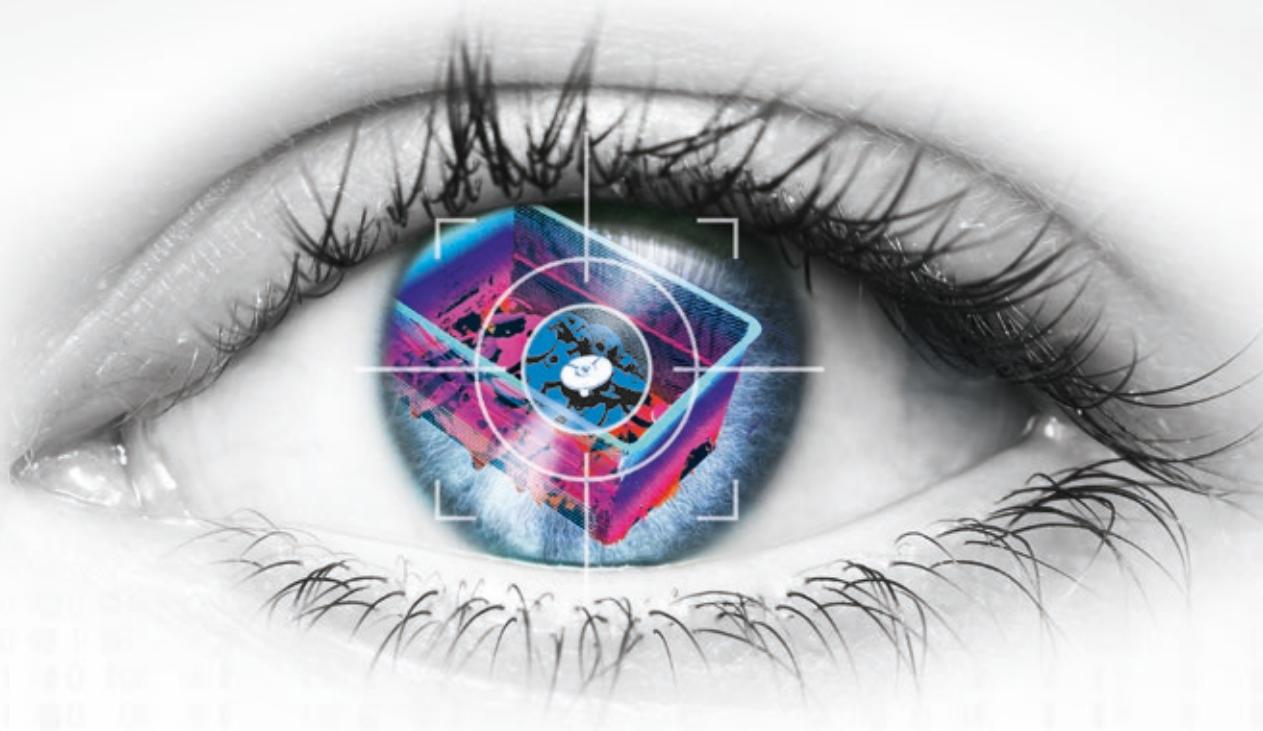
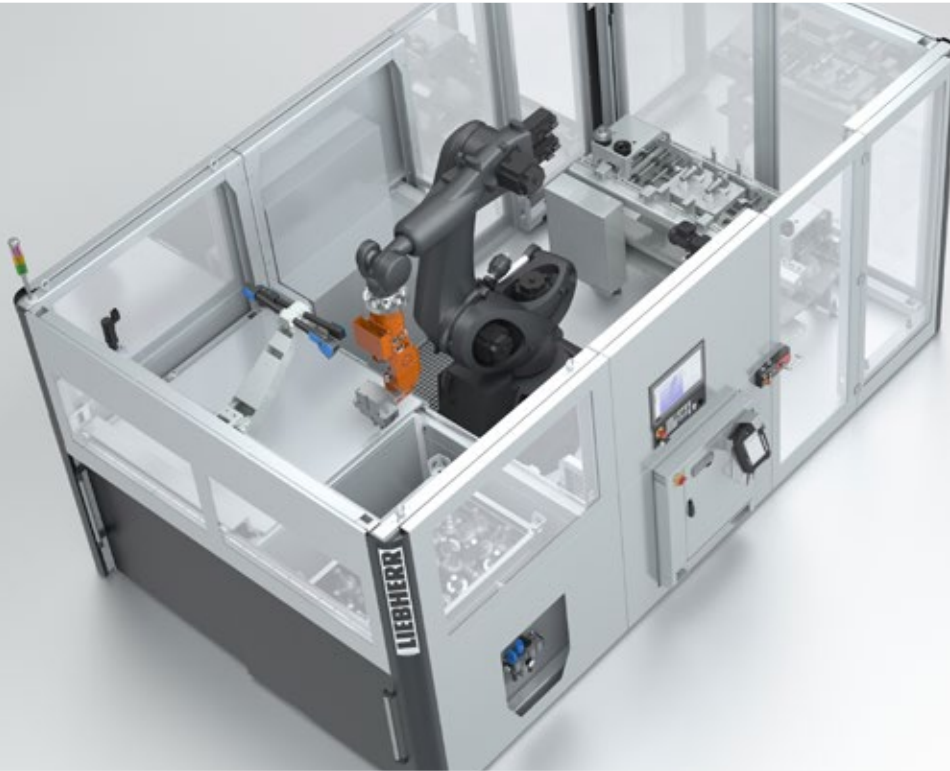
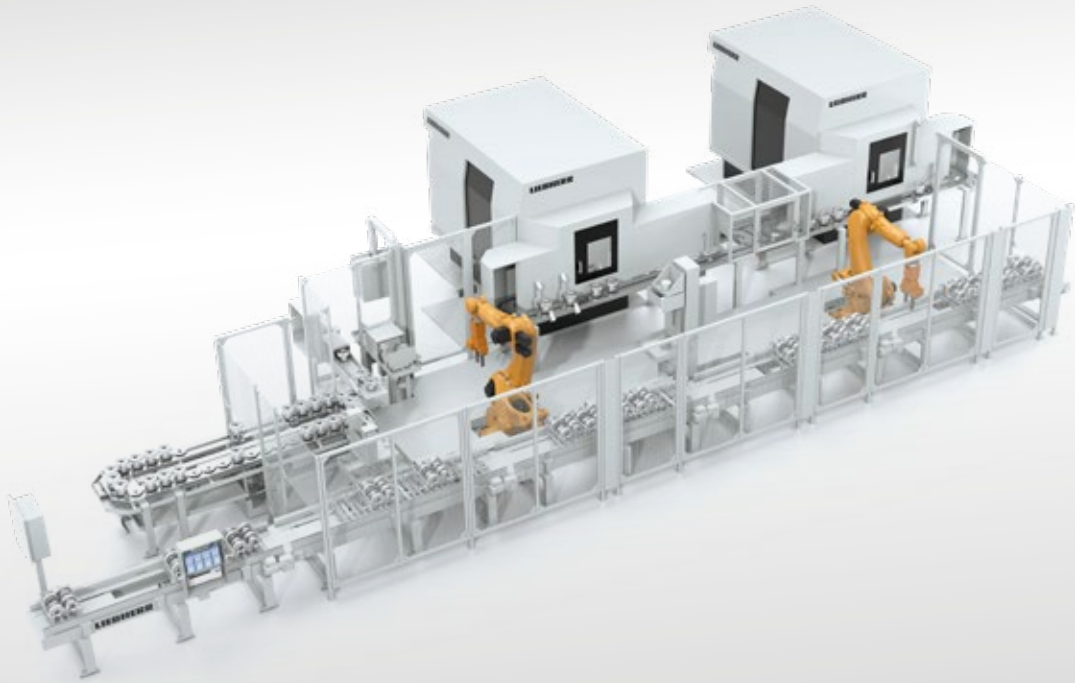


Loading, Palletizing, "Random Bin Picking"  
**Liebherr Robot Applications**



**LIEBHERR**

# Parts Handling and Palletizing



Example: Robot loads a gear hobbing machine and performs other functions such as cleaning, checking, and labeling

As a turnkey supplier of complete production lines, Liebherr covers all process steps from blank to finished part from a single source. In the area of robot applications, Liebherr performs parts handling, palletizing/depalletizing, and bin-picking tasks.

## Parts Handling

In parts handling Liebherr performs loading tasks for a wide range of machine tools. In recent years solutions from machining centers, turning machines, gear cutting machines, rotary transfer machines through to grinding machines have been implemented here. The robot cells are always designed specifically for the requirements in close cooperation with the customers.

## Palletizing

Liebherr uses 2D and 3D vision systems to perform palletizing and depalletizing tasks. Whether it be to detect and grip unsorted parts from Euro pallets or transport presorted parts in blisters.

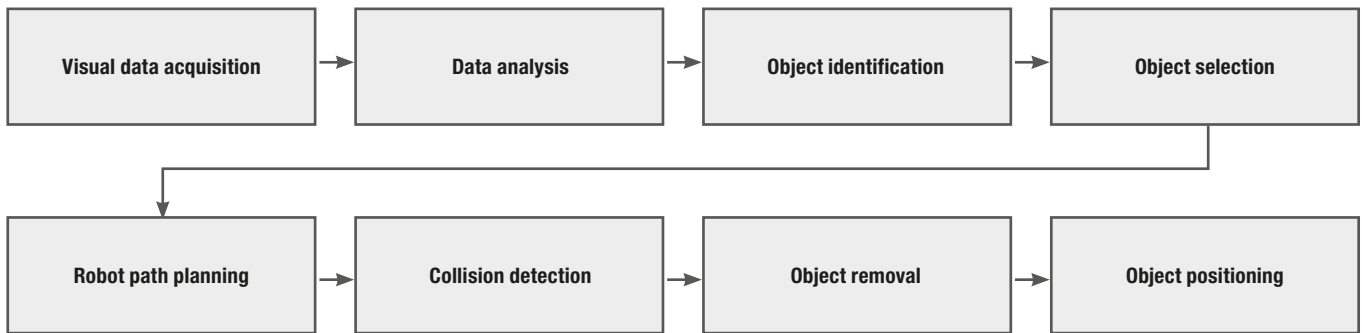


Example: Robot is palletizing refrigerator inserts

# "Random Bin Picking"

Automatic unloading of randomly arranged parts from transport containers, otherwise known as bin picking, is one of the most challenging industry automation applications. To date, only a few robot designs have met the demands on sturdiness and cycle times. With the flexible robot systems from Liebherr, the bin picking routine can be automated cost effectively. This raises capacities and lowers costs. Many tasks can be solved with tried-and-tested workpiece handling components from Liebherr's array of automation systems.

Liebherr has many years of experience with automation systems in various areas of industry and applications. This experience has been incorporated into the development of the new technology. The Liebherr robot systems are equipped with a reliable and sturdy 3D object detection system as well as powerful software for the segmentation, identification, and selection of information. Specially developed pickers with additional axes enable collision-free access and withdrawal of the parts from the bins (transport containers).

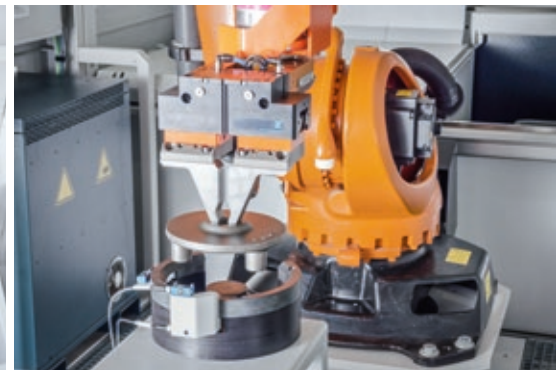
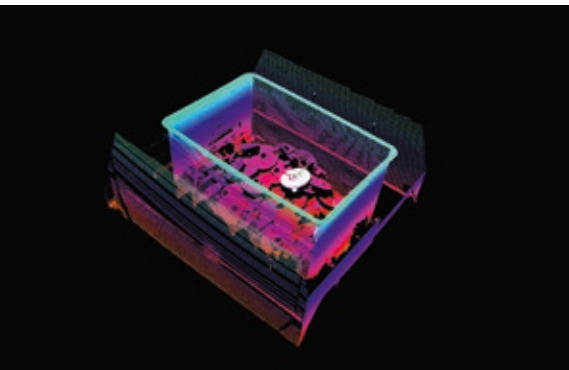


## Process Description

A complex interaction between image detection system, software, and robot is required to unload workpieces from a bin. Based on the range of parts, all of the necessary steps have to be adapted to each other in such a way that optimum withdrawal and positioning is achieved.



# Process Description



## Requirements

Randomly arranged parts need to be removed from a bin.

## Visual Data Acquisition and Analysis

Reliable 3D object detection systems record the data visually and analyze it.

## Planning Reliability

In the Kempten plant Liebherr offers the option of demonstrating the feasibility and cycle time beforehand according to the respective customer requirements using test cells with different robots or vision systems.

## Object Identification and Selection

Specially designed software segments, identifies, and selects the information about the workpieces as well as the technical framework conditions.

## Collision-Free Withdrawal of Parts

The intelligent picker has additional axes and enables collision-free withdrawal of parts from the bin.

## Object Positioning

Finally, the tools are precisely positioned at the defined location or on a machine.

# Flexibility



Supply / Vision System

Handling

Options

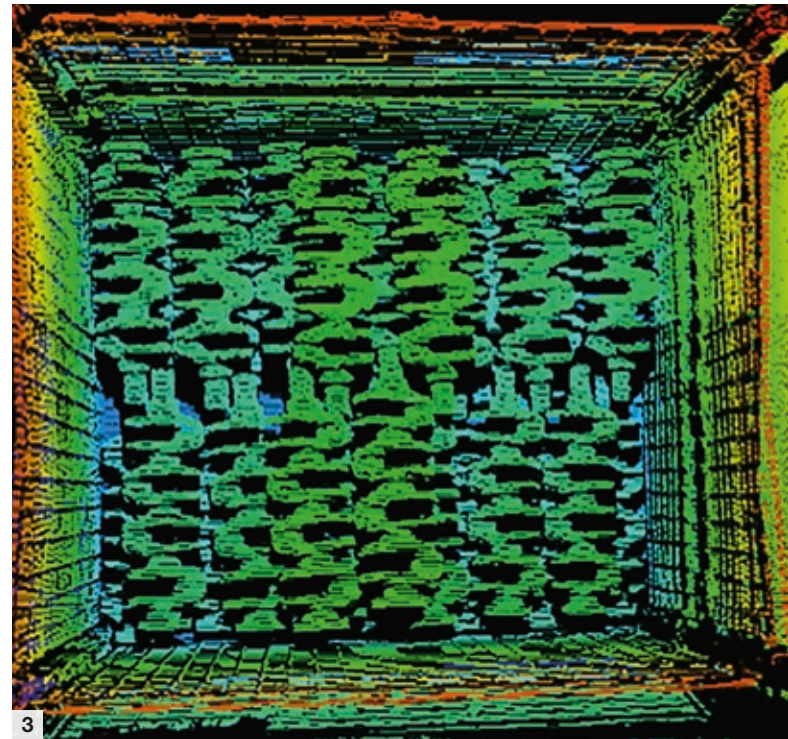
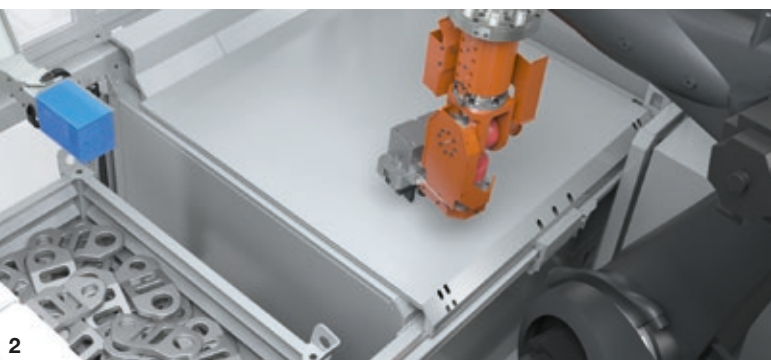
Output

The modular structure of the robot cell comprises two base modules, the supply module and the handling module. These can be combined with a customer-specific option and output module. The vision system is integrated in the supply module and is designed according to the workpiece and cycle time.



Video: "Random Bin Picking"

# Supply / Vision System



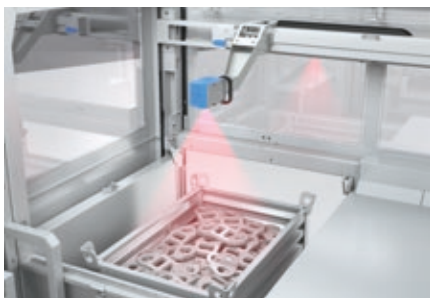
1 Supply module · 2 Operator protection · 3 3D point cloud

The hook-ready supply module serves to provide workpieces for the handling module. As a basic version, it is available with two or three units. These consist of provisioning areas, e.g. pallet cages or bins made of steel or plastic up to a maximum size of 1200 mm x 1000 mm x 1000 mm (LxWxH). Depending on the task, the module can be supplemented with a mobile vision system as well as operator protection for loading and unloading of bins in parallel with machine operation. Depending on the requirement, Liebherr works with three different vision systems.

The 3D vision system with laser run-time method is a red light laser and a very robust solution irrespective of the ambient light and the degree of contamination.

The 3D vision system with precise, two-stage laser triangulation method is a blue light laser and is suitable for workpieces made from metal, organic, and semi-transparent or reflecting materials.

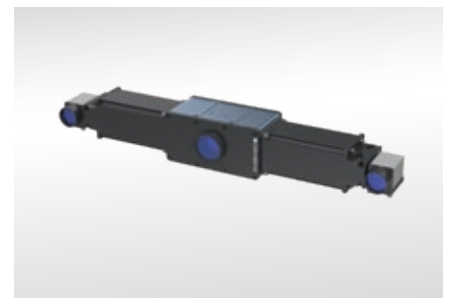
The extremely flexible 3D stereo vision system with triangulation method supported by an additional projector unit is ideal for short cycle times. A complete and homogenous depth information of the scene can be created by means of special projector technology.



Laser run-time method



Laser triangulation method



Stereo vision triangulation method



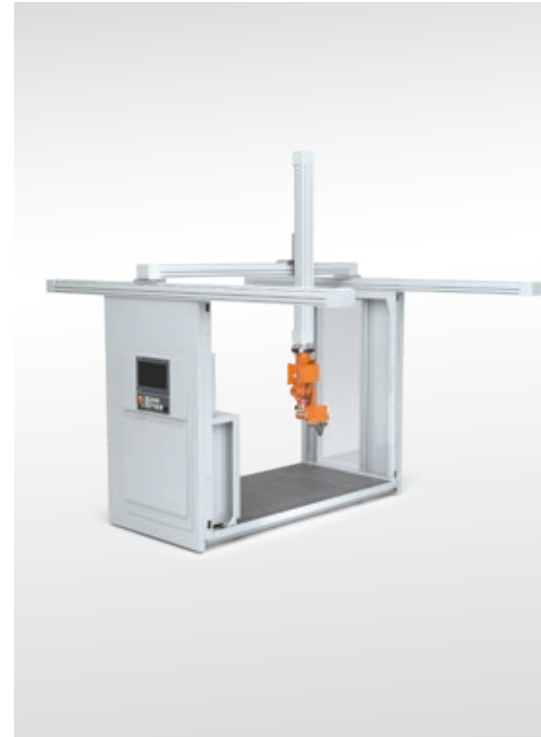
# Handling



Basic module



Robot system



Area gantry system

The Liebherr robot cell is underpinned by the standardized hook-ready handling module.

Various loading systems can be integrated in this link between supply and output module, along with controls and an operator panel.

The handling and supply modules are coupled together by a mechanical and electrical connecting system. Positioning and setup of the individual components are made much

easier for the customer in this way. Depending on the task, a flexible picker unit is available in sizes ranging from 0 to 5 kg, 5 to 20 kg, and 20 to 40 kg. In combination with suitable compensation elements, a high availability of the system is guaranteed. If required, the pickers can be supplemented with a 7/8 axis. In this way, flexibility during picking of the workpieces within the bin is increased. The degree to which the bin is emptied is optimized.



Picker with compensator unit

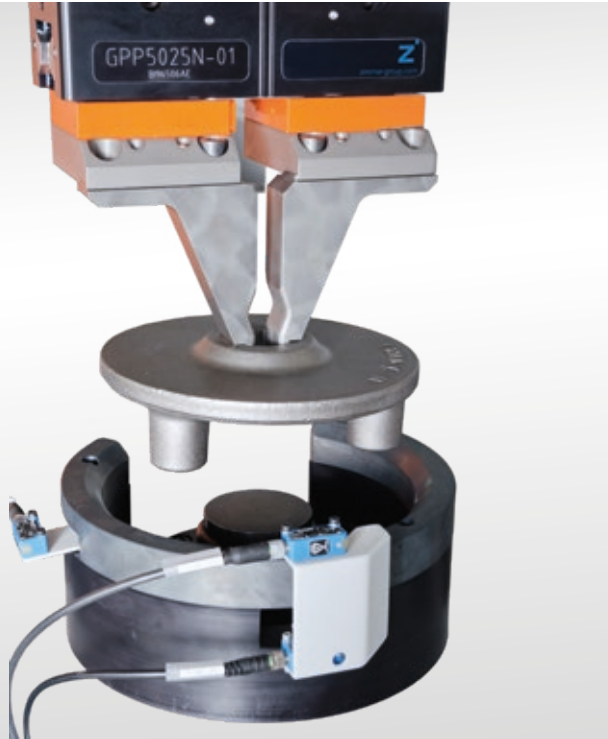


Picker with 7/8 axis

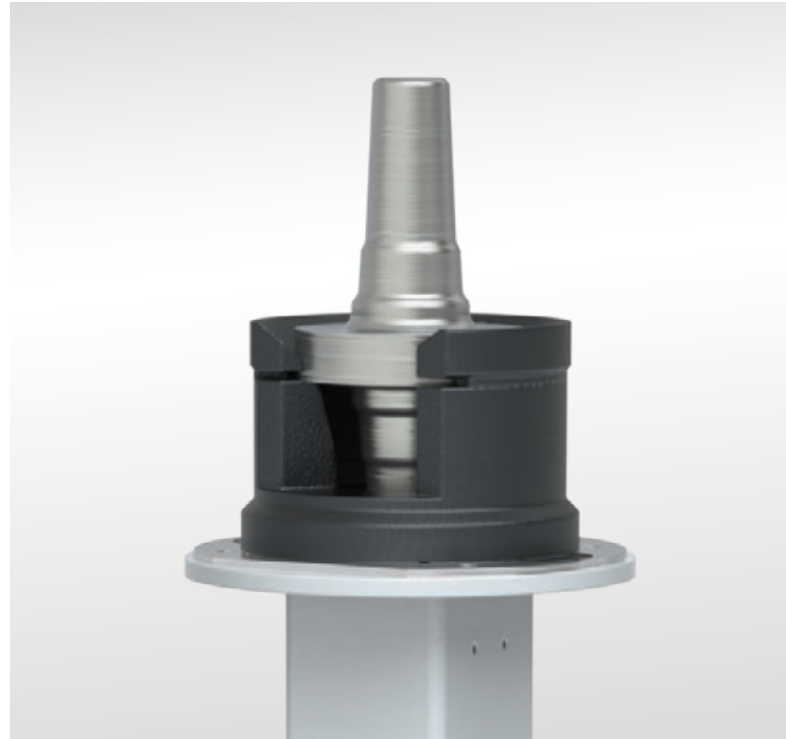


User interface with controls

# Options / Output



Intermediate storage



Repicking station

## Options

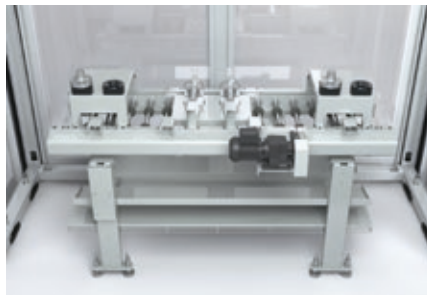
To optimize the unloading process from the bin, the workpieces are picked at different positions. These picking positions are not always suitable for final positioning of the workpieces. If necessary, Liebherr can offer suitable options such as intermediate storage areas, repicking stations, positioning devices, or detection stations.

## Output

The workpieces withdrawn from the bins can be transferred to a wide range of different customer-specific systems. Examples of this are direct loading of a machine tool, handover to a transport system, or organized storage in bins further down the line.



Direct loading of machine tool



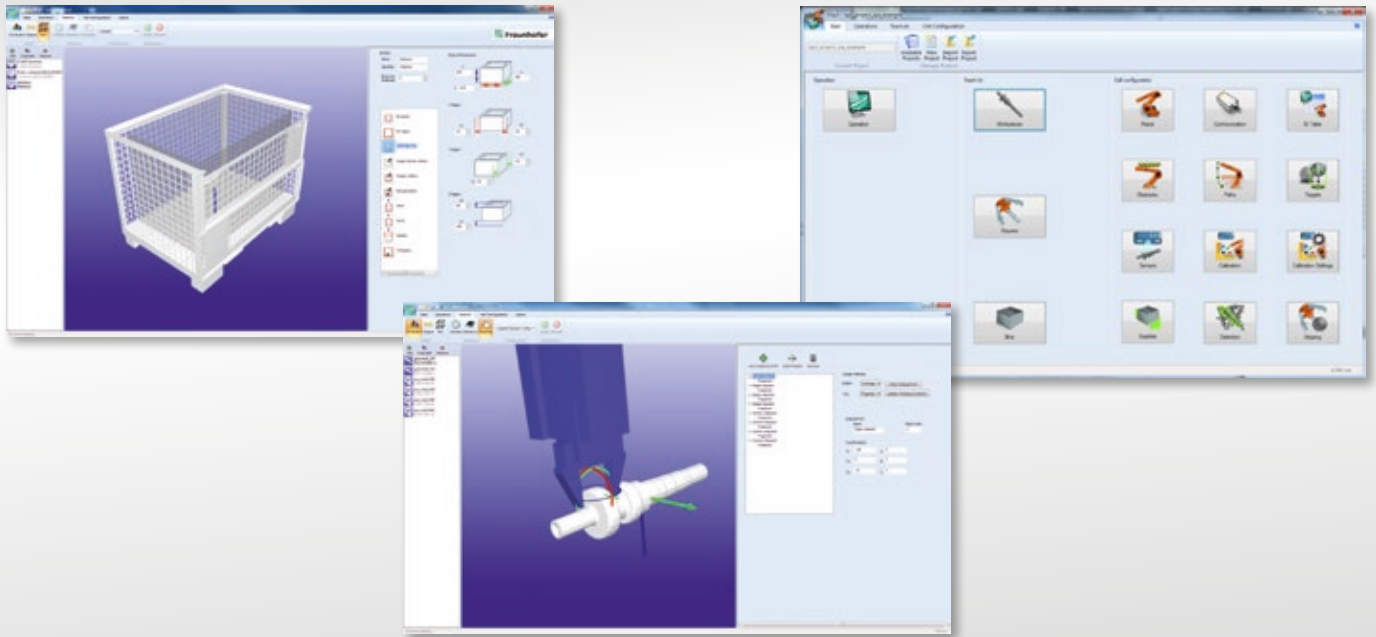
Loading transport system



Wired basket loading



# User-Friendliness



The control panel makes it possible to enter all of the necessary information quickly in easy steps:

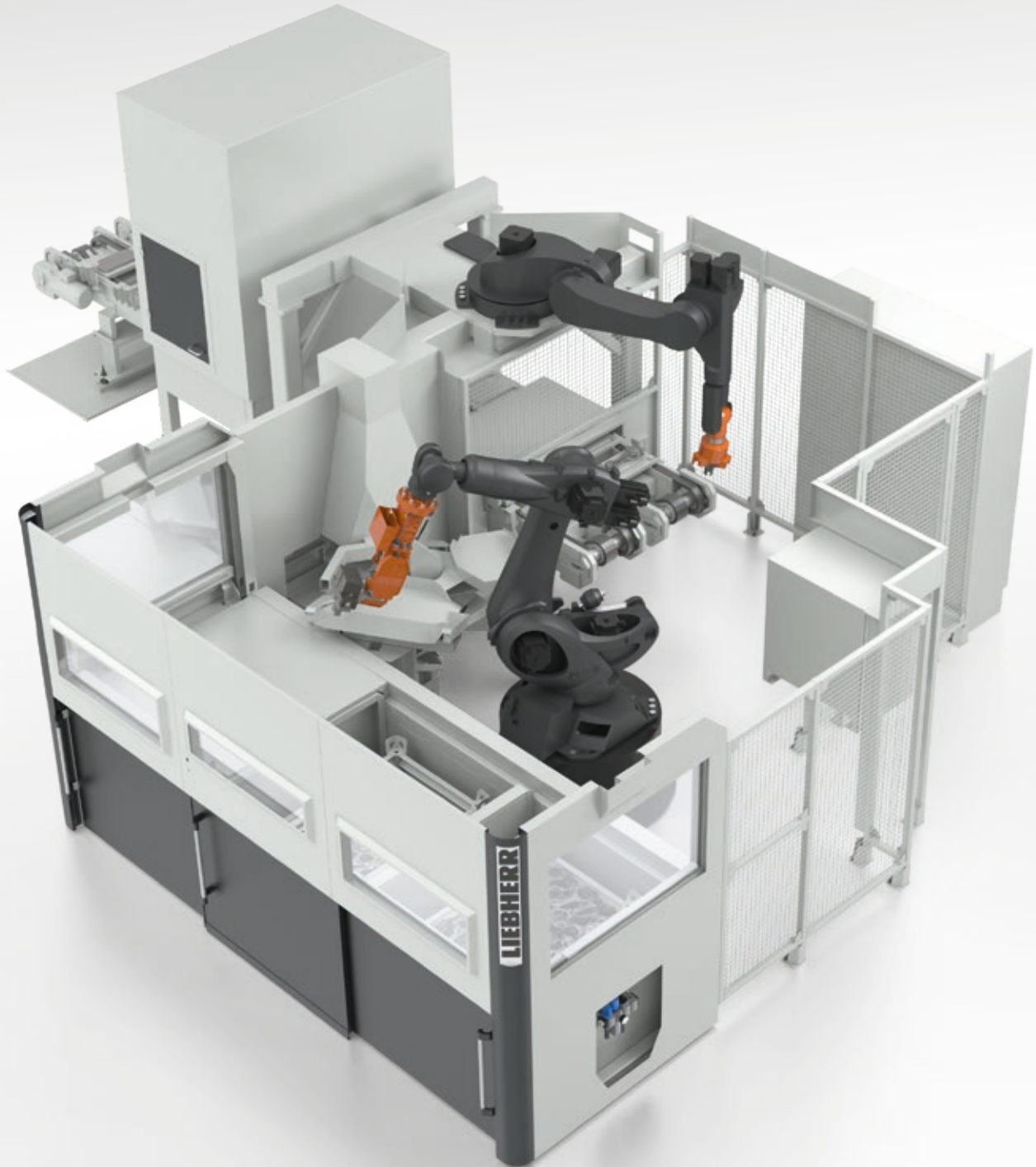
- Teach-in of workpieces and definition of potential picking points
- Configuration of bins (by entering dimensions or integrating existing data)
- Configuration or adaptation of pickers
- Selection of employed robots to check working area
- Input of obstacles present in robot's working area
- Calibration of system
- Definition of framework conditions for collision-free withdrawal of parts
- Rail scheduling

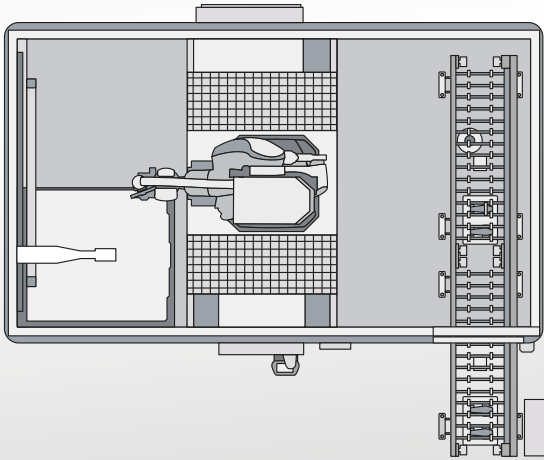
The processing stages are entered in a user-friendly manner via a menu-based control panel. Special programming knowledge is not required. Depending on which data are available from the customer, configuration of the work steps is carried out by means of:

- Graphic-guided programming masks
- Existing data sources (e.g. CAD data)

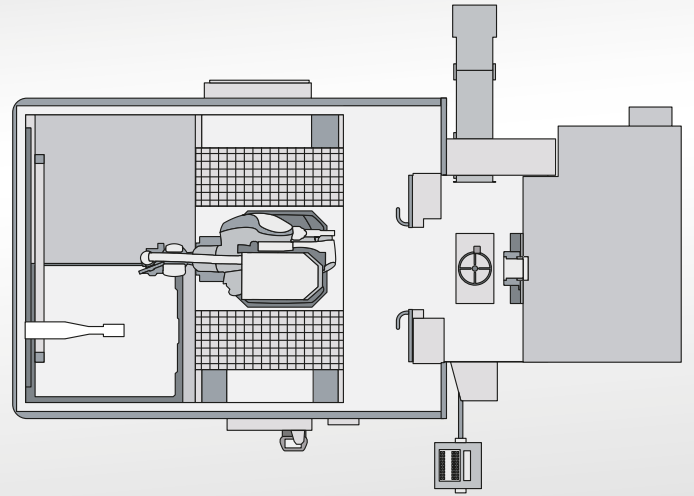
Potential gripping points are simulated and collision analysis is performed.

# Examples and Different Layouts

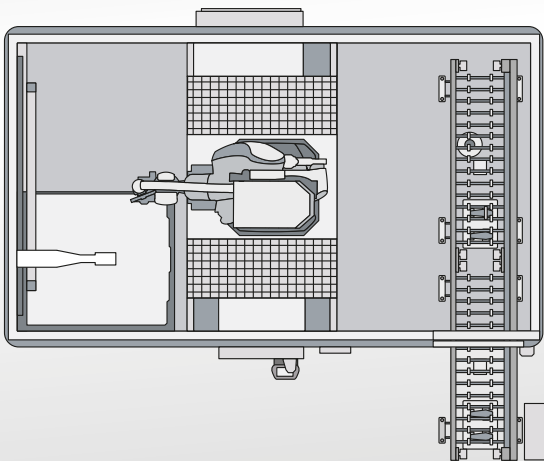




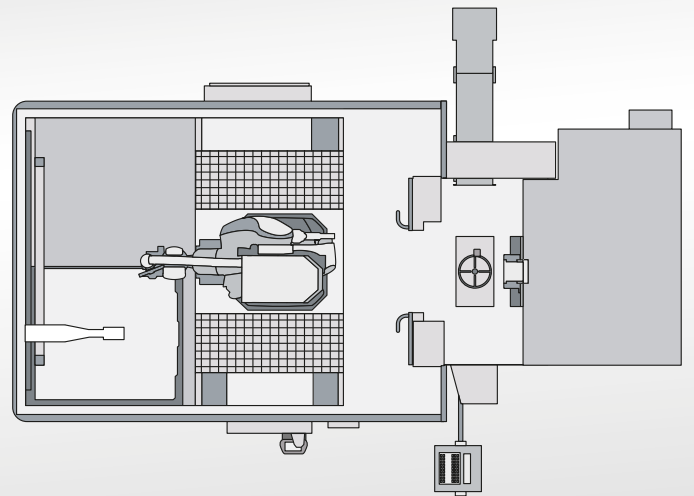
Conveyor loading



Machine tool loading



Wired basket loading



Commission handling



# Project Management



As a system supplier, Liebherr looks after the entire project planning including the clarification of machine specifications and interfaces with subcontractors. Each project is assigned to a project manager who assumes the entire order processing as the central contact person. We guarantee smooth running of the project by means of modern ERP and project management systems.

# Health & Safety, Environment



We are a certified company according to ISO 9001, ISO 14001, and OHSAS 18001. With help of our HSE Department (HSE = Health & Safety, Environment), we guarantee a high standard in occupational safety, health, and environment protection to our customers as well as within the organization.

Our measures exceed regulations laid down by the legislator. Our Total Safety approach aims to identify, correct, and avoid health, safety, and environmental risks in advance which may have a negative effect on employees and customers. For this reason our HSE Team monitors strict compliance with our guidelines in order to achieve the ultimate goal of "zero accidents".

Our H&S Team has many years of experience and works according to the principle of the continuous improvement process. With the use of standard tools such as FMEA (Failure Modes and Effects Analysis), possible causes can be analyzed in advance and appropriate measures introduced. During regular visits to the customer the H&S Team can compile risk assessments and initiate the appropriate measures to minimize the risk at the workplace. Strict compliance with environmental and safety regulations by all employees, as well as individual responsibility, are elements of our corporate culture.

# Service and Locations



## **Training**

We offer a comprehensive range of training courses both at the customer's premises and in our subsidiaries. The practical technical training courses are delivered by our experienced system technicians who are very familiar with the systems and applications owing to their many years of experience. These training courses enable you to help yourself and use systems safely in emergency situations, e.g. a power failure.

## **Customer Hotline and Remote Maintenance**

Our experts on the customer hotline provide professional initial assistance when needed. Many faults can be eliminated with the support of our experts via remote access.

## **Global Presence and Spare Parts Availability**

With our headquarters in Kempten and global subsidiaries, as well as service outlets, we guarantee a fast response time in order to be able to deploy a service technician to the customer's premises if necessary. A rapid replacement parts service is guaranteed thanks to the consistent modular system of the products and the use of basic components from well-known, global manufacturers. Original spare parts are stocked in the subsidiaries and can be delivered to your production sites within a short period of time. Included in the services offered are the provision of spare parts, inspections, maintenance, or modifications to systems.



## Service and Maintenance

Liebherr developed a system for optimizing repair and maintenance based on experiences with aerospace components within the Liebherr Group. As a result of this, maximum availability values and minimal total costs of ownership are achieved.

Most of the unexpected system failures can be avoided through preventive maintenance.

We also offer our customers optional "Wellness Checks"

to minimize the risk of machine downtimes and secure the machine availability over the long term. Axles, gearboxes, guides, carriages, as well as cables and hoses, are checked and replaced if necessary.

The system data is saved as a backup during each service and maintenance call in order to restore the status of the last maintenance if needed and thus quickly guarantee the restart of production.



### Locations of Liebherr-Verzahntechnik

- Liebherr-Verzahntechnik GmbH, Kempten, Germany
- Liebherr-Verzahntechnik GmbH, Ettlingen, Germany
- Liebherr-Utensili S.r.l., Collegno, Italy
- Liebherr-Verzahntechnik Paris, France
- Liebherr-Russland OOO, Moscow, Russia
- Liebherr-Gear Technology Inc. and Liebherr Automation Systems Co., Saline, USA
- Liebherr Brasil Guindastes e Máquinas Operatrizes Ltda., São Paulo, Brazil
- Liebherr-Machine Tools India Private Limited, Bangalore, India
- Liebherr Machinery Service (Shanghai) Co. Ltd., China
- Liebherr Japan, Tokyo, Japan
- Liebherr Machine Tools and Automation, Seoul, South Korea

# Machine Tools and Automation Systems from Liebherr

Liebherr employs roughly 1200 staff in the area of machine tools and automation technology and has production facilities in Kempten and Ettlingen (Germany), Collegno (Italy), Saline (Michigan, USA) and Bangalore (India). They are supported by expert and reliable marketing and service specialists at a large number of locations worldwide.

With over sixty years of industrial experience, Liebherr is one of the world's leading manufacturers of CNC gear cutting machines, gear cutting tools and automation systems. The company's innovative products are the result of pioneering ideas, highly qualified staff and state-of-the-art manufacturing systems at each of their locations. They are characterised by economy, ease of use, quality and reliability in combination with a high degree of flexibility.



## System Solutions in the Area of Machine Tools

Included in the production programme are gear hobbing machines, gear shaping machines and generating- and profile grinding-machines, all noted for their high degree of stability and availability. Particular importance is attached to the energy efficiency of the machines.

Gear cutting machines from Liebherr are supplied to renowned manufacturers of gears and gearboxes and large-scale slewing rings worldwide. They are in demand primarily from the automotive and construction machinery industries and also increasingly from the wind power industry for the manufacture of gears for wind turbines.

## High Quality Gear Cutting Tools

Liebherr manufactures high quality, precision tools for the soft and hard machining of gears and all Liebherr gear cutting machines are fitted with Liebherr tools. The range also includes Lorenz shaping tools and products customised for specific customer applications.

## Automation Systems for a Broad Range of Applications

Liebherr has a wide range of products for linear robots, pallet-handling systems, conveying systems and robot integration for projects in all areas of production and can provide above-average availability of systems.

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

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