Safeguarding Growth and Prosperity:
What successful innovators have in common

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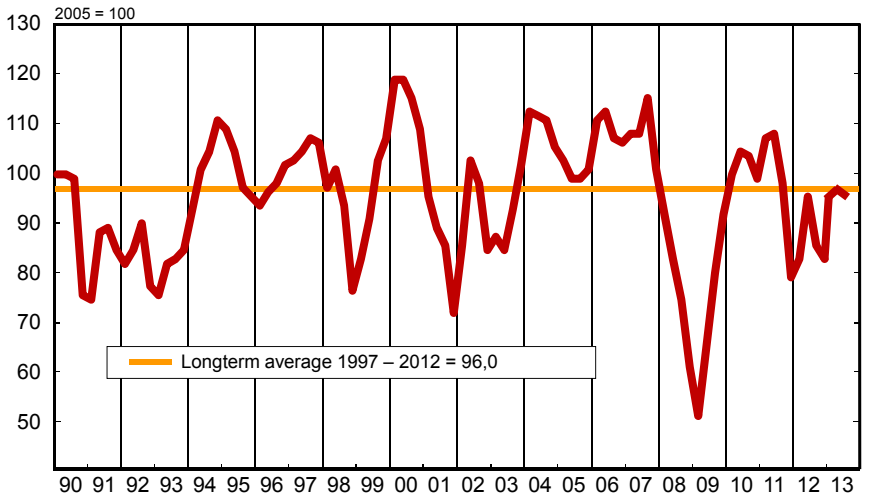
World economic climate* - up and down…



*arithmetic mean of judgement about the present and expected economic situation

Source: ifo, 2013

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It is by no means certain
that things will become better
when they change,
but in order to become better,
they have to change.

Georg Christoph Lichtenberg
German physicist and author
(1742-1799)

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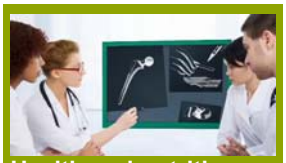
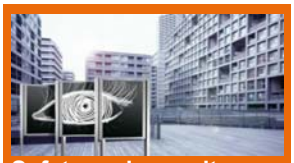
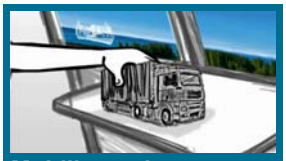
Challenges – »The Markets Beyond Tomorrow«



Health and nutrition
Affordable healthcare



Safety and security
Disaster prediction and management



Mobility and transportation
Low-emission, reliable mobility in urban areas

Information and communication

Production and environment
Life-cycle production

Energy and living
Low-loss generation, distribution and use of electricity

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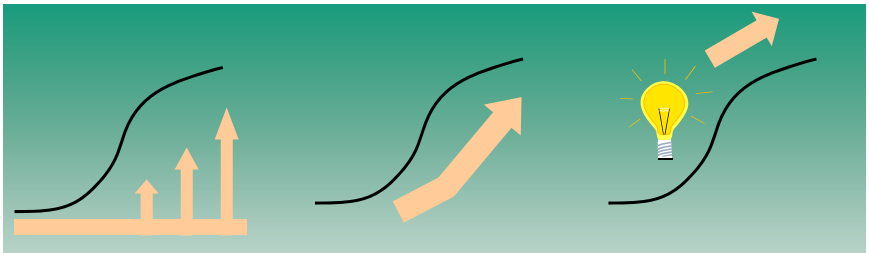
Three strategic approaches of innovation



Reserve the »right to play«

Sufficient investments to preserve the competitiveness without an early determination of further activities

Adaptation to the future

Speed, agility and flexibility for the recognition and utilization of chances in existing markets

Active creation of the future

Playing a leading role in determining the competition rules in the sector,
for example:
- determine standards
- generate needs

Source: Courtney/ Kirkland/ Viguerie modified by Fraunhofer IAO

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Innovation chances via new technologies

Energy Turnaround Technologies

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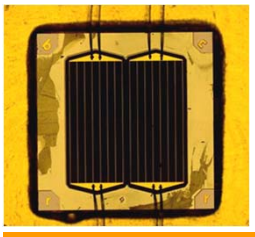
Research Example: Highly Efficient Solar Cells and Concentrator Modules

Scientists at the Fraunhofer ISE were convinced that a metamorphic triple-junction solar cell structure consisting of III-V compound semiconductors could challenge the existing efficiency record. By stacking multiple top-quality solar cells on top of each other on a substrate of germanium, the team created a triple-junction solar cell structure better adapted to the spectrum of wavelengths found in sunlight. This way a **record-efficiency of 41.1 percent** was achieved.



FRAUNHOFER Award 2010
Award of the »Fondation Louis D« (Research Award of France)
German Environmental Award 2012

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Research Example: Wind energy in offshore wind parks

alpha ventus in the North Sea:

- twelve 5 MW class offshore wind turbines have been built in a water depth of 30 metres, about 45 kilometres off Borkum
- 220 GWh per year
- Clean energy for about 50.000 households
- Coordination of research cooperation by Fraunhofer IWES

Offshore-windpark alpha ventus in the North Sea

Worldwide unique test rig for Fraunhofer IWES offshore wind turbine rotor blades in Bremerhaven

Source: Fraunhofer IWES

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eEnergy – Intelligent storage, networking and reduction by electronics

Intelligent networking: Virtual combination power plant works like a common power plant: Combination of 3 wind parks, 4 biomass- und 20 solar-power plants as well as 1 water power plant (Fraunhofer IWES)

Intelligent storage: The batteries of the electric vehicles can be used as variable storage

Reduction potential: Through speed-controlled drive 20 - 30% savings possible
Industry Germany: 20-25 TWh/a
Household Germany: 8 TWh/a

Reduction potential: Lighting up to **80%**, this means in EU-15:
Industry: > 40 TWh/a
Household: > 16 TWh/a

LED street light

Approximately **10 TWh/a** correspond to the production of one nuclear power plant or two 500 MW coal-fired power plants or 4000 wind power plant (1 MW-class)

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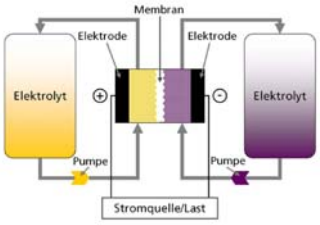
Redox-Flow-Battery: Successful breakthrough

New design for stationary systems with increased performance



Advantages:

- High charge efficiency (>80 %)
- High cycle robustness (>10.000)
- Flexible installation, easy scalable
- Fast operate time (µs – ms)
- Overcharge and low disconnect tolerance
- Low maintenance
- Less self-discharge
- Demonstrator with 0.5 m²/25KW

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Innovation chances via new technologies

Energy Turnaround Technologies

Resource Efficiency

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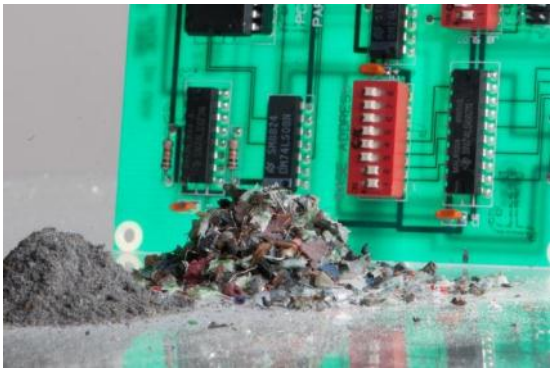
Resource efficiency: Research topics

1 Recycling of important raw materials out of product

2 Engineering of products under consideration of recycling conditions

3 Development of ecological and economic alternative materials



Example: Electronic scrap
There are up to 30 different functional metals in mobile phones and more than 50 in PCs!

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Resource savings potential

Example: automotive engineering	Effect/
Used material – lightweight construction e.g. aluminium, magnesium, carbon-fiber-reinforced polymer (CFRP)	saving ca. 200 kg per automobile
Downsizing e.g. 4 instead of 8 cylinder with nearly same performance	ca. 100 kg per automobile
Secondary effects e.g. less cubic capacity → less consumption → smaller tank; less weight → less inertia → smaller breaks	ca. 50 kg per automobile

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Source: BMW

Source: Audi

Example: machine tools	
Used material e.g. CFRP for robotics, ceramic for milling machine	considerable reduced energy input
Production process e.g. new laser → twofold performance, threefold cutting rate	reducing energy input up to 75 %
Coolant synthetic coolant instead of emulsion and direct injection	twofold tool service life

Fraunhofer IPK, ICT, Trumpf, BMW, Audi

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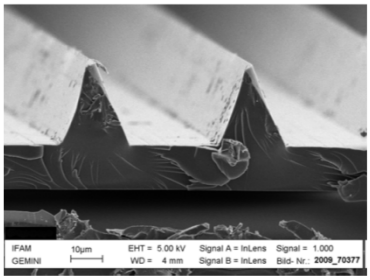
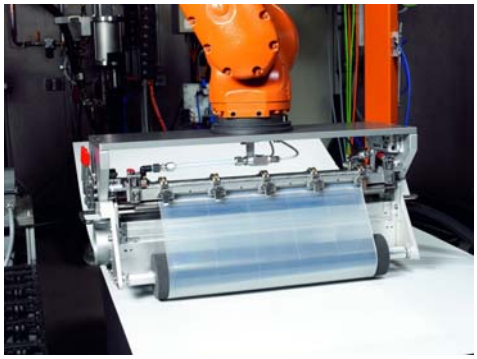
Research example: Sharkskin for airplanes, ships and wind energy plants

The inspiration comes from nature: The scales of fast-swimming sharks have evolved in a manner that significantly diminishes drag, or their resistance to the flow of currents. The challenge was to apply this knowledge to a paint that could withstand the extreme demands of aviation. Temperature fluctuations of -55 to +70 degrees Celsius; intensive UV radiation and high speeds. When applied to every airplane every year throughout the world, **the paint could save a volume of 4.48 million tons of fuel.**



Production and testing of riblet-structured coating surfaces at Fraunhofer IFAM



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More from less

We need a new paradigm change from
»realizing maximum profit out of minimal funds«
towards
»maximal creation of value out of minimal resources«

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Innovation chances via new technologies

Energy Turnaround Technologies

Resource Efficiency

Morgenstadt – City of the Future

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Fraunhofer initiative »Morgenstadt«

Challenges and fields of research

Decentralized and centralized energy
Generating and saving emmision-free energy

Mobility Transportation
Multimodal mobility systems

Planing Building
Buildings as climate-neutral power plants

Production Logistics
Urban production and supply

Information Communication
ICT platforms for Smart Cities

Urban processes Organisation
Collaborative decision-making processes

Security Protection
Resilient buildings and infrastructures

Convergence of city systems
municipal integration and technology management

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Fraunhofer‘s actual »Morgenstadt« research fields…

Resilient Infrastructures

Services Smartphone-Apps

Smart Cities Open Data

Energy Storage Technologies

IT-Tools for Building/City Planning

Virtual Power Plants

Plus Energy Houses + e-Mobility

Hydrogen Generation

Logistic Solutions

Urban Mining Resource Efficiency

Urban Mobility Concepts

Hybrid City Storage

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Innovation chances via new technologies

Energy Turnaround Technologies

Resource Efficiency

Morgenstadt – City of the Future

Industry 4.0

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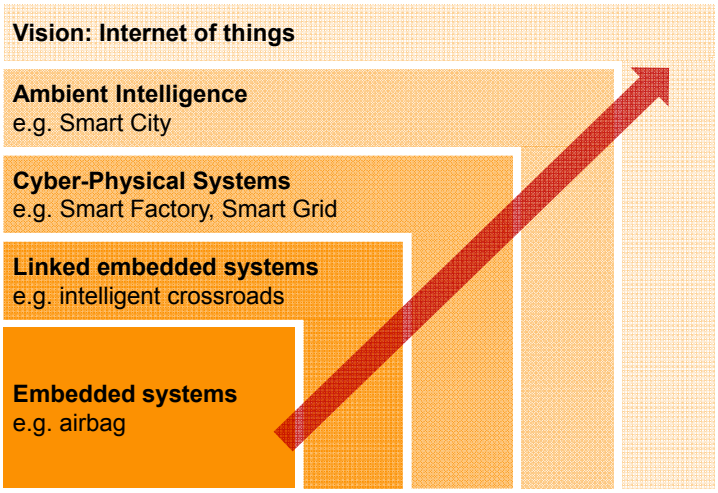
Technological Enabler

Internet of things becomes reality



Source:
PG Kommunikation,
DFKI, 2012

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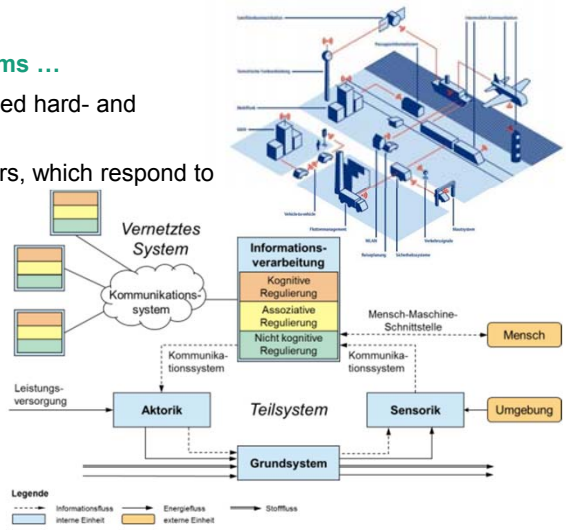
Industry 4.0 – Machines and factories sensorial linked with internet

CPS Cyber Physical Systems …

- are products with embedded hard- and software
- have sensors and actuators, which respond to the physical world
- use internet protocols and services for connection
- interact without application borders
- control enterprises and added value networks in real-time



Sources: www.acatech.de/cps and Gausemeier

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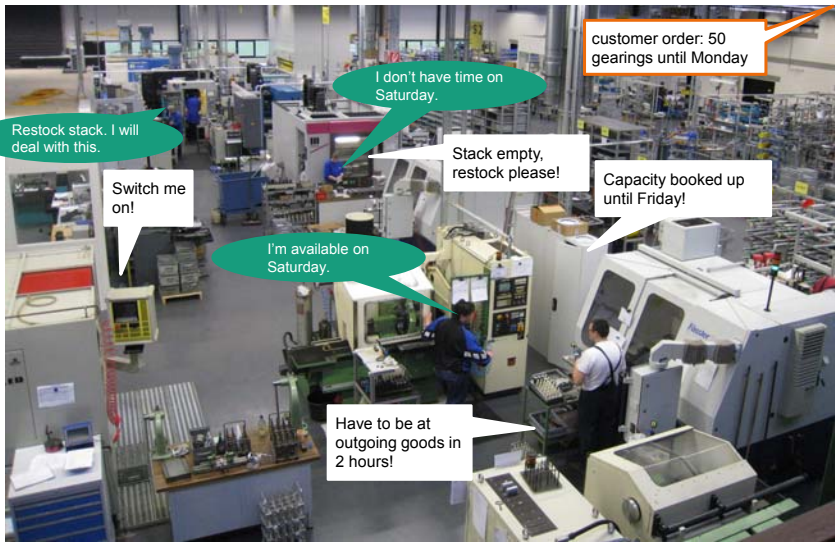
Industry 4.0 – Humans and objects decide cooperatively



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Fraunhofers secret:

10 good ideas a day
keep your competitors away

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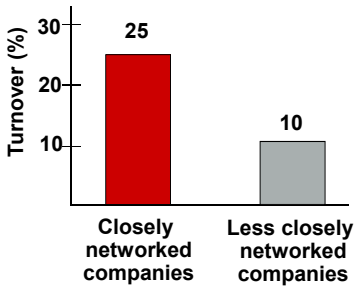
Cluster networks for successful innovations

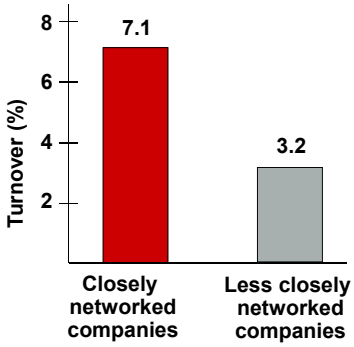
IMP³rove benchmarking shows – »close« networking results in higher growth rates

Among the small and mid-sized firms in Europe, 70% of the growth champions (10% of the most profitable fastest-growing companies) focus on close relations with network partners in innovation management

Generation of turnover from product and service innovations less than 3 years old



Average turnover growth rates over last 4 years



n = 1600

Source: European Benchmarking Study 2008, EU Project IMP³rove

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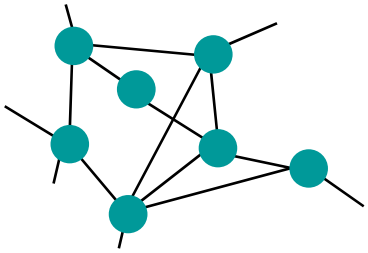
From Network to Net Value



Passion
Creativity
Openness
Respect
Trust

Initiative
Intelligence
Loyalty
Diligence

necessary and sufficient

necessary, but not sufficient

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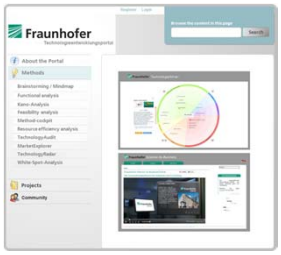
»Technology Development«			»Technology Market«		
To increase technology development capability systematically	To identify relevant new technologies	To find alternative, resource efficient technologies	To detect »patent gaps« in technologies	To discover new application fields / markets for technologies	Evaluation and visualisation of new trends
Tech-Audit	Technology Radar	Resource Efficiency Analyses	White-Spot Analyses	Market-Explorer	TrendArena®

Technology Development Portal



Companies need support in business model management

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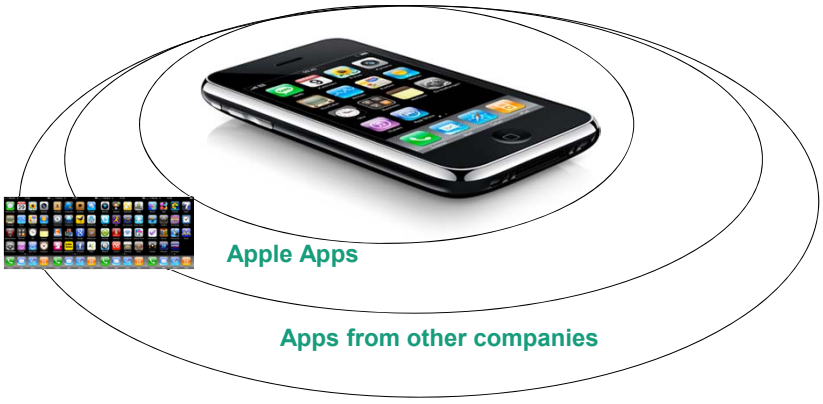
Is it really all about technology?

Example Service-Innovation in the field communication



From the telephone to a digital network

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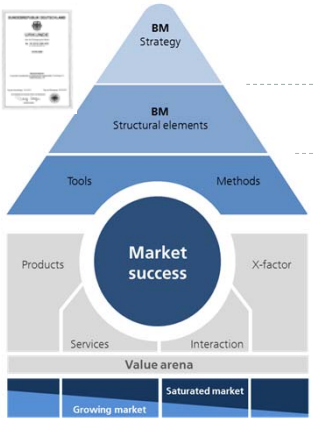
Fraunhofer House of Business Model Engineering

The elements of the Fraunhofer House of Business Model Engineering (BME)



- Definition of the different phases of business model (BME levels)
- Business model diagnostics / structure elements (market, performance, value creation, revenue model)
- Fraunhofer TechAudit, Technology Radar, Resource Efficiency Analysis, White-Spot-Analysis, MarketExplorer, TrendArena
- Value arena (valueable factors for the customer); what is decisive for market success is achieving the right balance of utility components: products, services, interaction, and emotional factors. The objective is to offer customers the greatest possible technical and social utility in every area, thereby attaining maximum value added.
- High-performance functions of products are most important for customer in a growth market. But it is also important to appeal to the emotions of the customer in a mature market.

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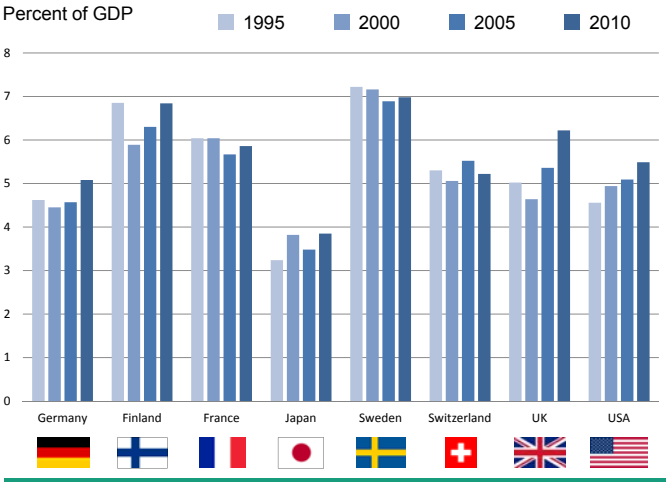
Public expenditure on education

Germany invests in education



Expenditure 2010: (in billion Euro)

DE	120,4
FI	10,2
FR	100,7
JP	125,8
SE	19,8
CH	15,3
UK	101,9
USA	600,8

Sources: Eurostat, OECD 2013

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Paradigm change in the learning area

Learning in the 20th century: Teacher centered	Learning in the 21st century: Learner and team centered
»Lecture«	»Facilitation«
Individual learning	Group learning
Listen, follow the lead	Working together
Information transfer	Expand the capability, skill
Lecturer as knowledge source	Lecturer as tutor
Static content	Dynamic content
Homogeneity of learning resources	Variety of learning resources
Exams and tests	Application and performance growth

Source: Fraunhofer IAO, according to Chute et al.

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Innovative working areas for knowledge worker

House of Knowledge Work, Center for Virtual Engineering, Fraunhofer IAO, Stuttgart

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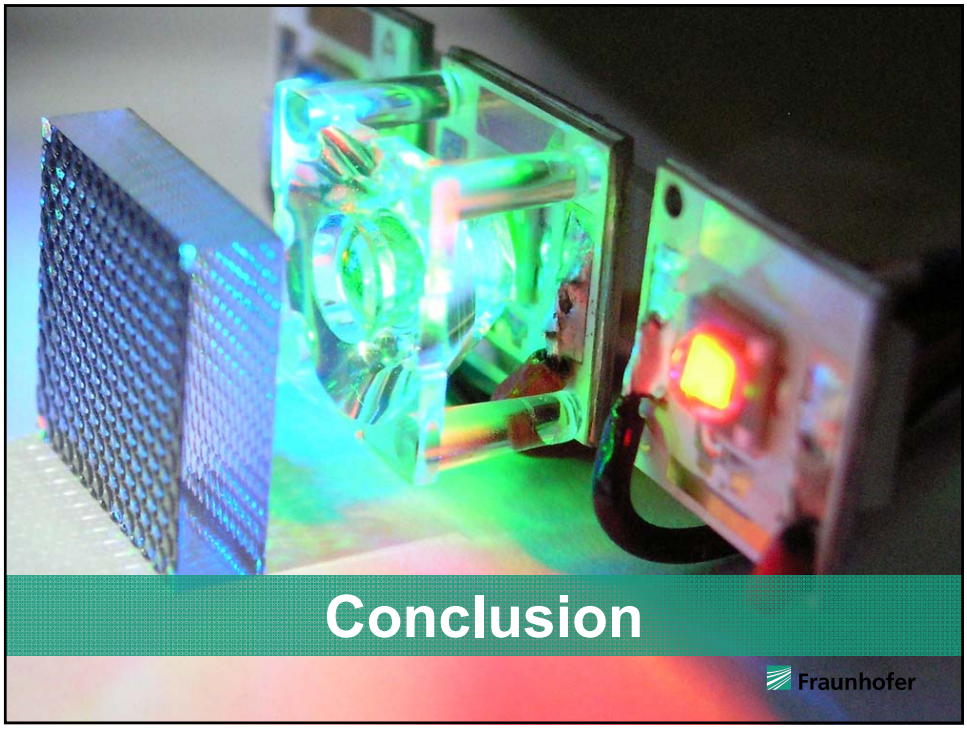

What successful innovators have in common

1. A clear strategy and an objective 
2. The best team available and best working conditions 
3. A determination to succeed 
4. A constant control loop of results 

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Working for the future.

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