Transformation of the Automotive Industry:

Technological developments and their impact on employment and value creation

Visit of the IHEDATE Institute | Stuttgart | June 28, 2023

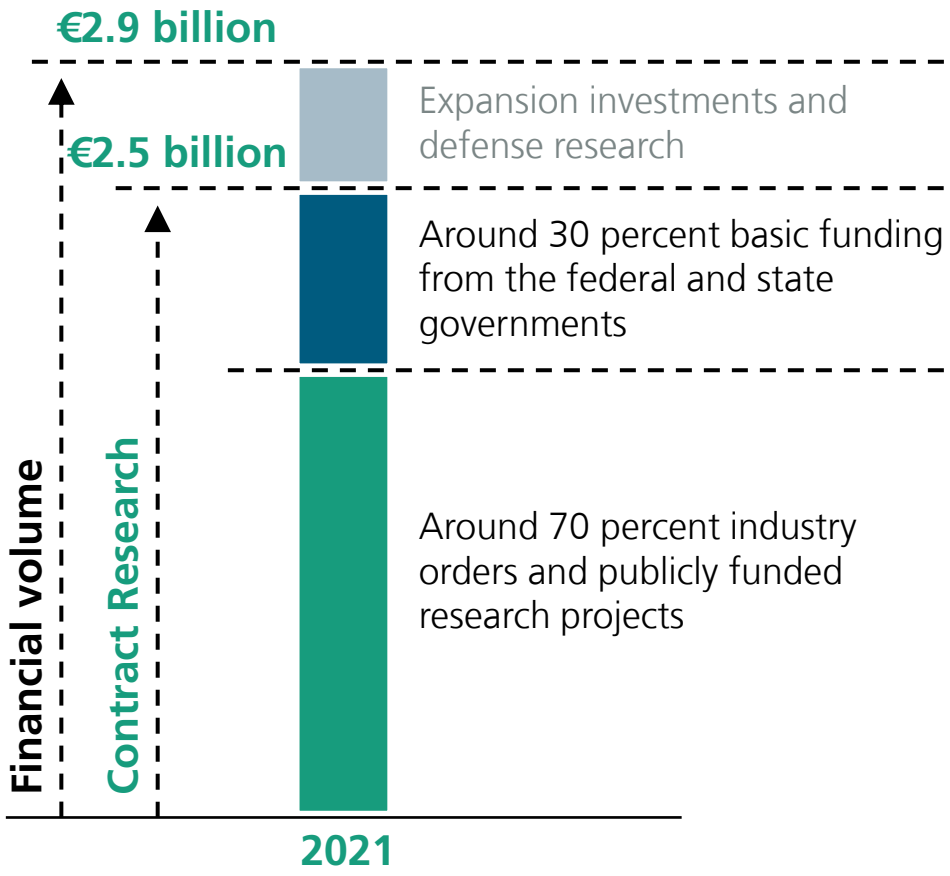
Dr.-Ing. Florian Herrmann

Profile of the Fraunhofer-Gesellschaft

Application-oriented research for the direct benefit of business and for the benefit of society

30,000 Employees

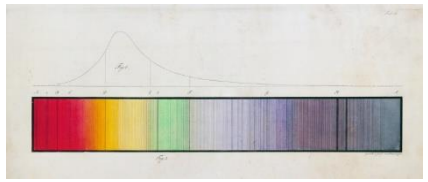
76 Institutes and research facilities



Fraunhofer IAO

Joseph von Fraunhofer
(1787 to 1826)

Fraunhofer-Gesellschaft
(since 1949)



Discovery of the **“Fraunhofer lines”** in the solar spectrum

Research and **development** on behalf of industry and government

New processing methods for lenses

Music format mp3, white LED, high resolution thermal camera

Manager and **partner** of a glassworks

Research volume: approx. **€2.9 billion per year**

Fraunhofer IAO

Application-oriented research for business and society

Fraunhofer IAO and IAT of the University of Stuttgart

630+
Employees

43,2
Mill. EUR
turnover

7
Locations and
research
facilities

- Center for Responsible Research and Innovation **CeRRI**, Berlin
- Fraunhofer application center **KEIM,** Esslingen
- Research and Innovation Center for Cognitive Service Systems **KODIS**, Heilbronn
- **Werksviertel**-Mitte Munich, living lab
- Fraunhofer Innovation Engineering Center **IEC**, Bozen (Italy)

Fraunhofer IZS

Institute Center Stuttgart

- IAO — Fraunhofer Institute for Industrial Engineering **IAO**
- IAT — University of Stuttgart Institute of Human Factors and Technology Management **IAT**
- IGB — Fraunhofer Institute for Interfacial Engineering and Biotechnology **IGB**
- IBP — Fraunhofer Institute for Building Physics **IBP**
- IPA — Fraunhofer Institute for Manufacturing Engineering and Automation **IPA**
- IRB — Fraunhofer Information Center for Planning and Building **IRB**

Fraunhofer IAO

Joining forces for sustainable success

Locations

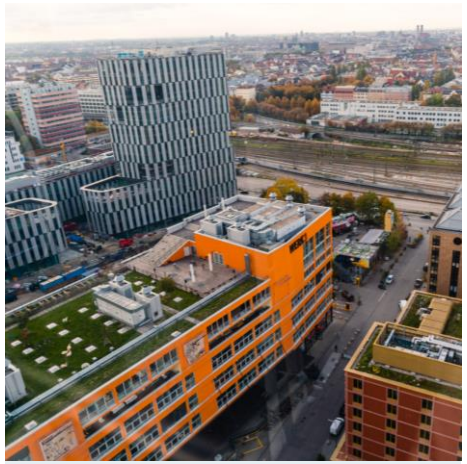
more

Center for Responsible Research and Innovation CeRRI, Berlin

www.cerri.iao.fraunhofer.de
(German only)

Forschungs- und Innovationszentrum für Kognitive Dienst-leistungssysteme (KODIS), Heilbronn

www.kodis.iao.fraunhofer.de/en

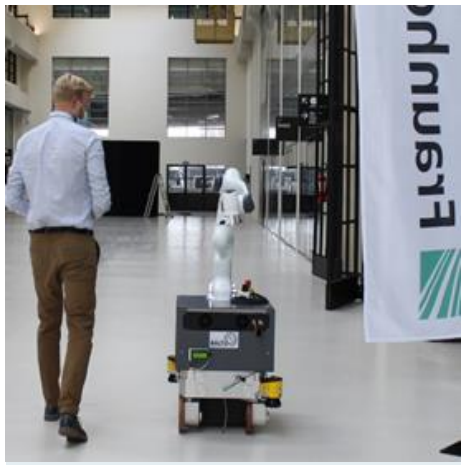


Werksviertel-Mitte Munich

https://s.fhg.de/pionierHUB
(German only)

Application Center KEIM at Esslingen University

www.keim.iao.fraunhofer.de
(German only)



Fraunhofer Innovation Engineering Center IEC, Bozen (Italy)

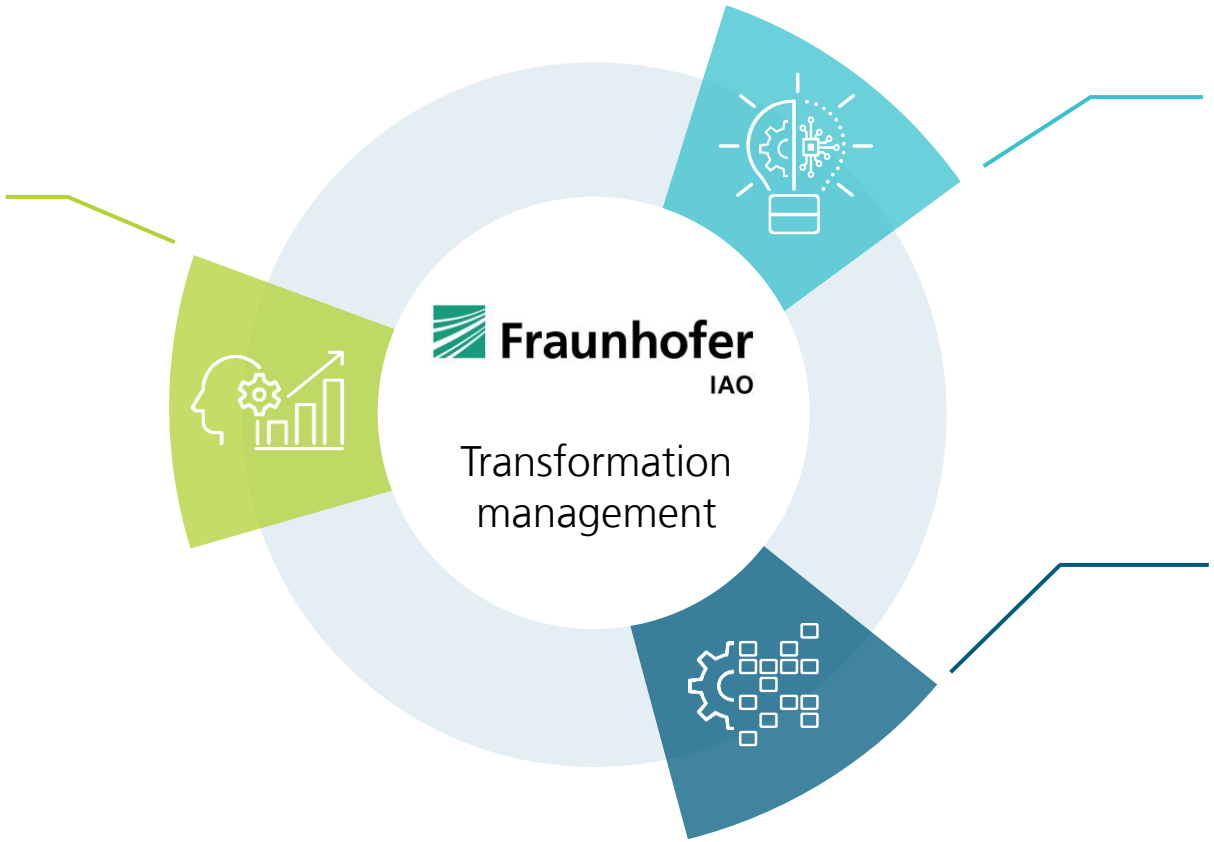
www.fraunhofer.it/en

Research and development fields of the Fraunhofer IAO

Work and innovation in the digital transformation for a sustainable world

Research on employment & corporate development

- Knowledge and innovation work
- Production work
- Service work
- Workforce transformation
- Change management



Technology & innovation management

- Technology radar
- Foresight and scenario management
- Smarter cities
- Mobility innovations
- Smart energy solutions

Digital transformation

- Product development
- Smart services
- Digital business models
- AI and learning systems
- Quantum computing

Fraunhofer IAO - we research and advise

01 Research

Publicly funded

- Funded research projects
- Operational development projects
- Studies
- User testing

Dare to innovate

02 Networks

Directly commissioned by industry

- Innovation networks
- Industrial working groups
- Expert seminars
- Business Breakfast

Share experience/ gain knowledge

03 Consulting

Directly commissioned by industry

- Awareness Workshop
- Quick Checks
- Analysis projects
- Design projects
- Evaluation projects

Increase competitiveness

Research in the field of automotive transformation at the Institute

Electromobility, digitalization and new business models as research priorities

Study »Electromobility and Employment« ELAB 2.0

»New Mobility Academy« qualification initiative

Study »Employment 2030« commissioned by Volkswagen (2020)

Transformation dialogs and platforms

ETA
EXPERTENKREIS TRANSFORMATION DER AUTOMOBILWIRTSCHAFT

strategiedialog automobilwirtschaft BW

NPM
NATIONALE PLATTFORM ZUKUNFT DER MOBILITÄT

Strategic workforce planning at suppliers

PYTHIA
AUTOMOTIVE

Study »Impact on jobs in the vehicle trade and repair business 2030 / 2040«

IG Metall

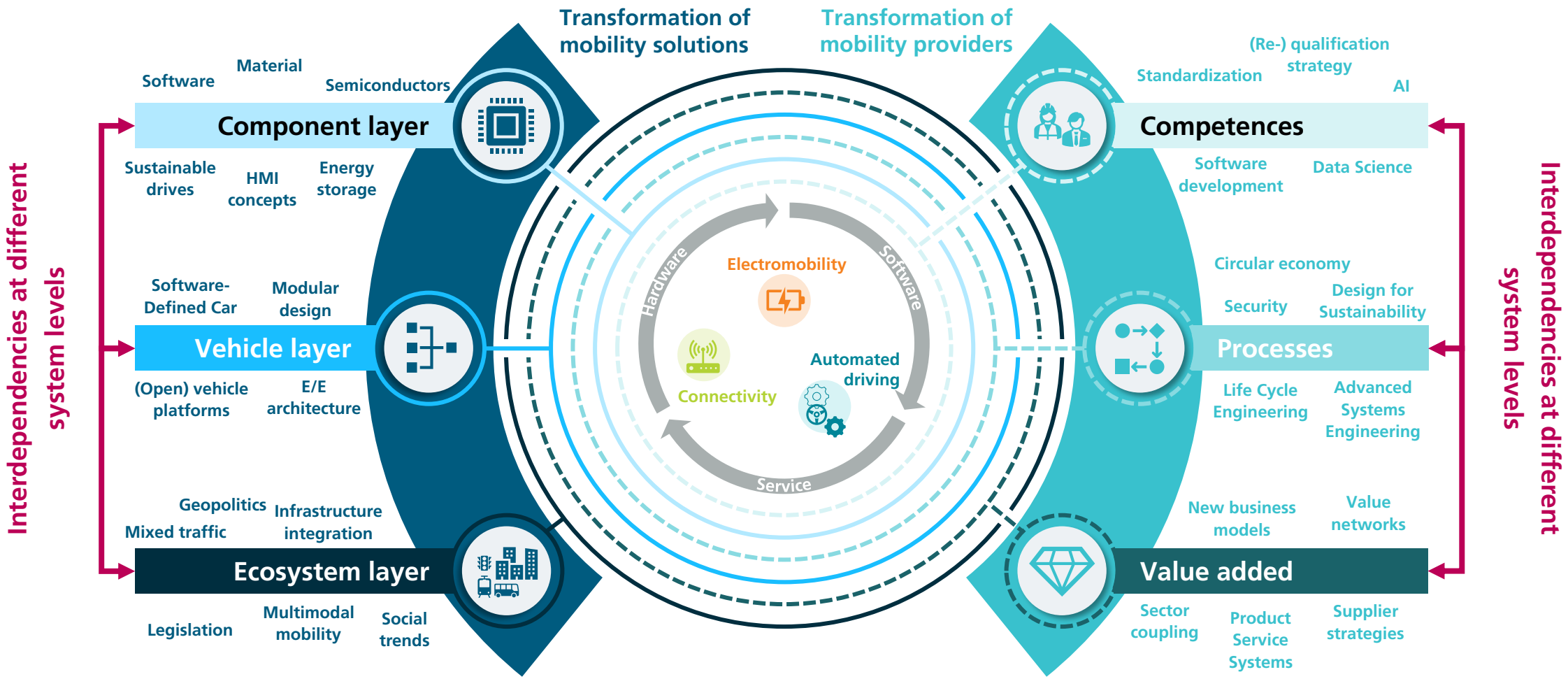
KRAFTFAHRZEUGGEWERBE BADEN-WÜRTTEMBERG

Fraunhofer IAO

ifa Institut für Automobilwirtschaft

Transformation of the automotive industry

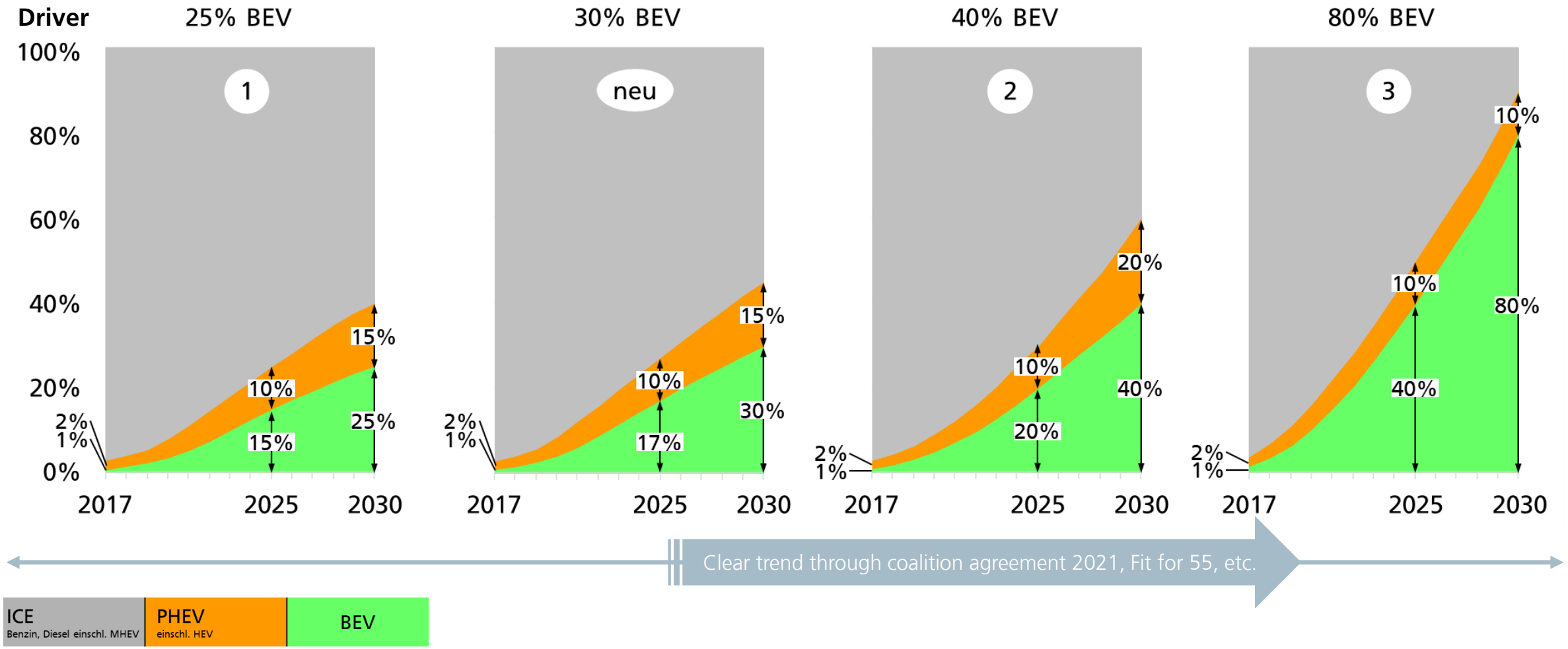
A multitude of changes are shaping entirely new mobility and value creation systems



Fraunhofer IAO

Electromobility: Changes in the OEM production mix

Transformation speed increases rapidly



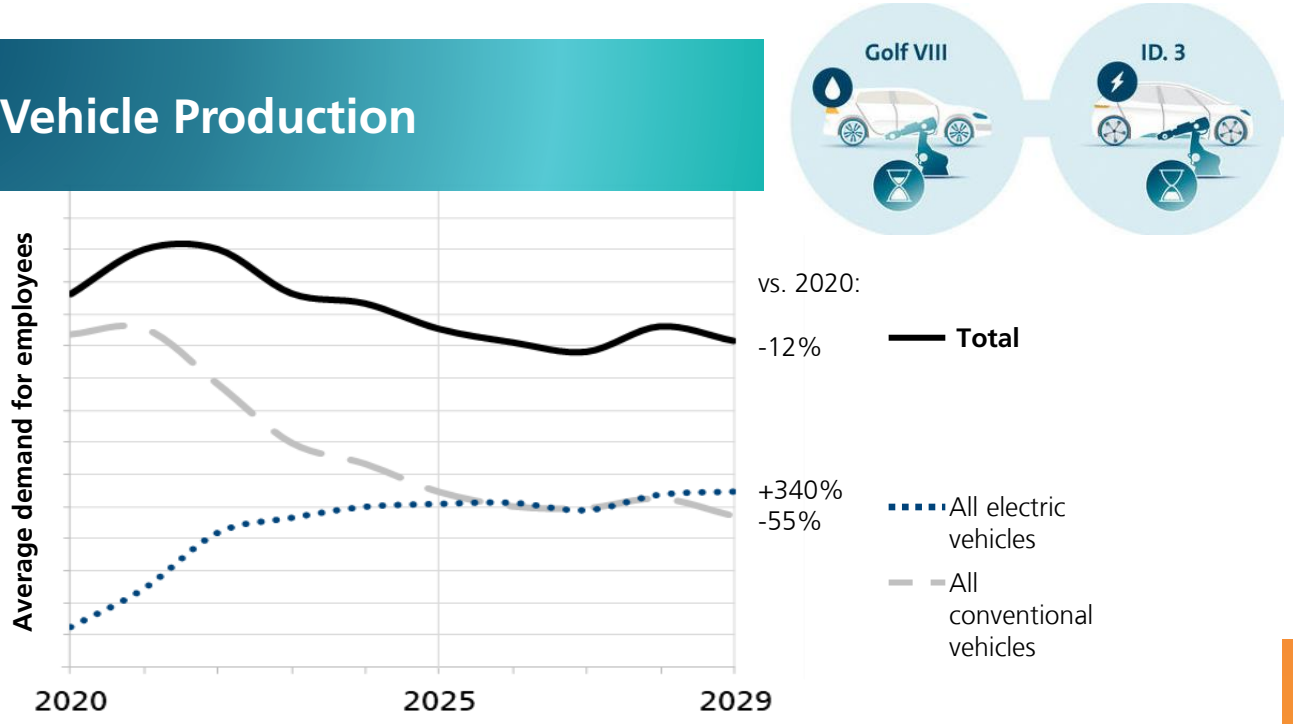
Quelle: ELAB 2.0, Final report 2018, Work within WG 4 of the National Platform Future of Mobility 2019/2020/2021

Fraunhofer IAO

Employment effects in vehicle and component production

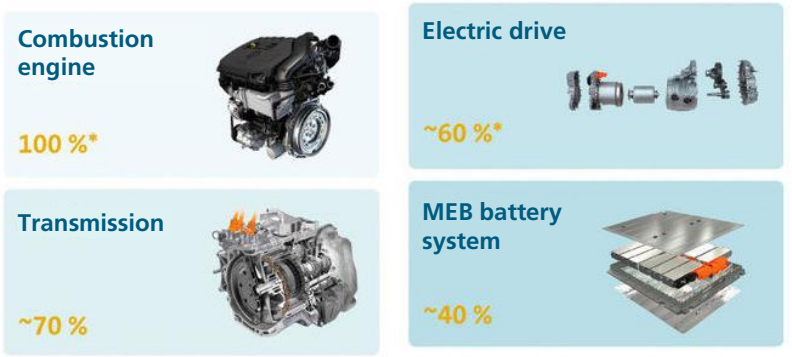
Findings from the Employment 2030 research project commissioned by Volkswagen

Vehicle Production



- The **roll-out of electromobility** in German plants might lead to a **decrease of employment demand by 12%** until 2029.[1]
- Decline in employment demand in vehicle production due to ratio and unit effects in particular.[2]

Component Production



- Powertrain **components for BEVs is 40 – 60 % are less employment-intensive** compared to an ICE.[2]
- Aggregated, ICE powertrains are 70 % greater in labor volume compared to those of BEVs.[2]

* *ICE forms 100 % employment intensity, all other figures refer to time spent in 2023 and 300,000 units.*

Source: Beschäftigung 2030; [1] Data basis for 2019 planning round, 2029 target year; [2] Related to the reference vehicles Golf 8 and ID.3
https://.volkswagen-newsroom.com/de/storys/fraunhofer-studie-beschaeftigung-bei-volkswagen-im-jahr-2030-6725?msclkid=dabe4e72cd2b11ec9084750e2eccfb34

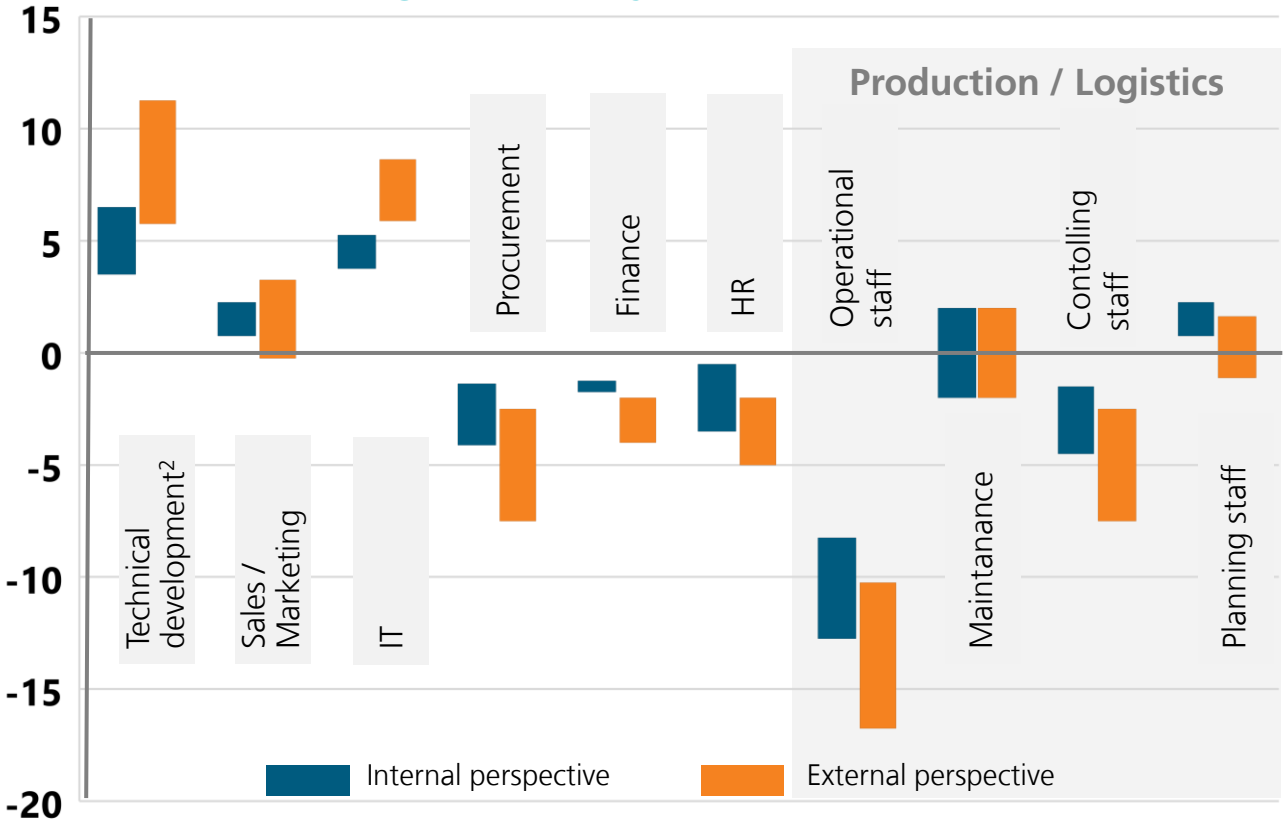
Fraunhofer IAO

Employment effects through digitization

Findings from the Employment 2030 research project commissioned by Volkswagen

- **Employees** considered in 32 job clusters.[1]
- By 2030: **Employment decline** primarily in direct areas of **production & logistics**.
- Noticeable employment effects in the **indirect sectors** not expected until after 2030 as a result of large-scale IT projects.
- Increasing **product complexity** and **new scopes of value creation** require new competencies in indirect areas as well.
- **Competence development in digital key topics** becomes a central challenge, as the required competence carriers are not sufficiently available on the market.
- **Tertiarization of work:** In production, increasing use of automation; in knowledge-intensive and creative areas, human skills remain indispensable.

[%] Expected change in employment in 2030 compared with 2020



[1] Coverage: 57% of VW AG VW Passenger Cars total

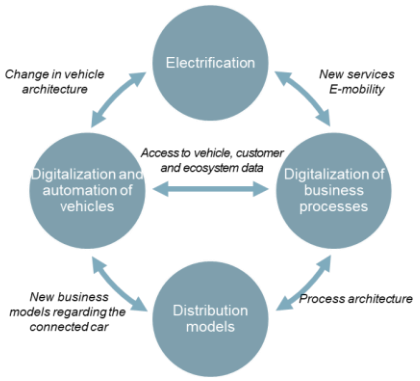
[2] Strong growth expected due to increasing work volume through product and process digitization

Fraunhofer IAO

Employment effects 2030/2040 within the vehicle trade and repair business

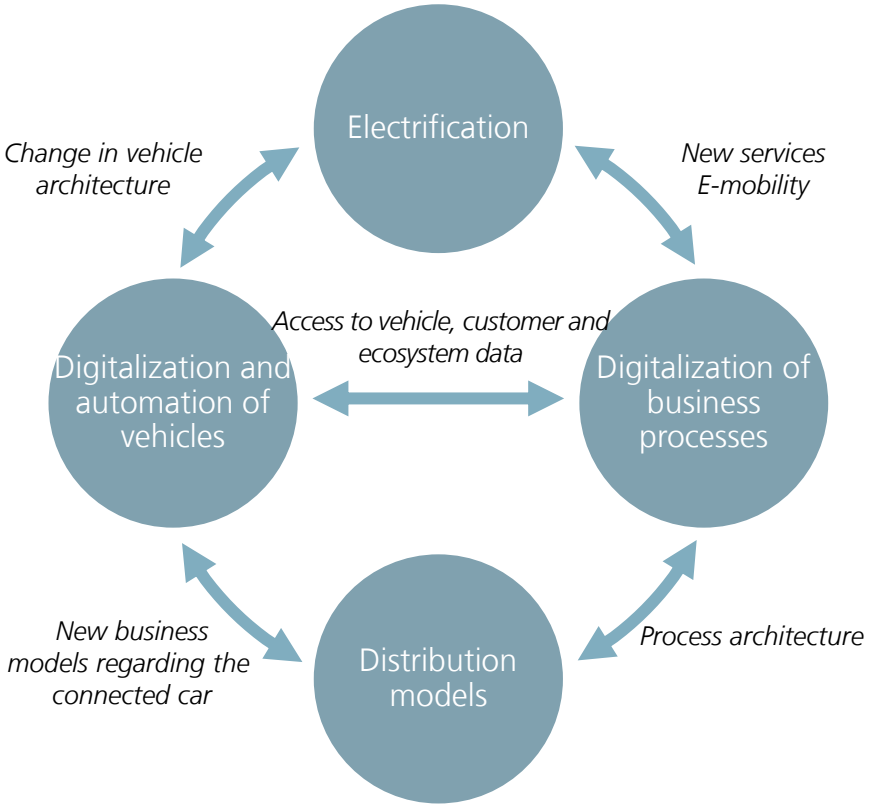
Study in cooperation with Institute of Automotive Economics IfA commissioned by e-mobil BW

Projection 1



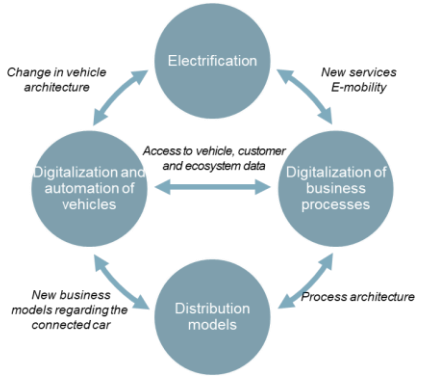
moderate

Projection 2



progressive

Projection 3



Employment effects 2030/2040 within the vehicle trade and repair business

Projection 2 - Transformation of the vehicle trade and repair business „leadership of the OEM“

NC-Sales (channels)
- Online direct sales: 30 %
- Agents: 30 %
- Franchised dealer: 40 %

UC-Sales (channels)
- Online direct sales: 17 %

Vehicle stock: 49 mio. (new registrations: 2,9 mio.)
BEV: 10 mio.
Automation: mainly level 2
Share connected car: 74

Repair frequency: 0,35
Maintenance frequency: 0,76

NC-Sales (channels)
- Online direct sales: 45 %
- Agents: 40 %
- Franchise dealer: 15 %

UC-Sales (channels)
- Online direct sales: 30 %

Vehicle population: 48.5 mio. (new registrations: 2,6 mio.)
BEV: 28 mio.
Automation: mainly level 3
Share connected car: 90 %

Repair frequency: 0,28
Maintenance frequency: 0,73

2022

14.460 Franchise

7.520 Franchised dealerships**

6.940 Franchised workshops

22.110 Independent

2030

11.510 Franchise

5.265 Franchised dealerships** -30%

6.245 Franchised workshops -10%

17.690 Independent -20%

- 18% Employees*

2040

10.060 Franchise

4.510 Franchised dealerships** -40%

5.550 Franchised workshops -20%

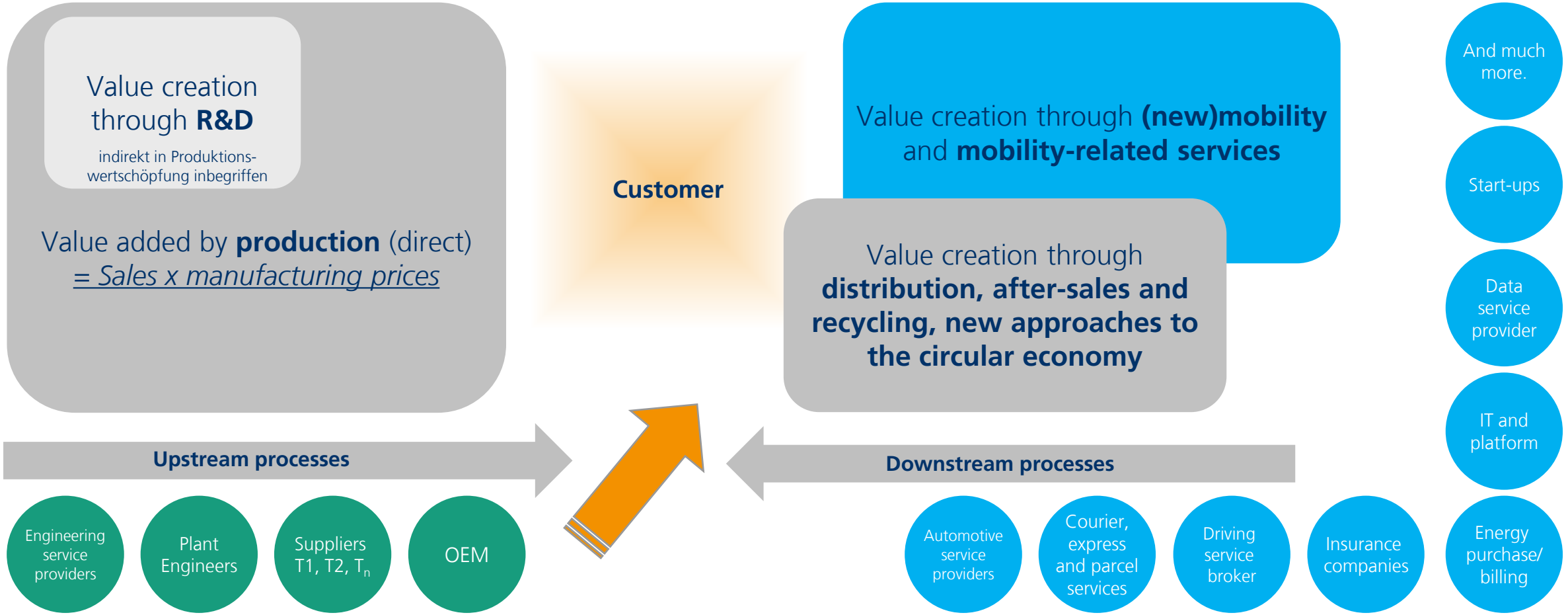
13.265 Independent -40%

-28% Employees*

*compared to 2022 | **the business model of „franchised dealership“ includes a workshop

Expansion of the value creation system

Value creation through service and in later phases increases

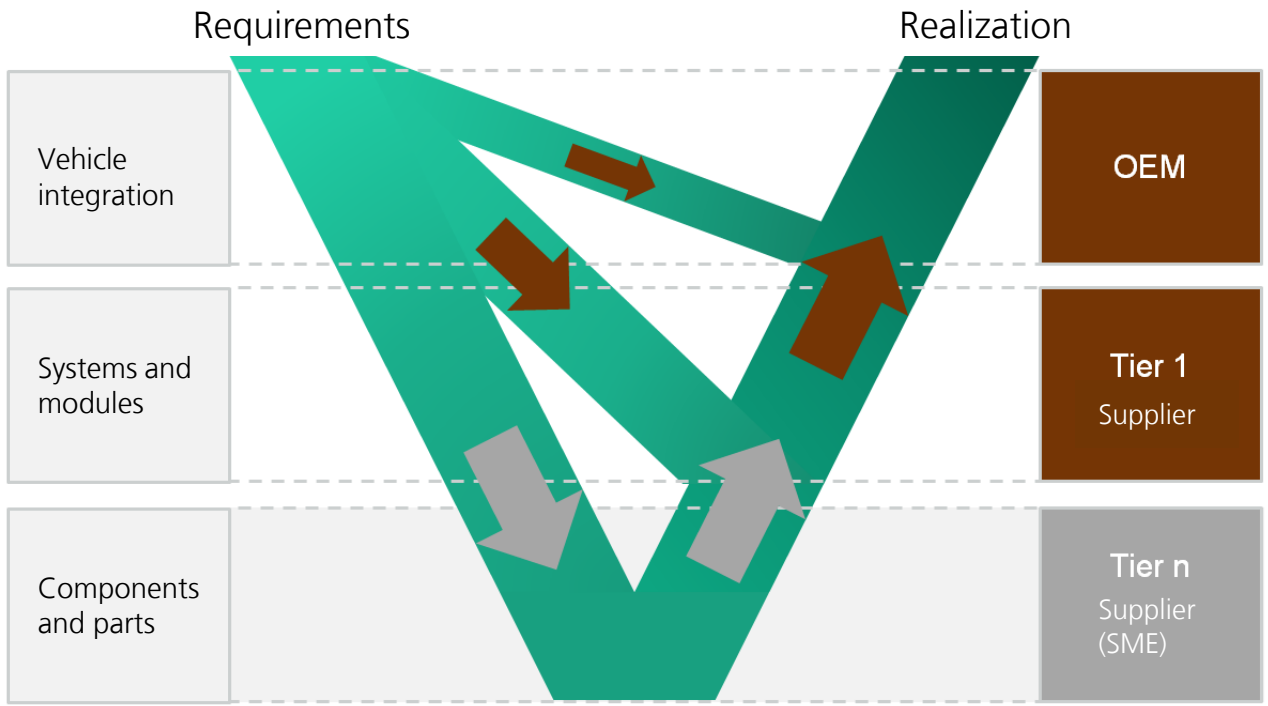


Fraunhofer IAO

Shift in the scope of value creation and required competences

Securing own value creation scopes as challenges especially for SMEs

V-Model of Value Creation



SystEM

Systematischer Ansatz zur Kosten-reduzierung in der **E-M**obilität

LieSE

Lieferant im System Elektromobilität

Ecosystem

Increasing importance of digitization (platforms, etc.) and startups across the ecosystem.

System

Increasing understanding of how components work together required.

Component

ncreasing skills required in handling electronics and high voltage.

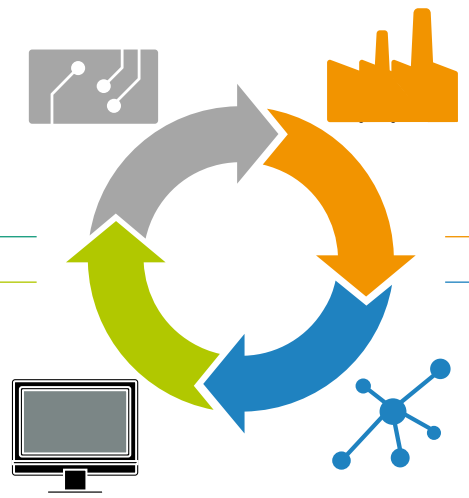
Note: The SystEM and LieSE projects were funded by the Baden-Württemberg Ministry of Economic Affairs

Future skills (abilities and knowledge) with strongly increasing importance

Example: Future Skills Cluster for Baden-Württemberg

Technological capabilities

- Cybersecurity
- Data management
- **Data science & AI**
- Design
- Intelligent Hardware & robotic
- IT-Infrastructur & Cloud
- **Sustainable & resource-saving technologiesSensortechnik & IoT**
- **Software development**
- Software-supported control of business processes



Industry capabilities

- **Alternative Antriebstechnologien**
- Analytische Chemie
- **Assistiertes & autonomes Fahren**
- Biotechnologie
- Electrical Engineering
- Entwicklung von Medizinprodukten
- Industrial Engineering
- Pharmazeutische Produkt-Verfahrensentwicklung

Digital key qualifications

- **Agile working methods**
- Digital & data literacy
- **Digital collaboration & interaction**
- Basic IT skills
- Programming skills

Interdisciplinary skills

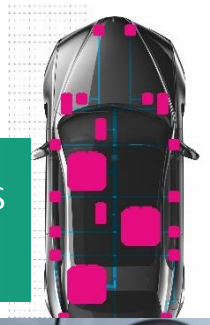
- Eigeninitiative
- Flexibilität
- Führungsfähigkeiten
- Kommunikation / Überzeugungsvermögen
- **Kreativität**
- Kundenorientierung
- **Organisationsfähigkeit**
- **Problemlösungs-fähigkeit**
- Resilienz
- Zielorientierung

Souce: Study "Future Skills - Which skills are critical for success in Baden-Württemberg today and in the future", AgenturQ 2021

New value creation paths for companies

Opportunities for tapping value creation potentials

Transfer of **product and process know-how** to future requirements of modern e-vehicles (e.g. contacting, filter systems, thermal management, E/E architectures)



Development of new competencies and **market fields** in automotive **growth drivers** (e.g. drive and charging technology, energy storage, fuel cell technology)

Transfer of product and process know-how to new application fields outside the vehicle (e.g. e-bikes and micromobiles, automated transportation, drones and air cabs, stationary applications, vehicle and infrastructure networking)

Establishment of new value creation systems and business models (e.g. hydrogen economy, new services and data-driven business models)

Challenge: "Utilization" of competencies from conventional fields and development of competencies for future fields

New value creation paths for companies

New value creation systems and business models - example hydrogen economy

Mobility and transport

- Public transport (bus, train, plane...)
- Freight transport (truck, ship...)
- Intra/extralogistics (forklift, apron vehicle)
- Car, drone, micromobile...
- Gas stations and infrastructure

Technologies (selection):

- Fuel cells (systems)
- Batteries (short-term storage)
- H2 combustion engines
- Storage & Compressors
- Safety technology
- Pipelines

Building heat and power

- Building heating systems
- (Emergency) power units
- Supply infrastructure

Technologies (selection):

- Fuel cell heating systems
- Batteries (short-term storage)
- Pressure accumulators
- Water treatment
- Electrolysers
- PV systems

Electricity sector

- Intermediate storage of green power (e.g. at generation plants)
- Power generation (gas turbines, peak load coverage)

Technologies (selection):

- Fuel cells (systems)
- Electrolysers
- Gas turbines
- Storage technologies
- Smart grid systems
- Transmission lines

Other

- Burners for process heat
- Mobile micro fuel cells (laptop, cell phones, lighting)
- Construction machinery and off-road applications

Technologies (selection):

- Fuel cells (systems)
- Storage technologies
- Burner technologies
- Electrolysers
- PV systems

Challenges: Economical production of green H2 (+E-Fuels), distribution infrastructure, safe and compact storage, general production readiness

Source: H2-Innovationslabor Heilbronn-Franken

Project example CYCLOMETRIC

More sustainable development of vehicle components in terms of the circular economy

Konsortium (Laufzeit 10/2021 – 09/2024)

Fraunhofer IAO
Fraunhofer IBP
ESB BUSINESS SCHOOL
Hochschule Reutlingen
Reutlingen University
Universität Stuttgart
Institut für Arbeitswissenschaft und Technologiemanagement IAT
Universität Stuttgart
Institut für Akustik und Bauphysik
Ganzheitliche Bilanzierung GaBi
Universität Stuttgart
Institut für Flugzeugbau
FORWARD ENGINEERING
IILS
Schweizer Design Consulting
DITF
DEUTSCHE INSTITUTE FÜR TEXTIL+FASERFORSCHUNG
DXC TECHNOLOGY
LOTUS

Bundesministerium für Bildung und Forschung

PTKA Projektträger Karlsruhe
Karlsruher Institut für Technologie

ARENA2036

Research subject

Impact of design decisions (e.g. modularization, material selection) in early phases of development on sustainability and cycle aspects of a vehicle.

Goal of the project

- Tool-based decision support for developers

Projektinhalte

- Development of a **meta-model for product architecture design** considering cycle-oriented influencing factors
- Definition of an **approach for cycle-oriented product development**
- Research approaches are based on **Advanced Systems Engineering**, in particular Model-Based Systems Engineering in combination with approaches of Life Cycle Assessment as well as Business Model Analysis.

Workforce Transformation

Concrete approaches for securing employment and expanding competencies

Within the company and between companies

- Development of new education and training formats and offerings (e.g. Faculty 73 at VW, Continental Institute for Technology and Transformation (CITT))
- Exchange of experience on framework conditions and best practices
- Early and proactive involvement of employees, e.g. in the testing of automation approaches and digitization tools

New paths and formats

- New ways of training future professionals and specialists, e.g. programming schools 42, Educational Technologies
- Establishment of new innovation and qualification formats in the company (Makeathons / Hackathons, Students teach Professionals, etc.)
- Agility in learning and in activities as well as strengthening of employees' personal responsibility to make the workplace more attractive
- Utilization of opportunities for hybrid working / new work

Together in the network

- Participation in clusters of excellence, innovation partnerships and collaborative projects, e.g. in the areas of digital vehicles, data-based ecosystems, new business models, climate neutrality
- Participation in regional competence hubs and their activities in the individual federal states
- Utilization of funding opportunities in the context of the transformation (e.g. funding package KoPa 35c)

Thank you for your attention

Dr.-Ing. Florian Herrmann
Florian.herrmann@iao.fraunhofer.de
https://www.linkedin.com/in/florian-herrmann-8356b557/