Safeguarding Growth and Prosperity: What successful innovators have in common

Hans-Jörg Bullinger
Fraunhofer-Gesellschaft
www.fraunhofer.de

World economic climate* - up and down…

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

Source: ifo, 2013
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)
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

Future Needs Innovation
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

---

Innovation Needs Research
Innovation chances via new technologies

Energy Turnaround Technologies

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
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

---

**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

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)
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

Innovation chances via new technologies

Energy Turnaround Technologies

Resource Efficiency
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!

Example: machine tools
- Used material: e.g. CFRP for robotics, ceramic for milling machine
- Production process: e.g. new laser → twofold performance, threefold cutting rate
- Coolant: synthetic coolant instead of emulsion and direct injection

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

Effect/
- saving ca. 200 kg per automobile
- ca. 100 kg per automobile
- ca. 50 kg per automobile

Source: BMW
Source: Audi
Fraunhofer IPK, ICT, Trumpf, BMW, Audi
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

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«
Innovation chances via new technologies

Energy Turnaround Technologies

Resource Efficiency

Morgenstadt – City of the Future

Fraunhofer initiative »Morgenstadt«

Challenges and fields of research

- Decentralized and centralized energy
- Generating and saving emission-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
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

Innovation chances via new technologies

- Energy Turnaround Technologies
- Resource Efficiency
- Morgenstadt – City of the Future
- Industry 4.0
Technological Enabler
Internet of things becomes reality

Vision: Internet of things

Ambient Intelligence
e.g. Smart City

Cyber-Physical Systems
e.g. Smart Factory, Smart Grid

Linked embedded systems
e.g. intelligent crossroads

Embedded systems
e.g. airbag

---

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

© Fraunhofer
Industry 4.0 – Humans and objects decide cooperatively

Restock stack, I will deal with this.

I'm available on Saturday.

Switch me on!

I don't have time on Saturday.

Stack empty, restock please!

Capacity booked up until Friday!

Have to be at outgoing goods in 2 hours!

customer order: 50 gearings until Monday

Fraunhofer's secret:

10 good ideas a day keep your competitors away
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

Source: European Benchmarking Study 2008, EU Project IMP³rove
From Network to Net Value

Passion
Creativity
Openness
Respect
Trust

necessary
and
sufficient

Initiative
Intelligence
Loyalty
Diligence

necessary,
but
not
sufficient

To increase technology development capability systematically
- Tech-Audit
- Technology Radar
- Resource Efficiency Analyses

To identify relevant new technologies
- Technology Radar

To find alternative, resource efficient technologies
- Resource Efficiency Analyses

To detect «patent gaps» in technologies
- White-Spot Analyses

To discover new application fields / markets for technologies
- Market-Explorer

Evaluation and visualisation of new trends
- TrendArena®

Companies need support in business model management
Is it really all about technology?
Example Service-Innovation in the field communication

From the telephone to a digital network

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.
Public expenditure on education
Germany invests in education

Percent of GDP

Expenditure 2010:
(in billion Euro)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>DE</td>
<td>120,4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FI</td>
<td>10,2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FR</td>
<td>100,7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>JP</td>
<td>125,8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SE</td>
<td>19,8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CH</td>
<td>15,3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UK</td>
<td>101,9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>USA</td>
<td>600,8</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Sources: Eurostat, OECD

© Fraunhofer
Paradigm change in the learning area

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

Source: Fraunhofer IAO, according to Chute et al.

Innovative working areas for knowledge worker

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

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