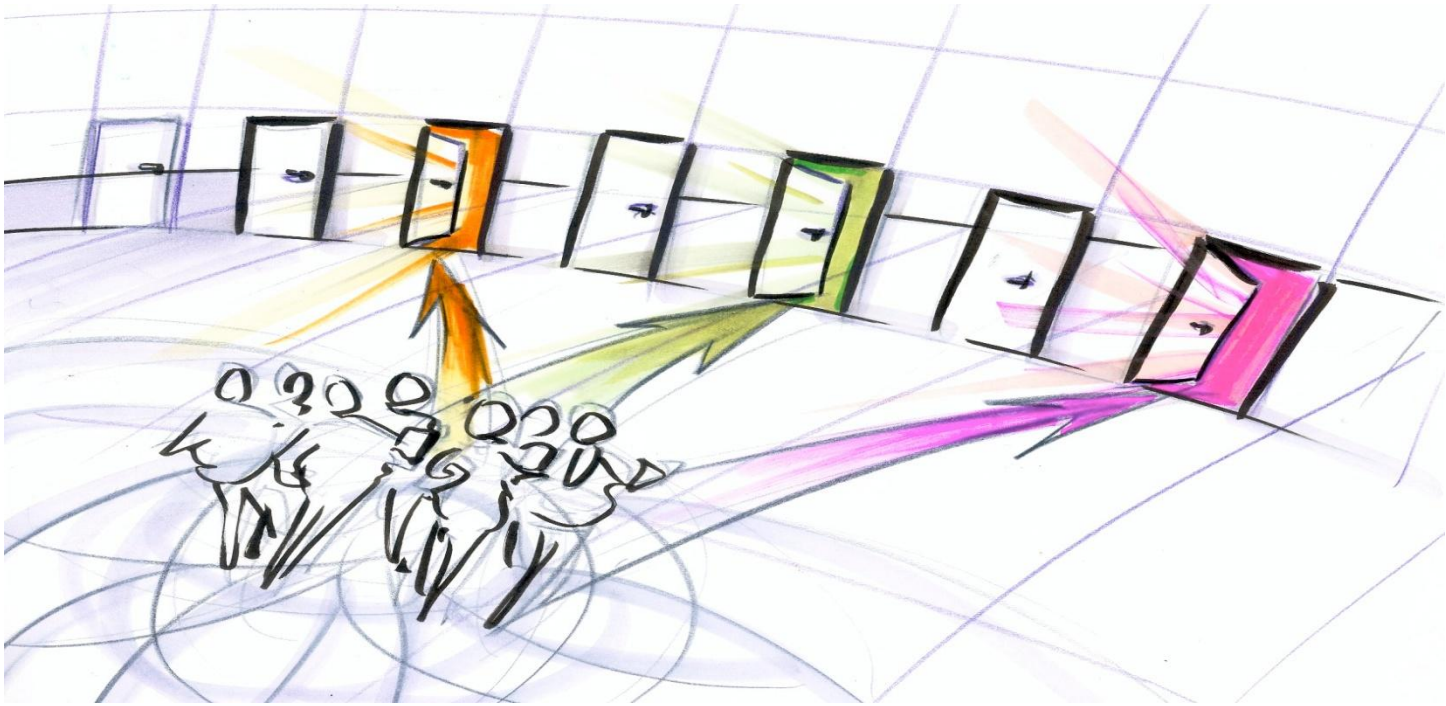
FORESIGHT IN GERMANY: IMPACTS OF THE NATIONAL BMBF FORESIGHT CYCLES

Kerstin Cuhls

NISTEP Conference 2015, Tokyo



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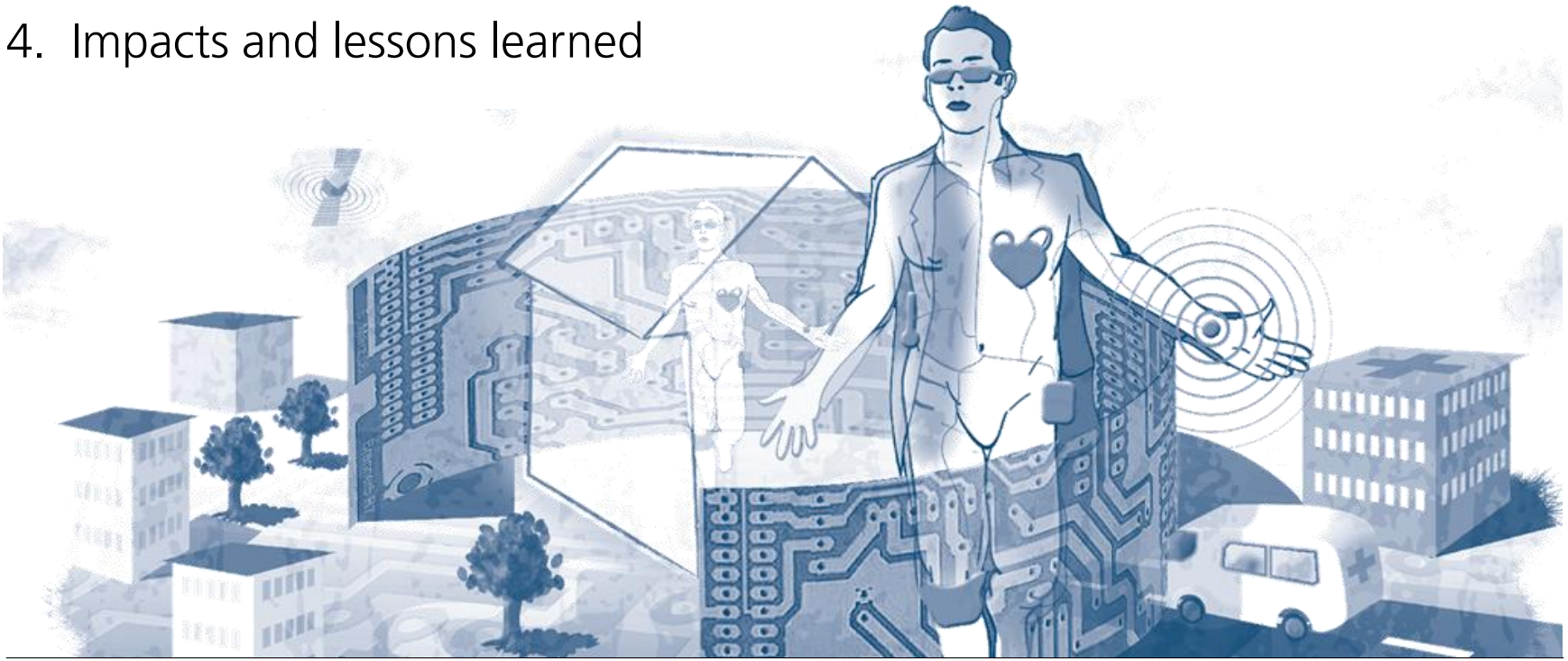
Agenda

1. Foresight in European countries
2. BMBF Foresight 2007-2009 (Cycle I)
3. BMBF Foresight Cycle II
4. Impacts and lessons learned



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Fraunhofer ISI – Competence Center and Business Units

Director

CC Energy Policy and Energy Markets

- Renewable Energies
- Energy Policy
- Climate Policy
- Electricity Markets and Infrastructures

CC Energy Technology and Energy Systems

- Energy Efficiency
- Energy Economy
- Demand Analyses and Projections
- Energy Management and Smart Grids

CC Foresight

- Future Alternatives and Society
- Futures Thinking and Dialogs
- Foresight for Strategy Development

CC Industrial and Service Innovations

- Industrial Innovation Strategies and Systems
- Innovative Production Systems and Value Chains
- Industrial Services

CC Sustainability and Infrastructure Systems

- Water Resources Management
- Transportation Systems
- Systemic Risks
- Sustainability Innovation and Policy

CC Emerging Technologies

- Bioeconomy and Life Sciences
- Innovations in the Health System
- Information and Communication Technologies

CC Policy and Regions

- Policy and Evaluation
- Regions and Clusters
- Innovation Indicators

CC Internal Services

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Europe: Foresighters all over Europe – EU, national, regional, communal, ...

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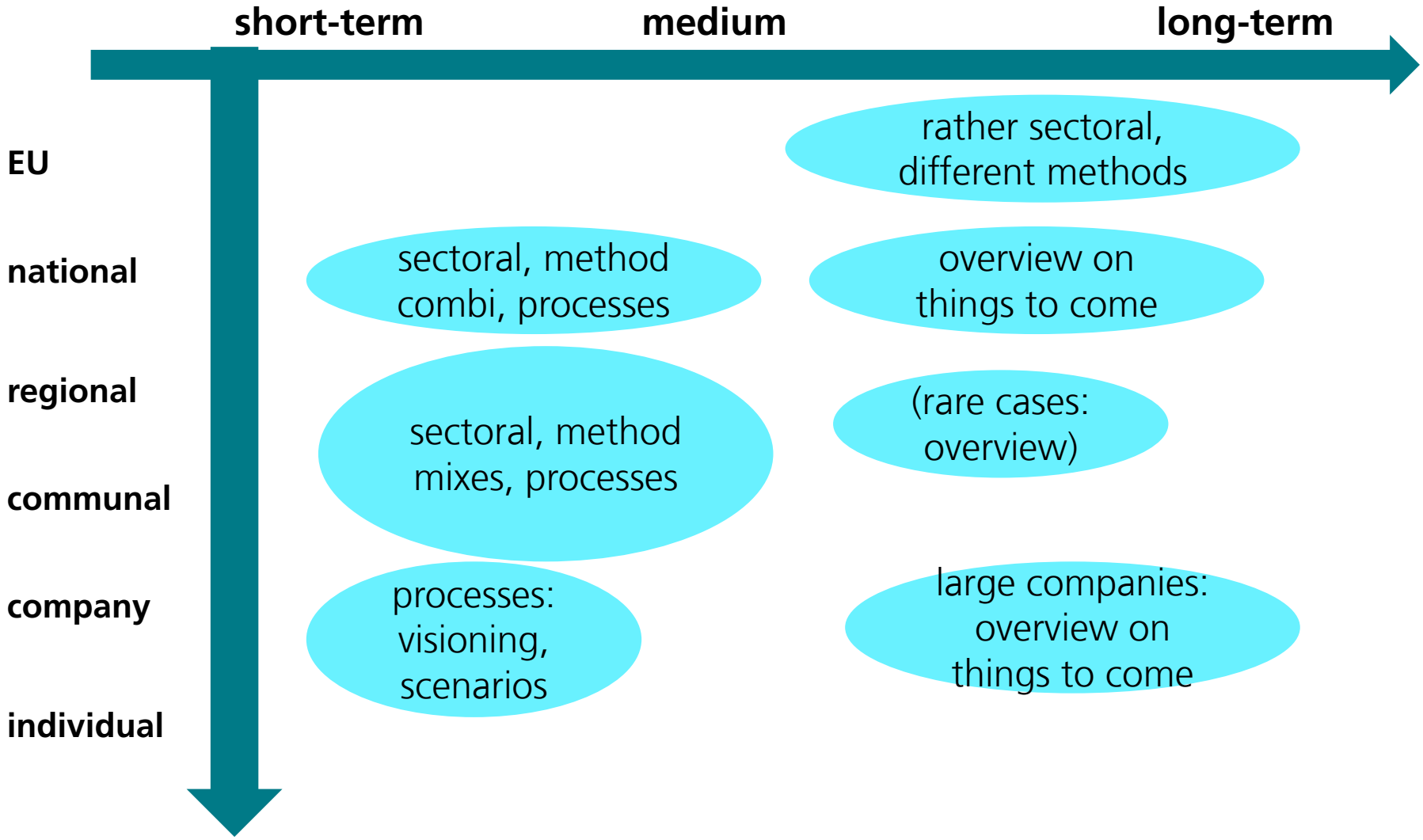
Different types of Foresight – different concepts



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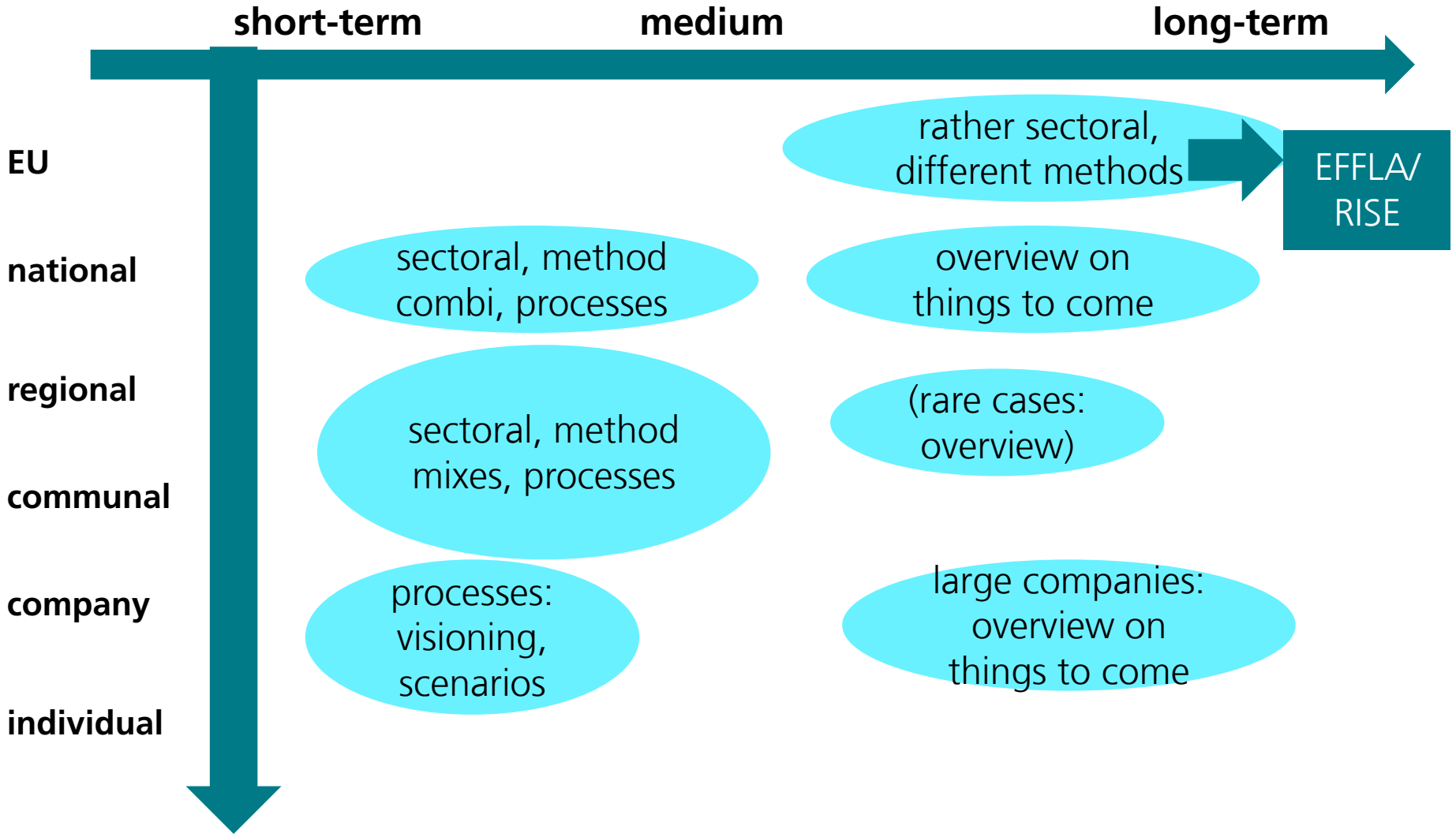
Different types of Foresight – different concepts



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Germany: BMBF Foresight/ national

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1. Objectives of the BMBF Foresight Process Cycle I (2007 – 2009)

- Identifying new research and technology focuses,
- Identifying (and deriving) areas of activity covering a range of research and innovation fields,
- Analysing potential fields of technology and innovation in which strategic partnerships might be possible,
- Deducing priority areas of research and development activity.

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Topic searches BMBF Foresight

November 2007

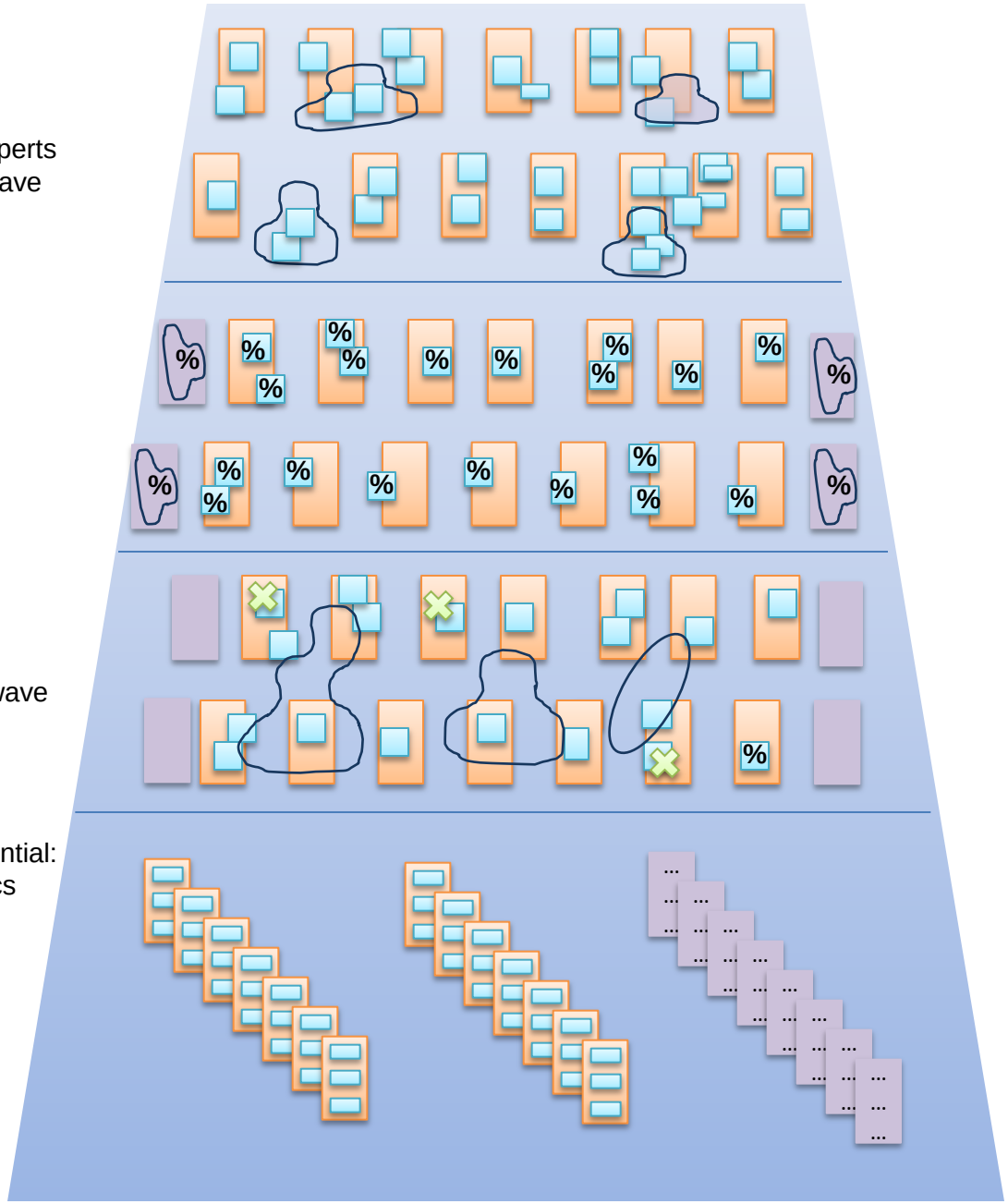
Research
Workshop of experts
Monitoring 1st wave

Online
survey

Synopsis of
researches
Monitoring 2nd wave

Analysis of potential:
Actors and topics

June 2009



Mapping of future topics

in 14 start fields

First re-clustering

1st report

Differentiated evaluation

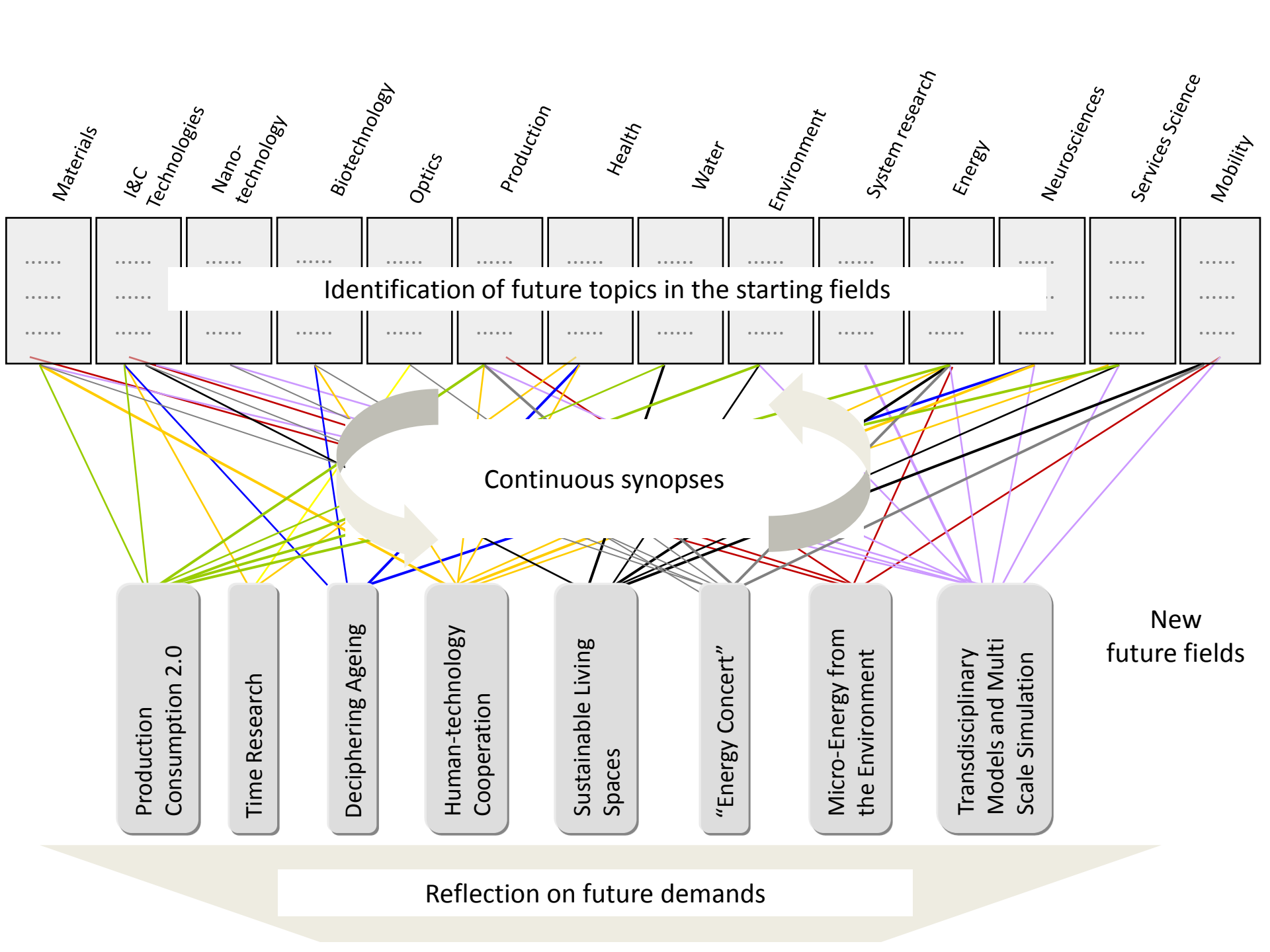
Selection according to
criteria, re-clustering

2nd report

Future topics evaluated for
14 start fields

Topics, actors, recommended action
in 7 new forms of future fields

3rd report


Materials
I&C Technologies
Nano-technology
Biotechnology
Optics
Production
Health
Water
Environment
System research
Energy
Neurosciences
Services Science
Mobility
Identification of future topics in the starting fields
Continuous synopses
Production Consumption 2.0
Time Research
Deciphering Ageing
Human-technology Cooperation
Sustainable Living Spaces
"Energy Concert"
Micro-Energy from the Environment
Transdisciplinary Models and Multi Scale Simulation
New future fields
Reflection on future demands

Results BMBF Foresight Process
The Seven New Future Fields

- On behalf of the Federal Ministry of Education and Research (BMBF)
  - **The BMBF's Foresight Process** (2007-2010)


ProductionConsumption2.0

http://www.bmbf.de/en/12673.php


Human-Technology Cooperation


Transdisciplinary Models and Multi-Scale Simulation


Deciphering Ageing


Time Research


Sustainable Living Spaces


Sustainable Energy Solutions

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Time Research

Future Research Topics

Potential Applications

Ultra-precise/ultra-short time measurement and 4D imaging

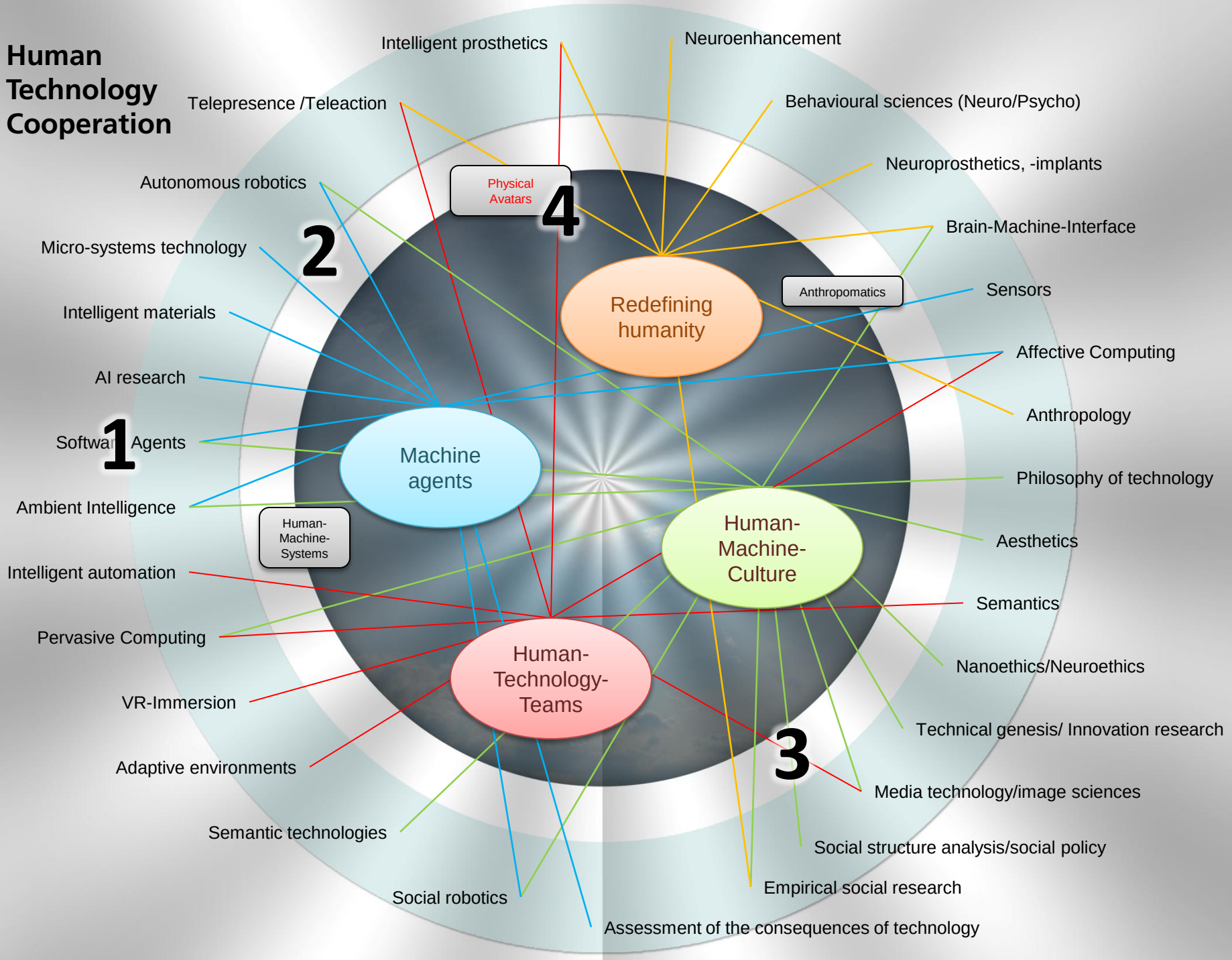
- 4D imaging/ short-term observation (e.g. Compact x-ray lasers for biomedical examinations, processes of the human body)
- Atto (second) electronics – control of processes on an atomic time scale
- Intramolecular energy transport (e.g. energy -efficient electronics, molecular computers)
- GPS applications (e.g. precision farming, machine remote maintenance)
- Optimised synchronisation of media and wireless communication

Biological clocks/ Chronobiology

- Understanding Biological clock(s) in people: avoiding disease, targeted therapies (chronopharmacology)
- Connections shift work/ energy implementation/ Adiposity, hormonal influences, effects of melatonin
- effects of social factors on human rhythms
- Concentrated learning at times when people learn best
- Dealing with time on scales beyond classical time scales
- New time structures in a society with more older and fewer younger people
- New sources of light

Parallelising or synchronising (efficiency processes)

- Making processes “more efficient” instead of just faster
- Synchronise internet server:speed, saving energy
- Synchronising production processes
- Structuring, parallelising, initiating innovation processes


Human Technology Cooperation
Intelligent prosthetics
Neuroenhancement
Telepresence /Teleaction
Behavioural sciences (Neuro/Psycho)
Neuroprosthetics, -implants
Autonomous robotics
Physical Avatars
4
2
Micro-systems technology
Brain-Machine-Interface
Anthropomatics
Sensors
Intelligent materials
Redefining humanity
Affective Computing
AI research
Anthropology
1
Softwar Agents
Machine agents
Philosophy of technology
Ambient Intelligence
Human-Machine-Systems
Human-Machine-Culture
Aesthetics
Intelligent automation
Semantics
Pervasive Computing
Human-Technology-Teams
Nanoethics/Neuroethics
VR-Immersion
Technical genesis/ Innovation research
3
Adaptive environments
Media technology/image sciences
Semantic technologies
Social structure analysis/social policy
Empirical social research
Social robotics
Assessment of the consequences of technology

Results and impacts of the BMBF Foresight Cycle I

1. Varied impact on agenda setting in research and innovation policy

- Development of **horizontal and interface topics** which are not addressed in mono-disciplinary approaches, such as human-technology cooperation
- BMBF has assumed a **pioneering role** during the course of the process
- Identification of **new topics**, such as producing / consuming (PC 2.0), chronobiology

2. New ideas for specialist divisions at the BMBF

- **Internal service provider** for divisions (reflect their foresight activities, address new topics)
- **Cooperative interministerial work** on the field ProducingConsuming2.0 in five BMBF divisions and BMU (Federal Ministry for the Environment, Nature Conservation and Nuclear Safety), BMELV (Federal Ministry of Food, Agriculture and Consumer Protection) and BMWi (Federal Ministry Economics and Technology)
- **Establishment of BMBF division 524** "Demographic Change, Human-Technology Cooperation/ later: Interaction"
- Further cutting-edge fields (aging, living spaces, energy) become part of the forward-looking projects of the **Hightech Strategy**

3. Broad reception and discussion of foresight results by the specialist public

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BMBF Foresight Cycle II (2012 - 2014)

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Background idea: Foresight supports research and innovation policy

BMBF Foresight is a strategic tool with the aim to anticipate long-term developments in society and research & technology in early stages

BMBF Foresight anticipates

- **long-term developments** in research and technology
- and **societal challenges**

on an interdisciplinary basis with a timeline of over 10 years

BMBF Foresight

- thus provides **sound orienting knowledge** for strategic decisions in German research and innovation policy in the early stages of the conceptual phase (solutions for research and innovation, identification of changes in framework conditions). Contributions to future "missions" (priority topics and beacons in research and innovation policy) are to be identified, among others.

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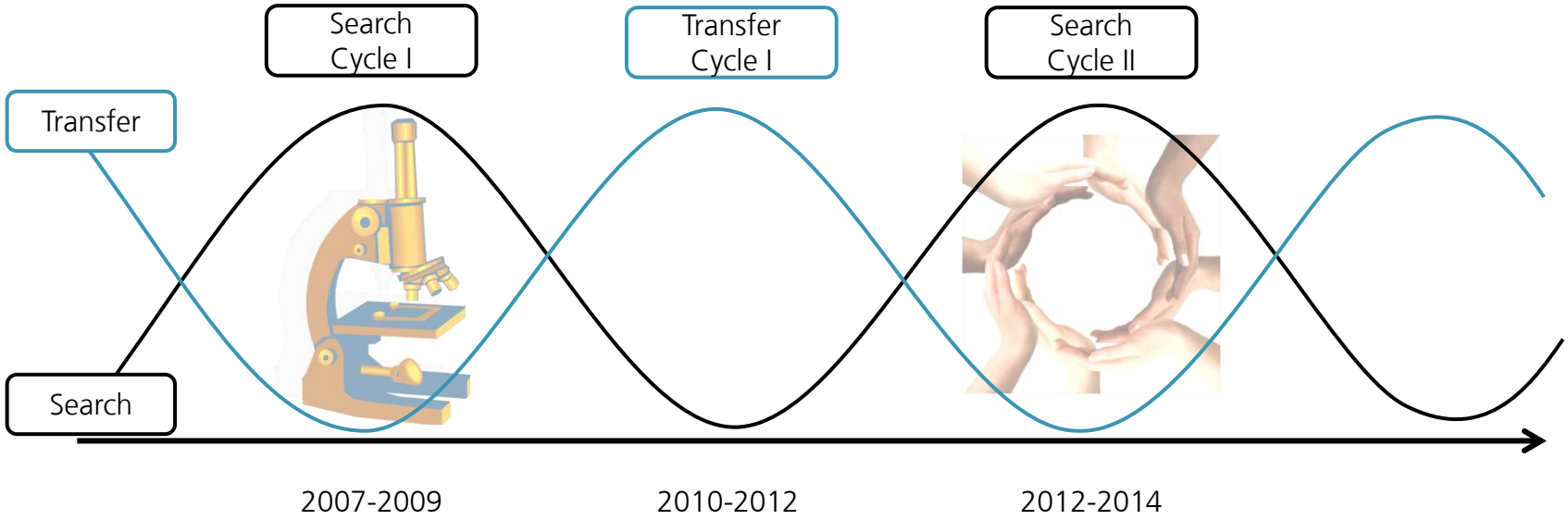
The current BMBF foresight process evolves in cycles



Technology trends "technology push"

Societal challenges "demand pull"

Evaluation

The role of BMBF Foresight

- It serves as a "**background**" for dialogues, road mapping and foresight in the specialist programmes and research organizations (longer time horizon, interdisciplinary approach, method-based).
- It is intended to **break with old patterns of thinking** (e.g.: focus on known mega trends).
- It creates free space and stimulates open, creative discussions
- It serves as an "**antenna**" and gives access to results of national and international foresight efforts.
- It ensures a **continuous dialogue with the leading minds** dealing with foresight.
- It is a centralised, interdisciplinary and inter-divisional complement to ongoing foresight activities in the divisions (e.g. trends in nanotechnology, div. 511).

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BMBF Foresight Cycle II: Overview

- European call for proposals launched by BMBF in 2012
  - **Objective**: New missions for German research and innovation policy
  - Focus: Societal changes, hidden trends

- Offer from consortium of VDI-TZ and Fraunhofer ISI (AIT subcontract) selected
- Project to last from May 2012 – April 2014
- Time horizon 2030
- Complemented by evaluation process, international sounding board and national board of key innovation system actors and experts

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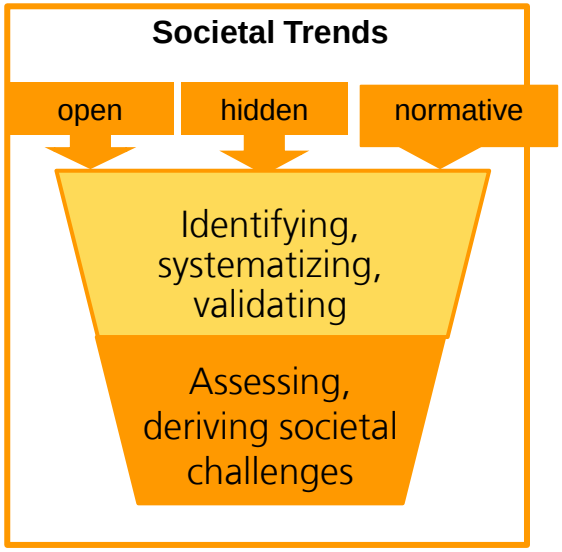
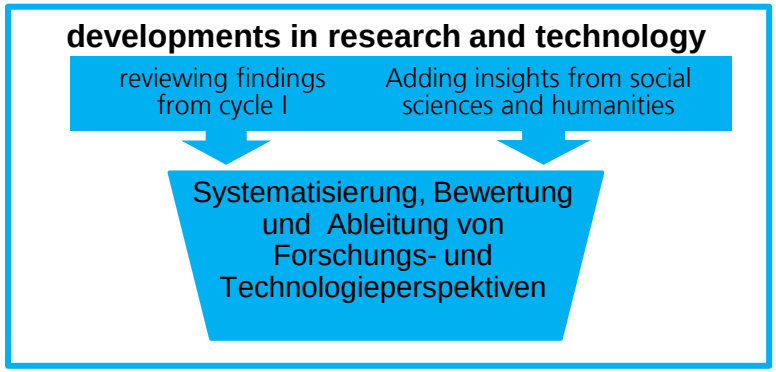
BMBF Foresight Cycle II: Process

1. Search for societal challenges in the future



topic complexes social challenges



2. Inventory Research and Technology

profiles research and technology developments

3. Linking up developments in society with those in research and technology

scenarios/ narratives research and innovation 2030

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Identification of Societal Trends

Open Trends

Screening of global sources including foresight and trend reports

Normative Trends

Exploration of value oriented statements and visions from relevant civil society actors.

Workshop with stakeholders and researchers on the core issues identified (cultural diversity, new modes of governance, sustainability and societal progress, social cohesion, virtual worlds)

Hidden Trends …

- 64 societal trends selected (from ca. 200 initially identified) and captured in a structured template.
- External feedback from BMBF departments, international sounding board and national board
- Match with update of Research and Technology Developments: Innovation seeds
- Narratives from the Future

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Identification of "Hidden Trends" II/III

For each need area:

- Systematic screening of non-mainstream media outlets
- Identification of actors with imagination capacity beyond today's trajectories based on foresight and "lead user theory":
  - **Demand pioneers**: feel certain societal development earlier than others due to specific needs (e.g. parents of disabled children)
  - **Lead users**: demand pioneers with knowledge and resources to act on their need (Founder of neighborhood initiative Vienna)
  - **Antennas**: Feel certain developments earlier because of close contact to demand pioneers (e.g. parkour coach) or avant-garde positions (e.g. artists)
- Intense involvement through interviews and creative workshop

„Hidden“ Workshop

AUSTRIAN INSTITUTE OF TECHNOLOGY
TOMORROW TODAY

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Identification of "Hidden Trends" III/III

Other measures to counteract the perception filters:

- Use of creativity and collective intelligence techniques
- Systematic taking into account of countertrends and "negative" developments
- Involvement of actors with diversity of backgrounds
  - panel of doctoral students from different disciplines and regions to counteract organisational filter

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Example 1 „Hidden Trend“

A new culture of swapping is emerging

Swapping of clothes, shoes, furniture and other commodities is en-vogue. Swapping takes different forms between fully commercial, welfare oriented and private. Motives are ranging from sheer need in emergency situations to sustainability oriented values and the desire for simpler lifestyles and less consumption.

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Example 2 „Hidden Trend“

Citizen science

More and more citizens are doing research of their own accord and increasingly are being directly integrated into scientific research projects. Citizen research is spreading, among other things, due to ever more powerful information and communication technologies, open data and increasingly affordable laboratory equipment. This decentralization of knowledge production harbors huge potentials for solving societal challenges such as preserving biodiversity, but also new risks such as product *bio-hacking*, for example genetically-engineered manipulations by amateurs. New types of challenges for research policy result from these developments.

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Example 3 „Hidden Trend“

Public Spaces

The societal relevance of public spaces is ever more recognized. At the same time the use of public spaces is being contested. On the one hand new practices like urban hacking, urban gardening and urban sports are emerging. At the same time public spaces are being privatized or restricted to commercial uses. Others are neglected due to strains on community budgets. In the long run, demographic change and rising energy costs will add up to the need for solutions.

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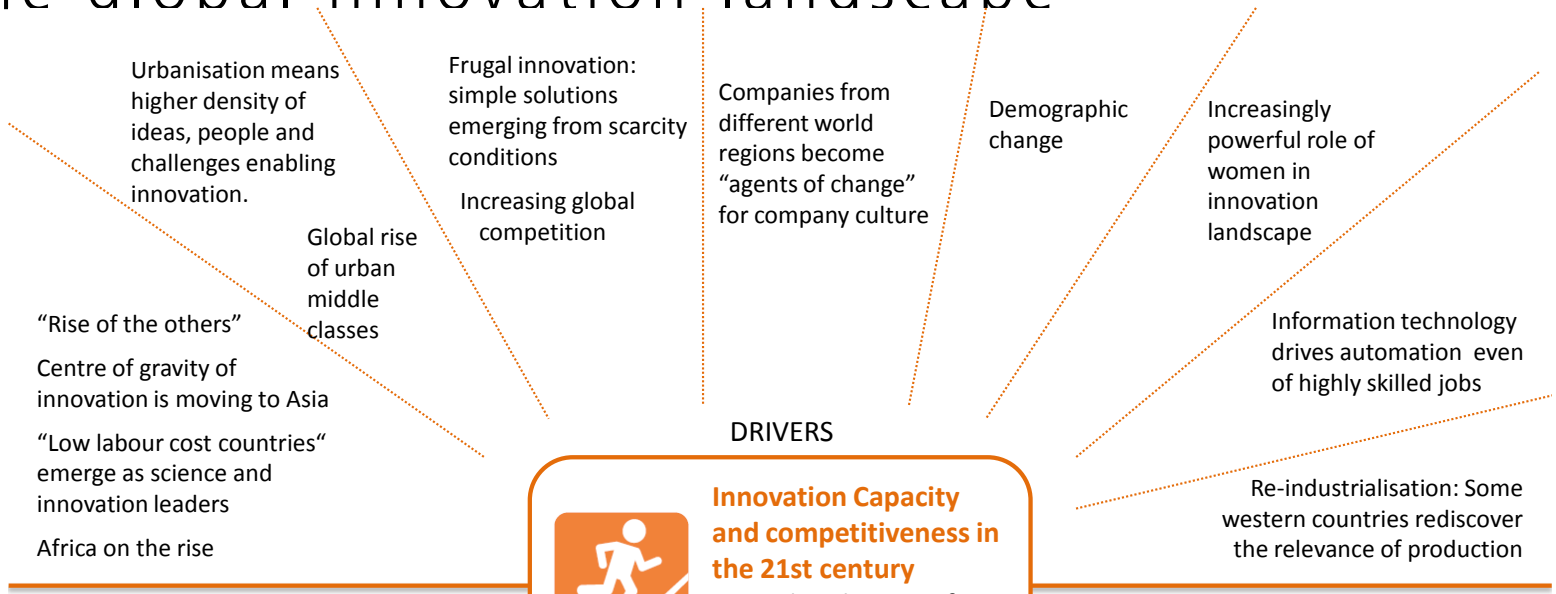
Societal Challenge: New Drivers and Actors in the global innovation landscape



POSSIBLE FUTURE PATHWAYS 2030

A – incremental change in the global competition landscape

German companies are exposed to global competition and are well integrated into global value creation networks. They are able to react flexibly to changes in local conditions.

B – developed countries overtaken

Developed countries are overthrown by unexpected speed in the rise of emerging countries. Aging and debt load hamper their ability to react.

C – new global distribution of labour and prosperity

There is a multitude of new forms of global cooperation in economy and science. National competence profiles become more differentiated and specialised. A new phase of global prosperity is emerging.

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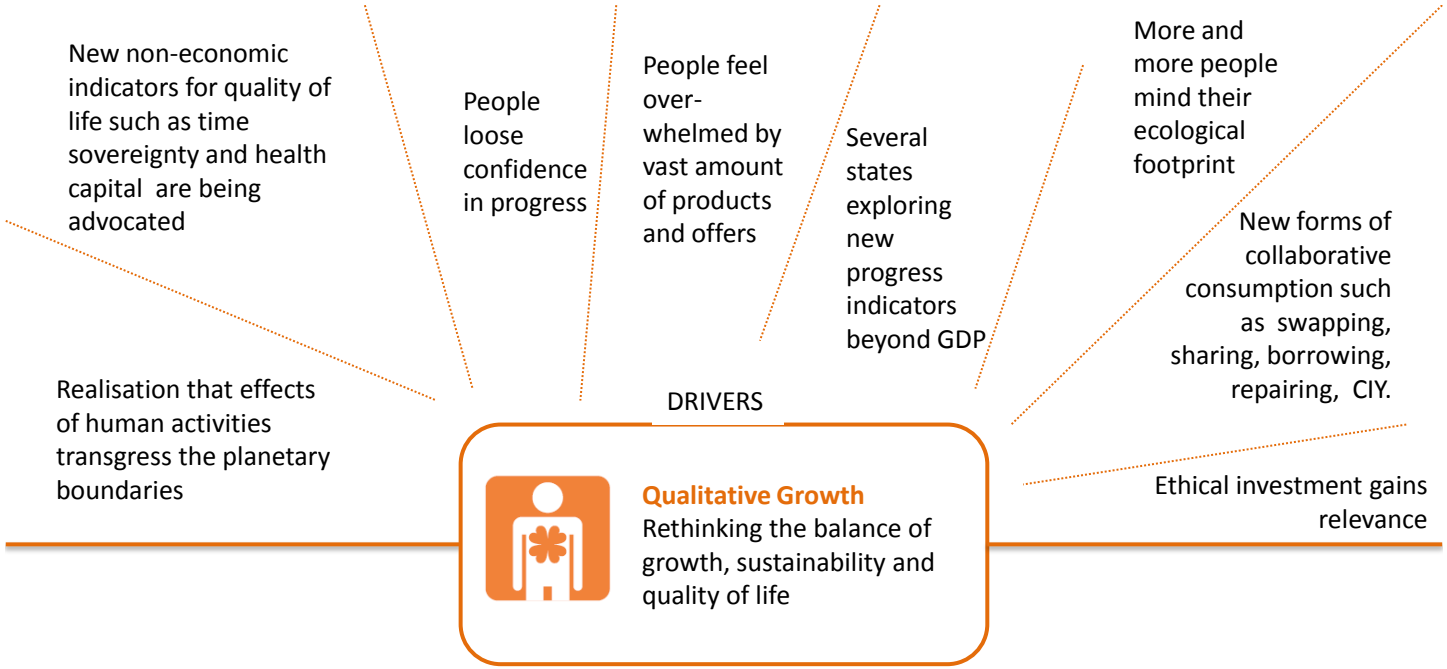
Societal Challenge: Qualitative growth – rethinking the balance of growth, sustainability and quality of life



POSSIBLE FUTURE PATHWAYS 2030

A – Novel consumption patterns in niches

Largely economic growth is still viewed as the main element of progress and wealth and remains the guiding post for decision making in economy, policy and society. The pursuit of other goals such as sustainability and cohesion is seen as secondary.

B - transformative change of our understanding of progress and consumption culture

Progress and quality of life are assessed through a new set of differentiated indicators

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Example Technological Perspective 2030: Health and Nutrition

Food allergies

Designer Food, Functional Food, Medical Food

- „Antisense-Strategy“ (Reduction of allergenic components)
- Metagenom analysis, probiotics, prebiotics
- Molecularbiological routine-diagnostics of food

Sustainable Healthcare System

- New concepts of healthcare provision and diagnostics

Medical technology and e-health

- Linking diagnostics and therapy
- High-Tech-Prostheses
- Bio implants
- IT-networked health system

Address new health challenges

- Aging
- Globalisation (e.g. Pandemics)
- Climate change
- Lifestyle/environment triggered diseases

Health and Nutrition

Health research (natural science & medicine) to foster health, combat diseases and secure provision of healthcare. Interplay of health and nutrition.

Molecular analytics and diagnostics

Better understanding due to more detailed insights into mechanisms (e.g. Imaging technologies)

Personalised medicine and nutrition

- Personalised therapies and nutrition concepts based on individual diagnostics (biomarkers)
- „Quantified self“, measuring food intake
- Modelling lifestyle and therapy effects

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Technological Perspective 2030: Photonics

Photonics for production

- Laser based quality control
- Intelligent laser based production networks
- Additive manufacturing: Laser based building up of products from raw material layer by layer (3D printing)
- Micro- and nano-structuring
  - Lithography for nanoelectronics
  - Inkless printing
- Laser based manufacturing processes allow for wider choice of materials

Photonics for life sciences and health

- Bio-photonics based diagnostics and therapy
- Photonics based lab on chip diagnostics
- Imaging and diagnostics
- Opto-genetics for brain research
- Photonic theragnostics (integrated therapy & diagnostics)
- Plasma medicine
  - Treatment of wounds
  - Sterilisation

Illumination and energy

- LED and OLED
  - Automatic control of intensity , colour and direction of light
  - Physiologically effective illumination
  - Light films in glass panels
- Photovoltaics
  - Large-area organic solar cells

Photonics is the technical harnessing of light. It focuses on the generation, control and most of all use of light in practically all domains of relevance for economy and society.

Emerging Technologies

- Quantum optics
  - Ultra high precision sensors
  - Quantum communication (e.g. encryption)
  - Quantum computing
- Nanostructured metals for high speed chips, solar cells, LEDs (plasmonics)

Photonics for information and communication

- Photonic communication networks
- Convergence of photonics and electronics
- Imaging and visualisation
  - human-machine-Interfaces

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Some observations

- trend towards more societal-oriented foresight in connection with science, technology and innovation is going on
  - complexity
  - assessments difficult
  - interconnected impacts/ systemic dynamics difficult to understand

- other strand: challenge-driven foresight
- more and more interdisciplinarity, issue-oriented foresight

- important: time and timing

Output

Reports (available in German language)

- 60 Trendprofile als Einseiter http://www.bmbf.de/de/24519.php
- aus der Verknüpfung der Trendprofile entwickelte „Gesellschaftlichen Herausforderungen“ http://www.bmbf.de/de/24525.php
- Technologiefelder (Aktualisierung), genannt „Forschungsperspektiven http://www.bmbf.de/de/24521.php
- Chancen und Herausforderungen in „Geschichten aus der Zukunft“ http://www.bmbf.de/de/24531.php

presentations, e.g.:

- 13.-15. März 2013, PACITA Conference, Prague
- 14. September 2013, IFA Academic Seminar, Winterthur
- 4.Oktober 2013, UNESCO Future Lecture, Paris
- Sino-German Innovation Forum, Beijing
- …

Application and Impact of BMBF Foresight

- ITA topics for future research projects derived directly from the processes (ITA = Innovation and Technology Assessment/ Analysis)
- **Cycle I:** presentations in the BMBF divisions raised awareness and some project/ programme ideas were confirmed or taken over
- some topics or fields integrated into the Hightech Strategy of the Federal Government, e.g. in the „Guiding Projects“ (Leitprojekte)
- comparison of own ideas and topics in the BMBF divisions with „outsider perspective“
- problem of integrating interdisciplinary topics into the existing portfolio, solution e.g. establishment of a new division (Referat 524 Demographic Change and Man-Technology Interaction)
- Cycle II: too early, integration of the „innovation seeds“ into the system and Hightech Strategy still going on
- **no direct „Master Plan“ in Germany!**
- but ideas integrated and used by the Federal Government Hightech Strategy

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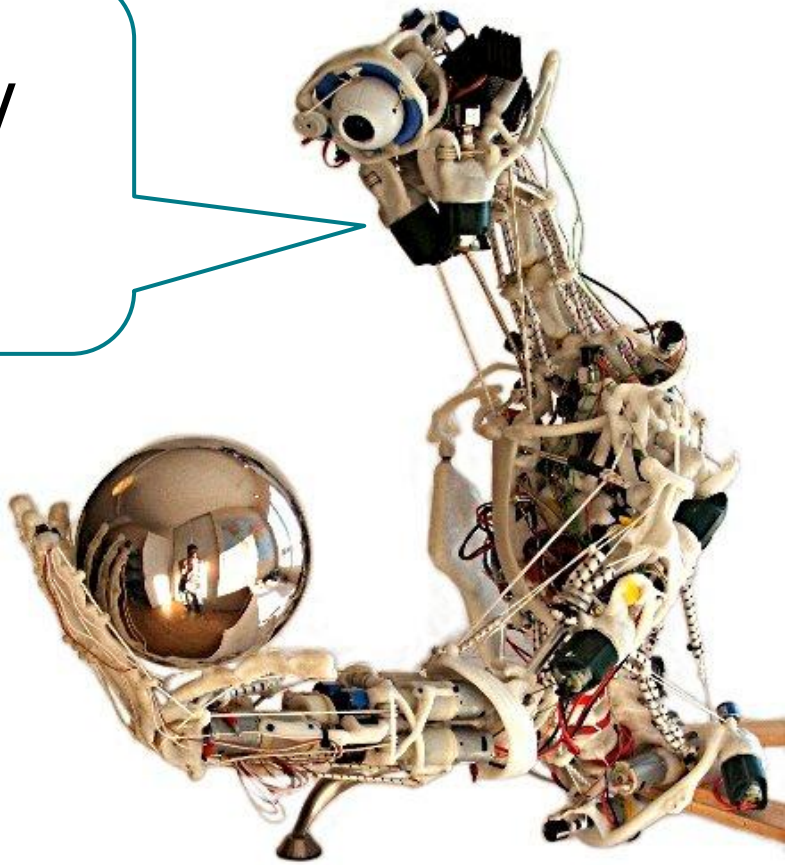
Thank you very much!



Anthropomimetischer Robotertorso - ECCEROBOT

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