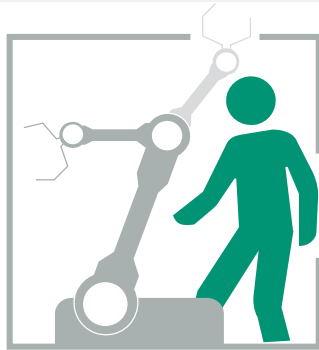
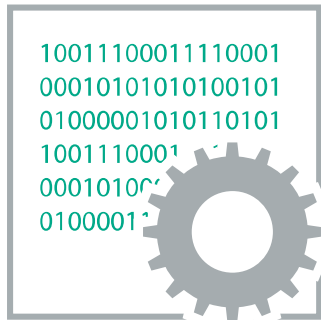


# FRAUNHOFER IFF MAGDEBURG

## AT THE FOREFRONT OF DIGITAL MANUFACTURING



# The Fraunhofer-Gesellschaft at a Glance

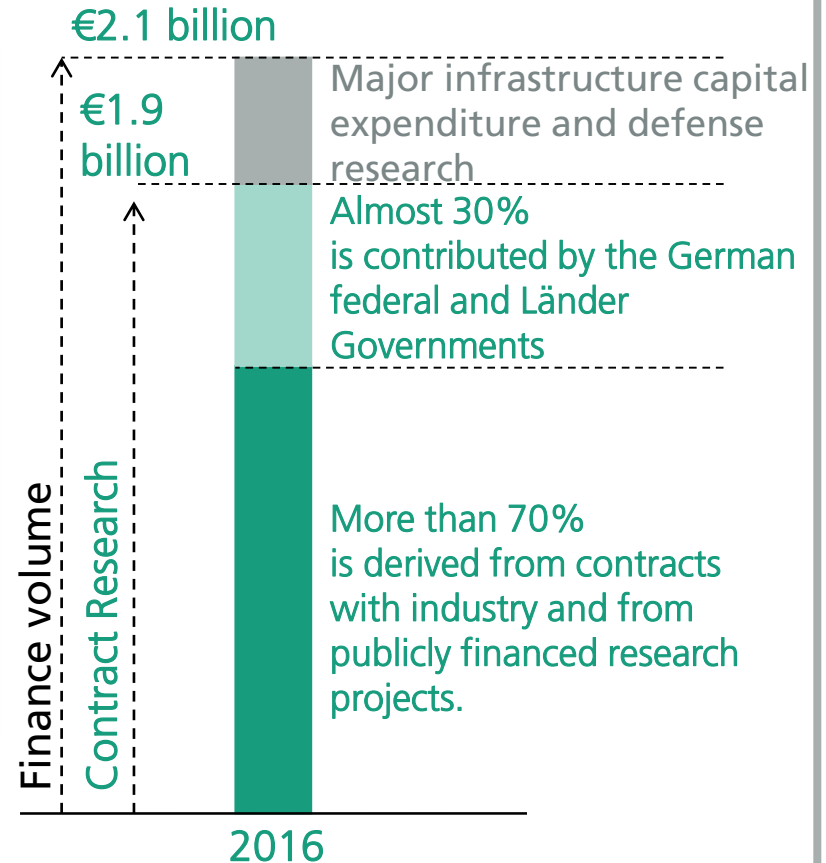
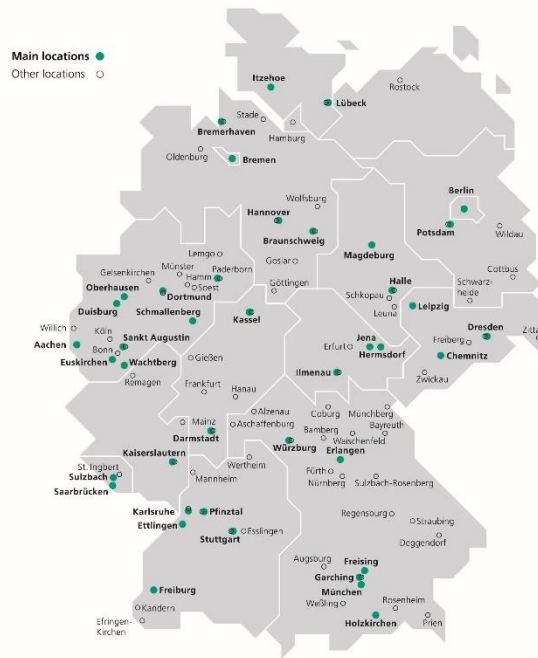
The Fraunhofer-Gesellschaft undertakes applied research of direct utility to private and public enterprise and of wide benefit to society.



24,500 staff



69 institutes and research units



# Fraunhofer Group of Production

## Leading Network of Applied Production Research

### ■ Key data

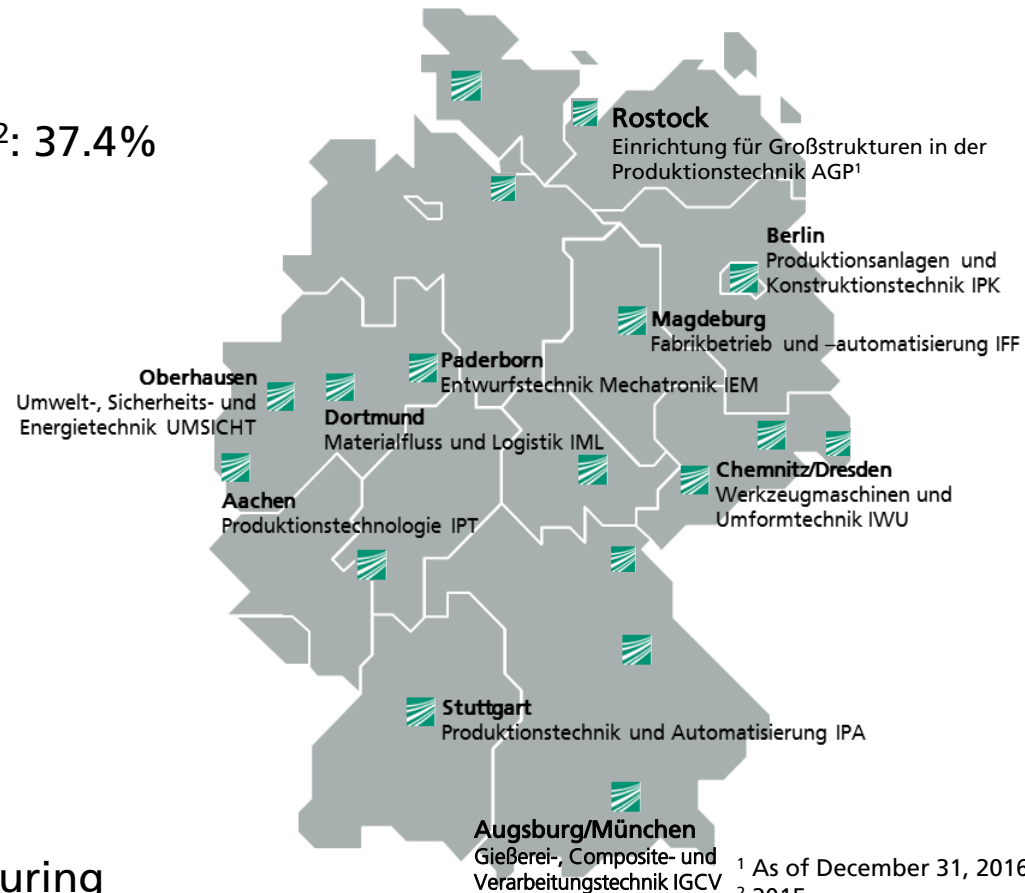
- 10 member institutes
- Researchers<sup>1</sup>: 1444
- Percentage of business revenue<sup>2</sup>: 37.4%
- Budget<sup>3</sup>: €267 million
- Chairman: Prof. Michael Schenk
- Business office:  
Fraunhofer IFF, Magdeburg

### ■ R&D Activities

- Product development
- Manufacturing technologies
- Manufacturing systems
- Manufacturing operations
- Production management
- Logistics

### ■ Other Specializations

- Resource efficiency in manufacturing
- Information technologies for manufacturing



<sup>1</sup> As of December 31, 2016

<sup>2</sup> 2015

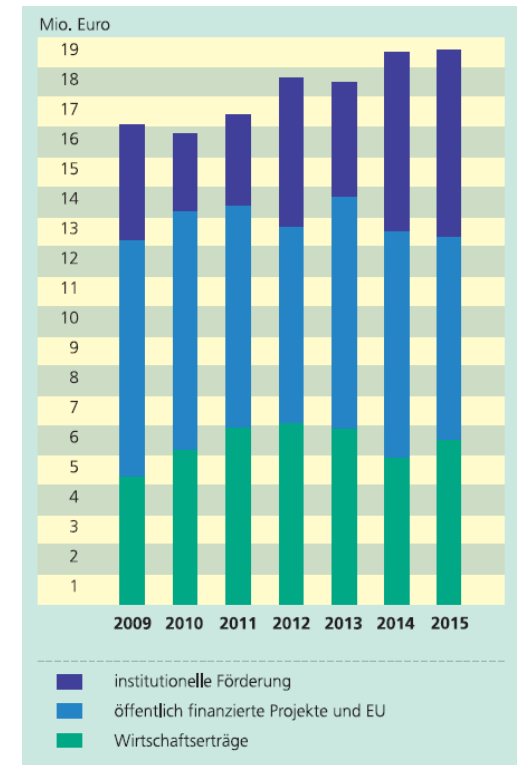
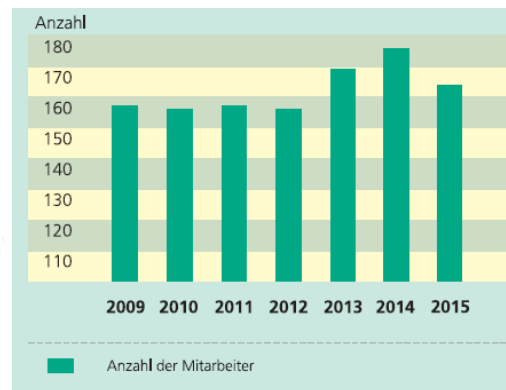
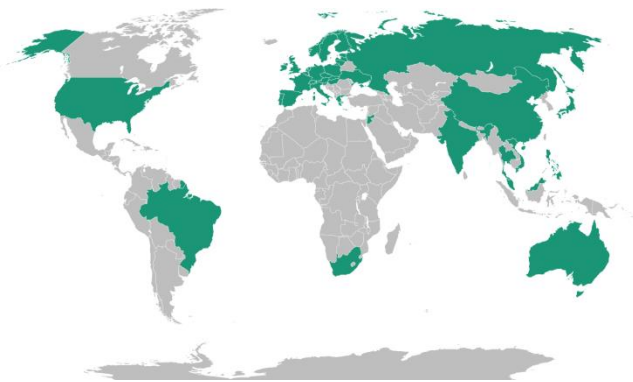
<sup>3</sup> 2016 budget

3

# Fraunhofer IFF Magdeburg

## In Figures

- 164 employees
- Research budget €18.6 million
- Operates two research buildings incl. various laboratories
- Project office in Bangkok, Thailand
- Active on six continents
- Institute Director: Prof. Michael Schenk



# The VDTC of the Fraunhofer IFF

## First occupant of Magdeburg's Port of Science



Grand Opening: 2006

Investment costs: €15.3 Mio.

Financing: 49% EFRE; 25,5% LSA; 25,5% FhG

### ■ Facilities

- Elbe Dom VR testing facility (18 meters in diameter, houses the cylindrical projection surface)
- VR prototyping and process design labs
- VR training and seminar rooms
- Energy research labs (energy management and conversion of wastes and residues)
- Smart farming labs (hyperspectral analysis of plant growth)

# VDTC – ProDiMA

## Deep regional integration of the concept and its implementation

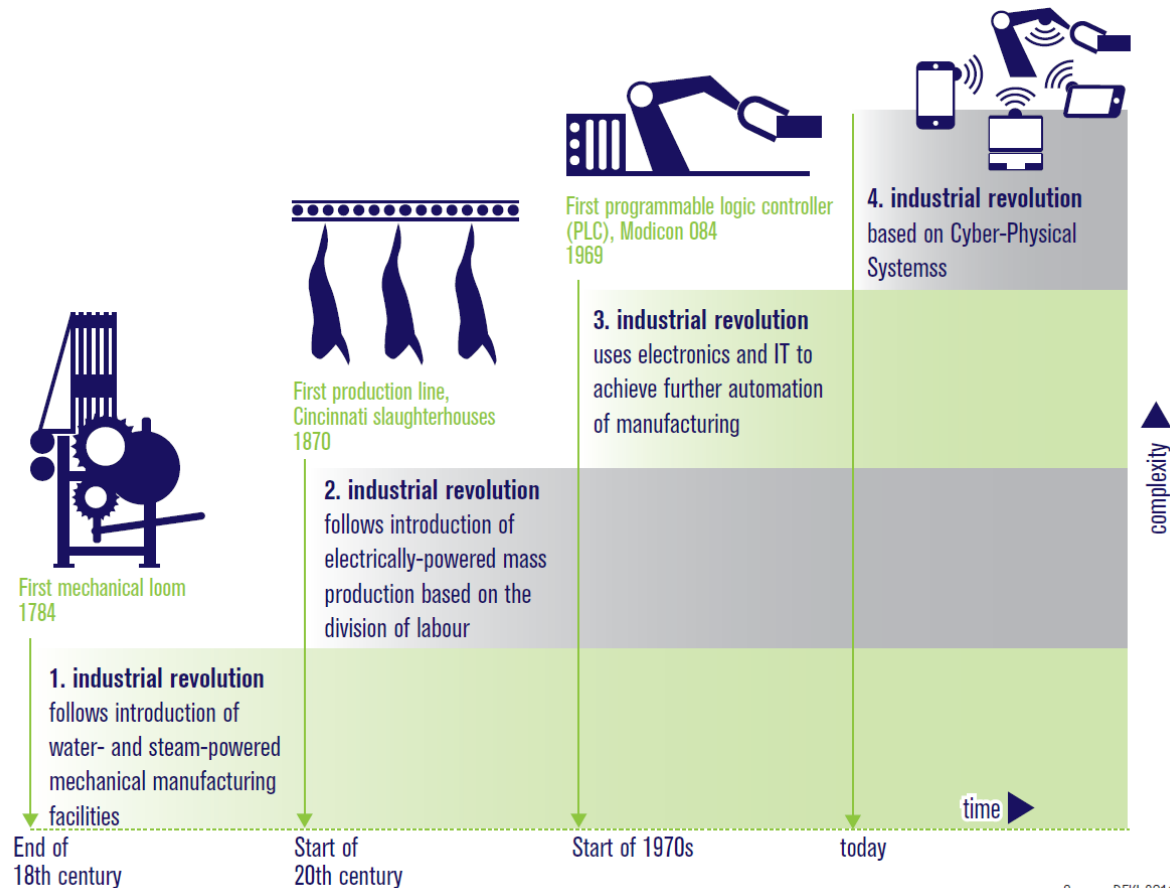
VDTC – ProDiMA is awarded the European Commission's „European Regional Innovation Award“ for Saxony-Anhalt



„This project supports the ongoing structural changes to the local economy.“

# Virtual technologies as enablers for Industry4.0

## The evolution of industrial production



Source: DFKI 2011

Source: acatech 2013,

[http://www.acatech.de/fileadmin/user\\_upload/Baumstruktur\\_nach\\_Wbsite/Acatech/root/de/Material\\_fuer\\_Sonderseiten/Industrie\\_4.0/Final\\_report\\_Industrie\\_4.0\\_accessible.pdf](http://www.acatech.de/fileadmin/user_upload/Baumstruktur_nach_Wbsite/Acatech/root/de/Material_fuer_Sonderseiten/Industrie_4.0/Final_report_Industrie_4.0_accessible.pdf)



# Virtual technologies as enablers for Industry4.0

## Industry 4.0 - A definition

**Industrie 4.0** is the technological evolution from **embedded systems** to **cyber-physical systems**.

Decentralized intelligence helps create **intelligent object networking** and **independent process management**, with the interaction of the real and virtual **worlds** representing a crucial new aspect of the manufacturing and production process.

Industrie 4.0 represents a **paradigm shift** from "**centralized**" to "**decentralized**" production - made possible by technological advances which constitute a reversal of conventional production process logic.



Source: <https://www.gtai.de/GTAI/Navigation/EN/Invest/Industries/Smarter-business/smart-products-industrie-4.0,t=industrie-40,did=589872.html>

8



# Digital Engineering and Operation

## Support along the entire product life cycle



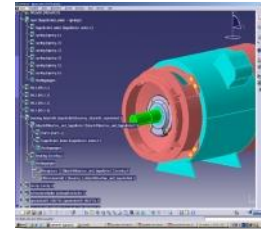
### Maintenance

- Assistant systems
- Visual interactive repair instructions



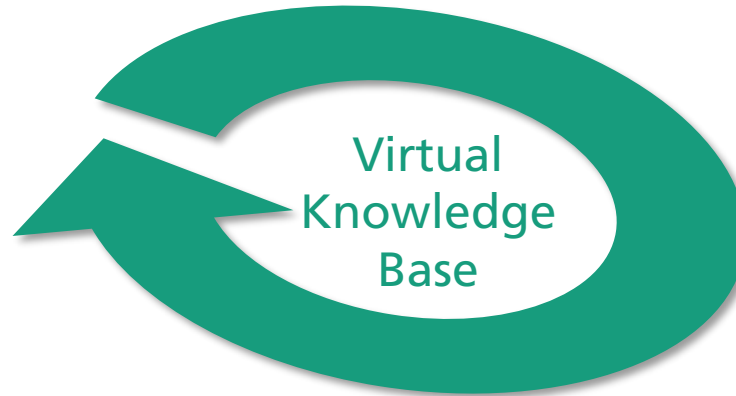
### Design Review

- Engineering
- Manufacturing
- Assembly
- Maintenance



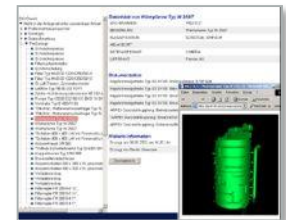
### Functional Test

- Mechanics
- Electronics
- Control systems



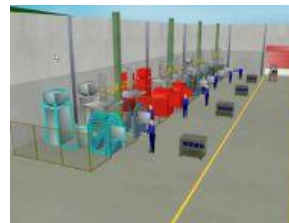
### Technical Documentation

- Visual interactive catalogs
- Electronic manuals



### Education and Training

- Technical staff
- Operation service
- Assembly service



### Factory Planning

- Layout planning
- Process planning

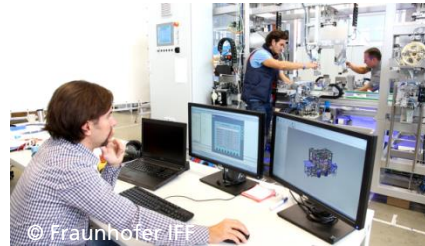


### Job Preparation

- Work scheduling
- Resource optimization
- Logistics functions

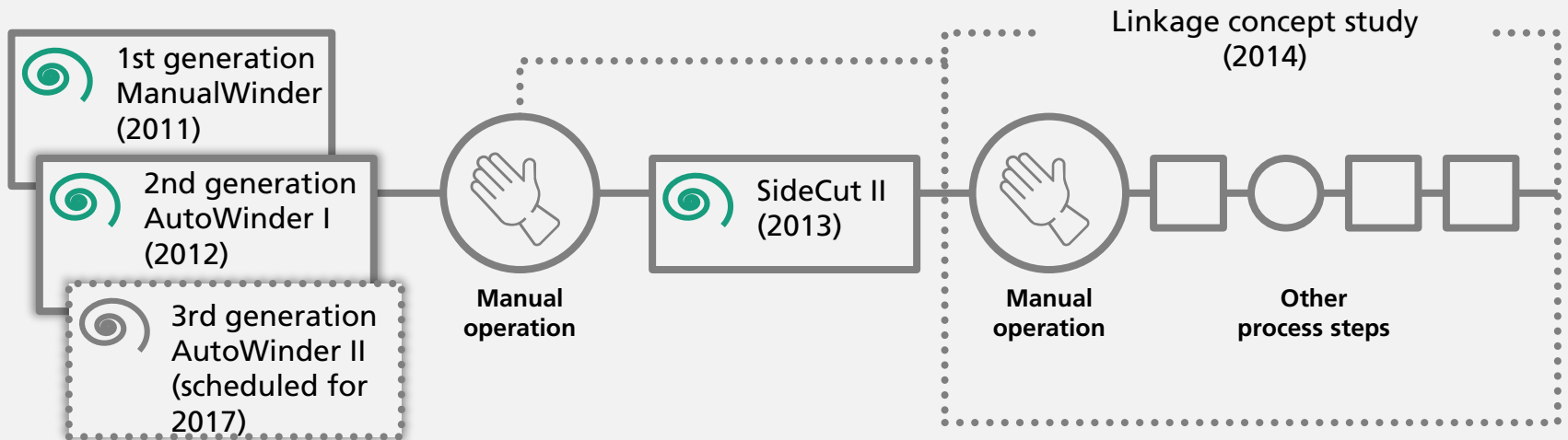
# Virtual technologies as enablers for Industry4.0

## Integrated and Parallel Product and Manufacturing System Design for LANXESS AG



- Use of virtual models to plan, develop and prototype the manufacturing system for innovative water filters in parallel to the product development process

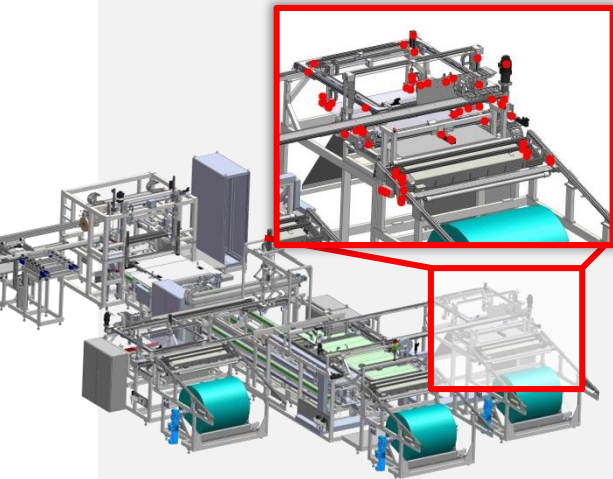
Planning and development of several (semi) automated manufacturing systems  
**Goal: Fully automated production facility (2020)**



# Virtual technologies as enablers for Industry4.0

## Integrated and Parallel Product and Manufacturing System Design for LANXESS AG

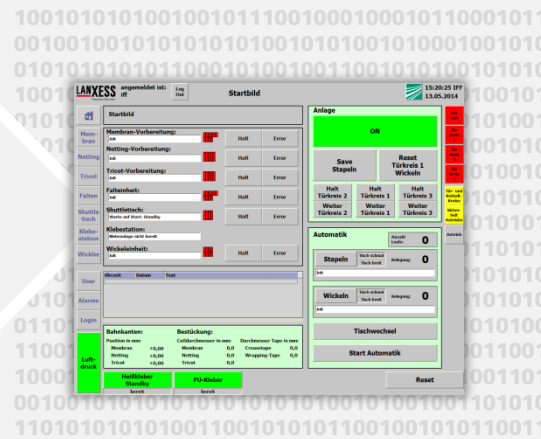
### Complexity



AutoWinder 1 consisting of a total of thirteen modules

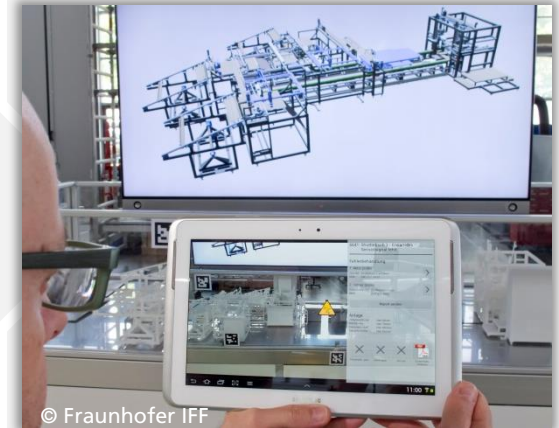
- 10,000 components
- 800 sensors
- 150 pneumatic actuators
- 30 electric drives

### Digital Engineering and Operation



- Constant analysis: Analysis of nominal and actual data from the virtual and the real system

### Benefits



Functioning Digital Twin:

- Error codes including solution strategies
- Maintenance data
- Supporting operational assistance system

# Virtual technologies as enablers for Industry4.0

## Visual Assistance and Inspection Systems



### Machine Manufacturers



Diversity of models and high complexity of jobs in assembly operations



Visual assistance and inspection systems for clamping system assembly

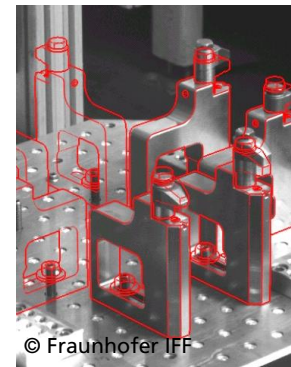
- Virtual templates to position and align components
- Augmented reality: Information supplied by camera images of the assembly scene, overlaid with 3D CAD models
- Upgradable with an inspection assistant



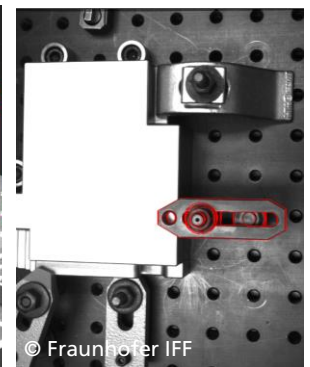
Zero-defect manufacturing

Shortened assembly time  
↓ 20%

↑ Reliability in the process chain



© Fraunhofer IFF



© Fraunhofer IFF



# Virtual technologies as enablers for Industry4.0

## Safe Human Robot Collaboration



### Tactile sensors for safety and haptic interaction

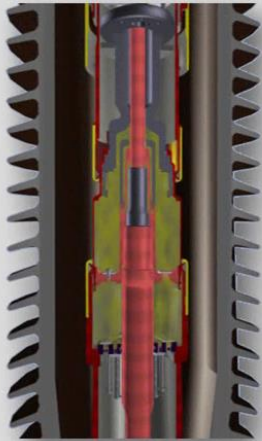
- Applied all around the platform, linear axis and as bumper
- With integrated damping material
- As input device for simple and intuitive movement of platform and linear axis



# Virtual technologies as enablers for Industry4.0

## Training and documentation for complex work places

### Components and functional processes



- > Interactive discovery of the components
- > Visibility of all parts
- > Understandable functional processes
- > Visualisation of different mediums, e.g. gas
- > Communication support for technicians in the field

### ■ Documentation

- Complete and holistic based on development and operational data (digital twin)
- Different and mutually enhancing media (text, video, interaction)

### ■ Training

- Available before actual machine based on virtual development data
- Highly interactive, high visibility of parts and dependent processes
- Efficient for infrequently performed actions
- For job preparation/training or in-the-field training

