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**

Finance volume 2016:

- **€2.1 billion**
- **€1.9 billion**

Contract Research:

- More than 70% is derived from contracts with industry and from publicly financed research projects.

Major infrastructure capital expenditure and defense research:

- Almost 30% is contributed by the German federal and Länder Governments.
Fraunhofer Group of Production
Leading Network of Applied Production Research

- **Key data**
  - 10 member institutes
  - Researchers\(^1\): 1444
  - Percentage of business revenue\(^2\): 37.4%
  - Budget\(^3\): €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

\(^1\) As of December 31, 2016
\(^2\) 2015
\(^3\) 2016 budget
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

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)

Grand Opening: 2006

Investment costs: €15.3 Mio.
Financing: 49% EFRE; 25,5% LSA; 25,5% FhG
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 Industry 4.0
The evolution of industrial production

Source: acatech 2013,
http://www.acatech.de/fileadmin/user_upload/Baumstruktur_nach_Website/Acatech/root/de/Material_fuer_Sonderseiten/Industrie_4.0/Final_report__Industrie_4.0_accessible.pdf
Virtual technologies as enablers for Industry 4.0

**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.

Digital Engineering and Operation
Support along the entire product life cycle

- Design Review
  - Engineering
  - Manufacturing
  - Assembly
  - Maintenance

- Functional Test
  - Mechanics
  - Electronics
  - Control systems

- Technical Documentation
  - Visual interactive catalogs
  - Electronic manuals

- Job Preparation
  - Work scheduling
  - Resource optimization
  - Logistics functions

- Education and Training
  - Technical staff
  - Operation service
  - Assembly service

- Maintenance
  - Assistant systems
  - Visual interactive repair instructions

- Factory Planning
  - Layout planning
  - Process planning

Virtual Knowledge Base
Virtual technologies as enablers for Industry 4.0
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)

1st generation
ManualWinder (2011)

2nd generation
AutoWinder I (2012)

3rd generation
AutoWinder II (scheduled for 2017)

SideCut II (2013)

Linkage concept study (2014)

Manual operation

Other process steps
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 Industry 4.0

**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 \( \downarrow 20\% \)
- ↑ Reliability in the process chain
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 Industry 4.0
Training and documentation for complex work places

- **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

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
Fraunhofer-Institut für Fabrikbetrieb und -automatisierung IFF
Sandtorstr. 22
39106 Magdeburg
www.iff.fraunhofer.de

Christian Blobner
International Business Development
Tel.: +49 391 4090 371
Fax: +49 391 4090 93 901
Christian.Blobner@iff.fraunhofer.de