
FORESIGHT AS EX-ANTE EVALUATION – THE CASE OF THE BMBF FORESIGHT PROCESS

Kerstin Cuhls

Business Area Futures Research and Foresight



The Fraunhofer Institute for Systems and Innovation Research (ISI)

- studies how **innovations** originate, which actors are to be integrated, who benefits from them and how they can be promoted
- evaluates economic, social and political **potentials** and the **limits** of technical innovations
- helps decision-makers in industry, science and politics in **setting a strategic course**
- utilizes the newest theories, models, social-science measurement instruments and databases and constantly develops them further
- handles circa **290 research projects** per year
- has **influenced** the German innovation landscape for more than 35 years as no other research institution has

Competence Centers of Fraunhofer ISI

Energy Policy and Energy Systems	Industrial and Service Innovations	Innovation and Technology Management and Foresight
Business Units	Business Units	Business Units
<ul style="list-style-type: none"> ▪ Energy and Climate Policy ▪ Energy Efficiency ▪ Renewable Energies ▪ Energy Economy 	<ul style="list-style-type: none"> ▪ Technical and Organizational Process Innovations ▪ Industrial Services ▪ Sustainable Production Systems and Location Management 	<ul style="list-style-type: none"> ▪ Futures Research and Foresight ▪ Management of Innovations and Technologies ▪ Strategies for Material Technologies
Fraunhofer ISI		
Sustainability and Infrastructure Systems	Emerging Technologies	Policy and Regions
Business Units	Business Units	Business Units
<ul style="list-style-type: none"> ▪ Water Resources Management ▪ Transportation Systems ▪ Systemic Risks ▪ Sustainability Innovations and Policy 	<ul style="list-style-type: none"> ▪ Biotechnology and Life Sciences ▪ Innovations in the Health System ▪ Information and Communication Technologies 	<ul style="list-style-type: none"> ▪ Policy and Evaluation ▪ Regions and Clusters ▪ Innovation Indicators

Agenda

- **What is Foresight?**
- What is evaluation?
- Evaluation of Foresight – a contradiction?
- Foresight as ex-ante evaluation
- The case of the BMBF Foresight Process
- Some Lessons Learned

What is Foresight?

**Foresight is the
structured debate
about complex futures**

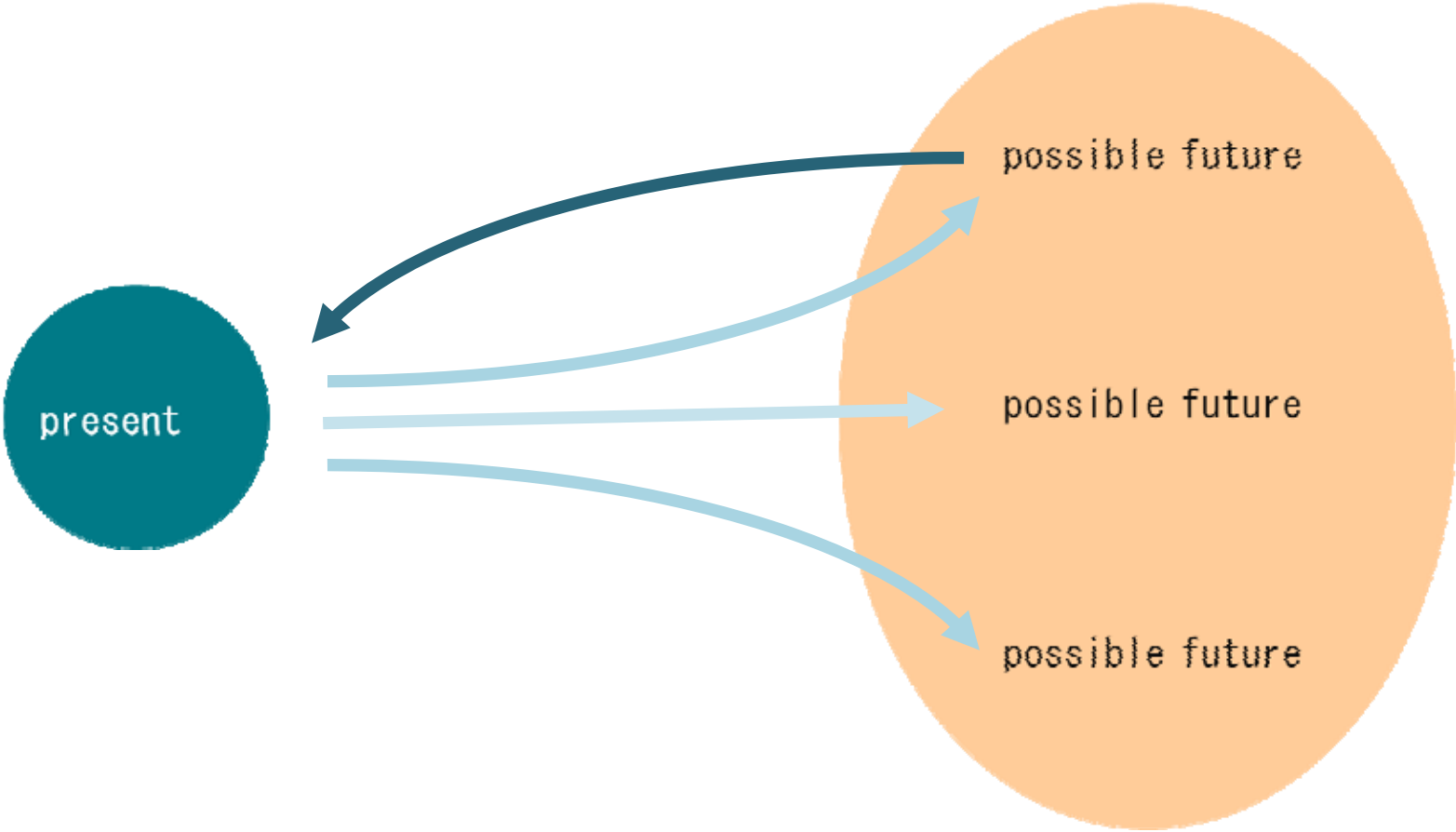
different Foresight definitions, see for example Georghiou, Luke et. al: The Handbook of Technology Foresight, Concepts and Practice, PRIME Series on Research and Innovation Policy, 2008

Foresight

Foresight is the structured debate about complex futures

- **structured:** systematic approach by applying methods of futures research, science-based, based on new theories of futures research
 - **structured debate:** interaction of relevant actors, active preparation for the future or different futures, orientation towards shaping the future
 - **complex:** consideration of systemic interdependencies, holistic view
 - **futures:** open view on different paths into the future, thinking in alternatives
-
- **long- and medium-term view**
 - **no planning**, but a step on the way to planning (strategic foresight)
 - **no prediction**

Systematic Exploration of Different Futures



Time Horizon



Objectives of Foresight

- To think long-term
- To enlarge the choice of opportunities, to set priorities and to assess impacts and chances,
- To get an overview about things to come,
- To prospect the impacts of current research and technology policy,
- To ascertain new needs, new demands and new possibilities as well as new ideas,
- To focus selectively on economic, technological, social and ecological areas as well as to start monitoring and detailed research in these fields,
- To define desirable and undesirable futures and
- To start and stimulate continuous discussion processes.

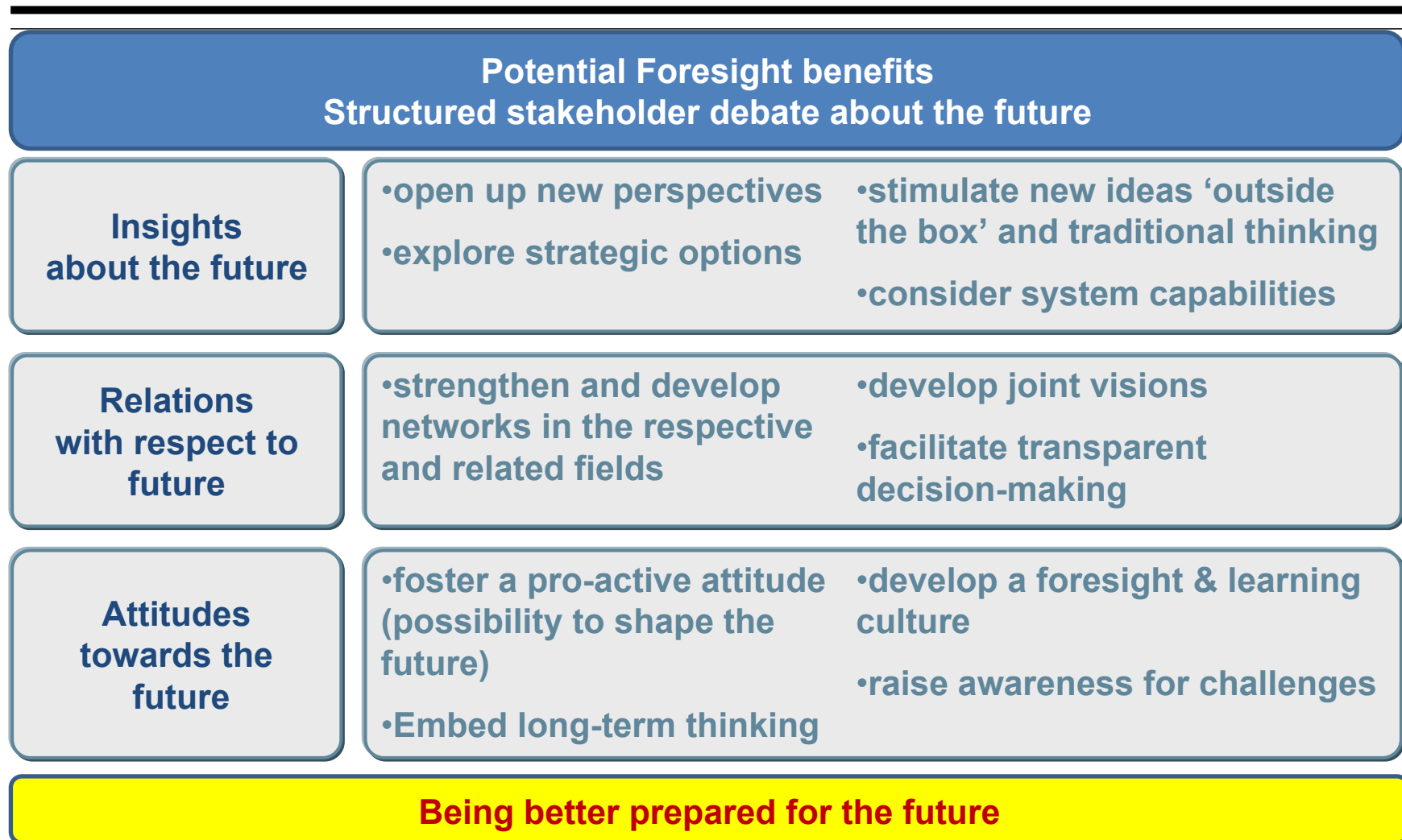
but:
predictions are
impossible

Objectives of Foresight

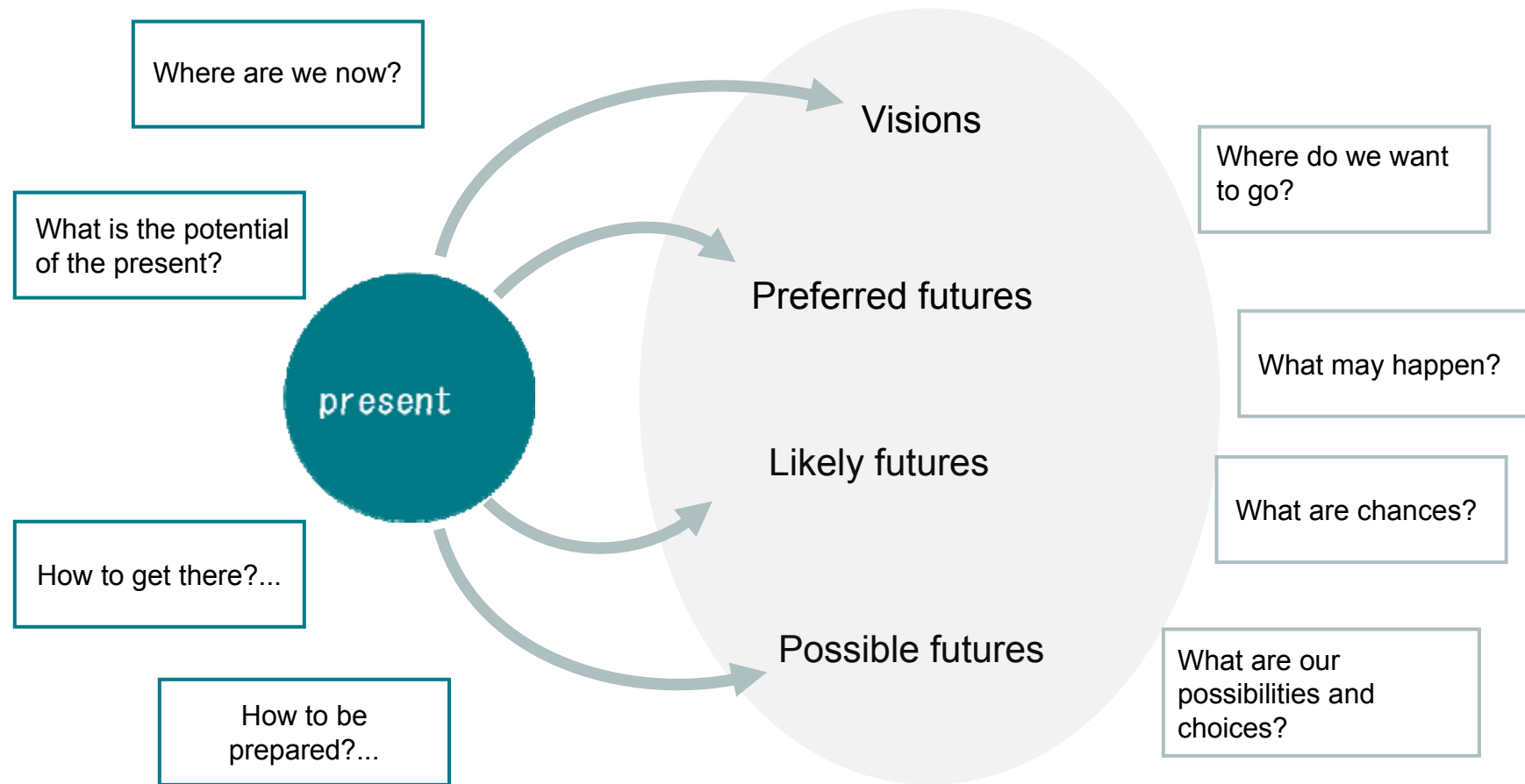
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- To start and stimulate continuous discussion processes.

In most of these cases, evaluation or assessments included!

Potential Foresight benefits



Different methods address different questions

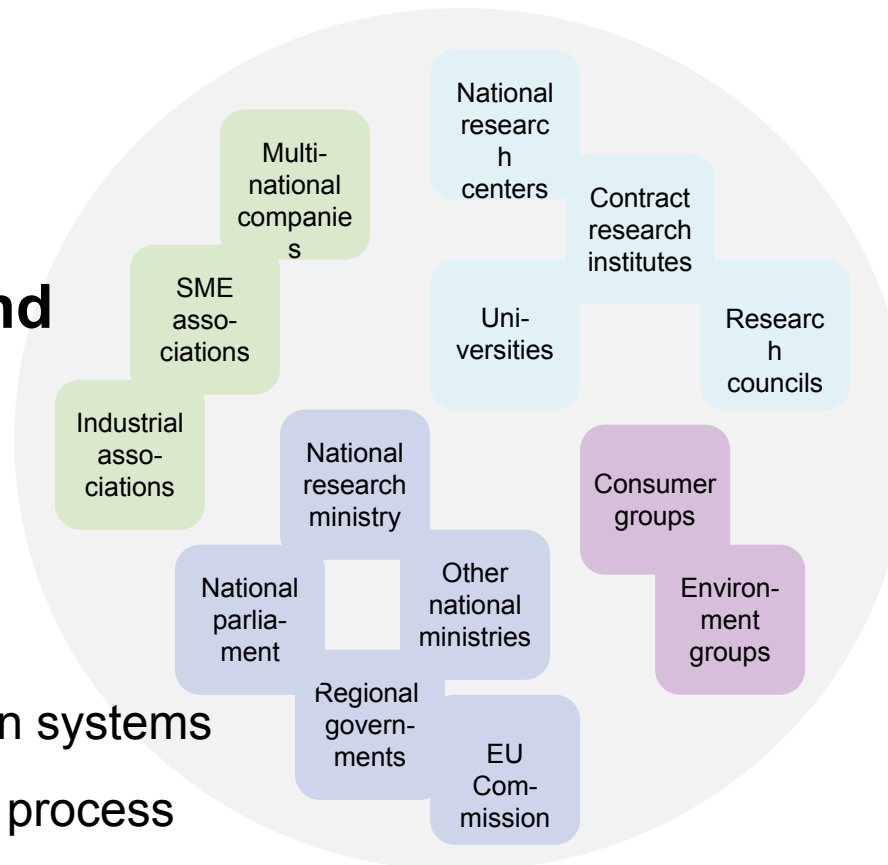


Making Use of Distributed Intelligence

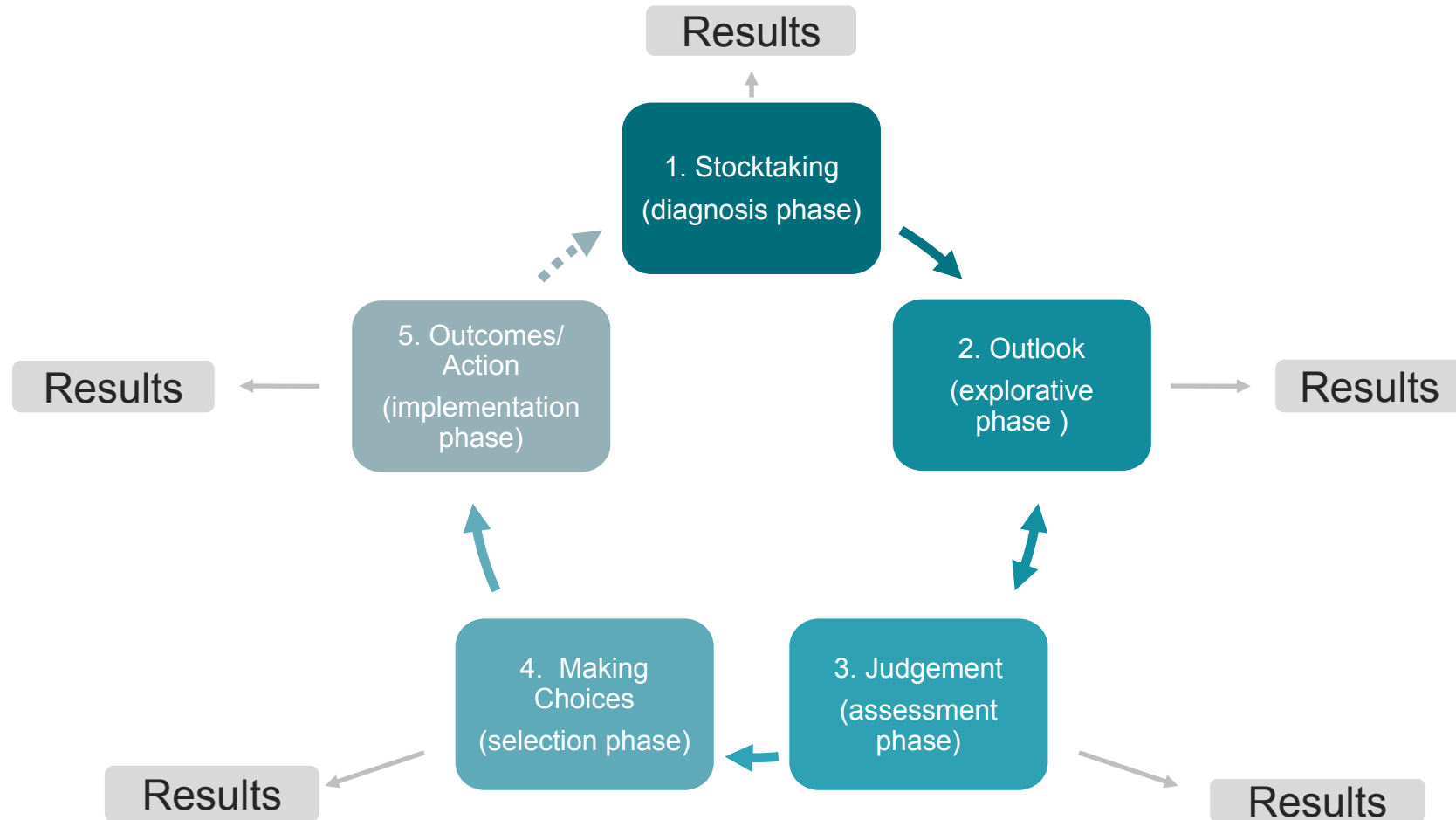
Strategic intelligence
of the different actors
in the innovation system

Arena of research and innovation policy

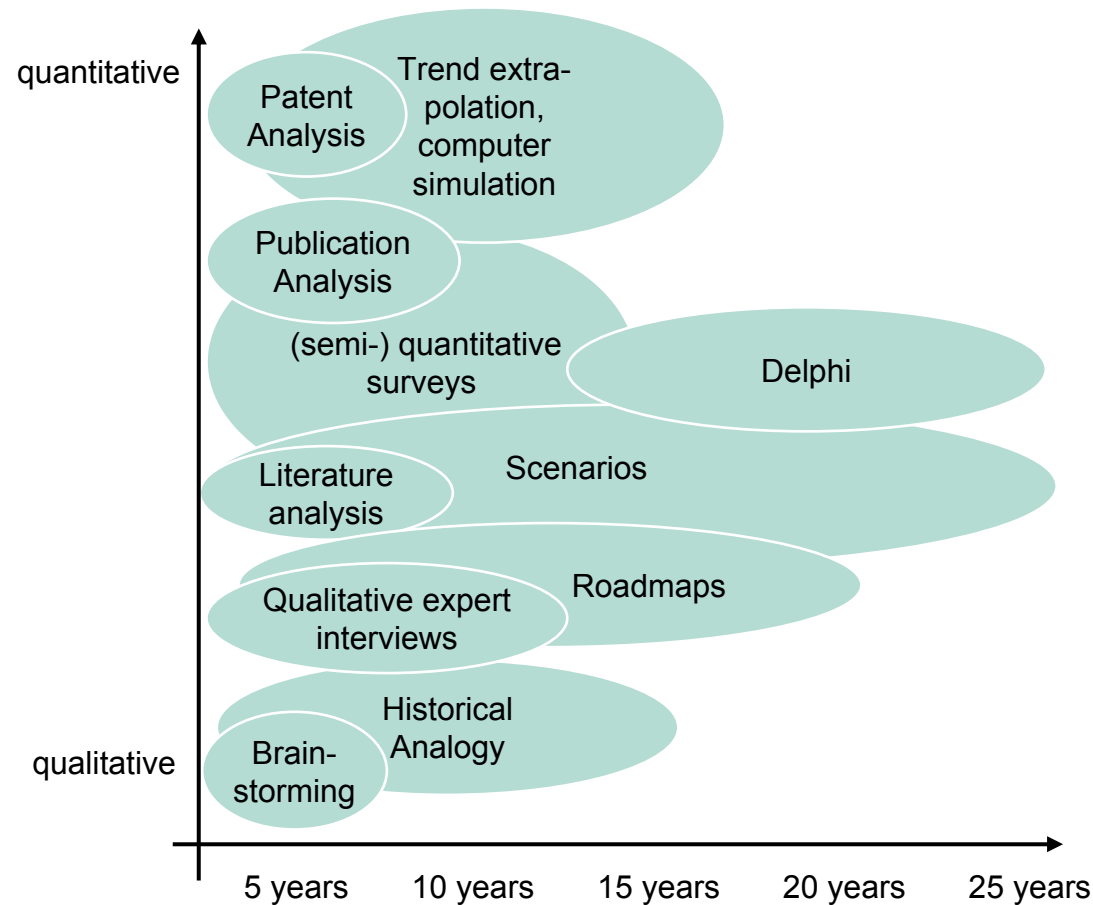
- Different interests, different perspectives
- No dominant actor
- Networks and negotiation systems
- Evaluation as a learning process



Phases of Foresight



Application of methods in Foresight



- raw classification of the different methods/ concepts
- depending on the implementation of the methods/ concepts into the project context shifts can result
- often a combination of the methods/ concepts is used

not all methods are about evaluation/ assessment, some are creative...

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What is Evaluation?

Evaluation ist the systemic investigation of an evaluand's worth or merit. Evaluands include programmes, studies, products, schemes, services, organisations, policies, technologies and research projects. The results, conclusions and recommendations shall derive from comprehensible, empirical qualitative and/ or quantitative data. (DeGEval, 2001).

Basic attributes:

- Utility
- Feasibility
- Propriety
- Accuracy

What is Evaluation?

Differentiation:

- **Issue of evaluation:** in the areas of FTI policy projects, programmes, institutions, policy instruments, national and/ or sectoral innovation systems...
- **Objective of evaluation:** knowledge creation, control, legitimacy, learning function (Stockmann 2007)
- **Purpose of the evaluation:** summative (balance), formative (active)
- **Timing of the evaluation:** ex ante, on-going / associative, interim, ex post

Dimensions of the Analysis

Phases of the programme process	Perspective of the analysis	Interest in knowledge	Evaluation concept
Formulation of the programme/ ... planning phase	ex-ante	"analysis for policy" "science for action"	preformative/ formative: active, shaping, process- oriented, constructive
Implementation phase	on-going	Both possible	formative/summative: both possible
Impact phase	ex-post	"analysis of policy" "science for know- ledge"	summative: summarizing, balancing, result- oriented

Source: Stockmann (2004, p. 17, own adaptation and translation)

Typical R&D evaluation issues and questions

(Arnold/ Guy 1997, p. 72)

- **Appropriateness:** Was it the right thing to do?
- **Economy:** Has it worked out cheaper than we expected?
- **Effectiveness:** Has it lived up to the right expectations?
- **Efficiency:** What's the return on investment (ROI)?
- **Efficacy:** How does the ROI compare with expectations?
- **Process efficiency:** Is it working well?
- **Quality:** How good are the outputs?
- **Impact:** What has happened as a result of it?
- **Additionality:** What has happened over and above what would have happened anyway?
- **Displacement:** What hasn't happened which would have happened in its absence?
- **Process Improvement:** How can we do it better?
- **Strategy:** What should we do next?

ex-post

Evaluation methods – „Toolbox“ I

Quantitative: Statistical data analysis

- **Innovation Surveys:** basic data describe the innovation process, using descriptive statistics
- **Benchmarking:** comparisons based on a relevant set of indicators across entities

Quantitative: Modelling methodologies

- **Macroeconomic modelling and simulation:** broader socioeconomic impact of policy interventions
- **Microeconometric modelling:** effects of policy intervention at the level of individuals or firms
- **Productivity analysis:** impact of R&D on productivity growth at different levels data aggregation
- **Comparison group approach:** effect on participants using statistical sophisticated techniques

Source: Polt, W. et al., RTD Evaluation Toolbox (2002)

Evaluation methods – „Toolbox“II

Qualitative and semi-quantitative methodologies

- **Interviews and case studies:** direct observation of naturally occurring events to investigate behaviours in their indigenous social setting
- **Cost-benefit analysis:** economic efficiency by appraising economic and social effects
- **Expert panels/peer review:** scientific output relying on the perception of peer scientists
- **Network analysis:** structure of cooperation relationships and consequences for individuals and their social connections into networks
- **Foresight/ technology assessment:** identification of potential mismatches in the strategic efficiency of projects and programmes

Source: Polt, W. et al., RTD Evaluation Toolbox (2002)

Guiding Model: Formative Evaluation and Strategic Intelligence

(according to Kuhlmann/ Bühler)

- Typical formative evaluation
 - Systematic process with elements of advice, facilitation and assessment
 - Intends the support of policy decision-makers, programme managers and participants of R&D programmes
 - Ideally looks at the whole programme process from design over implementation and impact analysis to the re-design
 - Stimulates learning and adaptation process for all participants
 - Contributes to the general success (sometimes even finishing) a process and to the design of new measures/ processes
- Formative evaluation as an element of strategic intelligence
 - delivers and evaluative contribution to reflexive, incremental policy development
 - Needs a deep understanding of the target structures, the context and the governance structures
 - Includes the diverse perspectives of the actors and the different levels

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Two possibilities of the application of evaluation in the context of foresight

- 1. evaluating foresight activities/ processes
- 2. regards foresight (process) itself as an evaluation process

➤ ex ante

■ **in both cases: formative evaluation**

Evaluation of Foresight (processes) – a contradiction?

- yes: if you try to evaluate the prediction, their precisions etc.
- yes: because self-destroying prophecies can be something very good
- but: processes are costly, therefore the performance of the process needs to be evaluated
- according to questions/ criteria like:
 - efficiency
 - reaching the objectives
 - including the stakeholders
 - is there an add-on?
 - use of methods....

Evaluation of Foresight (processes) – a contradiction?

- therefore, there are only a few evaluations of foresight processes available
- most of them short (workshop) or dissertations
- e.g., UK (Michael Keenan)
- e.g. Czech Republic (1 day workshop with external experts)
- e.g. Hungary (evaluation panel)
- e.g. Swedish Foresight

- Others:
- FUTUR in Germany
- The BMBF Foresight Process in Germany (until now no „classical“ evaluation)

FUTUR in Germany

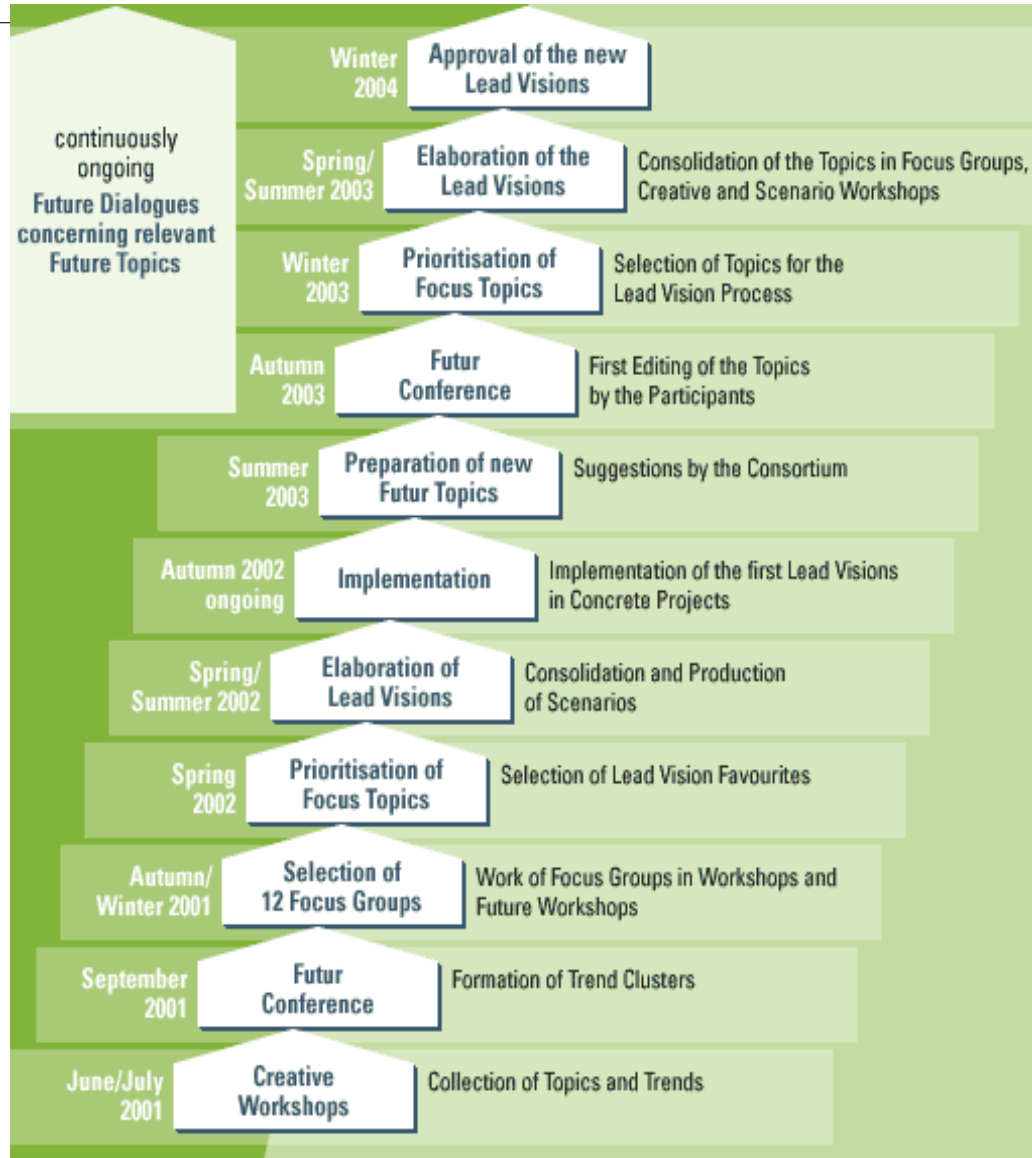
- Futur was a foresight process, initiated by the German Federal Ministry of Education and Research (BMBF). ("Futur" is the Latin word for "Future").
- Futur 0 started in spring 1999, the attempt was not successful and completely redesigned
- restart of Futur in 2001, taking up the results of the first process and drawing on the experiences
- Futur phased out by the end of the year 2005.
- Intended to introduce 'fresh ideas' (Lead Visions) into the research funding portfolio of the BMBF.

FUTUR in Germany: objectives

- Meeting key future requirements of society
- Developing interdisciplinary research subjects
- Conducting a participative process
- Developing “Lead Visions” (through a strategic dialogue) to be directly implemented in research funding programmes by the BMBF and the funding agencies
- Preparation of decisions that are
 - technologically feasible
 - socially acceptable
 - demand-oriented
 - economically and ecologically reasonable

FUTUR in Germany

–process with several stages



Milestones on the way to Lead Visions

Source: BMBF

Two evaluations in FUTUR

- in 2002/3: international panel, head: L. Georghiou
- in 2004/5: international panel, head: A. Salo
- formative evaluation
- scientific secretariat: Fraunhofer ISI

➤ Formative evaluations of the foresight process as such in order to learn for the process itself and for future processes

Both evaluations of Futur: Major Questions

1. Were the objectives of Futur achieved? (summative evaluation)
2. How is the process as such to be assessed and what can be learned from it for future foresight processes?
Where are potentials for improvement in the process?
How efficient and effective were the different instruments applied?
(formative evaluation)

Procedure in the first evaluation

- concept for the evaluation
- hypotheses derived from the objectives and principles of Futur
- descriptive paper about the process
 - mainly from documents
 - late in the process
- survey at the end of the first phase of Futur (participants, BMBF, consortium)
- both were used to assess the hypotheses
- evaluation panel got the documents
- workshop of the evaluation panel in Karlsruhe with BMBF
- evaluation report written by the panel

Questions and tasks in the second evaluation

- were the major targets of the process achieved?
- how was the implementation of lead visions and subjects conducted (if possible at all),
- assess conceptional-methodologic strengths and weaknesses of the process
- examine, if the proposals for improvements from the previous evaluation were taken over and if they were successful in the improvements aimed at
- to examine the visibility of Futur

Procedure in the second evaluation

- concept for the evaluation
- hypotheses derived from the objectives and principles of Futur
- descriptive paper about the process based on
 - documents
 - monitoring of all events (ISI)
 - surveys at all major events
 - continuously in the process
- survey at the end of the phase
- surveys and monitoring results were used to assess the hypotheses
- evaluation panel got the documents
- workshop of the evaluation panel in Berlin with BMBF (with Undersecretary of State...)
- end report written by the panel (handed over to BMBF, but not published)

Futur – the German Research Dialogue

- ended in 2005

Some results of the evaluation

- was much too complex and complicated
- did not involve the sponsor BMBF sufficiently
- but successful in working out so-called "Lead Visions" for BMBF
- topics for which BMBF established a special fund to pay for interdisciplinary, trans-departmental projects
- e.g. in Brain Research, Networked World, the Bionic House...

Lessons Learned I

- The performance of the foresight activity can be evaluated (monitoring, formative evaluation).

Summative evaluation very difficult:

- What impact really derives from the foresight?
 - difficult to measure objectives, no indicators, no fixed data
 - time-lag for realisations and implementations
 - self-fulfilling prophecies, self-destroying prophecies: failures can be a "success", how can this be measured?
 - Question how to measure the communicative effects, networking effects, participation...remains unsolved
-
- The evaluation reports should be published – why inventing the wheel again? Evaluations should be regarded as learning tools.
 - It is very helpful in learning processes – if all parties are willing to learn.

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Foresight as ex-ante evaluation

Foresight	Evaluation
Structured information about the future	Structured information (present/ past)
Assessment of things to come	Assessment of things (programmes) that were performed/ of the past
Learning process	Learning process
Knowledge creation, sometimes by making statements about the future or filtering out (mega)trends	Knowledge creation, often by testing hypotheses
Together with different participants, „stakeholders“	Together with the „performers“ (= „stakeholders“)
Different methods, e.g. surveys, interviews	Different methods, e.g. surveys, interviews
Different assumptions about the future	Hypotheses of the past

Questions in evaluation processes and foresight processes are similar

Evaluation	Foresight
Appropriateness	Can it be the right thing to do?
Economy	Is it important for the economy?
Effectiveness	Can it be effective?
Efficiency	What ROI can be expected?
Quality	What kind of output can be expected?
Impact	What impact will the future development have?
Additionality	What is the additionality if the development is realised?
Process Improvement	What can be improved? What are the topics that help to improve something?
Strategy	What has to be done for a realisation?

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Four Objectives of the BMBF Foresight Process



1) Identification of new focuses in research and technology



2) Designation of areas for cross-cutting activities



3) Exploration of fields for strategic partnerships



4) Derivation of priority activity lines for R&D policy

BMBF Foresight Process – Procedure and Methods

1. Identification of emerging issues in research and development and characterization of the dynamics of knowledge with a customized set of methods

- extensive research through 22 topic coordinators (literature, expert dialogues)
- statistical analysis of scientific publications (bibliometrics)
- broad online survey (2659 responses)
- international Monitoring Panel (70 interviews worldwide)
- detailed documentation of the results

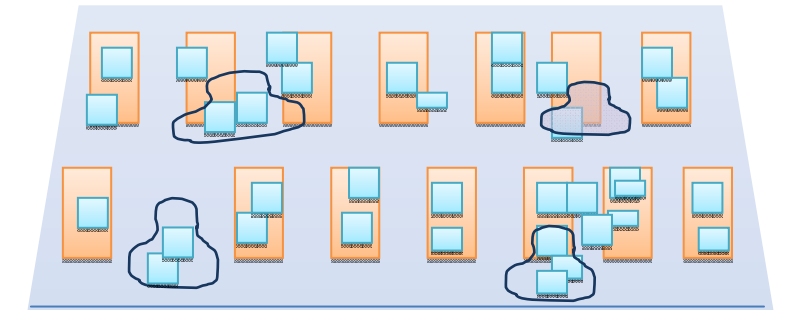
2. Synopsis and working out long-term prospects for significant cross perspectives

- with a view on the dynamics of knowledge development ("Knowledge Dynamics"), the research landscape (institutional integration) and the needs side


Topic searches

November 2007

Research
Workshop of experts
Monitoring 1st wave



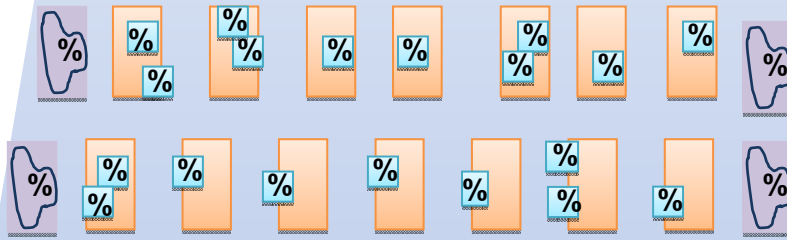
Mapping of future topics 


in 14 start fields 

First re-clustering 

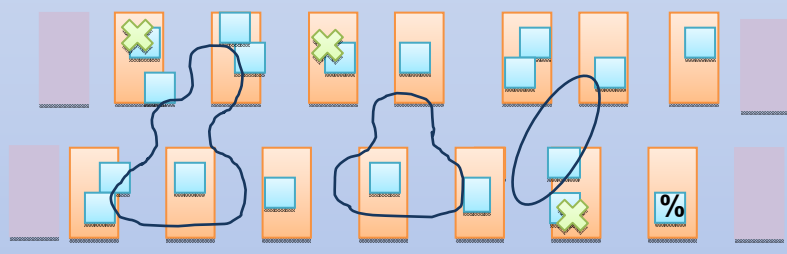
1st report


Online survey



Differentiated evaluation 

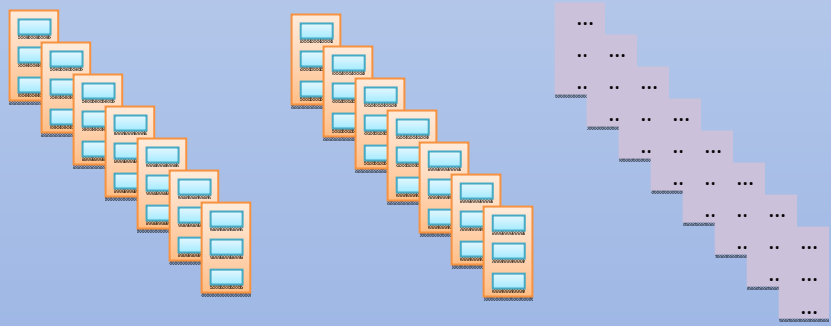
Synopsis of researches
Monitoring 2nd wave



Selection according to criteria, re-clustering 

2nd report

Analysis of potential:
Actors and topics



Future topics evaluated for 14 start fields

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

3rd report

June 2009

Criteria for the selection of topics = ex-ante evaluation

1. in 10-15 years + X in research and technology on the agenda

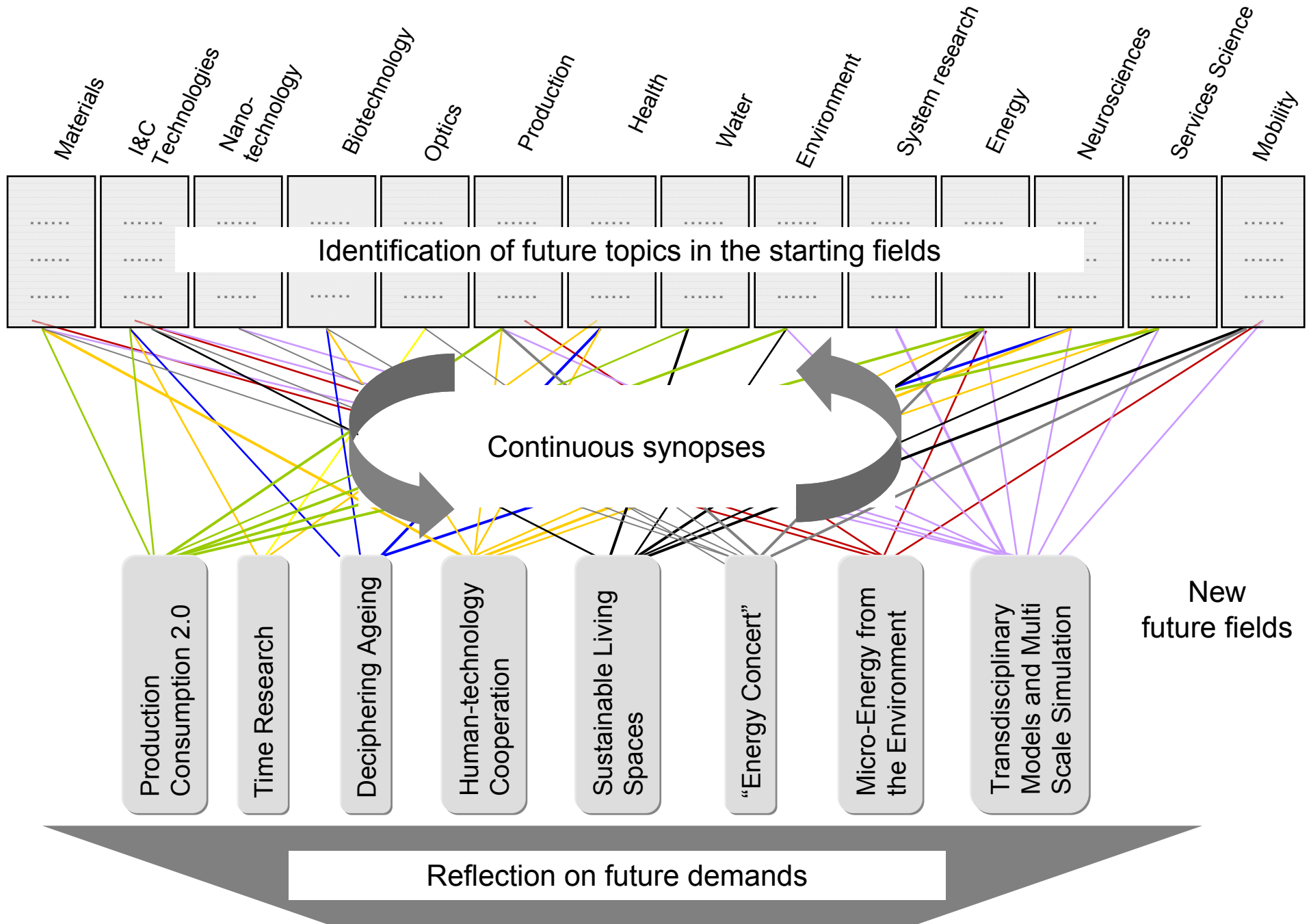
2. special importance:

- Relevance to the gain in knowledge in science and technology
- Inspiration for other research areas
- Theme supports the economic development of Germany and contributes to international competitiveness
- Theme saves or improves the quality of life
- Theme builds on skills of German research and industry
- Theme with sustainably resource conservation, climate and environmental protection

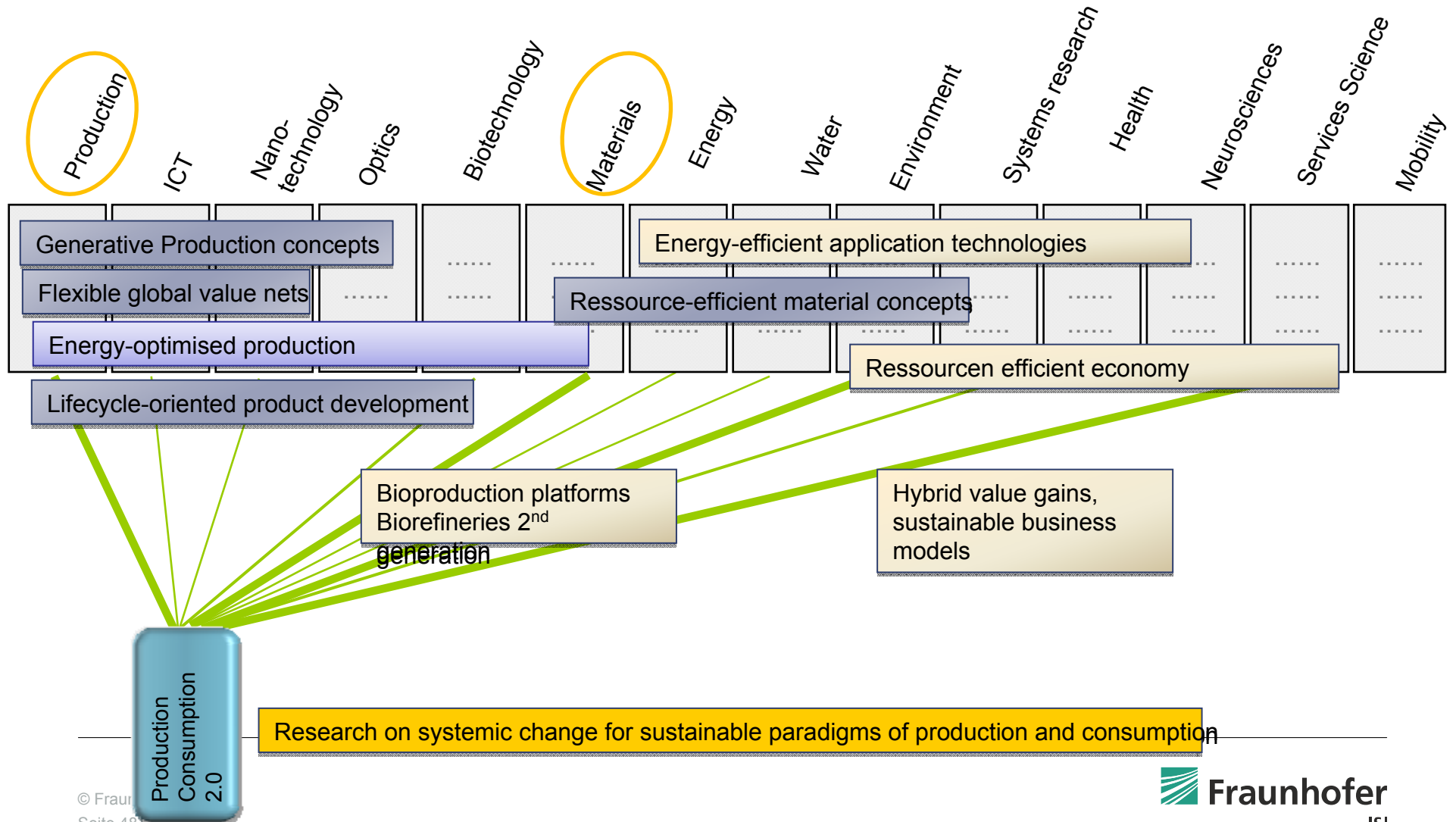
Criteria for the selection of topics = ex-ante evaluation

- Theme supports the solution of an already existing or just emerging problem for the future relevance (e.g. as to shift the age structure in Germany, the emergence of mega-cities and agricultural land scarcity)
- There is an answer to a long-term relevant, global, current or upcoming challenge, which is already known or at least sketched out, but only after several years comes to bear (e.g. as demographic change, climate change, resource depletion).
- The subject contributes to the solution of a central technical problem (“technical dilemma”).

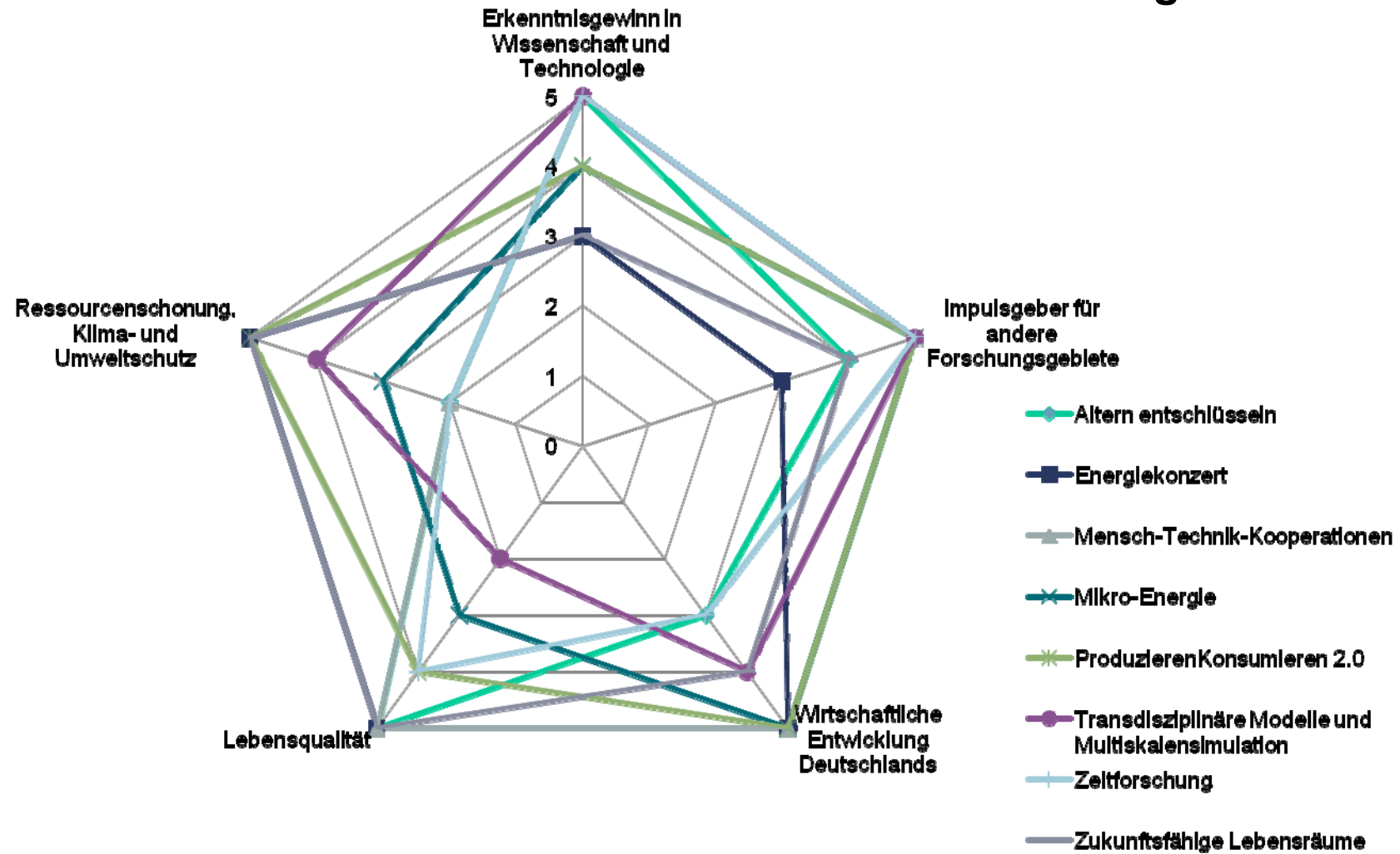
➤ **There is a need to support the subject.**



Bird's Eyes Perspective: Topics in the Future Field of ProductionConsumption 2.0



Relevance of the New Future Fields according to the criteria



Human-Technology Cooperation

Telepresence / Teleaction

Intelligent prosthetics

Neuroenhancement

Behavioural sciences (Neuro/Psycho)

Neuroprosthetics, -implants

Brain-Machine-Interface

Sensors

Affective Computing

Anthropology

Philosophy of technology

Aesthetics

Semantics

Nanoethics/Neuroethics

Technical genesis/ Innovation research

Media technology/image sciences

Social structure analysis/social policy

Empirical social research

Assessment of the consequences of technology

Autonomous robotics

Micro-systems technology

Intelligent materials

AI research

Software Agents

Ambient Intelligence

Intelligent automation

Pervasive Computing

VR-Immersion

Adaptive environments

Semantic technologies

Social robotics

Redefining humanity

Machine agents

Human-Machine-Culture

Human-Technology-Teams

Physical Avatars

Anthropomatics

Human-Machine-Systems

Human-technical teams

Human-machine culture

Machine agents

Re-orienting humanity

- Semantic technologies as a “hub” in human-machine knowledge spaces
- Cooperative concepts of “autonomous” machines with people in hybrid human-technical teams
- Physical avatars – *telepresence and teleaction*
- Adaptive environments with multimodal interfaces
- Ergonomics of the mind – *Which instructions do machines need for human beings?*
- Enhancement cultures, socio-cultural embedding and their implications in research – *Revision of terms such as performance, standard, normal, healthy, natural*
- Concept of a “digital territory”, that mediates interaction with the “Internet of things” – *accessibility, data sovereignty, avatars’ abilities*
- Behaviour models for mobile robots behaviour training for robots
- Responsibility concepts for “autonomous” machine agents
- Machine perception and interpretation of objects, gestures expression, language and behaviour Technology In the real world
- Anthropocentric cooperative design for hybrid human – technical teams *expectations, projections, (misunderstandings)*
- Identity-sensitive neuroprosthetics-/wetware and human
- Anthropofine assistance concepts

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

Biological clocks/ Chronobiology

Parallelising or synchronising (efficiency processes)

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

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What Future?



Some future assumptions are not bad...



Translation: In the year 2000. Our police. Good forecast?
...others are rather wrong

Lessons Learned III

- Ex-ante evaluation can be meant long-term
 - Foresight methods can be integrated and used
 - Different fields, topics can be evaluated according to a set of criteria
 - Ex-ante evaluation and foresight work with self-fulfilling and self-destroying prophecies
 - We can observe new interdisciplinary thinking in new topic fields, therefore new methods to evaluate are needed
 - Comparison of completely different fields (e.g. technology fields) are necessary.
 - Surveys, also Delphi surveys are a possibility to bring in judgement
- **Foresight is often applied as ex-ante evaluation**

Lessons Learned IV

We should ask ourselves:

- What are the **criteria** to judge?
- What are **assumptions** that we do not question, anymore?
- What is lying behind the criteria for our judgements?
- Do we have **pictures** in mind (even cultural pictures) that are just transferred („traditions“) but that we should question?

➤ Both in Foresight and in evaluations.

Foresight Verlaufssystem/ Tracking System

- New project (Fraunhofer ISI)
- Track the new future fields from the BMBF Foresight Process
- Monitor the changes: in the landscape, actors, wording of the topic or content
- Evaluation system with qualitative indicators (Kenngrößen), e.g. about changes in innovation landscape...

FORESIGHT AS AN EVALUATION FOR EARLIER CHOICES

Kerstin Cuhls

