L>



## Knut Jendrok

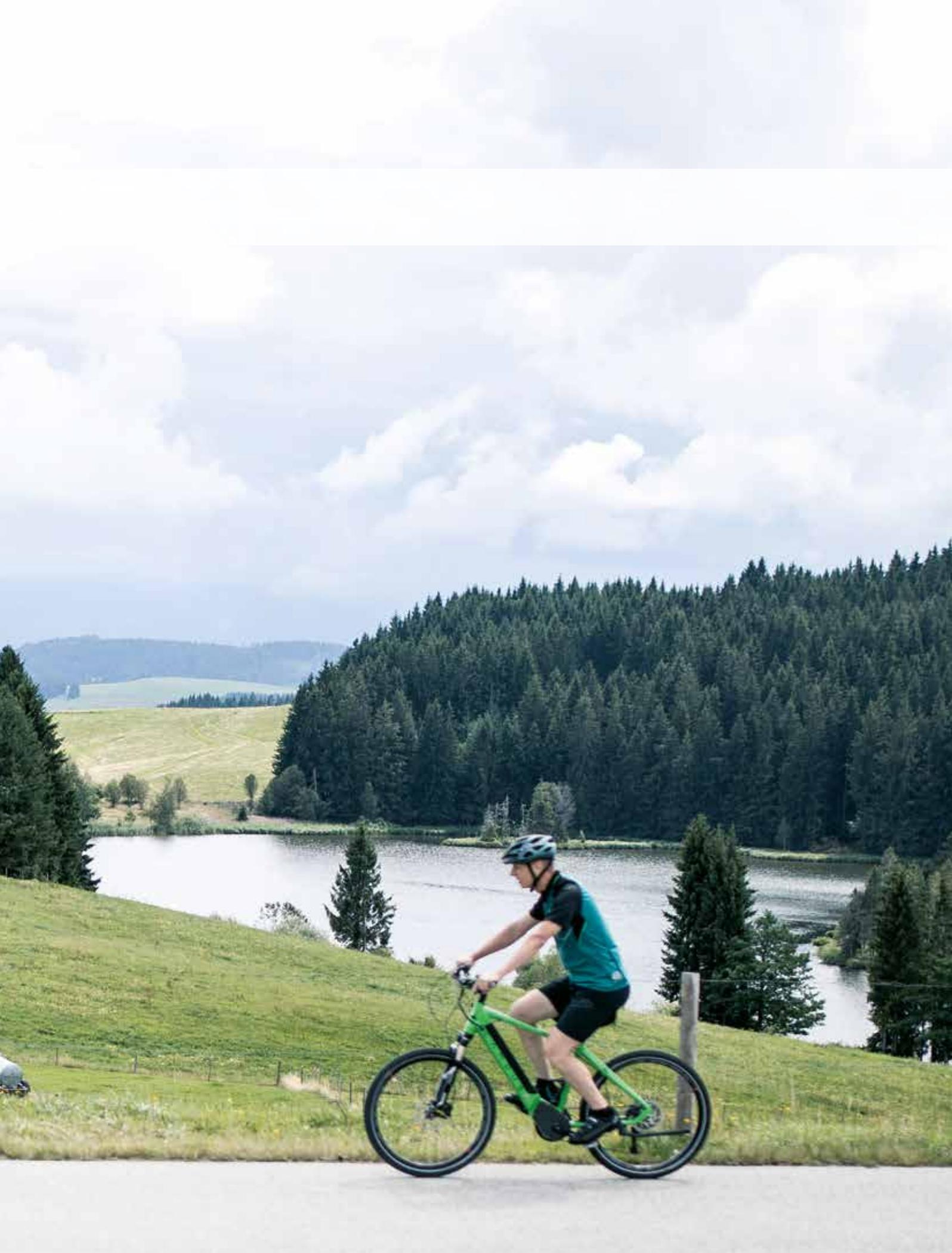
Sales Automation Systems

Kaufbeurer Strasse 141,  
 87437 Kempten, Germany  
 Phone: +49 831 786-1482  
[knut.jendrok@liebherr.com](mailto:knut.jendrok@liebherr.com)



# Practice







Source: MTU Aero Engines AG

## Liebherr and MTU Aero Engines: partners in automated machining of turbine blades

**The aircraft propulsion systems of today are wonders of technology. Above all else, the blades in the hot gas area have to withstand loads that, until fairly recently, seemed uncontrollable. Since air travel is rapidly growing in demand around the world, the production technology employed until now needs to be modernised.**

“The highest degree of accuracy is required when machining high precision blades for turbines”, explains Marc Weiß, Senior Manager Flexible Production Systems at MTU Aero Engines in Munich. The company is among the leading group of manufacturers of civil and military aerospace propulsion systems of all performance classes as well as stationary industrial gas turbines.

Turbine blades are cast parts, usually made of nickel-based alloys that are difficult to cut. Highly complex geometries

need to be machined with extremely high precision. During operation, the blades have to endure the most extreme conditions – tremendous centrifugal forces, temperatures close to melting point and heavy vibrations. A break could lead to destruction of the power plant. For this reason, extremely strict quality requirements apply for all steps of the manufacturing process. For the development of a new, highly automated production system, therefore, only partners that were able to guarantee the highest level of quality and reliability were considered.

### **A quantum leap in automation**

“The requirements of MTU were vast and necessitated more than a ten-fold increase in staff productivity”, remembers Michael Appel, Regional Sales Manager for Automation Systems at Liebherr-Verzahntechnik GmbH in Kempten. Due to an acute staff shortage, MTU ran the risk of failing to meet the huge increase in demand. It was therefore important to massively increase productivity to prevent this. Until now, one employee was needed to manually operate one to two machines in a production chain of individual stations.

In contrast, the new solution relies on just one employee to achieve a very high processing depth at four parallel-operating, fully-automatic grinding machining cells.

Each cell consists of a PROKOS XT 6-axis grinding machining centre from BLOHM, which is supplied by a robot from AMT. The robot receives workpieces, clamping fixture, dressing tools and gripper tongs from a fully-automatic Liebherr pallet handling system (PHS). Thanks to its 250 pallet slots, it is able to supply the machining centres for at least 66 hours unmanned to allow the systems to work through a complete weekend also with flexitime operation. A loading portal (LP) – also from Liebherr – runs on the other side of the manufacturing cells via which the machines can be supplied with tools and grinding discs.

The “brains” of the outfit is a control system from SOFLEX, which networks all of the plant units together and enables self-organised production to the furthest degree. This new flexible production system (FFS) can machine a mixture of about



“The system that we have created together is very complicated and way more advanced than the technology employed to date.”

Marc Weiß, Senior Manager Flexible Production Systems at MTU Aero Engines Systems

15 different component types in any number required. Moreover, the workplace for the machine operators has also been laid out in a disabled-friendly manner.

#### Close partnership with engineering

“The actual challenge for Liebherr was to select our modular automation components in such a way and to link them with the other systems that a smooth interaction was facilitated”, adds Michael Appel.

Liebherr also took on the responsibility for CE certification of the entire system. Cooperation in the very small, but very efficient engineering team was coordinated by MTU. The partner organisations, in each case are among the top providers in their markets, worked on equal footing as a team. They exchanged ideas and developed the decisive characteristics of the system in dialogue. This also included details like an auxiliary function for the



Liebherr's pallet handling system and gantry loader make a significant contribution to increasing productivity



The acute shortage of skilled labour prompted MTU to invest in a system that guarantees a very high level of processing depth with only one employee

operator where a laser pointer indicates the position to which the next part to be sorted belongs.

**Criteria for partner selection**

“The system that we have created together is very complicated and way more advanced than the technology employed to date”, says Marc Weiß enthusiastically. Reportedly, Liebherr impressed not just by having suitable products in the area of automation: The fact that the technology used is very well established and has proven itself very well in practice among many users was also important. A particular highlight was said to be the com-

petence of the sales department. Technically, Michael Appel proved to be an extremely capable partner who became heavily involved and was able to provide many good ideas. The ramp-up of the overall system went successfully and the results so far have met the planning specifications. With the new system, MTU considers itself to be well equipped for the requirements of the future and the expected shortage of skilled workers.

**MTU Aero Engines AG**



- Industries:** Aviation / power units
- Company size:** Approx. 10,000 employees
- Founded:** 1934 as BMW Flugmotorenbau GmbH
- Headquarters:** Munich, Germany
- Locations:** 15, worldwide
- Turnover:** Approx. 4.6 billion euros (2018)
- Website:** www.mtu.de

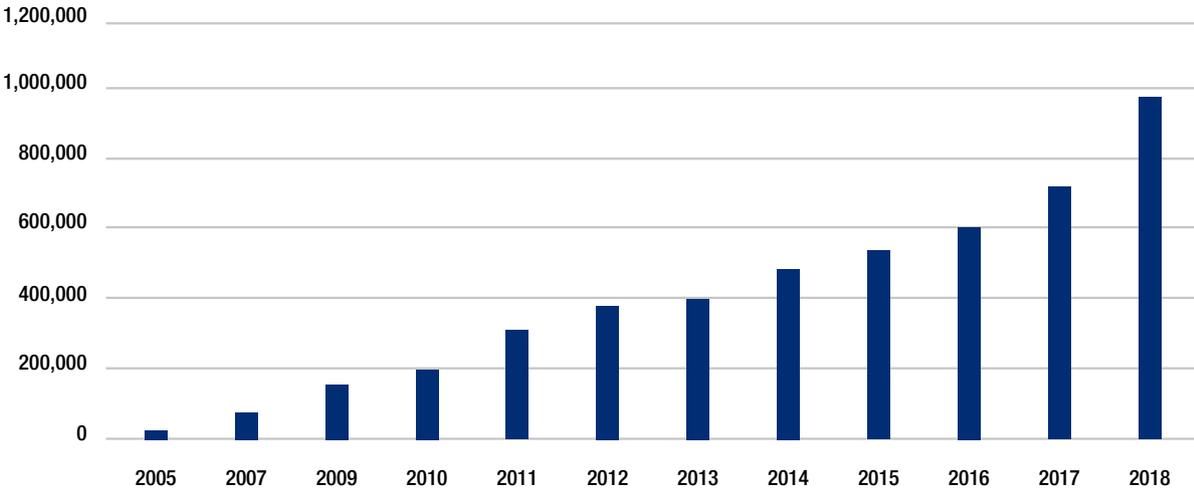
# In the fast lane

**For the mobility of the future, we need solutions today. Sometimes this means starting from scratch. With a new production line, new processes and new machines.**

Few topics are currently so intensely discussed as climate and the question of future-viable mobility. Stress caused by car traffic, particularly air pollution and the associated driving bans, but also noise and increasing lack of space are becoming more and more problematic, particularly in cities. There is therefore an urgent need for innovative solutions. Electric mobility is highly regarded as a promising solution approach. It is viewed as the key technology for sustainable mobility concepts. As well as e-cars and electric buses, electric mobility also encompasses the currently booming market of electrically driven bicycles. This is understandable, since the e-bike is not only environmentally friendly and space-saving, but also scores highly for its riding pleasure and health benefits. This is also reflected in the growing sales figures: almost a million e-bikes were sold in 2018 in Germany alone, with an increasing tendency.



**E-bike sales figures in Germany**



E-bike sales figures in Germany at a record high – around 980,000 e-bikes were sold in 2018. Source: <https://www.ziv-zweirad.de>

**Everything new for future-viable drives**

Morat Swoboda Motion GmbH is also counting on bio-electrical hybrids. The joint venture, comprising the Franz Morat Group and Swoboda, is passionately dedicated to the topic of electric mobility and develops and produces drive components for e-motive products. In 2017, the company received a nomination for a large-scale project and therefore decided to commission a new manufacturing hall in Nowa Ruda, Poland. In order to fulfil the high demands of the e-bike market, the production hall was planned and equipped completely from scratch, including all the machines and associated automation.

The company recognised this future market and its potential early on. Stephan Mayer, project manager for the construction of the factory in Nowa Ruda, recalls: “We quickly decided that we wanted to construct a new factory in Nowa Ruda, directly adjacent to the already existing Franz Morat Group assembly factory. Planning of the manufacturing line began in 2017, and the ground was broken in July 2018. Our aim was to create a manufacturing hall in which to address the specific challenges of gear wheel production for e-motive drives.



The Nowa Ruda plant has three Liebherr gear hobbing machines and six Liebherr generating gear grinding machines

We wanted as much automation as possible and, above all, a machine landscape at the highest technological level”, Mayer explains. Building up a production line from A to Z has the advantage of being able to choose the right cooperation

partners from the start, including for the gear cutting machines. Discussions were carried out with different providers, including Liebherr-Verzahntechnik GmbH, which installed three LC 60 gear hobbing machines and six LGG 180 generating gear



“The decisive factor when selecting machines was that, with Liebherr, we had a provider that covers both technologies, i.e. gear hobbing and generating grinding. ”

Stephan Mayer, Project Manager, Franz Morat Group



grinding machines in the new plant in Nowa Ruda. The entire production is fully automated.

### Highest demands made of gear technology

On the basis of the upcoming project, the most important requirements were defined: the basic prerequisites were high process stability, series suitability and the greatest possible efficiency by means of short machining times. "But we also wanted to respond to the specific needs of the e-bike market. Because anyone who has ridden an e-bike knows that the wheel must run smoothly. So it's not surprising that particularly high demands were made of the toothed gears." Stephan Mayer summarizes: "The teeth interlock with each other, which is how the rotation of one toothed gear is transferred to the next one. The whole thing works like a clock mechanism. If the individual teeth do not lock in perfectly, the motor won't work at all."

With the e-bike, disturbing noises from the drive create an unnatural riding feeling. "After all, nobody likes a clattering noise that follows you around when you want to enjoy a tour through the forest", says Mayer

with a grin. "That's why we have performed diverse modifications to the surfaces of the toothed gears and optimised the gear geometry. To do this, we worked together very closely with Liebherr's technology application department. Together, we found a very successful method and adapted the process parameters so that the drive units produce no noise, and the e-bike rider hears a natural soundscape during the ride", Mayer reports with satisfaction. Purchasing a total of nine Liebherr systems paid off. "The decisive factor when selecting machines was that, with Liebherr, we had a provider that covers both technologies, i.e. gear hobbing and generating grinding. We wanted a competent point of contact who would completely understand our process and deliver suitable solutions", the 35-year-old project manager reports.

### Reliable partners – in the long term

With the gear hobbing and generating gear grinding machines, Liebherr makes a significant contribution to toothed gear manufacturers' ability to provide highest-quality components on a large scale. Quality is found not only in the machines but also in the employees: "The entire process development, up to accept-

ance, ran very smoothly", Mayer explains. "We developed a lot of things jointly with the technology department. The support also works flawlessly", he adds. High value was placed on good supervision, since new staff also had to be simultaneously inducted at the new site. That makes it all the more important to have reliable contact partners. Mr Mayer is satisfied: "We are proud of what we have achieved with this project. Our results have borne us out. We aspire to be regarded as one of the main suppliers of the e-motive market. With Morat Swoboda Motion and the new production line, we are in an excellent position to fulfil future requirements."

### Morat Swoboda Motion GmbH & Co. KG

## Morat | swoboda

<b>Industries:</b>	Drive components for electric vehicles
<b>Founded:</b>	March 2018
<b>Production plant:</b>	Nowa Ruda, PL
<b>Website:</b>	<a href="http://www.morat-swoboda.com">www.morat-swoboda.com</a>

### About the parent companies:

#### Franz Morat Holding GmbH & Co. KG

<b>Company size:</b>	Approx. 700 employees
<b>Founded:</b>	1912
<b>Turnover:</b>	Approx. 90 millions Euro (2018)

#### Swoboda Wiggensbach KG

<b>Company size:</b>	Approx. 4,000 employees
<b>Founded:</b>	1947
<b>Turnover:</b>	Approx. 450 millions Euro (2018)



# Liebherr World

## Ring in the future together

To celebrate its 50th anniversary, Liebherr-Verzahntechnik GmbH invited international customers to Kempten. Through talks and machine presentations, Liebherr employees presented the latest

developments in gear cutting machines, gear cutting tools, gear cutting measurement technology and automation systems. The festivities also offered ample opportunity for personal discussion.



## Experiencing the future for 50 years

On 29 June 2019, almost 5,000 visitors streamed onto the Liebherr-premises in Kempten for Family Day. In fantastic weather, the employees led their families through production,

sampled culinary delicacies and enjoyed attractions for young and old alike.



## From prototype to series production

**It begins with an idea. But designers often have a long way to go before a perfect workpiece is made using a suitable manufacturing process. It is good that reliable partners such as Liebherr participate and share their experiences.**

“Every one of our customers has a development department with good ideas”, reports Dr. Oliver Winkel, Head of Technology Application. “But getting these parts to series production economically, and of sufficient quality, is a challenge for which many companies need partners.” It doesn’t matter whether these are improvements to existing parts, or new developments. Converting a CAD drawing to a machine, and later to the production environment, is always challenging.

“Together with one of the leading truck manufacturers, we have improved an already existing gearbox by refining the tooth flank surfaces to achieve greater efficiency and a longer service life. To do this, collision gears also had to be polished with small grinding worms”, says Dr. Andreas Mehr, in providing an example of the improvement process of the technology at Liebherr-Verzahntechnik GmbH. “This was a joint learning curve, during which we further developed the process from manufacturing the first prototypes under “laboratory conditions” to large-scale series production.” In the end, the polished gears made it possible to significantly upgrade the gearbox.

### **From gears to sprockets**

From time to time, the experts of Liebherr-Verzahntechnik GmbH have to venture into unknown territory. “We utilised our gear experience for a customer to shape non-circular gears, into sprockets on a crank shaft, and then tested the necessary prototypes on Liebherr machines”, explains Bernd Rösch, Head of the Testing Department. Thorough tests are extremely important, particularly at the limits, emphasises the expert. “Some effects are difficult to estimate and foresee. Customers then gladly visit us during the test phase, where the most-advanced machines and technologies are available.”

Liebherr engineers learn a great deal about the component design and their application in the course of such activities – knowledge that in turn can be used in machine development. Aside from the machine, the processing knowledge of the experts is also in great demand. Oliver Winkel: “Let’s take the trend towards higher power densities as an example. With double helical gears, we eventually reach the point at which gear hobbing no longer works, and the manufacturing process has to be changed to 5-axes milling.”

---

Or another example from practice: A customer wanted to substitute honing for gear hobbing. In a benchmark process with various bidders, Liebherr was able to assert itself with its engineering know-how as the new partner.

**Design of reliable processes**

“Sometimes, it is also a matter of process reliability. One of our customers wanted to relocate manufacturing resources for cycloid gears from the USA to low-wage countries. The process was very complicated, however, with many steps and frequent readjustments. Therefore, a new, more reliable process needed to be established for the new sites”, says Andreas Mehr about a different case. Liebherr already had a reputation as a reliable partner, and subsequently carried out trials with hobbled gears. Together, an alternative to the existing profile grinding method was found and implemented in this way.

**Independent of how the requirements present themselves:**

Customers have access to many years of experience and expert resources with Liebherr as a partner and, as a result, are able to build prototypes faster and take them more reliably to series production.



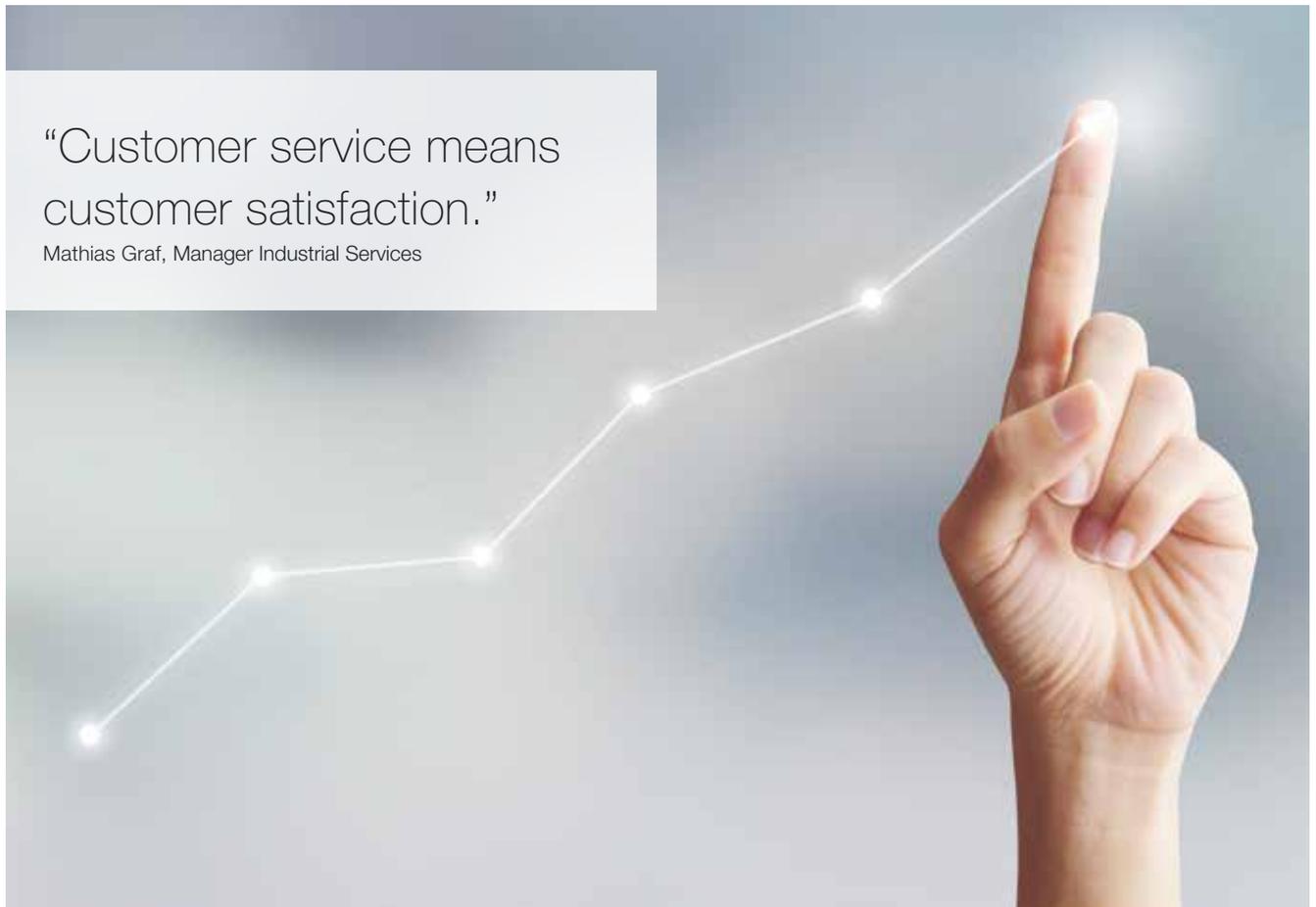
Customers benefit from the know-how of Liebherr employees during the development phase



Processes can be tested and improved in the test department

“Customer service means customer satisfaction.”

Mathias Graf, Manager Industrial Services



## Focus on customer productivity

**With the newly formed “Industrial Services” department, Liebherr-Verzahntechnik GmbH is reimagining the service ethos.**

Customer orientation and service are a matter of course for the Liebherr Group. Without the two of them, how else can you meet the self-imposed demands on quality? This area is therefore being extended and expanded in a targeted manner in the interests of the customer: “By launching the department of industrial services, we want to deal with the topic of service with more verve and significantly enhance the range for our customers”, explains Mathias Graf, manager of the new department. He is bringing eleven years of experience in customer service and a good feel for marketing to the task.

“The focus here has to be on the customer and his requirements. Only in this way is it possible to generate the correct added value for the customer”, says Mathias Graf about his approach. “We have to consistently adapt ourselves to the challenges of our customers. Classic tasks such as on-site service and spare parts provision are just the basis.”

### **Added value across the complete life cycle**

All of the service offers have one thing in common: Ultimately, they should all guarantee the availability of machine tools and automation systems and increase productivity. “Consequently, we will put together a package for our customers in future that is tailored to their needs”, says Mathias Graf. The service package will take account of the entire life cycle of the plant: from planning to commissioning and production to end-of-life or even second life cycle through remanufacturing measures.

In the first step, Liebherr is harmonising the standard service portfolio globally, for example maintenance and inspection, training and also support and the hotline. “Our customers shall receive the same service standard at the highest level globally.” Liebherr is also expanding its portfolio in the area of advanced services. The focus here will be on technical advice, service level agreements, optimisation of processes and digital services.

### Digital services with Liebherr quality

Industry 4.0 also plays an important role at Liebherr. Status monitoring, preventive maintenance, enhanced reality or also the digital marketplace are just a few of the topics from the digital world on which the company is working.

“Our customers shall receive the same service standard at the highest level globally.”

Mathias Graf, Manager Industrial Services



Service means closeness to the customer

“We have taken on a great deal”, says Mathias Graf in summarising the plans for the new units. “Our vision is to put much greater emphasis on the service character of our company. We want to be more than “just” a machine builder with the usual range of services. We also want to continue being a reliable, global partner for our customers, support them proactively in all matters and set new benchmarks with Liebherr quality.”

### Mathias Graf

Manager Industrial Services

Kaufbeurer Strasse 141,  
87437 Kempten, Germany  
Phone: +49 831 786-1455  
mathias.graf2@liebherr.com



The range of services offered extends over the machine's complete life cycle

# As flexible as our own range

**Due to the high demand, the automation division of Liebherr-Verzahntechnik GmbH has restructured the area of robotics and made it a separate department. The editors of Liebherr Magazine went to visit and had a look around.**

Jürgen Groß, Head of Sales of Flexible Production Systems and Production Cells, greeted us at the entrance of his new area. “The great advantage here in this area is that we hear about everything”, he says enthusiastically as he looks over the spacious office that has been home to his team of co-workers since October 2018. “We benefit from extremely short routes here and immediate feedback, which enables sensitive project control – not just in quoting for jobs but also when jobs are taken on – and prevents the loss of valuable information.”

## Everything in one area

We pass desks with large engineering design screens at which CAD drawings for “Flexible Cells” are created. “We offer customer-specific solutions from individual production cells to complete production systems – the main thing is that the robot is the heart because for us it is always the focal point.” A few work-places further and we find the desk of a co-worker who is actually employed in a different department: Christian Reisch works for the purchasing department but has been relocated to this department and is therefore physically part of the team. Being this close makes it easier to configure the robot with the supplier

right from the planning phase. Furthermore, it is possible to respond quickly to the variance of the cells through timely procurement.

“In this office, we have in effect realised the organisation plan of the department spatially”, says Jürgen Groß in describing the concept. From initiating the order and project management to mechanical and electrical design to control technology – they all sit side-by-side. Right in the adjoining room are their own laboratories with camera systems where customer-specific inspections can be carried out. At this point, we have reached one of the high tables in the middle of the room that are intended for standing at and holding brief talks. For telephone conversations and intensive discussions there are telephone cells with a table and monitor that are affectionately referred to as gondolas. Up to four co-workers can withdraw to these. A compromise for working in an open-plan office that requires respect and consideration.

## Transparency for optimum project flow

“We have laid new paths in terms of space and organisation”, reports Jürgen Groß. The functional three-head leadership of



Projects can be discussed quickly and unbureaucratically at the large table in the middle of the room

the department follows above all an interdisciplinary team ethos. "We are not interested in hierarchies. Our attention is on coordinated project development and outstanding communication." Taking a look at ongoing and potentially incoming projects together on a daily basis is as much part of the day-to-day activity as "Lessons Learned" meetings, in which experiences and problems are shared among all participants and specialist areas. Information and responsibilities are transparent at all times for the entire team. This is thanks to a large organisational board.

"We have in effect realised the organisation plan of the department spatially."

Jürgen Groß, Head of Sales of Flexible Production Systems and Production Cells



Small "gondolas" offer peace and quiet for meetings

"Since the areas here on the ground floor had to be modernised, we had the opportunity to define the layout according to our needs", explains Jürgen Groß. This is where the restrooms, showers and lockers once were. Restructuring has opened up a bright and friendly office that offers room for a good 20 members of staff. "They come from all faculties because the more we know, the better we are able to minimise project risks. This is not just in

the interest of our customers; it is for our main advantage as well. At the same time, it makes everyone here responsible. Everyone identifies with our projects. We are all passionately committed and everyone fights to ensure that everything works." A quick glance around and we can see the staff nodding in agreement. In this area everyone really does get to know about everything.



The Robotics department team

# Liebherr Academy “Gear Technology”: local presence

**How do you get closer to the customer? For Liebherr the answer is simple: by increasing presence locally. This also applies to the Academy of Liebherr-Verzahntechnik GmbH, which safeguards the competent operation of Liebherr machines with its wide-ranging offer of customer training courses. In this way, specialist operators can utilize the possibilities of the machine ideally and assure its availability.**



“Many competences and abilities are currently concentrated in Kempten”, Mathias Graf says to describe the present situation. He is in charge of the market service and, together with the central service, is responsible for disseminating Liebherr knowledge in the world. China is a main area of focus. As one of the biggest sales markets, it has seen a major rise in the demand for services. “We must significantly expand our range here and want to act strategically.”

## **Liebherr Academy as a centre of knowledge**

One of the components of this is the Liebherr Academy for Gear Technology. As a training centre for customers and staff, it imparts knowledge on all aspects relating to Liebherr machines. Among the range of seminars are training courses for operators, electronics technicians and mechanics. The centre is located in Kempten. Based on this example, other institutions will follow in the USA and China. The aim is to establish a universally high level of training for operators all around the world.

“With a comprehensive programme of training courses and seminars, we contribute towards the success of our customers. Our seminars are oriented around practical scenarios and cover the areas of machine operation, maintenance and application technology”, summarizes Oswald Mildenerger, Team Leader of Customer Training. In addition to on-site training at the Liebherr factory, courses can also be run on the customer’s premises. The comprehensive training material is always included in the offer: “We want to hand documents to the course participants that they can later refer to in case of any doubt and use to further expand their knowledge.”

## **Training courses unlock potential**

The advantages for the customer are plain to see: They are in a much better position to exploit the potential of their Liebherr machine if the operators are informed comprehensively about its possibilities. Downtimes are reduced through competent operation. Malfunctions are more seldom, which in turn saves costs. An increase in productivity is often possible as the machine is



“Our training courses contribute towards the success of our customers.”

Oswald Mildenberger, Team Leader of Customer Training

Time for questions: Processes can be explained particularly well directly at the machine

utilized better and employees are more motivated. Furthermore, training courses of this kind also teach effective communication with customer service so that a remedy can be found more quickly in the event of a malfunction.

“We can see a clear demand in the market for offers of this kind and want to meet this at a high level”, explains Oswald Mildenberger as the reason for the company’s dedication. Training courses can help to maintain the quality of production or even improve it, particularly with staff turnover or changes to the product.



### Standard training courses

#### Operator training for setup technicians and machine operators

- Assemblies / control panel
- Operating modes
- Scope of standard programme
- Structure of data input
- Work examples / setup procedures

#### Electronics technician training for servicing and repair

- Description of machine
- Drive systems
- Measuring systems
- Add-on devices
- Diagnostics
- Description/structure of control system

#### Mechanic training for servicing and repair

- Description of machine
- Drive systems (mech.)
- Lubrication chart
- Hydraulics
- Clamping
- Assemblies



Discover more:

[www.liebherr.com/trainings](http://www.liebherr.com/trainings)





## Future challenge: modernisation of trade training for industrial mechanics

**What challenges does Industry 4.0 present to companies and their apprentices? Liebherr is already working on the measures necessary for overcoming the technical obstacles of the future in order to train its own professionals.**

Increasing quality expectations of customers, globalisation and Industry 4.0 – are the three major factors of today's work environment. In order to do justice to these expectations, Liebherr-Verzahntechnik GmbH has further developed the trade training programme for industrial mechanics to set new standards and, with pioneering concepts, is demonstrating how the company can succeed in responding to these requirements in a timely manner. "The big technical challenges that we are adjusting to the increasing interplay of electronics and mechanics as well as

progressive digitalisation", explains Walter Ferstl, Head of Trade Training at Liebherr-Verzahntechnik GmbH. "We have to prepare our young professionals in this regard so that in the future they are able to communicate, plan and work together in international, interdisciplinary teams."

Sophisticated high-tech products such as automation systems and Liebherr-Verzahntechnik GmbH's export rate of approximately 75 percent make remote diagnosis and international teams directly on-site indispensable. The job profile of industrial mechanics thereby comprised of a broad and complex range of tasks with international assembly assignments that make day-to-day work life diverse and exciting, but also challenging. Especially when electrical work such as the exchange of defective motors, sensors or actuators has to be carried out. Until now, activities such as these had to be performed exclusively by electronics technicians, not least because of legal safety aspects.

### **Further developments encompassing theory and practice**

To ensure that industrial mechanics also have the necessary skill set relevant to trade proficiency and safety in future, for example being able to reconnect and commission a motor, preliminary measures have already been implemented at Liebherr-



Apprentices learn on the new electro-hydraulic training system



Very popular: the Erasmus+ assignment abroad in Norway

Verzahntechnik GmbH in order to further develop the trade training programme: “We are currently working on integrating certain core and trade qualifications in our training programme”, reports Ferstl. To do this, the training content is not just orientated around the latest technology in the workshop but also entails the integration of completely new modules, e.g. from hydraulics training. “We were able to gain first experiences on which we are currently building our concept while rewriting details about a transducer from the area of automation as a training module for our industrial mechanics.” The aim, however, is not just to arm the industrial mechanics with as much knowledge of electronics as possible during their training – conversely, this approach is also pursued to facilitate optimum co-operation. “In training, the idea is to encourage trainees to feel that there are people around them. They should know that problems are solved together, decisions are made together about who the right point of contact is – as a company, as a team”, emphasises the training manager.

Two additional qualifications have therefore been included here, which the IHK

(German chamber of commerce and industry) has been offering since the summer of 2018. Liebherr-Verzahntechnik GmbH took immediate advantage of this further training opportunity and has assumed a pioneering role nationwide. The first examinations for the additional qualification “certified electrician for specific activities” were held in July 2019 and will be taken as an in-house test in future by all industrial mechanics as a permanent element of their trade training. All apprentices with a special interest in electrical engineering have a second module option available to them that upgrades the training profile for industrial mechanics significantly: The additional qualification “certified industrial electrician” can be obtained in the third year of training and consolidated with a final IHK (chamber of commerce and industry) examination.

#### International teamwork

The budding industrial mechanics appeared highly motivated even a few weeks before the exams. This elevated commitment may well have had something to do with the four week foreign assignment that

the apprentices completed just before and saw as an enrichment for their social and professional competency. Within the scope of an Erasmus+ programme as part of their training, the 20 apprentices from Kempten swapped their workplace in Germany for workplaces in Norway, taking up duties in one of 20 partner organisations there respectively. Starting with simple assembly tasks, this training programme at Liebherr-Verzahntechnik GmbH has been permanently established as a training module since 2000 – about 90 to 95 percent of apprentices travel abroad to partner organisations for four to eight weeks. Evidence of the effectiveness of this module was confirmed this year once again: “During their foreign assignment, our apprentices really became aware of how closely mechanics and electronics are connected and how great the necessity for additional professional qualifications has become. Their enthusiasm for acquiring relevant knowledge is so much the better for it”, says Walter Ferstl happily.



Discover more:

<https://go.liebherr.com/77Q2NB>



# Only the best

**Quality management has a special place at Liebherr, it protects the core of the brand. The following is an overview of the processes necessary for quality assurance provided by Christof Porsche.**

The proverbial Liebherr quality is not a matter of chance. Christof Porsche is the custodian of this topic on account of him being responsible for quality management (QM), machine approvals, certifications and complaints handling. He has been with Liebherr-Verzahntechnik GmbH for 30 years, holding various posts such as Head of Machine Production and has been Head of the QM Department for seven years.

## Focused on fault avoidance

With his team of 30 co-workers, he is responsible for two areas: the products themselves and the processes for their manufacture. "Fault avoidance is always at the forefront for us, checking the quality is just another aspect", he explains the fundamental concept of his approach. Nevertheless, the inspection of products takes up a large part of the work of his department as no machine gets past his staff: every Liebherr machine, without exception, runs through an approval process orientated in part strictly around the requirements of the customer. "We employ a complete final check during which each machine processes at least one workpiece. Usually, though, a small series of items are produced in which the dimensions of all individual workpieces are evaluated according to statistical criteria in order to safeguard the accuracy of the machine for series production. No product leaves the building unless it has been approved by me."

Only experienced workers with extensive knowledge are employed in his area. They become involved as early as the development phase of a new machine and accompany the entire process of

creation. "We pursue our quality aims consistently up to and beyond the entire production creation process. We have the complete support of the company management when doing this because quality has a very high priority in the corporate values." To Christof Porsche, ongoing improvement is important because quality, too, is a process. "Checking and if in doubt discarding cannot be our aim. Mistakes need to be noticed and dealt with right from the outset."

„We pursue our quality aims consistently up to and beyond the entire production creation process.“



Christof Porsche, Head of the QM Department

## Advisors to specialist departments

In the event of complaints, these are also handled by the QM staff. After all, it is especially important to learn from the respective fault: Where did the problem lie? How can it be ruled out in future? Are suppliers affected? Which specialist departments need to be informed? "We consider ourselves to be advisors more than controllers. We become aware of important aspects for design, procurement and production that can improve the processes there significantly."

Ultimately, the purpose of quality management is always customer satisfaction. Christof Porsche: "The expectations of the quality of Liebherr machines and automation are high. Our aim is not just to meet them but also, where possible, to surpass them."



---

## Expansion in China

Liebherr entered the Chinese market in 1978, when it opened its first office in Beijing. China has meanwhile developed into one of the most important export countries for high-class gear cutting machines and automation systems. A new plant was therefore ceremoniously opened in China on May 22nd, 2019.

In Yongchuan, Liebherr assembles gear hobbing machines and generating gear grinding machines. The new plant establishes close links to customers in China and guarantees quick delivery times. A technology and training centre promotes the qualification and further training of the growing customer base.



The opening of the new site underscores Liebherr-Verzahntechnik GmbH's goal of delivering added value directly in China, keeping the quality of the products at the highest level and thus achieving the greatest possible customer benefit.

## Strong cooperation: Partner Level Award by John Deere

Liebherr's motto is always: "Highest quality in everything we do". Both products



and customer care must meet these standards and make an important contribution to the customer's success. The fact that Liebherr-Verzahntechnik GmbH was awarded the Partner Level Award by John Deere for the fourth time demonstrates that this Liebherr principle is followed out in the industry. The award is the highest supplier evaluation that John Deere gives out. The criteria for awarding the prize include the supplier's quality, technical support, supplier reliability, understanding of the customer and cost management.

Karl Sauterleute, former Head of Sales for gear engineering in Kempten, and his successor Peter Wiedemann received the award in a ceremony in the Rosengarten Congress Centre in Mannheim on March 13th, 2019. The business relationship between Liebherr-Verzahntechnik GmbH and the world market leader in the agricultural engineering sector has lasted over 30 years.

The award further strengthens this long-term cooperation. "We also view this recognition as an incentive and obligation to continue to be a reliable supplier and partner of John Deere – for the next 30 years as well", said Peter Wiedemann.

## Interactive machine experience with Virtual Reality

New technologies offer new possibilities – including for product presentations by Liebherr-Verzahntechnik GmbH. At the China International Machine Tool Show in Beijing in April, Liebherr presented a machine virtually for the first time.

Although the rolling and profile grinding machine LGG 280 was not exhibited on site, visitors were able to experience it up close through virtual reality glasses – reflecting their motto, "Digitise the future with us!" As a flexible alternative to a ma-

chine presentation, virtual reality offers numerous areas of application. For example, in Beijing, even a retooling of the machine from external to internal grinding was presented using VR.

"Our virtual trade fair experience was extremely popular and a great success. We want to continue to use this tool and to develop the functions and areas of application in future", explains Thomas Weber, Head of Marketing at Liebherr-Verzahntechnik GmbH.





## At icy altitude

**Four tower cranes were in full-time operation during construction of the highest building in Europe, the Lakhta Tower. A Liebherr service technician ensured at a dizzy height that everything ran smoothly even in extreme weather conditions. A retrospective.**

### Service as a high wire act

430 metres above ground, surrounded by thick fog, an icy wind blows through the metal bars of the tower crane. Ivan Dikun lies on his belly on a narrow metal web to check a sensor of the tower crane. “Up here the non-stop wind and cold temperatures in the winter are the biggest challenges for us”, the service technician explains. Today, the crane on which he is standing has been taken out of service for scheduled routine maintenance. The service work must be carried out as quickly as possible in order not to hinder the construction progress.

The Lakhta Tower is the highest building in Europe today at 462 metres. The high-rise is located about ten kilometres outside the inner city of St. Petersburg. The construction company, Renaissance Construction, used three 710 HC-L 32/64 Litronic crane towers and one 357 HC-L 12/24 Litronic crane tower to build the skyscraper. The cranes climbed up the facade and inside of the tower by means of a hydraulic device. They were always one step ahead of the skyscraper.

### Under extreme conditions

This was assured by service technician, Ivan Dikun. At an altitude of more than 400 metres, even standard tasks, such as checking limit switches and sensors, were a high wire act. “We always have to be aware of our own safety and that of other workers on the construction site – regardless of how high we are”, explains Dikun. A dropped tool could have fatal consequences in the same way as a trip.

The actual challenge on the Lakhta Tower though is not the height but the weather. “We are only about 1000 kilometres away from the Arctic Circle. It can drop to minus 32 degrees Celsius here and the wind can reach over 130 kilometres per hour”, says Dikun. The tower cranes are designed to cope with such extreme conditions. Maintenance work, on the other hand, can only be carried out up to a maximum of 72 kilometres per hour. A steady hand is a basic requirement in addition to having a good head for heights. “You need a certain talent to be able to avoid any spillage when changing oil in the wind”, grins the technician.

---

## 87 floors in record time

Construction of the Lakhta Tower started in 2015. Work on the outside of the high-rise was completed after just three years. A very rigid schedule for a project of this size.

“One particular requirement for us therefore, was the technical support from Liebherr throughout all phases of the project”, says Rustam Doshchanov, project manager at Renaissance Construction. The construction company worked closely with Liebherr’s own project department, Tower Crane Solutions, a year before building started. “The sooner we work together, the better we can adapt the crane concept to our customer’s individual needs”, explains Benedikt Bärtele, project manager from Tower Crane Solutions.

To ensure rapid progression of the construction of Lakhta Tower high performing tower cranes had to be employed on account of the height of the building and the extreme weather conditions. Tower cranes of the 710 HC-L 32/64 Litronic series were chosen that enable maximum loads of up to 64 tons and lifting speeds of up to 176 metres per minute. Due to the challenging shape of the high-rise, there was no chance for a standard solution. The climbing process of the cranes was tailored individually to the facade concept and the construction progress of the building.

Ivan Dikun completes his maintenance work after about two hours. “Dispatcher, please come. The inspection has been carried out, the crane can be brought back into service”, Dikun speaks into his crackly radio. As he climbs down the inside of the tower crane, it has already resumed work on the highest building in Europe.

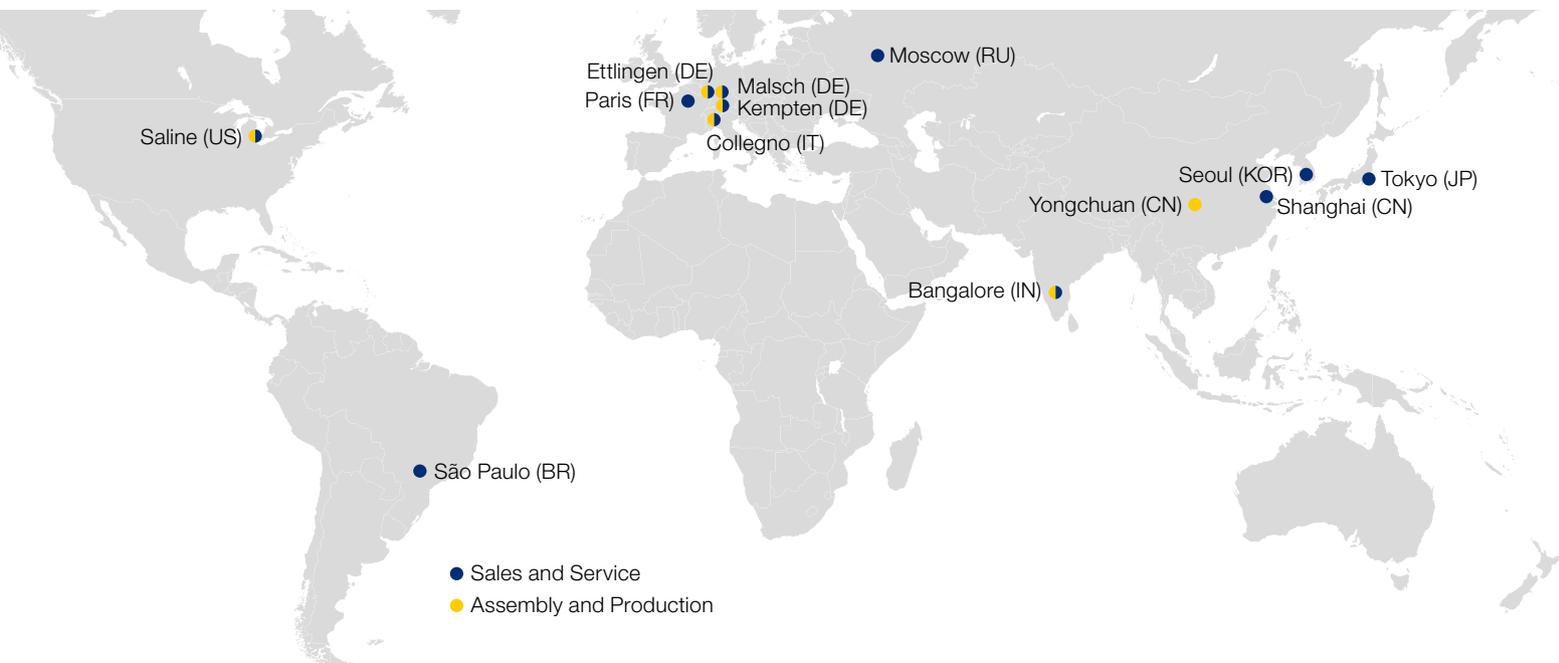


Discover more:

[https://go.liebherr.com/  
63aQAQ](https://go.liebherr.com/63aQAQ)



# Your solution provider



## Liebherr-Verzahntechnik GmbH Gear Technology and Automation Systems

Kaufbeurer Strasse 141  
87437 Kempten  
Germany  
☎ +49 831 786-0  
☎ +49 831 786-1279  
info.lvt@liebherr.com

## Liebherr-Verzahntechnik GmbH

Plant Ettlingen/Gear Tools  
Hertzstrasse 9-15  
76275 Ettlingen  
Germany  
☎ +49 7243 708-0  
☎ +49 7243 708-685  
tools.lvt@liebherr.com

## Liebherr-Verzahntechnik GmbH

Plant Malsch/Metrology  
Dieselstrasse 1  
76316 Malsch  
Germany  
☎ +49 721 17087-0  
☎ +49 721 17087-200  
info.lvt@liebherr.com

## Liebherr-Verzahntechnik GmbH

6 Place Du Village  
92230 Gennevilliers, Paris  
France  
☎ +33 1 412110-35  
info-machineoutil@liebherr.com

## Liebherr-Utensili S.r.l.

Via Nazioni Unite 18  
10093 Collegno TO  
Italy  
☎ +39 114 248711  
☎ +39 114 559964  
info.lut@liebherr.com

## Liebherr-Gear Technology, Inc. Liebherr Automation Systems Co.

1465 Woodland Drive  
Saline, MI 48176-1259  
USA  
☎ +1 (734) 429-7225  
☎ +1 (734) 429-2294  
info.lgt@liebherr.com

## Liebherr Brasil Guindastes e Máquinas Operatrizes Ltda.

Rua do Rocio, 288 Salas 81 / 82  
Vila Olímpia  
04552-000 São Paulo - SP  
Brazil  
☎ +55 11 3538 1509  
info.lbr@liebherr.com

## OOO Liebherr-Russia

Bolshoy Palashevskiy pereulok 13/2  
123104 Moscow  
Russia  
☎ +7 495 280 18 91  
☎ +7 495 280 18 92  
info.lru@liebherr.com

## Liebherr Machine Tools India Private Limited

353/354, 4th Main, 9th Cross,  
4th Phase  
Peenya Industrial Area  
Bangalore – 560 058  
India  
☎ +91 80 41 1785-91  
☎ +91 80 41 272625  
info.mti@liebherr.com

## Liebherr Machine Tools and Automation Korea Ltd.

174-30, Saneop-ro, Gwonseon-gu,  
Suwon-si, Gyeonggi-do  
07590 Seoul  
South Korea  
☎ +82 31 294 9888  
info.mak@liebherr.com

## Liebherr (China) Co., Ltd.

Building 1, 88 Maji Road  
China (Shanghai)  
Pilot Free Trade Zone  
Shanghai 200131, China  
☎ +86 21 5046 1988  
info.lms@liebherr.com

## Liebherr Japan Co., Ltd.

3-7-8, Kudan-Minami  
Chiyoda-Ku, Tokyo  
102-0074  
Japan  
☎ +81 3 6272-8645  
info.lvt.ljc@liebherr.com

## Liebherr-Verzahntechnik GmbH Gear Technology and Automation Systems

Kaufbeurer Strasse 141, 87437 Kempten  
☎ +49 (0)831 786-0, ☎ +49 (0)831 786-1279  
www.liebherr.com, info.lvt@liebherr.com



 LinkedIn  
<https://go.liebherr.com/E8ByKq>



 Twitter  
<https://go.liebherr.com/T92xu7>



 YouTube  
<https://go.liebherr.com/QDydxV>