

From Basic Research to Application

Introduction to Technology Transfer

Prof. Dr. Eberhard Sauter - Head Technology Transfer

Your awareness about knowledge transfer

- What is knowledge and technology transfer (KTT)?
- Is KTT relevant for you?
- What experiences did you make in respect to KTT?
- Which transfer channels do you know/did you use so far?

Motivation for Transfer



EFI – **Commission of Experts for Research and Innovation** (2017): Report on research, innovation and technological performance in Germany 2017, Berlin: EFI:



Bundesministerium
für Bildung
und Forschung

„Germany admittedly **cannot afford to forgo excellent research results that are beneficial to society and the economy**. Hence, both in research organizations and in R&I policy, **greater importance should be attached to the objective of knowledge and technology transfer..**“



From the **Mission of the Helmholtz Association of German Research Centres**:
We [..]. We **contribute to solving the major challenges facing society, science and the economy** by contributing to shaping our future by combining research and **technology development** with perspectives for **innovative application** and provisions in tomorrow's world.

Motivation for Transfer

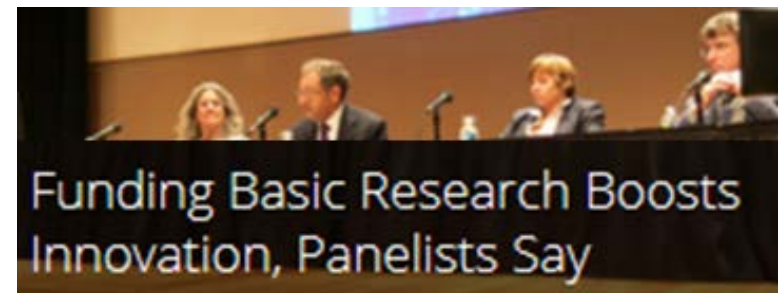


From the **AWI Mission Statement**:

“Advice and Innovation

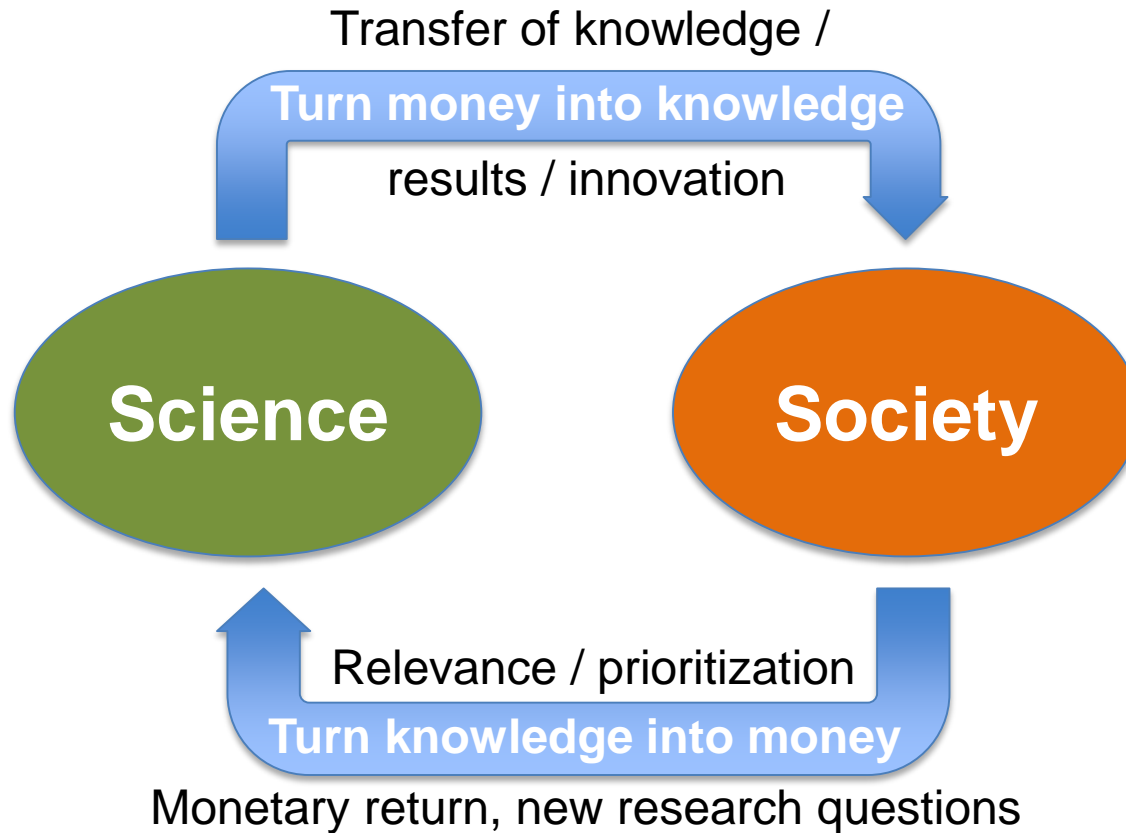
A particular concern for us is to **provide the public with sound and comprehensible information about our research results** and the way in which we achieve them. In addition, we provide **knowledge-based consulting services** for politics, business and society.

Wherever possible, we strive to leverage research and development results to **support green innovation** or the **development of sustainable technologies**. Likewise, we maintain **high standards** in occupational, health and environmental protection.”



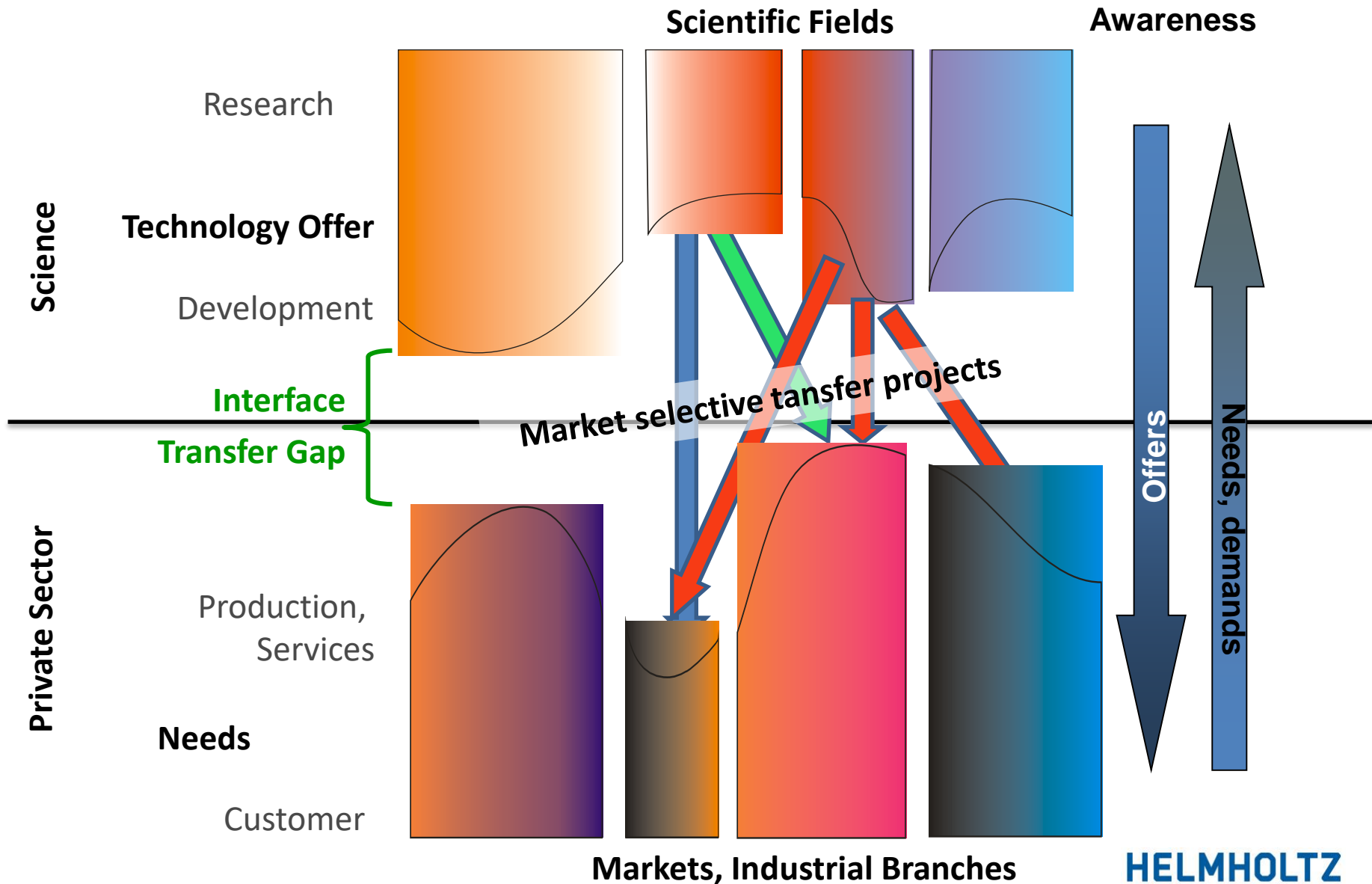
AAAS = American Association for the Advancement of Sciences

Motivation for Transfer





Concept Model TechTransfer



Problem: development or commercialization gap

The University

The Marketplace

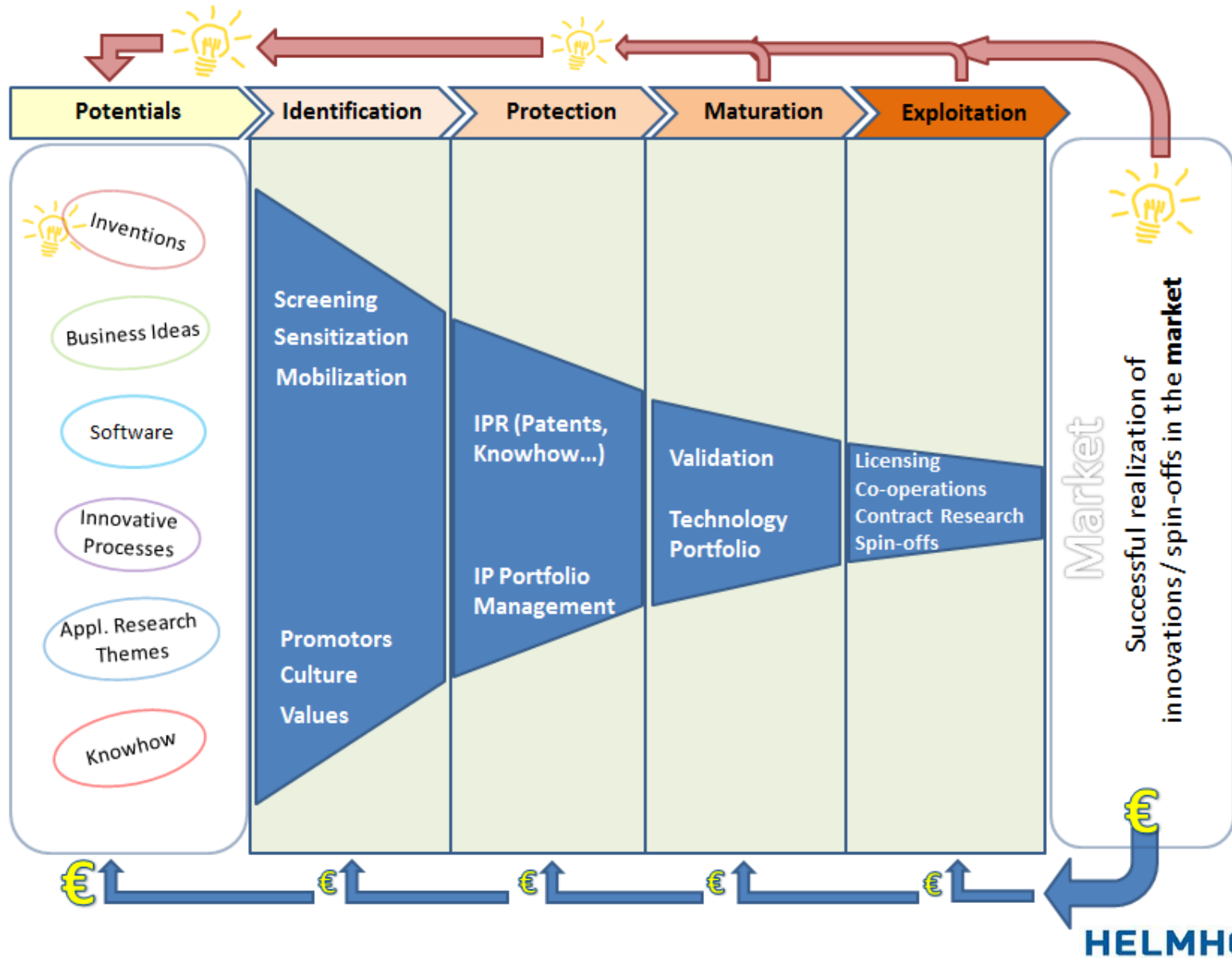


- This gap is THE limiting factor in technology transfer
- Promising innovations lie fallow or are transferred prematurely
- Components of the gap:
 - poor understanding of /communication with market
 - lack of know-how / capabilities (of the university)
 - lack of "entrepreneurial" education (of the inventors)
 - difficult to find "drivers" / entrepreneurial teams
 - hard to find really, really early-stage seed money
 - negative perceptions of "pure scientists" getting "polluted by commercial interests"

The What, How and Why of Technology Commercialization

Commercialization is a set of activities which add value to a discovery by bridging the gap between conception and creation of a marketable product or process, to create financial gain for inventors, investors and their respective institutions and stakeholders

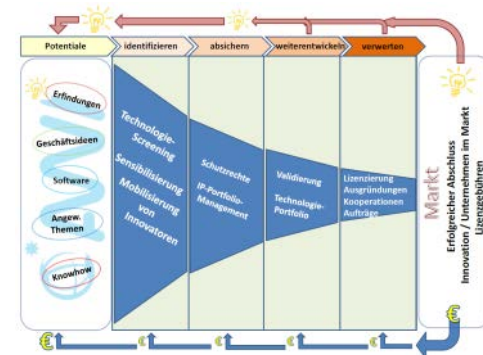
Technology Transfer Approach



Implications of the innovation funnel



- Importance of KTT increases / KTT became strongly obligatory
- Explorative **selection process: not everything succeeds**
- **Culture of innovation** (appreciation of new ideas, inventions, impulses)
- **Professional transfer structures** to turn inventions and new (business) ideas into innovations (incl. matching with market / customer needs)



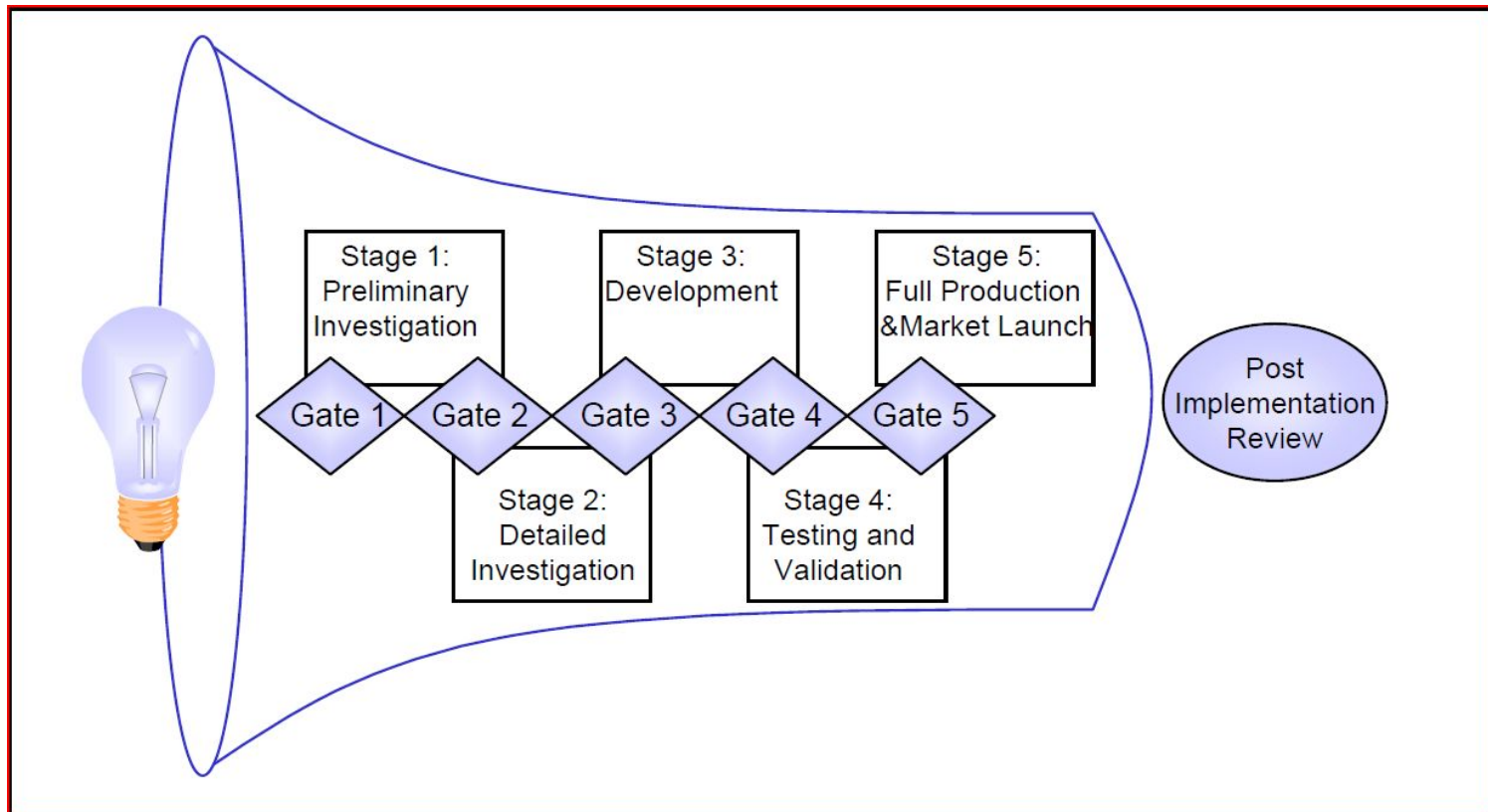
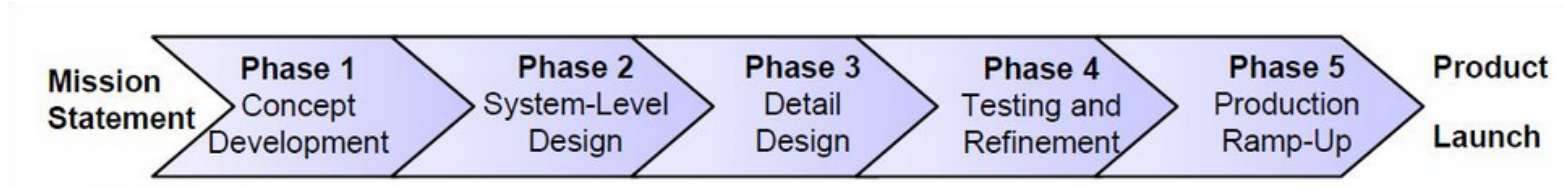
➔ Two basic lines of activities:

(A) **Take-up of opportunities** (inventions) emerging from any AWI activities ➔ professional guidance to validation, exploitation

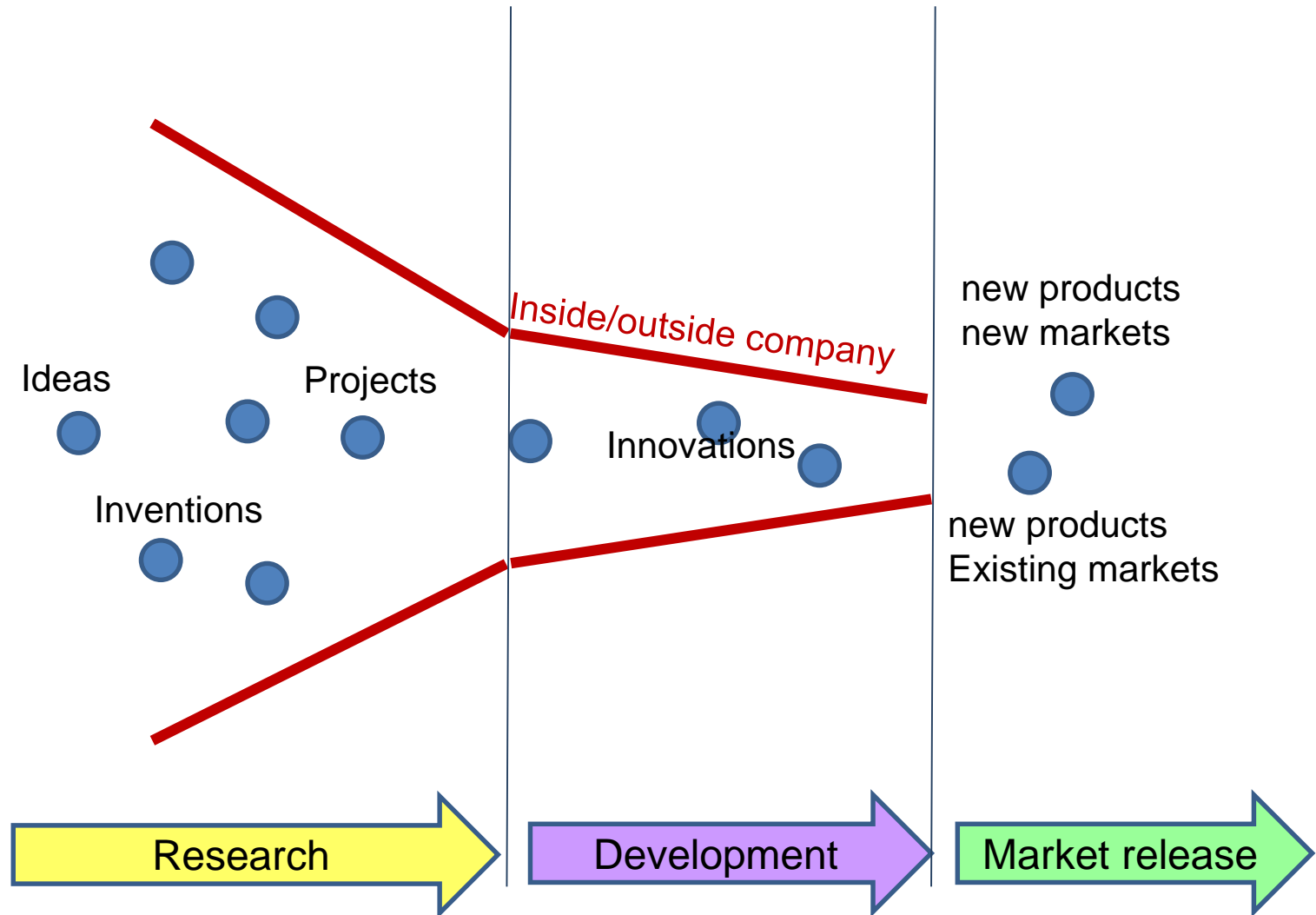
(B) Establishment of a number of specific **applied themes on the longer term** (e.g. KTT “Ankergruppen” Bionics und Aquaculture etc.)

- Overcome the Death Valley of Tech Transfer: **secure resources for validation** (proof of technology, certificate, env. impact assessments, prototyping) in particular with radical inventions
- ➔ **Innovation Funds** (complementing KT and Strategy Funds)
- ➔ Adequate **selection criteria** (incl. termination criteria)

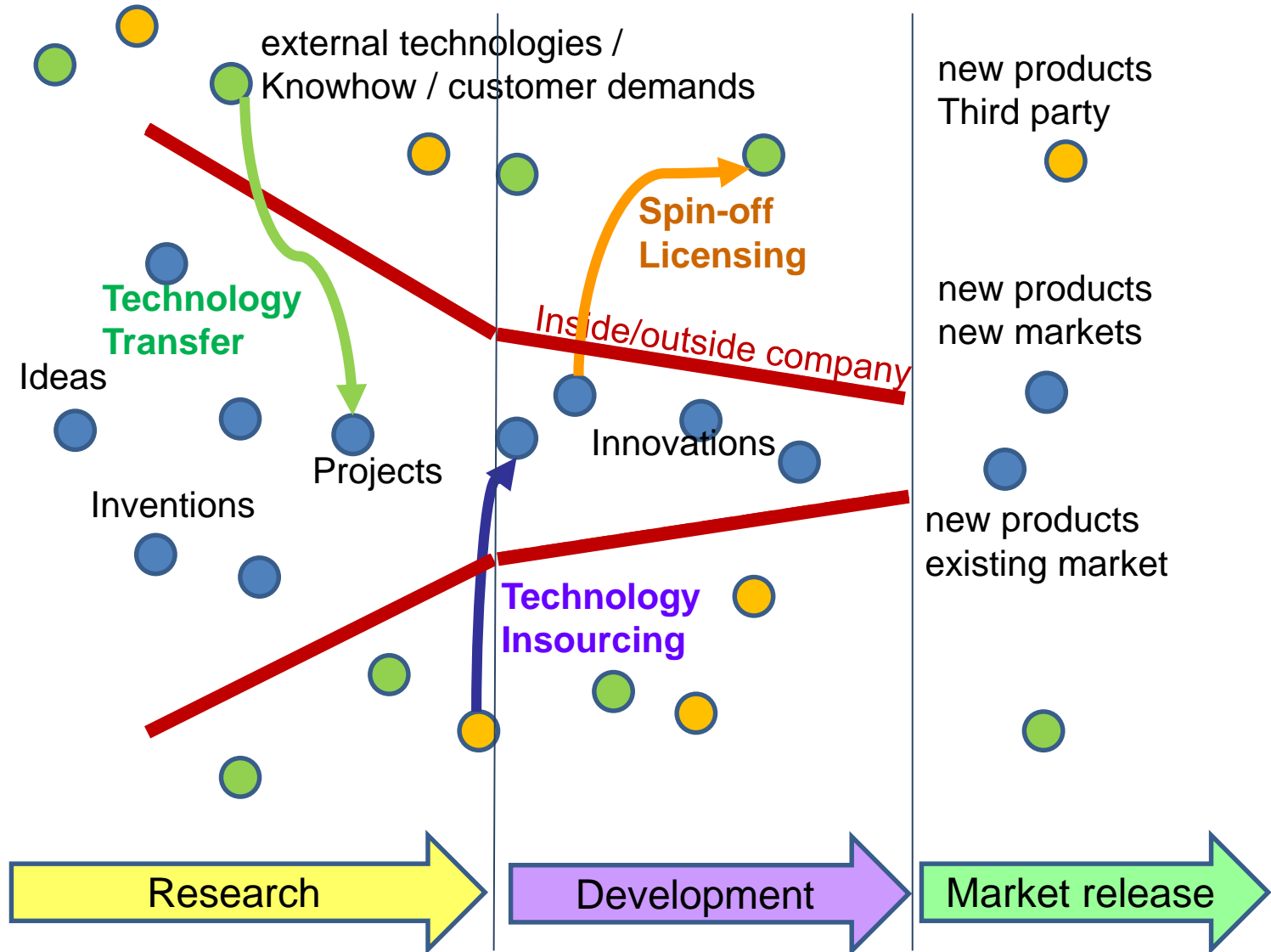
Stage Gate Model of Innovation Management



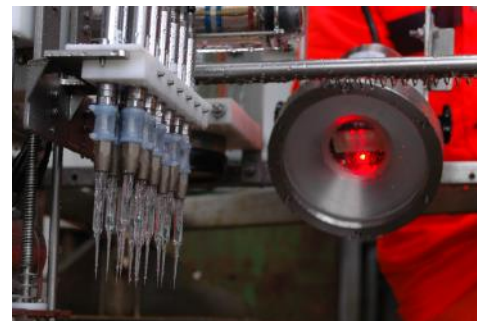
Closed Innovation Model



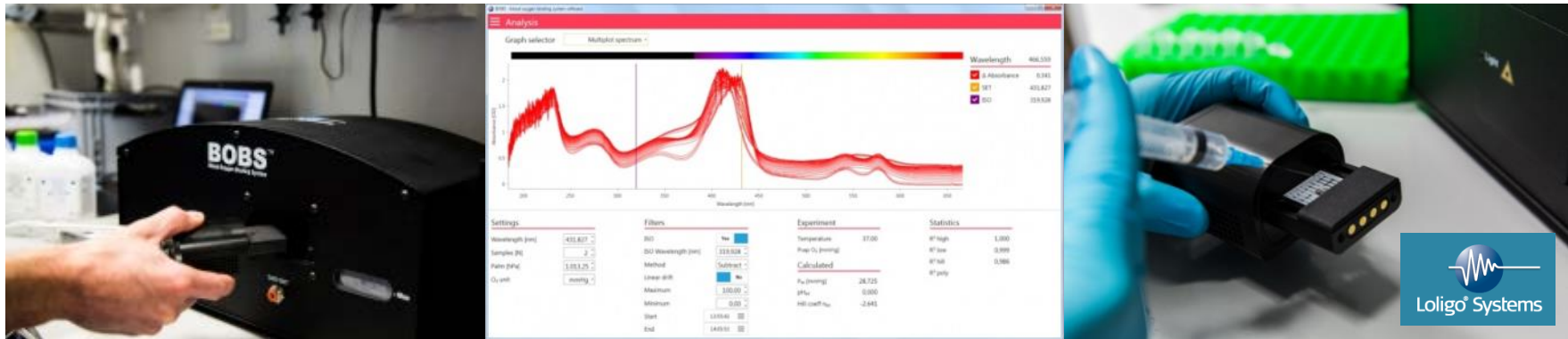
Open Innovation Model



Examples for AWI KTT projects

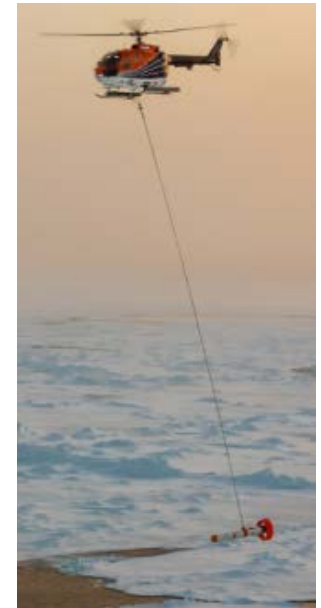
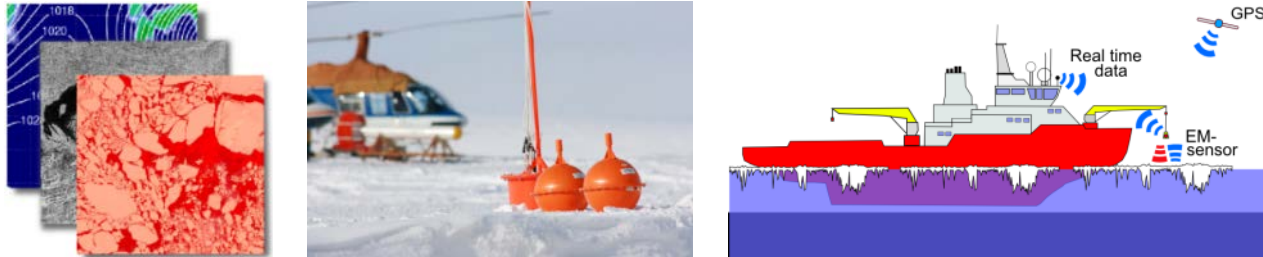


Diffusion Chamber: Blood Oxygen Binding System (BOBS™):



- **June 2013 Invention** (AWI Section “Integrative Ecophysiology”, F. Mark / M. Oellermann):
- → Method / instrument for simultaneous high-resolution pH and spectrophotometric recordings of oxygen binding in native blood microvolumes
- Very high temporal resolution from smallest sample volumes in a wide temperature range
- **Applications:** Physiological research / investigations of blood / pigments
- **Patent registration** in DE, USA, DK, FR, UK
- **Out-licensing** to Loligo Systems, DK
- **December 2016: Launching** of Blood Oxygen Binding System (BOBS®)

Results and expertise emerged from the AWI Section Sea Ice Physics were used to spin-out the company **Drift & Noise Polar Services GmbH** (registered in 2013).



The start-up offers **sea ice management products and services** for academic and corporate customers in the fields

- Assessment of sea ice and environmental conditions
- Sea-ice-related risk management to meet high HSE standards
- Sea Ice Physics (incl. ship-/airborne EM ice thickness measurements)
- Operational Ice Maps (including near real time sea ice monitoring from remote sensing)

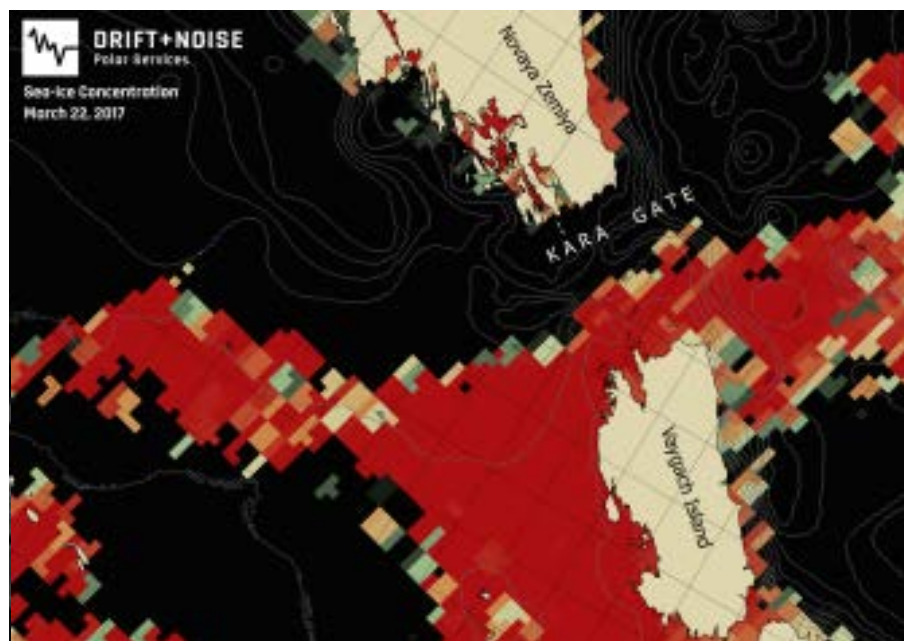
The company provides both open scientific and customized commercial solutions according to individual needs.

Drift & Noise was amongst the finalists of the 2016 Copernicus Masters Challenge (ESA innovation and start-up competition)



DRIFT+NOISE
Polar Services

Sea ice maps merged from Sentinel 1 SAR charts and Modis optical images

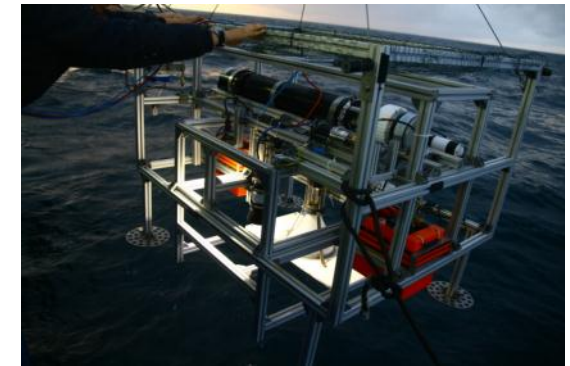
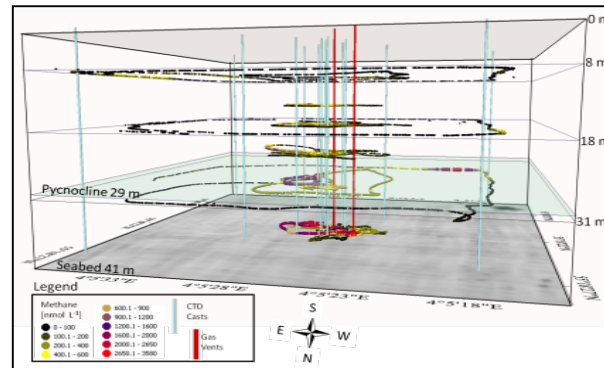
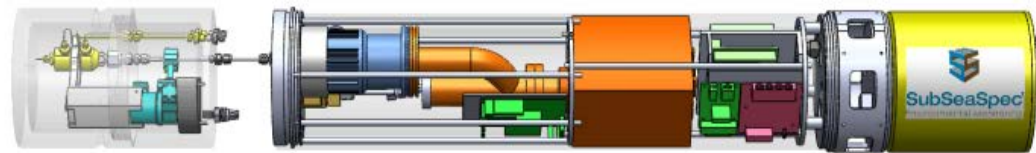


Ice Pad: near real-time ice data products on hand-held devices



AWI Section Marine Geochemistry

Underwater mass spectrometer for the simultaneous multi-parameter analysis of solutes → AWI Spin-off „SubSeaSpec“ → technological innovation

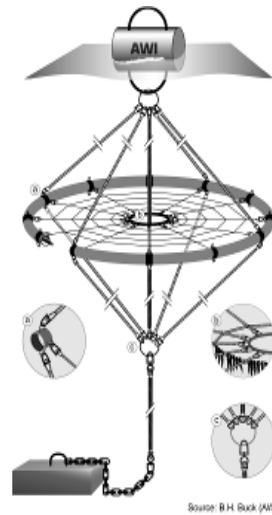
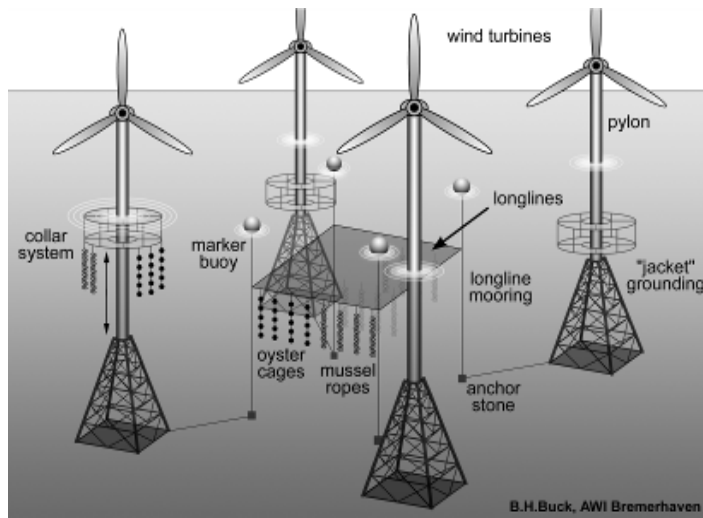


- Mobile (AUV, ROV) or stationary deployments (→ spatial / temporal gradients)
- Environmental monitoring, surveillance of oil/gas production sites
- Localization of waste deposits (e.g. ammunition)

→ New invention: gas inlet system in cooperation with Bionics Group → joint project

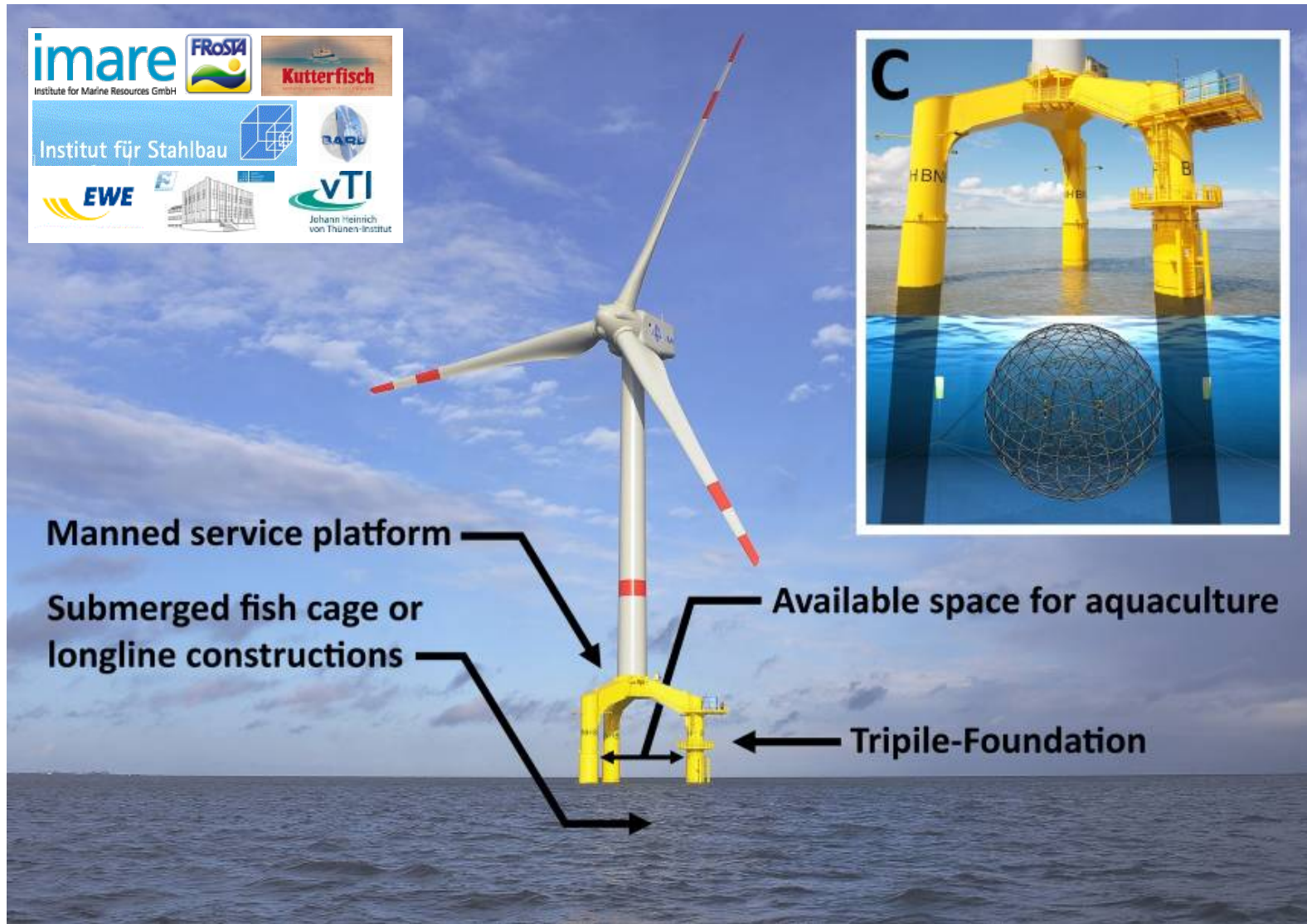
Marine Aquaculture

Growing importance of aquaculture due to shrinking fish stocks



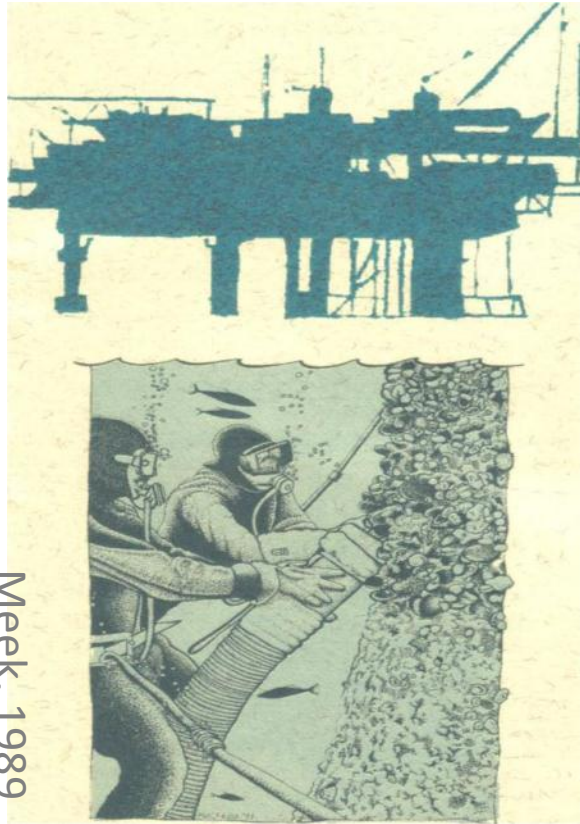
- Cultivation of fish, crustaceans, mussels and algae
- Cooperation projects
- Environmental compatibility of aquaculture → sustainability
- Concepts for the multi-use of offshore wind farms
- Integrated coastal zone management

Marine Aquaculture

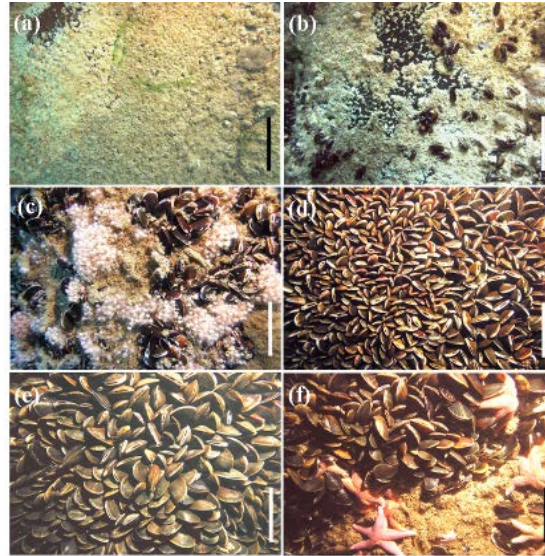


Marine Aquaculture

Harvesting and use of biofouling



Meek, 1989



Joschko et al. 2008



Spin-off Project: Helgoland Lobster



Production of lobster larvae and juvenile lobsters for restocking in the North Sea as ecological compensation measure for wind energy plants



- Know-how has been developed in the [AWI Section Shelf Sea Ecology](#)
- Lobster caging principle patented by AWI (DE102013010828B4)
- Restocking with lobster larvae as compensation measure for offshore wind parks
- **Spin-off Company: Reefauna** (prepared within “Helmholtz Enterprise”) offers cultivation and release of lobster, monitoring services, accompanying research

- **Unique AWI infrastructure:** 130 m³ recirculation aquaculture systems (RAS) for basic to applied aquaculture research
- RAS cultivation of organisms from micro algae up to ray-finned fish
- Innovation and application lab offering technical and biological support for customers including special experiments, analytics and sensors



Research for sustainable aquaculture

Development of new circulation systems

- Energy and resource efficient aquaculture plants
- Nutrient neutrality: minimal environmental impacts

New candidates and feedstuff

- Efficient utilization of animal feed
- Economical and ecological sustainable operation

Outreach and Impact:

EuroShrimp 2017 Bremen:

international multi-stakeholder
shrimp symposium

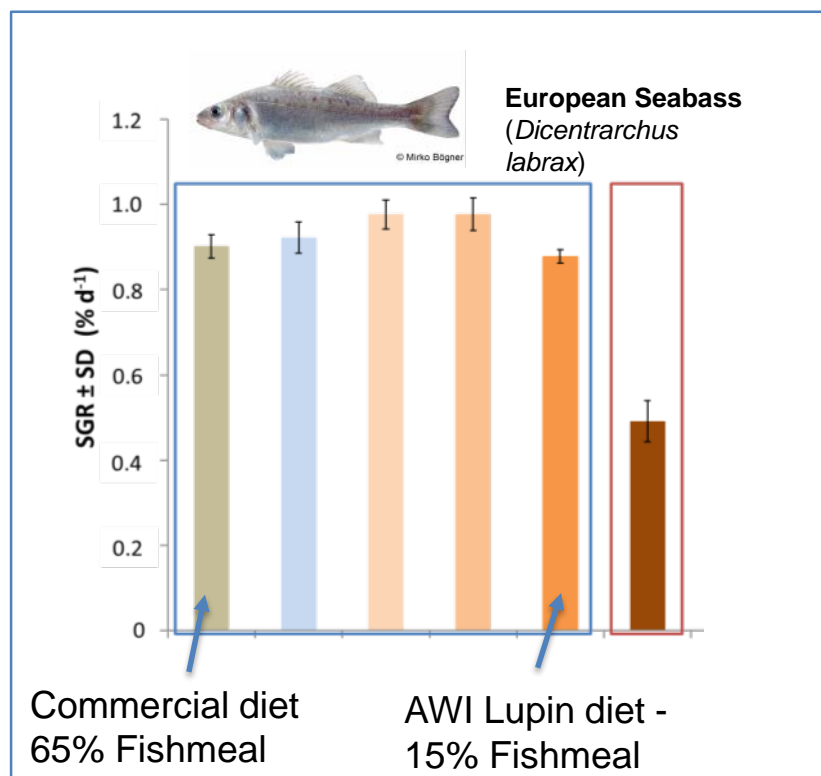
Sustainable Aquaculture Diets - Lupins



Challenges: anthropogenic impacts such as **overfishing** and **pollution** drive **coastal and shelf system change**

➔ **rising importance of sustainable aquaculture**

- Reducing **fishing pressure** and **marine pollution** = sustainable coastal use
- Replacing **fishmeal** with **organic, fertilizer-free lupins** from Germany



- 80% replacement of fishmeal with lupin – **no growth reduction**
- Can reduce fishmeal use for European Seabass alone by **100 kT = 400 kT fish**
- Tests with commercial farmers – Atlantic salmon and Whiteleg shrimp
- Aquaculture now produces more protein for humans than **fishing, beef or sheep farming** with ½ the **water use** and **CO₂ footprint!**

AWI selected to represent BMEL / BLE at International Green Week '18

Sustainable Production of Caviar

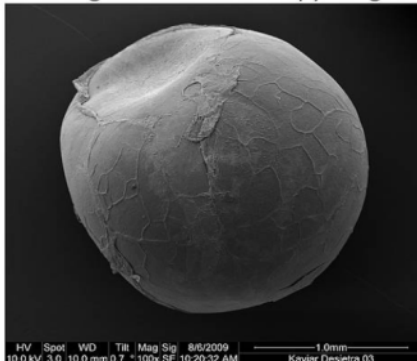


New production method invented at and patented by AWI yields high quality caviar without necessity to kill the sturgeon:

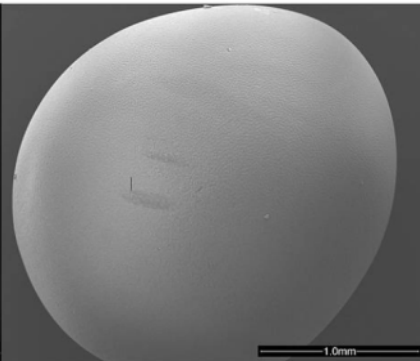
- repeated harvesting
- high economic efficiency and sustainability
- premium product, very long shelf life
- international licensing



Scanning Electron Microscopy Images



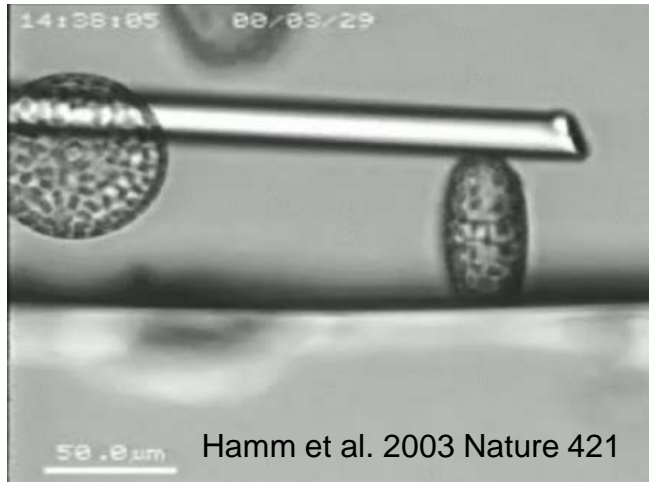
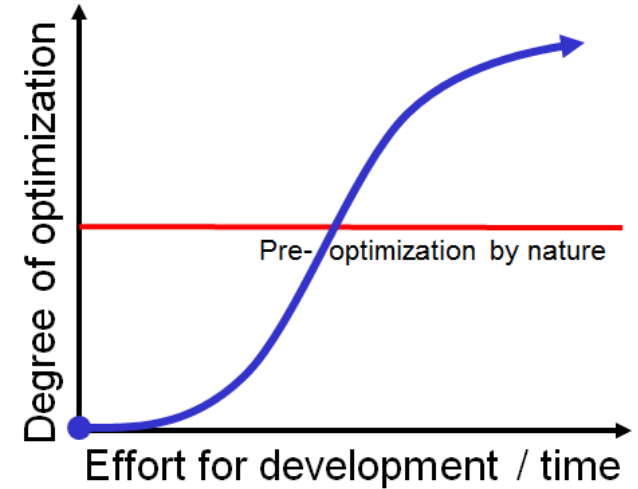
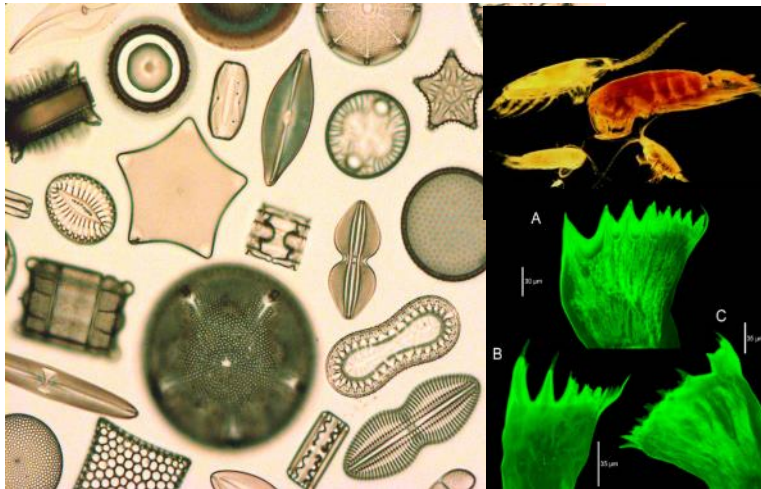
Conventional caviar, grain stage III



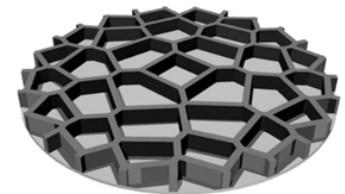
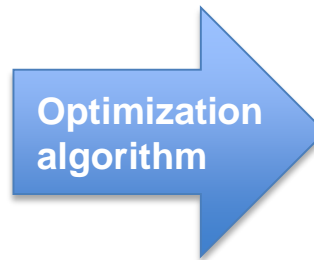
Stripped sturgeon egg (AWI method)



Structural lightweight optimization derived from plankton research



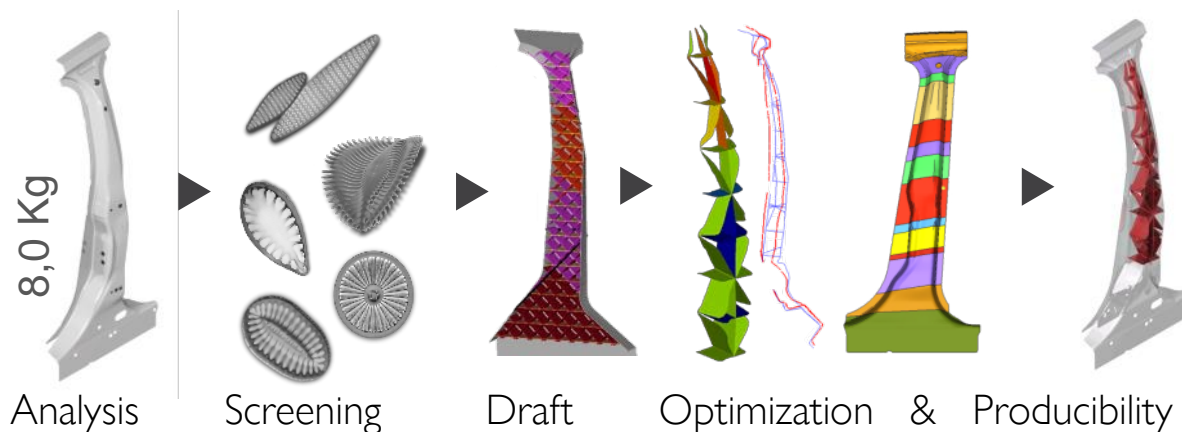
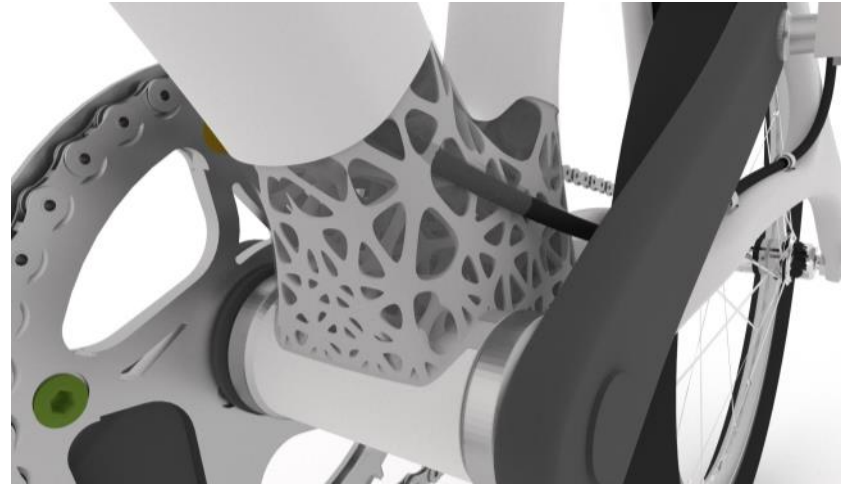
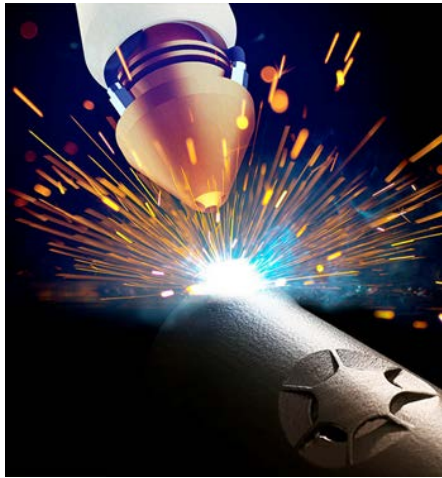
Analysis of nat. forms



Optimized
techn. component

Diatom frustules (SiO_2) withstand $\sim 700\text{t/m}^2$!

Very high potential for weight reduction and emission reduction, in particular in combination with additive manufacturing technologies and composite materials
→ div. patents, numerous industry projects

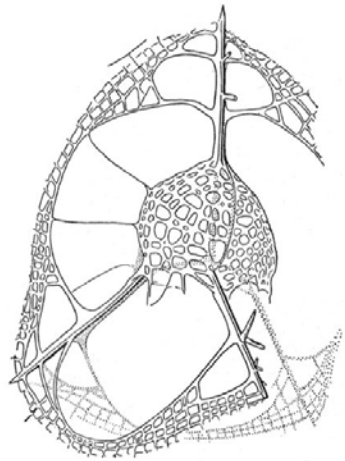


5,3 Kg: - 34% weight

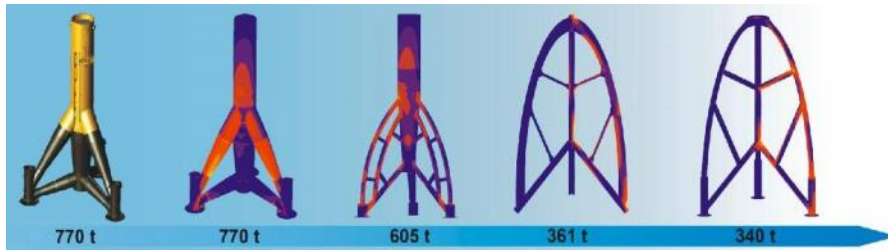


Product

Offshore Foundation for Windmills



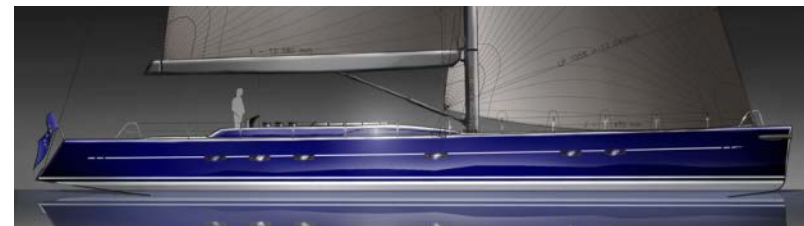
100 μ m



WeserWind GmbH
Offshore Construction Georgsmarienhütte

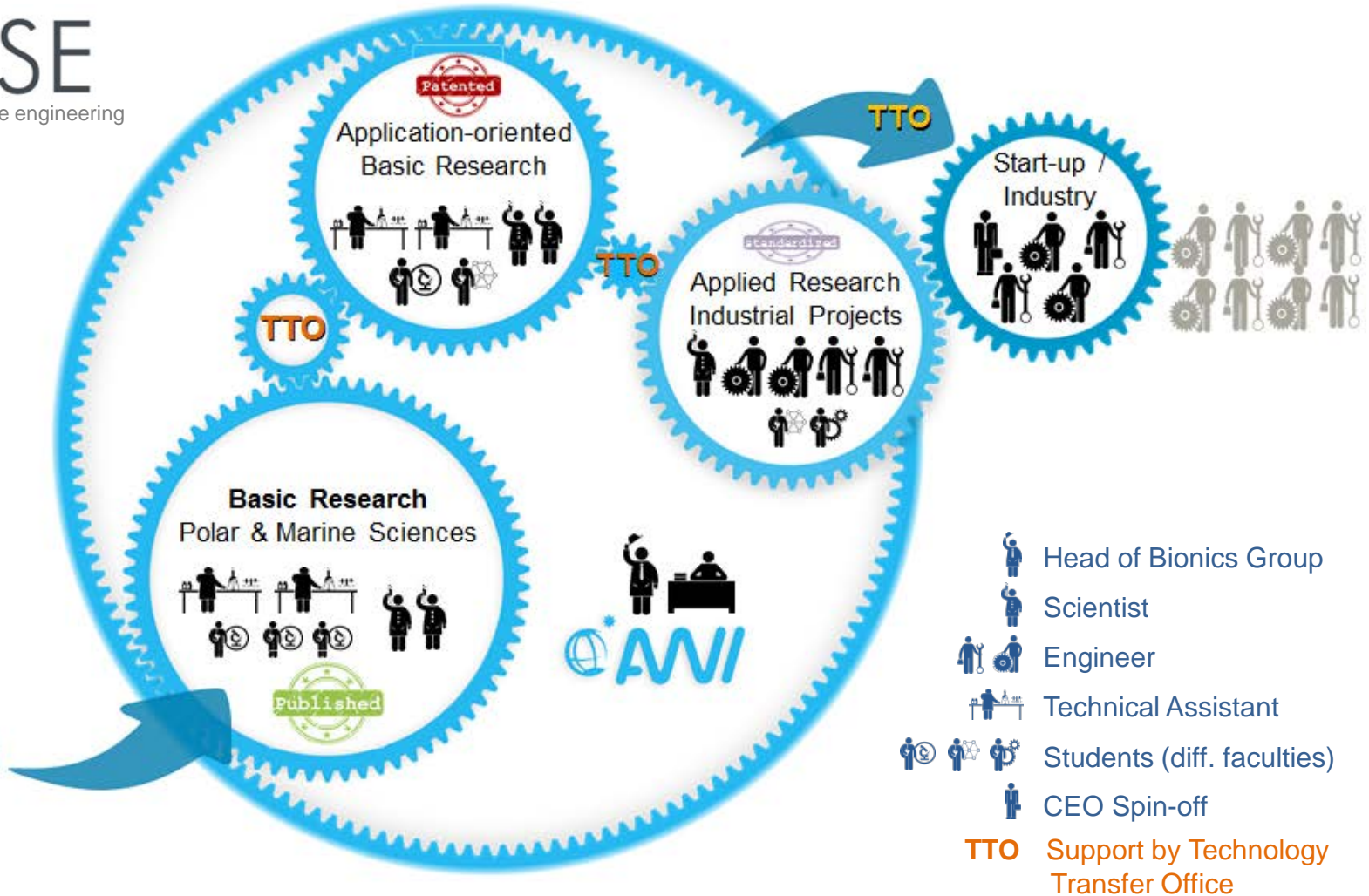


Light weight elements for increased stiffness with high performance racing yachts



judel/vrolijk & co
YACHTDESIGN & ENGINEERING

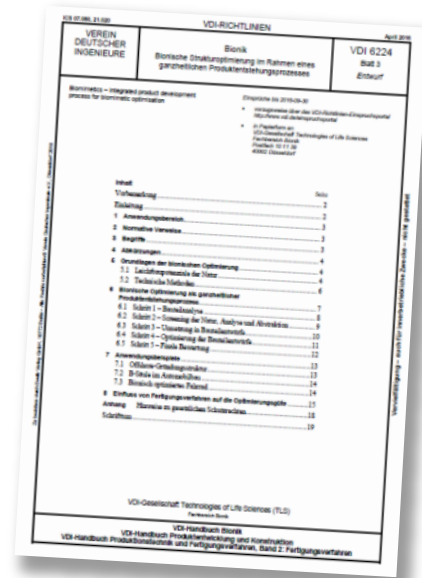
Bionics Group - Strategic Approach



Contribution to resource efficiency and standardization

VDI-Guideline: VDI 6224 Sheet 3:

Bionic structure optimization in the framework of a holistic production design process



New basic research themes induced by transfer activities (partners)

- Biomechanics, vibration damping, permeability (Uni Kiel, DLR, OttoBock)
- Adaptation mechanisms in marine ecosystems (AWI)
- Material sciences: nanostructure analysis (DESY, MIT)
- Morphogenesis, future production methods (Polysecure)
- Further cooperation potentials (HGF **innovation labs next round**)

August 2018: Spin-of ELiSE GmbH

Spin-offs



iSITEC GmbH, Bremerhaven (1996)
Scientific measuring and control technologies

O.A.Sys Ocean Atmosphere Systems GbR, Hamburg (2001)
Scientific data evaluation, modelling



FIELAX Gesellschaft für wissenschaftliche Datenverarbeitung mbH,
Bremerhaven (2002) – Maritime services and technologies

MarNaS Biochemicals GmbH, Bremerhaven (2013)
– Marine natural compounds / research reagents



Drift & Noise Polar Services GmbH, Bremen (2014)
– Sea-ice measurements, ice routing, predictions

SubSeaSpec UG, Sellstedt (2015)
Underwater mass spectrometry, dissolved gas analyses, gas standards
For environmental monitoring, science and exploration



ELISE GmbH, Bremerhaven (2018)
Generative Engineering – algorithm-based light weight constructions

- Does anybody have own entrepreneurial experience?
- Did you think about creating your own business?
- Do you know about the existence of support structures for start-ups in your academic institution?
- What would motivate you to start you own business?
- What would you expect to be the challenges / difficulties?

Value Drivers → Business Scenarios



What are the critical factors driving a new business / market / competitors?

Production goods

- Machines, equipment
- Buildings, plants
- Investment / capital
- Amortization cycle

Human Resources

- Core team / management
- recruitment/ development
- Qualification
- Site / local factors

Know-how

- R & D (vs. sales)
- Innovation pipeline
- Timeliness of information
- New products / markets
- Diversification / growth

Temporal Dynamics

- Today
- Tomorrow
- Day after tomorrow (potential market)
- Anticipation of trends

Assets

- Intellectual property
- Specific competences
- Unique selling points
- Build-up of trade mark

Materials

- Purchase / availability of raw materials
- Make or buy
- Substitute

Markets

- Position in value chain
- Customers (retention)
- Suppliers / distributors
- Competitors
- Market position

Business Plan to be addressed

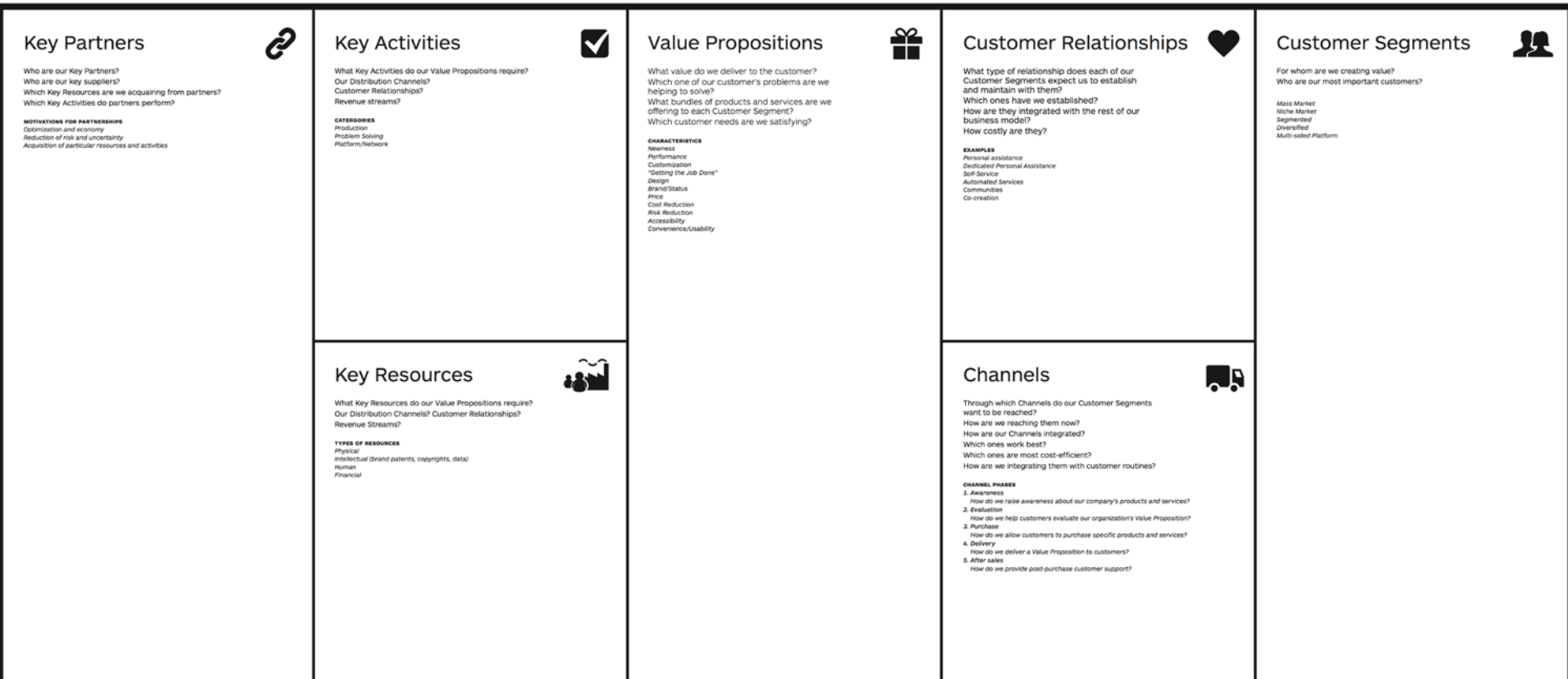
- **Executive Summary**
- **Description of enterprise:** structure, development, mission, vision, philosophy
- **Products, services,** customer values, USPs (today, tomorrow, future)
- **Market & competition,** relevant segments, volume, trends, competitors
- **Marketing,** distribution strategy, positioning, pricing
- **Production,** R&D, logistics, customer support, suppliers,...
- **Management,** Key personnel, partners
- **Financing strategy,** own capital, financing gaps, investors, banks, funding options
- **Finance tables,** specification of costs, sales, earnings, profit-and-loss statement, best/worst case scenarios, cash flow tables, liquidity plan, ...

→ Flexible model → test complex sets of possible boundary conditions

→ Feasibility, strategy, roadmap, next steps

→ **Convince yourself and others**

➔ Business Model Canvas



Cost Structure



What are the most important costs inherent in our business model?
Which Key Resources are most expensive?
Which Key Activities are most expensive?

IS YOUR BUSINESS MORE
Cost Driven (cheapest cost structure, low price value proposition, maximum automation, extensive outsourcing)
Value Driven (focused on value creation, premium value proposition)

SAMPLE CHARACTERISTICS
Fixed Costs (salaries, rents, utilities)
Variable costs
Economies of scale
Economies of scope

Revenue Streams



For what value are our customers really willing to pay?
For what do they currently pay?
How are they currently paying?
How would they prefer to pay?
How much does each Revenue Stream contribute to overall revenues?

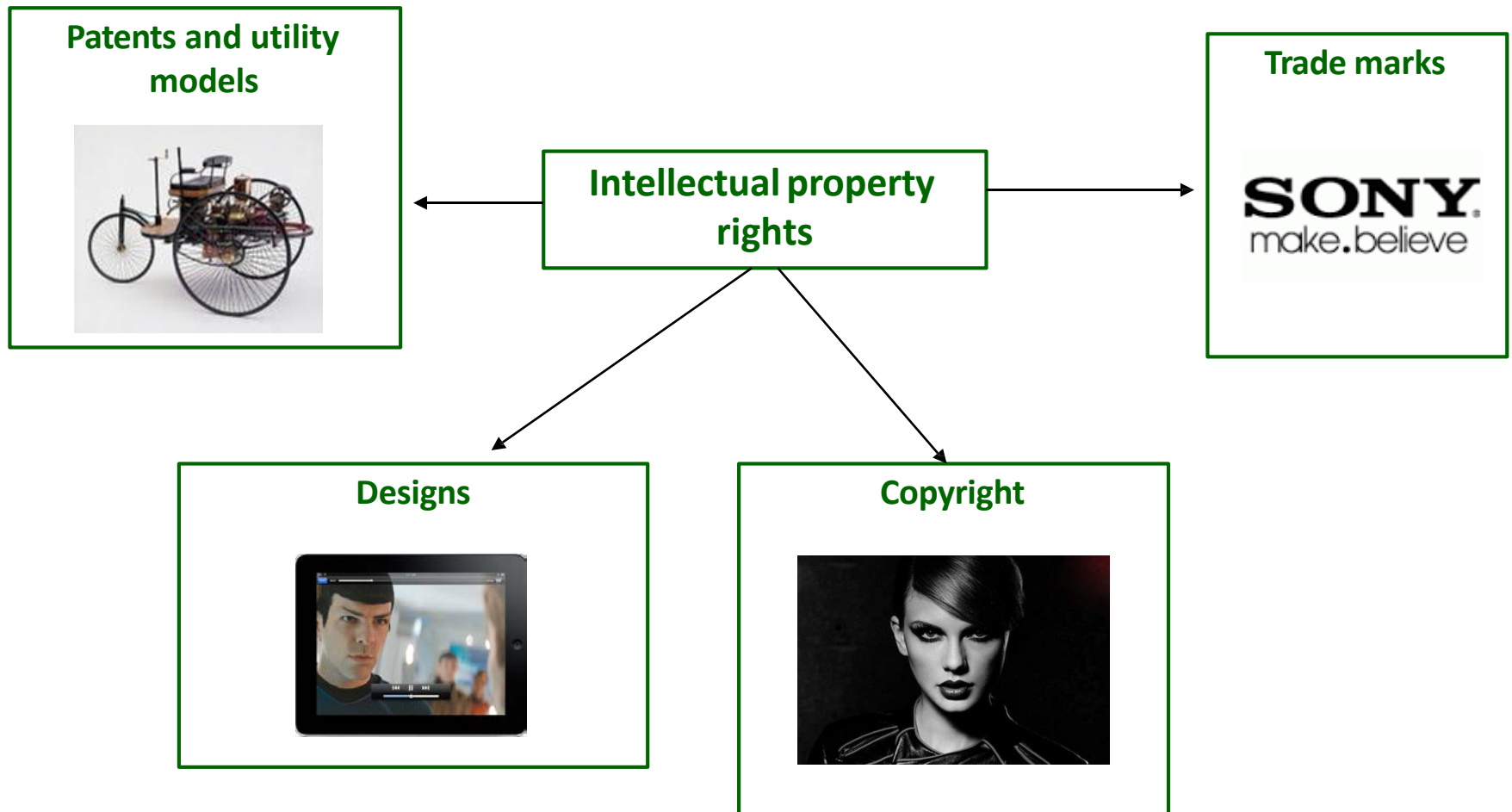
TYPES	FIXED PRICING	DYNAMIC PRICING
Asset sale	List Price	Negotiation (bargaining)
Usage fee	Product feature dependent	Yield Management
Subscription Fees	Customer segment dependent	Real-time-Market
Lending/Renting/Leasing	Volume dependent	
Licensing		
Brokerage fees		
Advertising		

- What are IPRs? Which IPRs do you know?
- How can IPRs be used for KTT / your business?
- How could third party IPRs affect your activities?

The concept of intellectual property

- Subject-matter = intangible goods
 - Examples: invention, work, sign
 - Non-exclusivity: impossible to keep others from using inventions, music, etc.
 - Non-rivalry: many people can use them at the same time
- Intellectual property rights (IPRs) = property-like (absolute) rights in intangible subject-matter
 - Owner = author, inventor, but perhaps also investor
- Terminology:
 - Intellectual property = generic term for all IPRs
 - Industrial property: rights in intangible assets of trade relevance (**patents, designs, trade marks**)
 - Copyright: right protecting creative activity in the cultural sector

Intellectual Property Rights





Registered rights

- Patent, utility model, plant variety right
- Registered design
- Registered trade mark

Unregistered rights

- Copyright
- Unregistered trade mark
- Trade names
- Unregistered Community design

What is a patent?

- What is the principle of the patent system
- What is the deal behind a patent?
- Are patents good or bad?

What is a patent?

- **Patent = exclusive right to an invention in return for the disclosure of an invention**
- Subject-matter = technical (mainly or entirely)
- Patents require registration by a national or a regional office
- Conditions of grant
 - Protectable subject-matter
 - Novelty
 - Inventive step
 - Industrial applicability

Key requirement: Novelty



Article 54 Novelty

- (1) An invention shall be considered to be new if it does not form part of the state of the art.
- (2) The state of the art shall be held to comprise everything made available to the public by means of a written or oral description, by use, or in any other way, **before the date of filing of the [European] patent application.**
- (3) Additionally, the content of [European] patent applications as filed, the dates of filing of which are prior to the date referred to in paragraph 2 and which were published on or after that date, shall be considered as comprised in the state of the art.

Key requirement: Novelty



State of the art:

- (1) Everything made available to the public in any way, anywhere, at any time
- (2) Unpublished patent applications
- (3) Types of disclosure: written description, oral description, public use
this includes:
 - Abstracts
 - Conference talks, posters
 - Scientific publications (also authored by the inventors), reports
 - Websites

Art 56 Inventive Step

An invention shall be considered as involving an inventive step if, having regard to the state of the art, **it is not obvious to a person skilled in the art.**

Software patents

- If the invention is at least partly technical
- If it solves a technical problem which goes beyond the mere operation of a computer?

Examples

Patentable

- Program which operates X-ray
- CAD program
- Operating system (eg Windows)
- Telephone exchange system

Not patentable

- Pension benefit system
- System operating “Dutch auction“
- Method hedging risk in commodity trading
- Method allowing use of western- style keyboard for Chinese characters

Bio patents / gene sequences

Art 5 Biotech Directive (98/44/EC)

1. The human body, at the various stages of its formation and development, and the simple discovery of one of its elements, including the sequence or partial sequence of a gene, cannot constitute patentable inventions.
2. An element isolated from the human body or otherwise produced by means of a technical process, including the sequence or partial sequence of a gene, may constitute a patentable invention, even if the structure of that element is identical to that of a natural element.
3. The industrial application of a sequence or a partial sequence of a gene must be disclosed in the patent application.

→ Your ideas?

→ Discussion

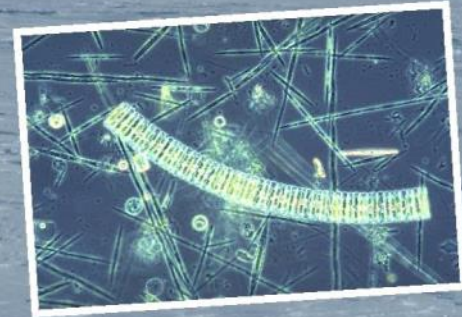
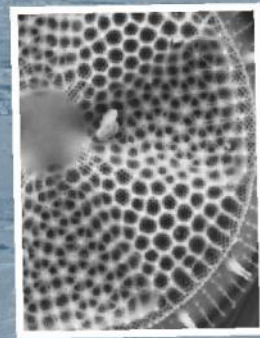
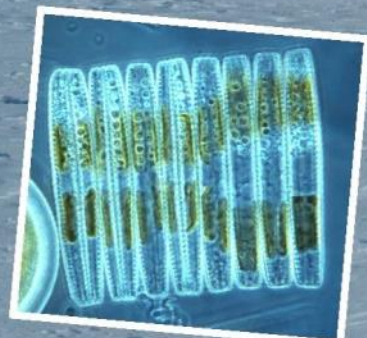
Eberhard.sauter@awi.de



Technische Dokumentation	
Dokumentationsblätter	
Dokumentationsart	Bezeichnung, Nr.
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2	2009-11-11
3	2009-11-11
4	2009-11-11
5	2009-11-11
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