

Technology Foresight



UNIVERSITY OF
SURREY



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Co-funded by the
Erasmus+ Programme
of the European Union

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TECHNOLOGY FORESIGHT

Dr. Karlheinz Steinmüller

Dr. Karlheinz Steinmüller



Occupation

| | |
|--------------------|--|
| Since 2001 | Sci. Director of Z_punkt |
| 1997 | Co-Founder of Z_punkt |
| 1991 - 2001 | Researcher / project manager at SFZ – Sekretariat f. Zukunftsforschung Gelsenkirchen |
| 1982 – 1991 | free-lance writer |
| 1977 – 1982 | Scientist at ZKI – Zentralinst. f. Kybernetik und Informationsprozesse Berlin |

Education

| | |
|--------------------|---|
| 1969 – 1971 | Physics (TU Chemnitz) |
| 1971 – 1973 | Physics (Humboldt-Uni Berlin) |
| 1973 | Diploma in theoretical physics |
| 1973 – 1976 | Post-grad. Philosophy (Humboldt-Uni Berlin) |
| 1977 | Dr. phil. |

Interests

- Futures studies, public & corporate foresight
- Emerging technologies
- Scenarios and wild cards
- History and methodology of futures studies
- Science fiction

Books (all with Angela St., in German lang.)

| | |
|------|---|
| 2015 | Standards and Quality Criteria of Futures Studies (co-editor) |
| 2014 | The Wormhole Odyssey (story cycle) |
| 2010 | Computer Twilight (stories) |
| 2008 | Darwin's World (biography) |
| 2008 | Pulaster. Novel of a Planet |
| 2006 | The Future of Technologies |
| 2005 | The Dream Master (novel) |
| 2004 | Wild Cards. If the Improbable Happens |
| 2004 | Andymon. A Space Utopia |
| 2003 | Hothouse Age (stories) |
| 2000 | Futures Studies in Europe (co-editor) |
| 1999 | Visions. 1900 – 2000 – 2100. A Chronicle of the Future |

Z_punkt. The Foresight Company



- Founded in 1996
- Staff of ca. 15
- Focus on Corporate Foresight
 - Scenarios & Strategies
 - Innovation & Creativity
 - “Futurizing” the Company



Agenda

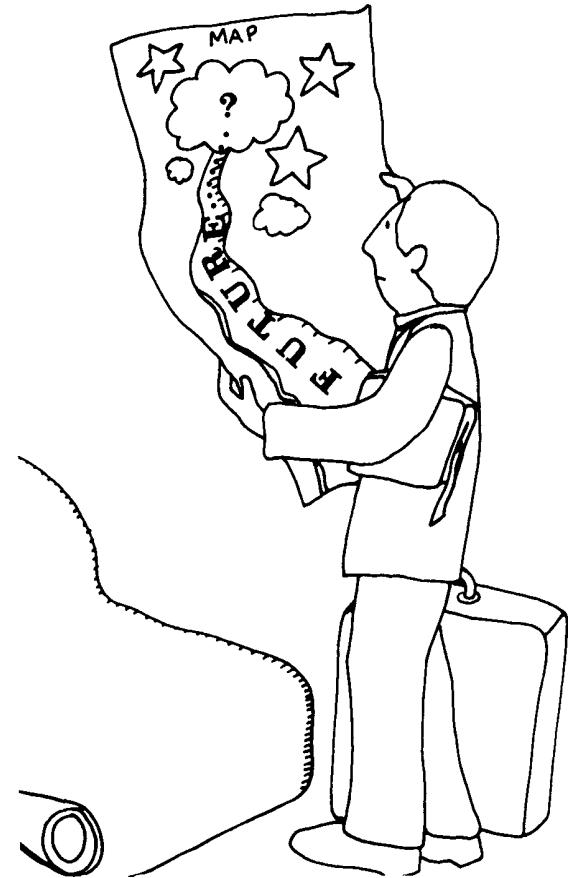
| Time | |
|-------|--|
| 09:00 | Introduction |
| 09:15 | Presentation on methods and tools Q & A |
| 11:00 | Break |
| 11:15 | Introduction to Exercise Exercise |
| 12:30 | Reflection on Exercise Results Wrap-Up |
| 13:00 | Lunch Break |

PART 1

METHODS & TOOLS

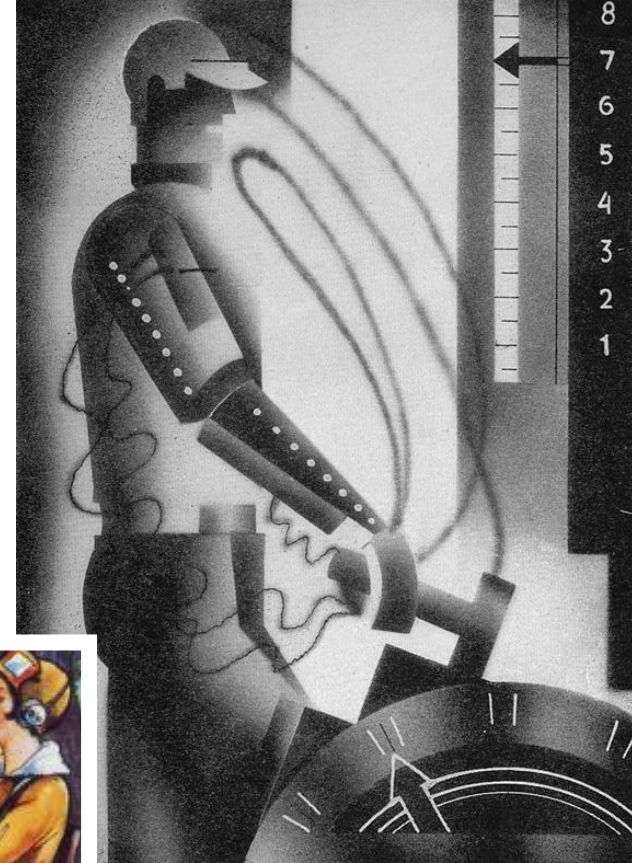
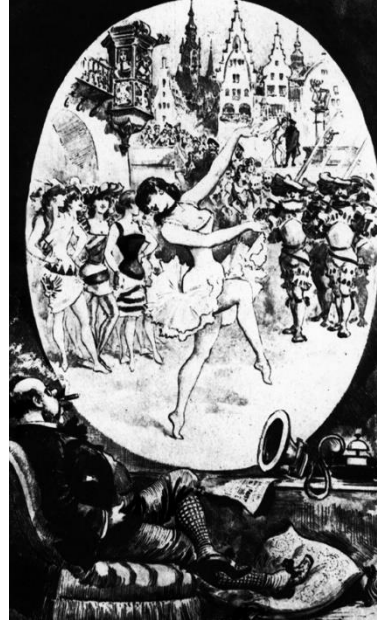
Overview

- **Looking Back**
- **Technology Foresight**
- **Innovation Processes**
- **Methods, Tools, Resources**
- **Conclusion**



Looking Back: Many Visions

- 1880 Albert Robida:
Telephot
- 1910 Henry Sloss:
Mobile phone
- 1912 H. G. Wells:
Atom bomb
- 1923 Karel Čapek:
Robots
- 1924 J.B.S. Haldane:
Genetic engineering
- 1930 Birkenhead:
Shortening of work
hours



Some Did Materialize in a Way...



Hugo Gernsback: Radio for All, 1922

Some Nearly Came True...



ELECTRONIC HOME LIBRARY Home facilities for education and entertainment in the world of tomorrow will make today's tele-

Westinghouse's Gwilym Price expects such tapes to reproduce shows in three dimensions and color, using screens as shallow as a picture on the wall.

Some Missed the Point.

"Airplanes are interesting toys but of no military value."

Marechal Ferdinand Foch, Professor of Strategy, Ecole Superieure de Guerre

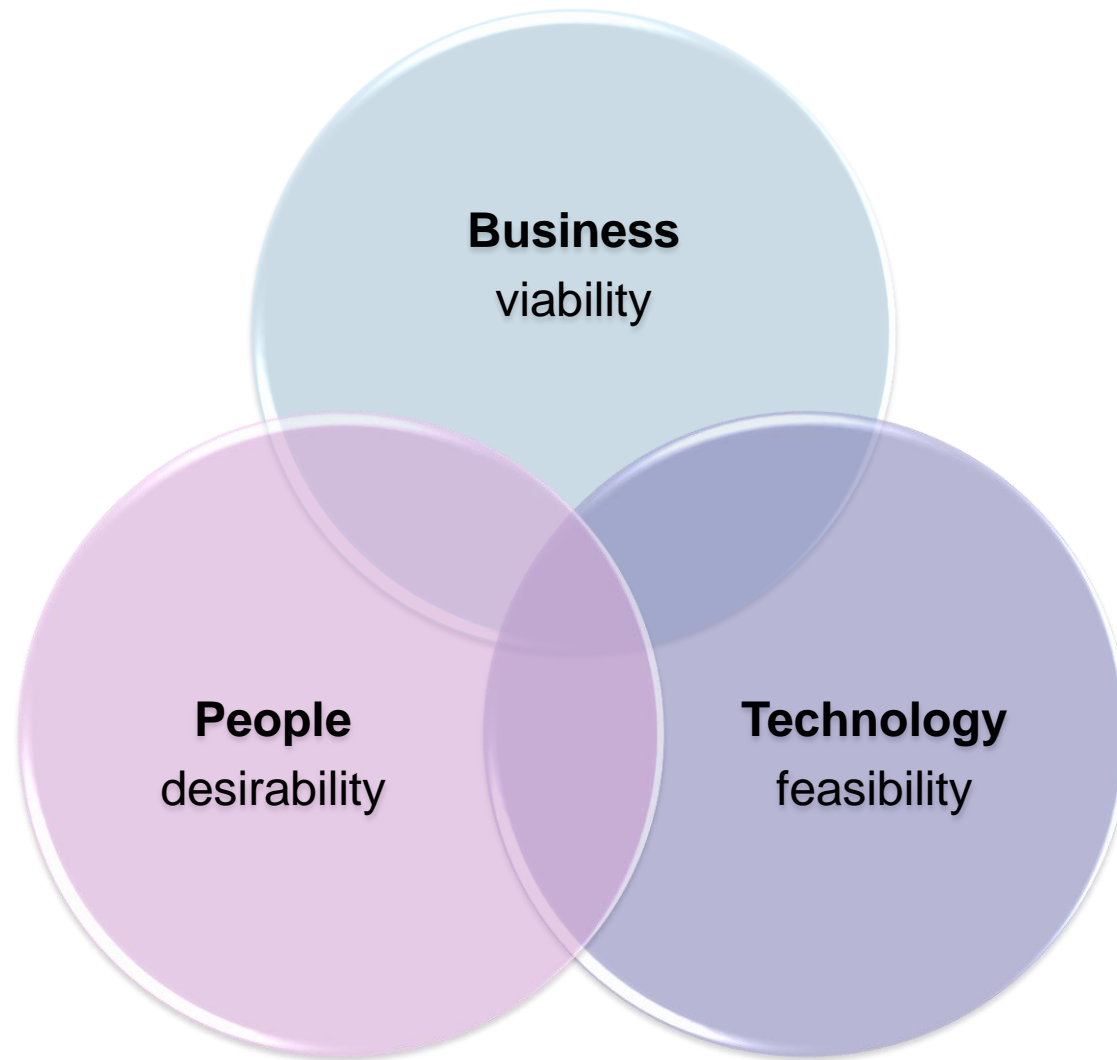
"Everything that can be invented has been invented." - Charles H. Duell, Commissioner, U.S. Office of Patents, 1899

"I think there is a world market for maybe five computers."

Thomas Watson, chairman of IBM, 1943

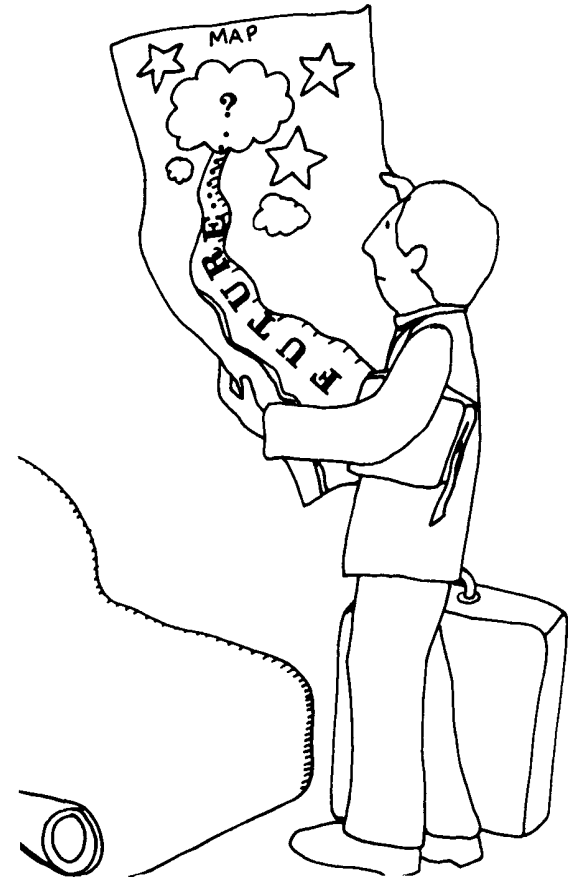


The Magic Triangle of Innovation



Overview

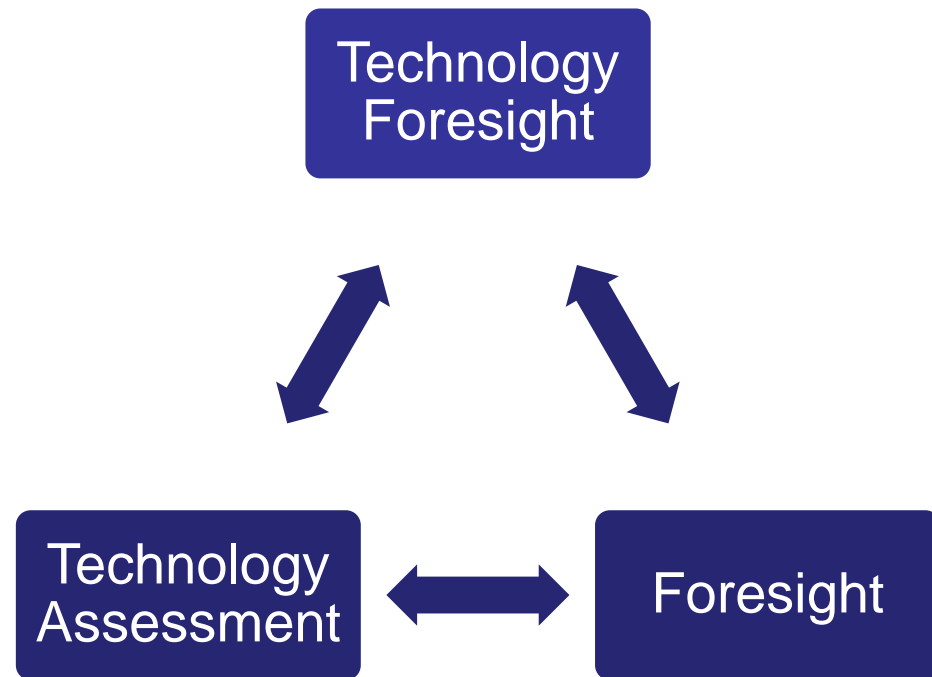
- Looking Back
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Technology Foresight

"Systematic attempts to observe the long-term future of science, technology, the economy and society, with the aim to identify the emerging technologies that will probably produce the greatest economic and social benefits".

http://future.wikia.com/wiki/Futurology:_Technology_Foresight



Foresight and Technology Assessment

Foresight

can be defined as a

- systematic,
- participatory,
- future intelligence gathering &
- medium-to-long-term vision-building process

aimed at present-day decisions and mobilising joint actions.

Focus on:

Societal dimension

Mega-trends ...

High Level Expert Group: Foresight for Europe, EC / DG Research, 2002

Technology Assessment is a

- scientific,
- interactive, and
- communicative process

that aims to contribute to the formation of public and political opinion on societal aspects of science and technology.

Focus on:

- Public opinion (on risks and opportunities)
- Possible regulatory measures

en.wikipedia.org/wiki/Technology_assessment

Technology Foresight: Tasks

Public domain

- Identification of promising technologies and of potential risks
- Public investments in science & technology
- Best way to support promising technologies by framework conditions (regulation to direct development of technologies)

Corporate domain

- Identification of economically promising technologies
- Analysis of efforts needed
- Analysis of markets and competitors
- Analysis of public policies

Technology Foresight: General Procedure



- Bounding
- Framing

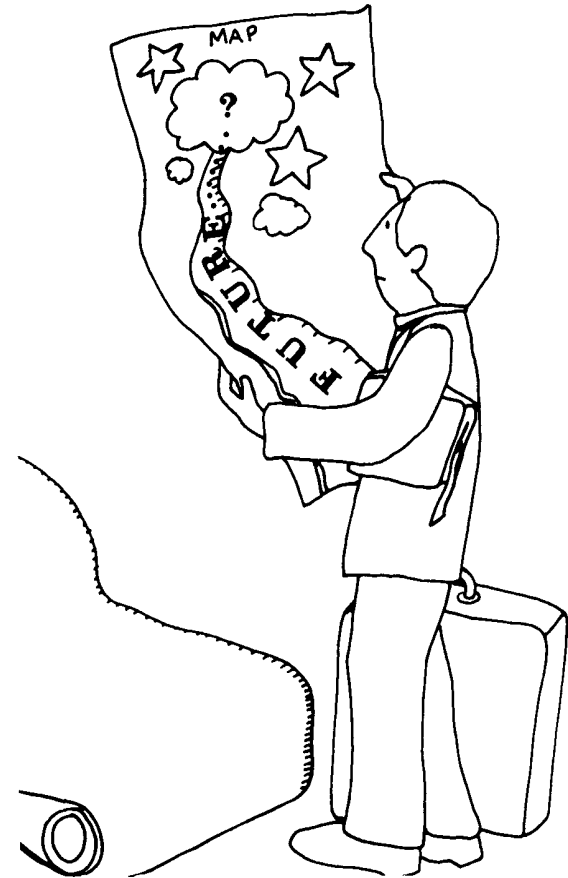
- Horizon Scanning & Mapping
- Surveys
- Interviews
- Patent Analysis
- Bibliometrics

- Trend Extrapolation
- Delphi
- Vision Building

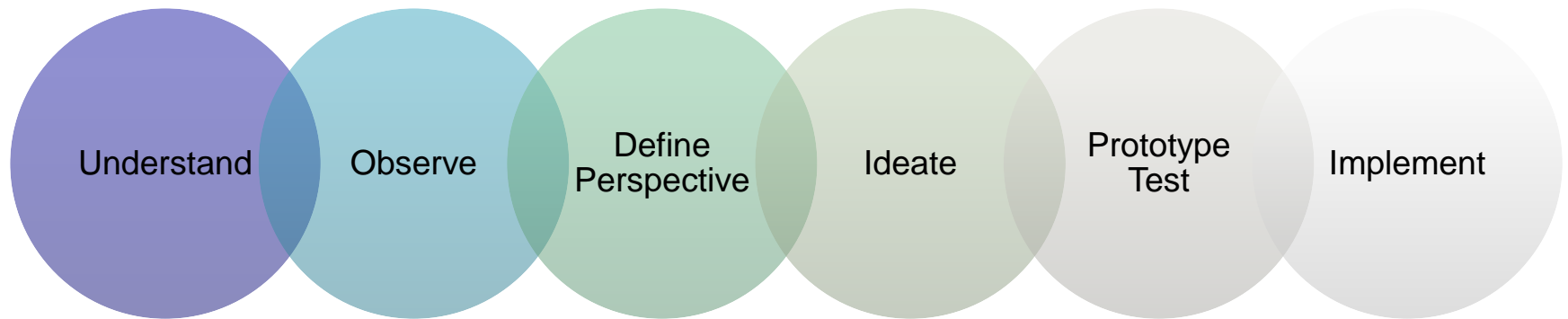
- Impact Assessment
- Business Model Development

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Innovation Process – as seen from Design Thinking



Innovation: Z_punkt Approach

Phase 1

Identification and analysis of potential growth field

1 Trend analysis

2 Challenges and demands

3 Demands in future context:
„Future Spotlights“

4 Idea generation

Phase 2

Exploration and assessment of potential growth fields

5 Idea assessment
Prototyping / Market Analysis

6 Development and assessment of business models

7 Documentation

8 Portfolio of future products

Innovation Workshops: Some Tools

Live Illustrator



Future Wheel



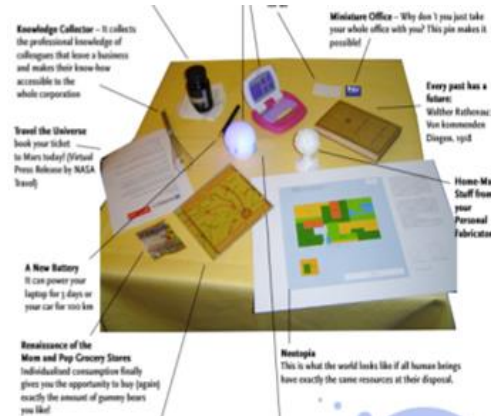
Brainwriting



Future Exposition



Future Finds



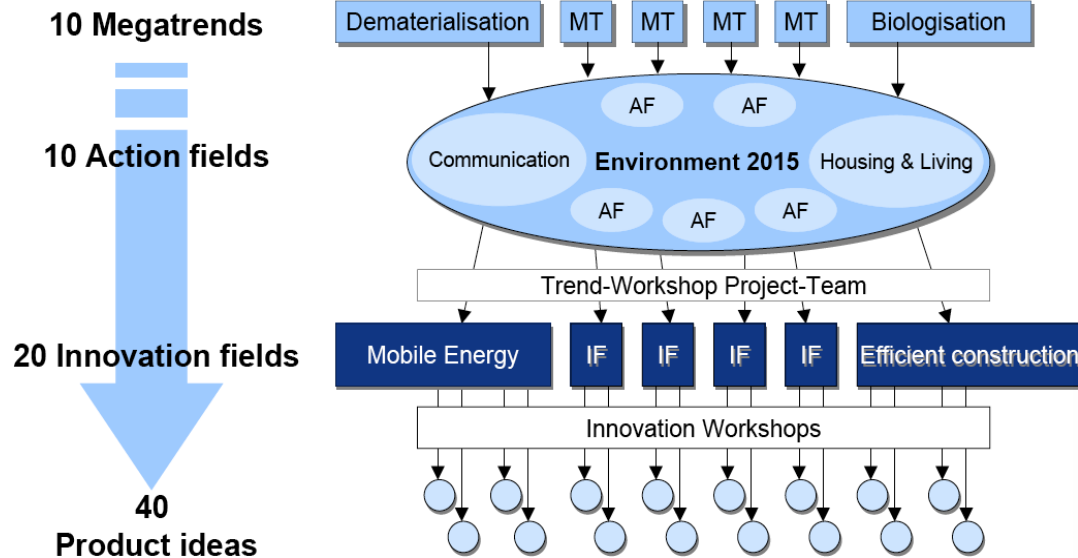
World Cafe



Trend Based Innovation: Example

Managing the Fuzzy Front End: From Megatrend to Product Innovation Z-Punkt Approach

BASF
The Chemical Company



→ Future Trends and Scenarios stimulate creative Thinking

As Best Practice Example released for publication by client BASF

Actionfield Construction: Trends and Innovation fields

BASF
The Chemical Company

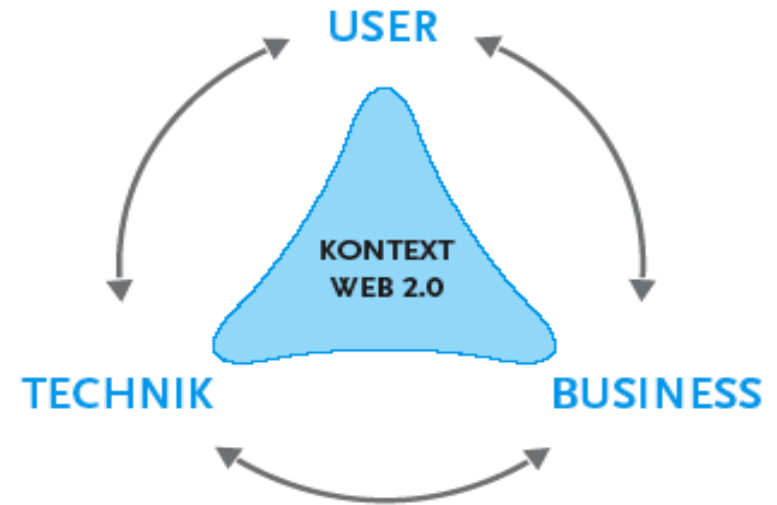


Co-Innovation: Involving Everybody

The User as Co-Innovator

- Usability labs
- Product clinics
- User feedback
- Teaming up with users
- Lead user method
- Open innovation / Crowdsourcing

→ From Consumer to
“Prosumer”

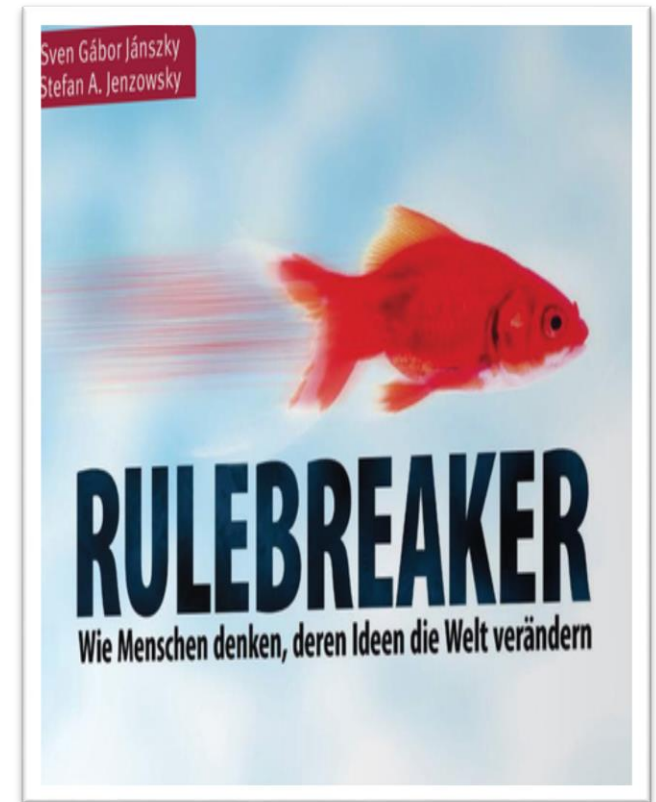


Mass Customization & Open Innovation News

This blog continues a long running newsletter on mass customization, personalization, customer integration, and open innovation – all strategies building on value co-creation between suppliers and customers. Published and edited since 1997 by Frank Piller, TUM / MIT.

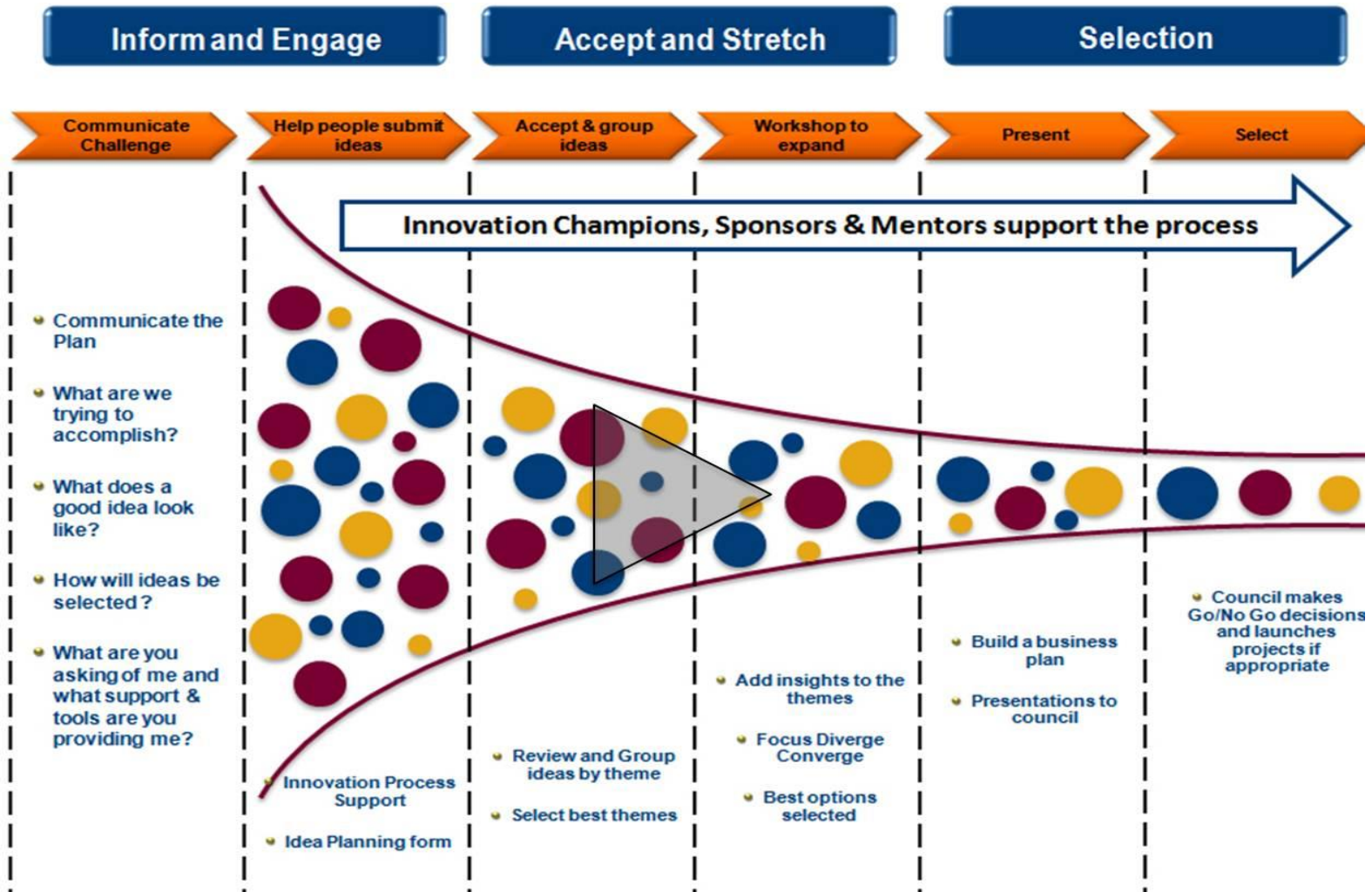
Innovators as Rulebreakers

- Innovations are not made by processes, but by human beings!
- Focus on non-customers!
- Take benefit from disruptive innovations!
- Find rulebreakers from within!
- Make rulebreaking a task for the board!
- Cannibalize yourself!
- Appreciate diversity!
- Do not go for the quick profit!



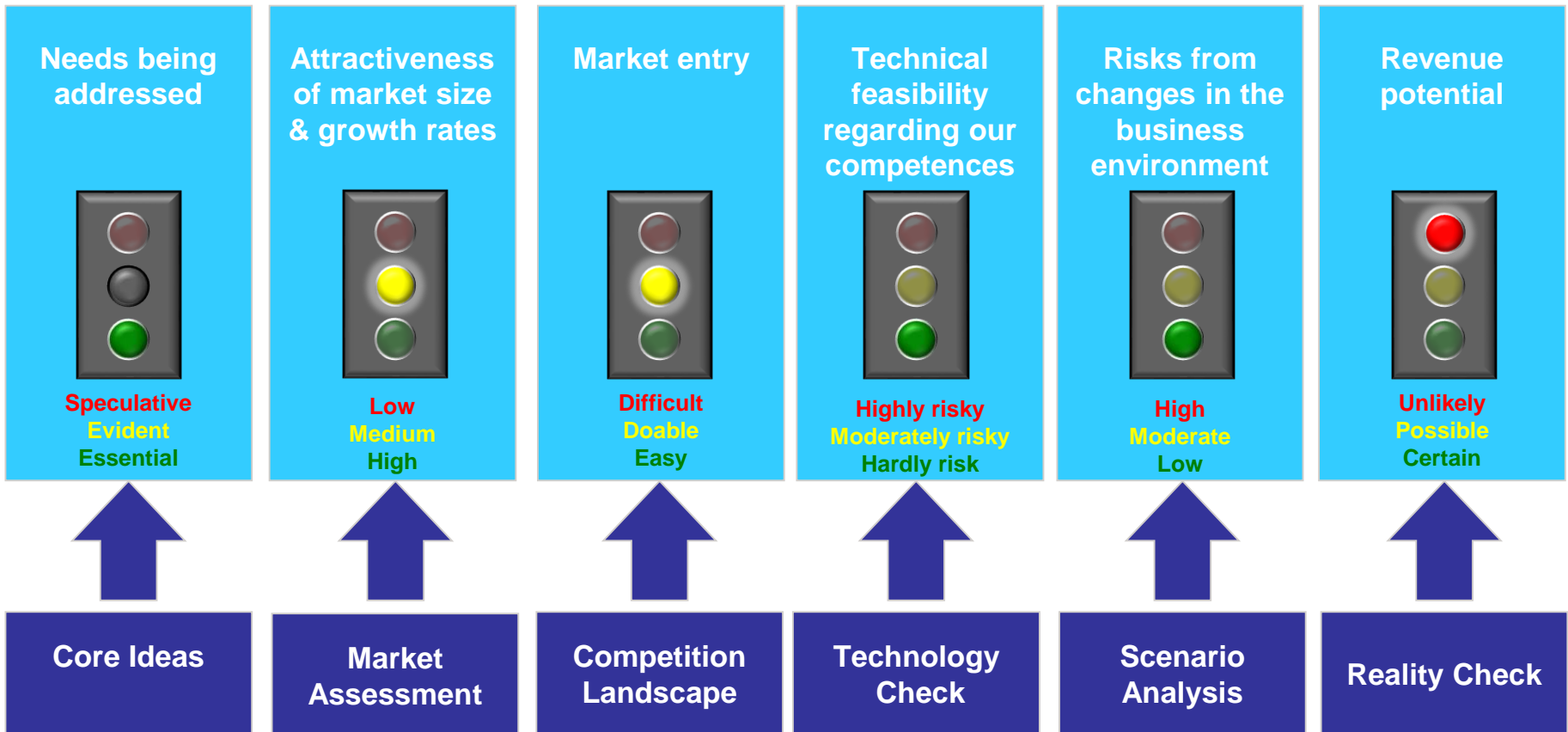
(2010)

Innovation Funnel



<http://www.desai.com/our-approach/innovation-funnel/tabid/88355/Default.html>

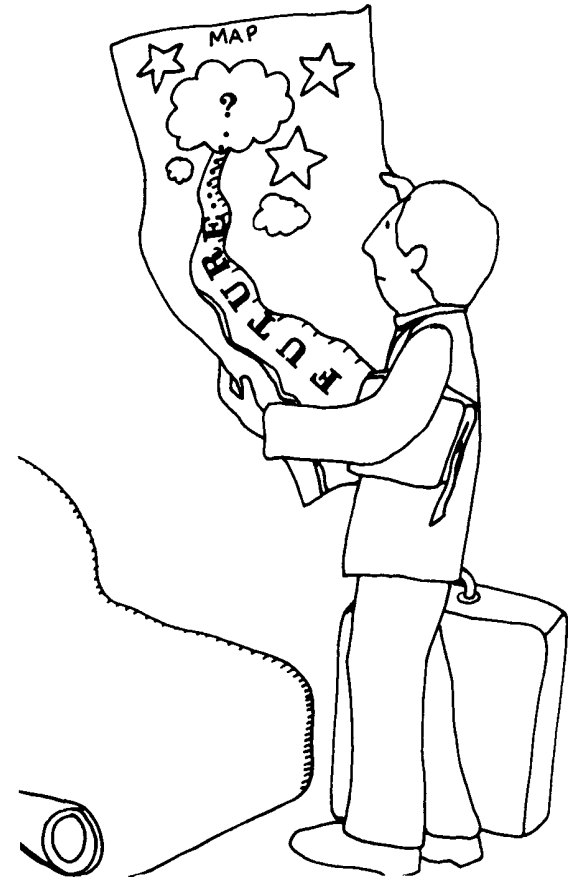
Assessing Ideas: Traffic Lights



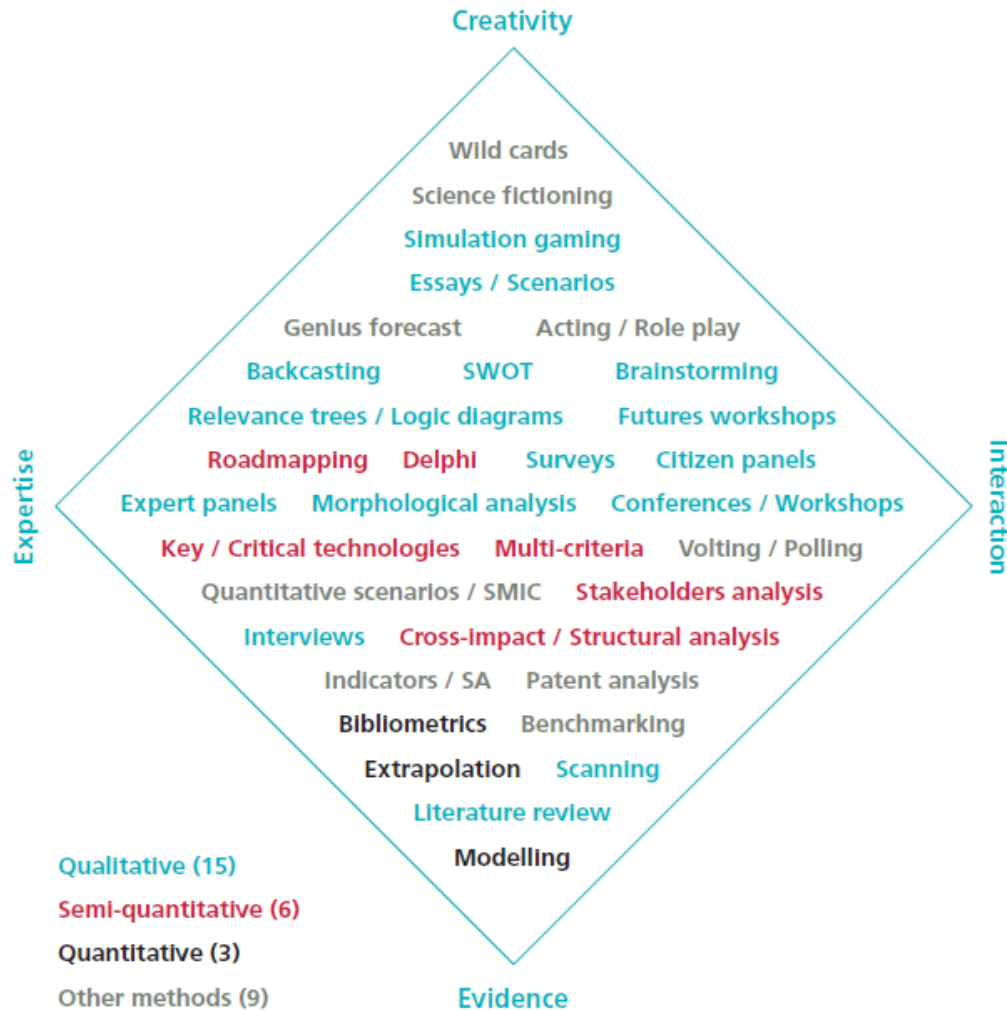
Technology foresight supports the assessment of ideas!

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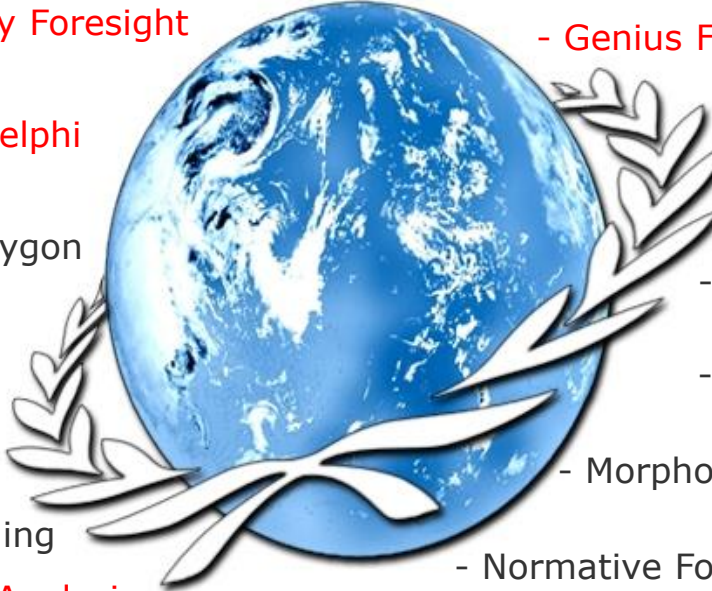


Many Methods: The Foresight Diamond



Popper, R.: Mapping Foresight, 2009

Methods of Specific Relevance for TF

- 
- Environmental Scanning
 - Text Mining for Technology Foresight
 - The Delphi Method
 - Real-Time Delphi
 - The Futures Wheel
 - The Futures Polygon
 - Trend Impact Analysis
 - Wild Cards
 - Structural Analysis
 - The System Perspectives
 - Decision Modeling
 - Substitution Analysis
 - S&T Road Mapping
 - Agent Modeling
 - Field Anomaly Relaxation
 - Prediction Markets
 - Genius Forecasting, Intuition and Vision
 - Simulation and Games
 - Participatory Methods
 - Scenarios
 - Using Vision in Futures
 - Interactive Scenarios
 - Robust Decisionmaking
 - Relevance Trees
 - Morphological Analysis
 - Normative Forecasting
 - Statistical Modeling
 - Heuristics Modeling
 - Casual Layered Analysis
 - Personal Futures
 - Technology Sequence Analysis
- The Millennium Project**
- Chaos and Non-Linear Dynamics

Methods used by the national nodes of the Millennium Project

<http://www.millennium-project.org/>

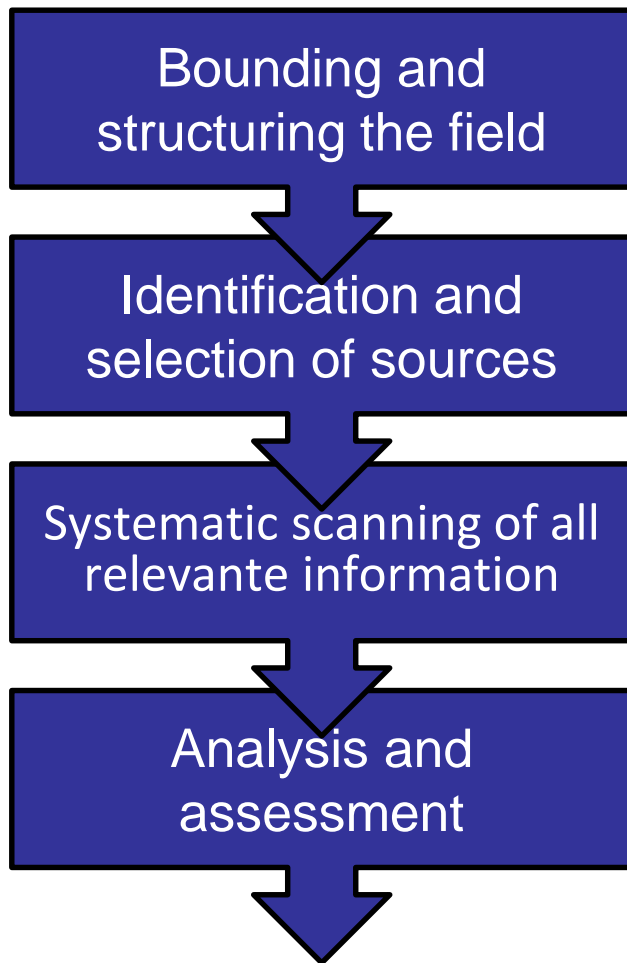
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Horizon Scanning

aka Environmental Scanning



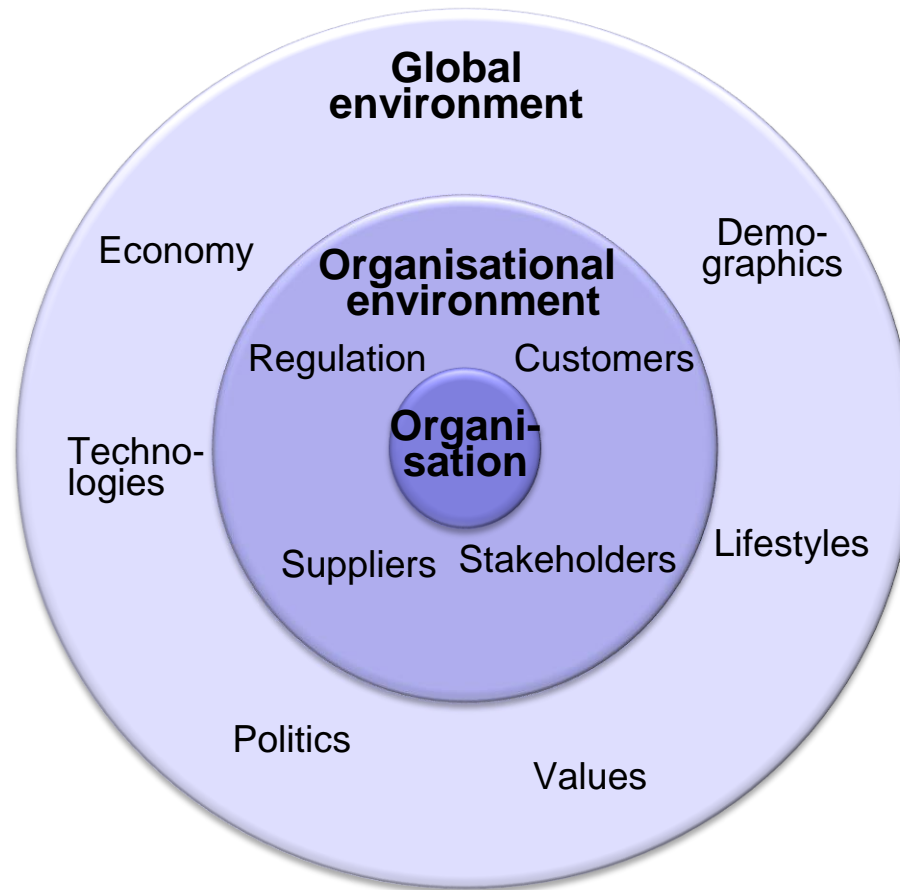
Environmental Scanning

- Primary futures tool for identifying and monitoring emergence, growth, and coalescence of change.
- Related to issues management and competitive intelligence.
- "Environment" refers to the information environment – all media – and "scanning" to the logically structured, iterative monitoring of selected information sources.

18 September 2004, Wendy L. Schultz, Infinite Futures

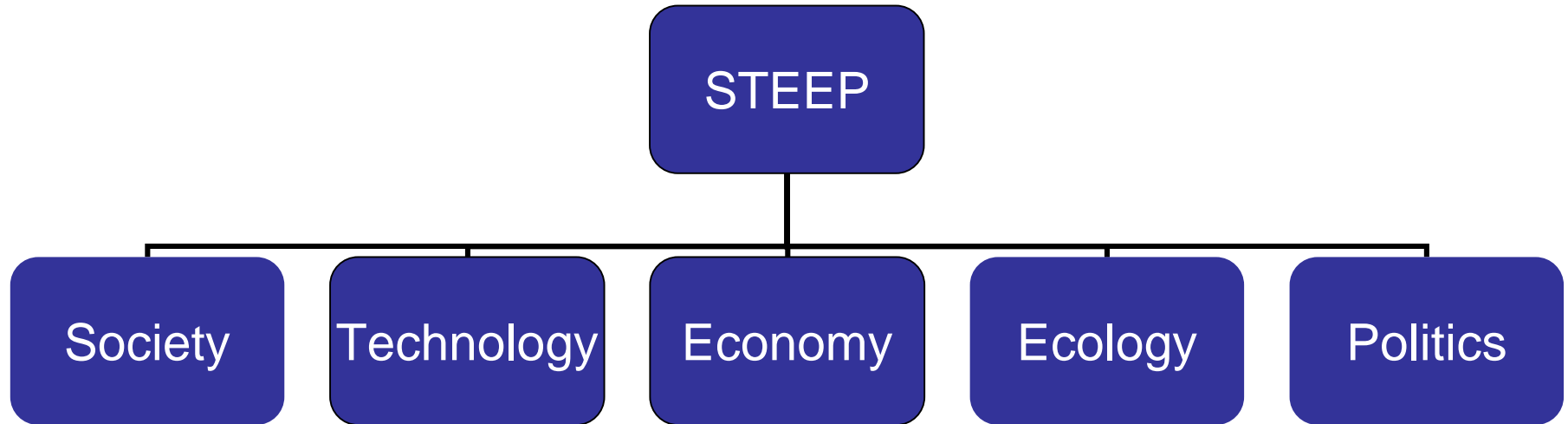


Different Ways to Structure the Field: Zooming into the Business Environment



Alternative:
Porter's
Diamond

Different Ways to Structure the Field: STEEP Sectors



360° View – “Everything” has to be scanned ...

Mapping Drivers of Change: Mega-Trends



SOCIETY

- Demographic Change
- Women on the Rise
- Cultural Diversity
- New Patterns Of Mobility



CONSUMPTION

- Individualization
- New Consumption Patterns
- Health Thrives



BUSINESS

- Globalisation 2.0
- Knowledge-Based Economy
- Changes in the Work World
- Business Ecosystems



TECHNOLOGY

- Digital Lifestyles
- Biomimicry: Learning From Nature
- Ubiquitous Intelligence
- Technology Convergence



POLITICS

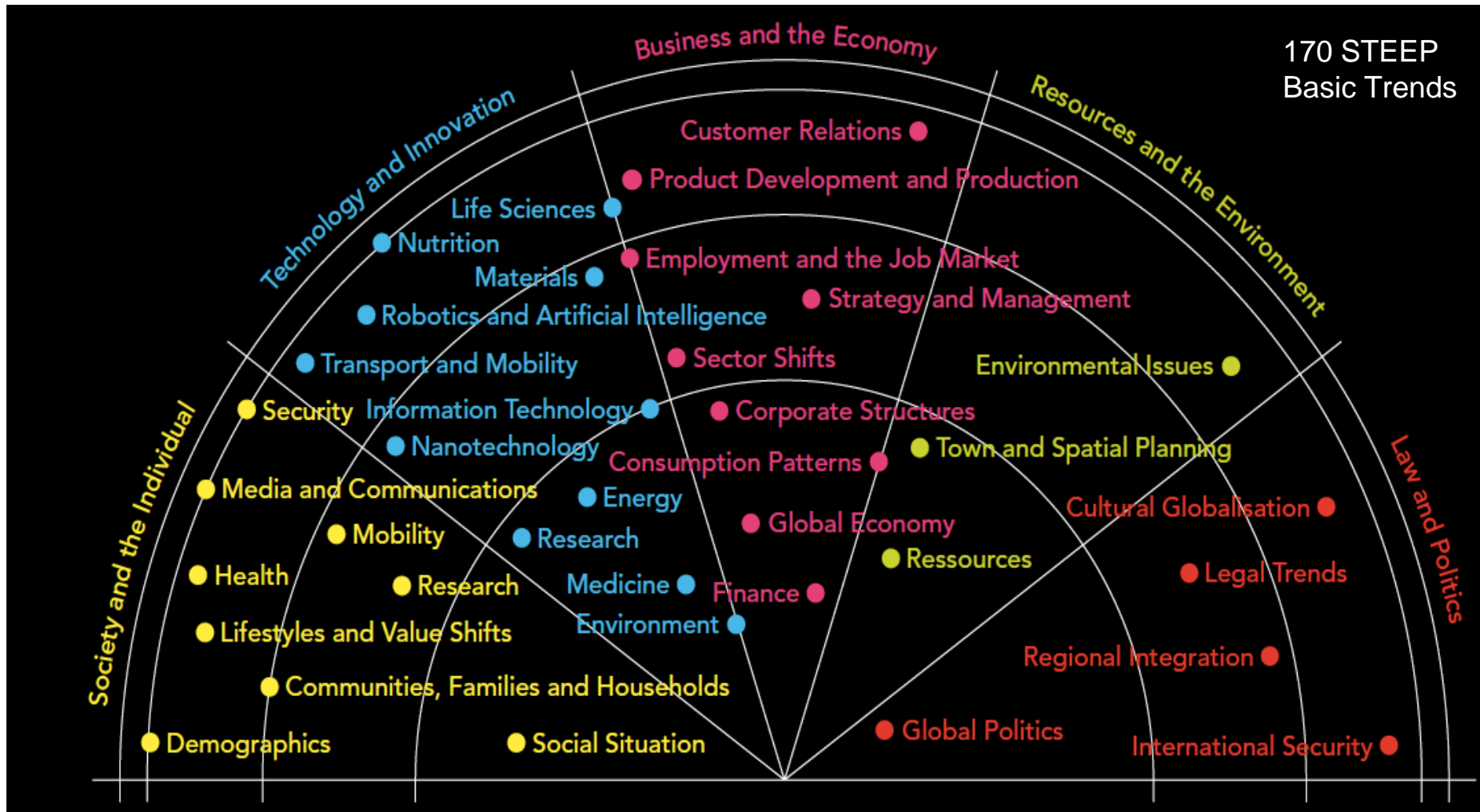
- Urbanization
- New Political World Order
- Growing Security Threats



ECOLOGY

- Reorientation in Energy & Resources
- Climate Change
- Environmental Impacts

Sources & Resources – Example: Z_punkt Trendradar 2020



<http://www.trendradar2020.de/>

Sources & Resources – Some Examples

General Consultancies

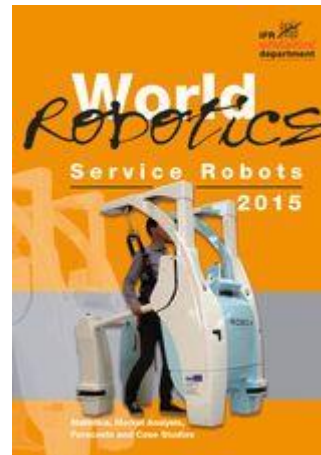
- Gartner
(<http://www.gartner.com/technology/home.jsp>)

Specialised Consultancies

- Materialsgate
(<https://www.materialsgate.de/en/>)
- Wohlers (3D printing)
(<https://wohlersassociates.com/>)

Industry Associations

- International Federation of Robotics
(<http://www.ifr.org/service-robots/statistics/>)

The image shows the cover of the 'Wohlers Report 2016'. The cover is dark purple and black. It features a collage of four images: a 3D printed part, a robotic arm, a 3D printed part, and a 3D printed part. The text 'Wohlers Report 2016' is prominently displayed in white. Below it, it says '3D Printing and Additive Manufacturing State of the Industry Annual Worldwide Progress Report'. There is a 'NEW' starburst in the top left corner. The Wohlers Associates logo is at the bottom.

Trends. Analysis. Forecasts.

Your source for everything 3D printing

- Undisputed industry-leading report for 21 consecutive years
- Estimates and forecasts based on years of hard data
- Input and analysis from the largest group of experts worldwide

Order your report today!

WOHLERS ASSOCIATES
wohlersassociates.com

Sources & Resources – Some Examples

International Organisations

- OECD (International Futures Program)
(<http://www.oecd.org/futures/ifppublicationsandstudies.htm>)

Foresight Institutes

- Institute for the Future
(<http://www.iftf.org/maps/20-combinatorial-forecasts/20-combinatorial-forecasts-map/>)
- Shaping Tomorrow
(<https://www.shapingtomorrow.com/>)

National Platforms

- UK Government Office for Science
(<https://www.gov.uk/government/collections/foresight-projects#horizon-scanning-reports>)



Scanning: Different Sources

| Sources | Disadvantages |
|--------------------------------|---------------------------|
| Papers in specialized journals | Often outdated |
| Conferences | Very heterogeneous |
| Statistics | Never up to date |
| Internet search | Unstructured / unreliable |
| Expert interviews | Expensive |
| Surveys | Expensive, time consuming |

There is always a lack of quality data.

What Does Scanning Deliver?

Information, but

- heterogeneous
- multiple
- unorganized
- contradictory & unreliable
- pertinent and irrelevant

Nevertheless:
the very fundament!

Assess with respect to

- Relevance
- Degree of granularity
- Hidden (or obvious) perspectives (“ideologies”)
- Consensus or productive dissent?
- Scientific accuracy vs. openness for novelties?

Looking For *Weak Signals*

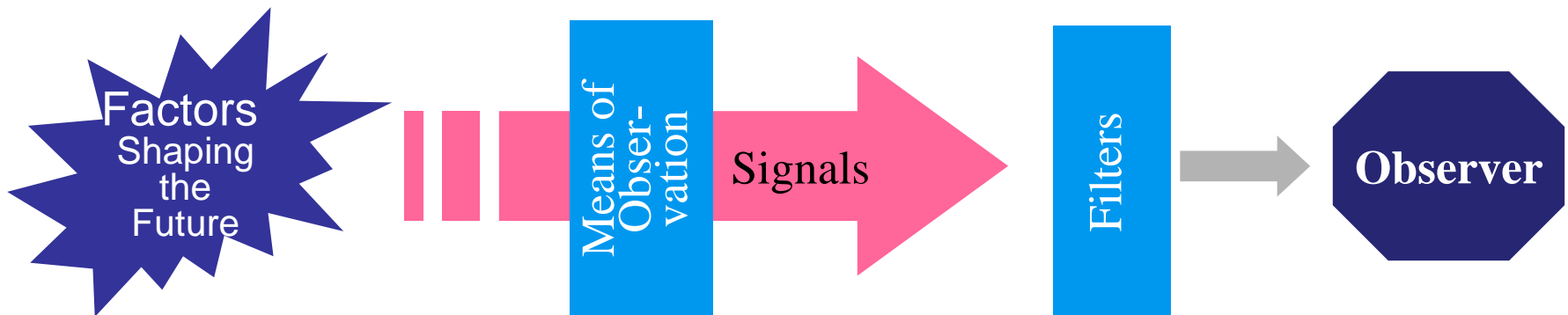
Igor Ansoff 1984:

“Other issues will contain weak signals, imprecise early indications about impending impactful events..... all that is known (of them) is that some Threats and Opportunities will undoubtedly arise, but their shape and nature and source are not yet known.”

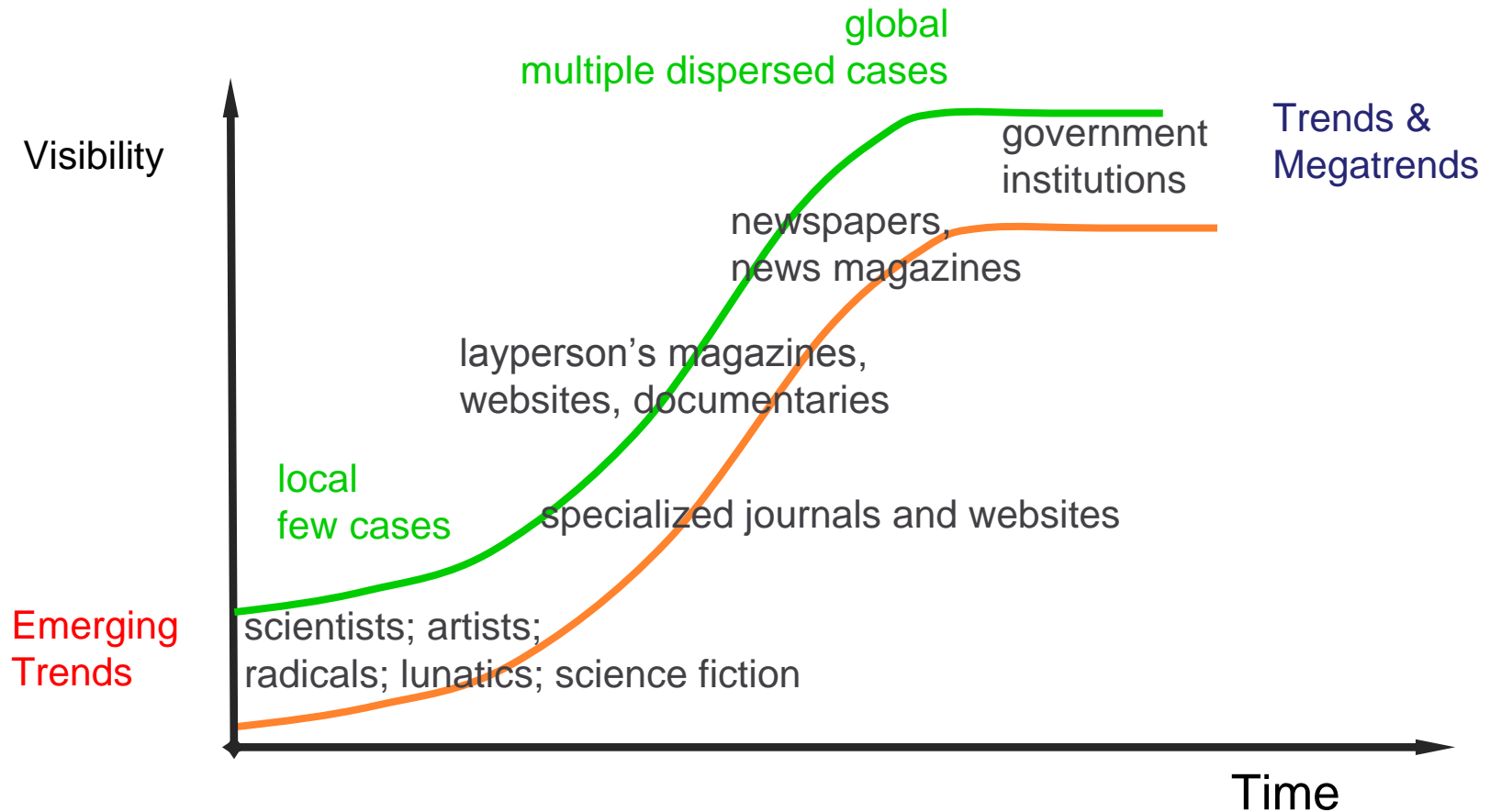
Michel Godet:

“...a factor of change which is now barely perceptible but will make up tomorrow’s heavy or mega-trends.”
But also indicators of ruptures, wild cards and other discontinuities

The channel model of weak signals

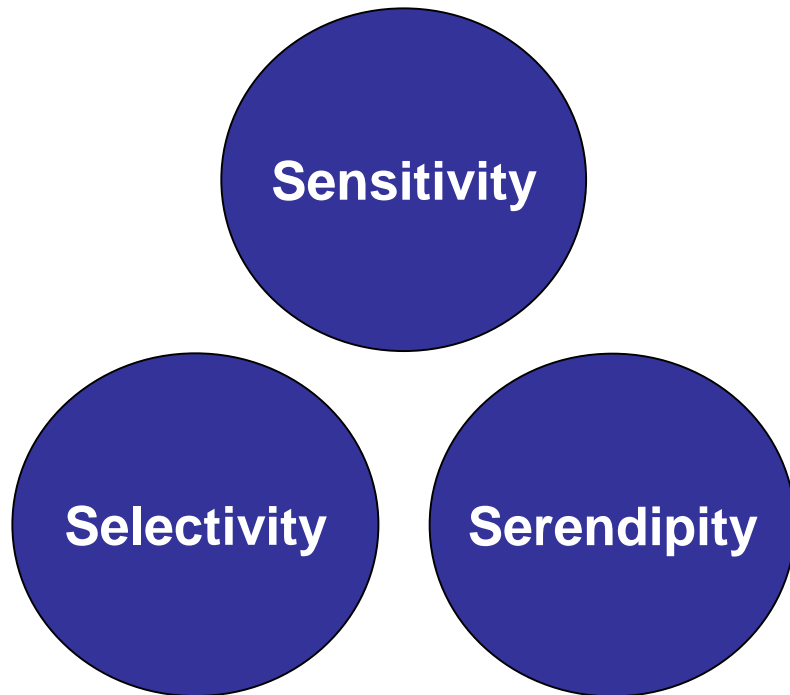


Where to Find Weak Signals?



© adapted from J. Coates, *Issues Management*

The 3 S of Weak Signal Search



- How to develop sensitivity?
- How to balance sensitivity vs. selectivity?
- How to organize serendipity?

There are too many and never enough weak signals.

Weak signals – Example: *iKnow* WiWe Bank

The screenshot shows the iKnow website interface. At the top, there is a navigation bar with links for iNews, iDelphi, iBank, iScan, iCommunity, iLibrary, iOracle, and iProject. Below this is a search bar and a navigation menu with options like WI-WE Bank, Wild Cards, Weak Signals, and WI-WE Scan. The main content area is titled "Scanning all WI-WE for query 'borders'" and includes filters for Type of WI-WE (all WI-WE, Wild Cards, Weak Signals) and Group of WI-WE (submitted only, iKnow community). A "Filter: Inspired by" section lists various sources such as FP7, ERA dimensions, other EU, other IGOs, RTOs, government, business, NGOs, lawmakers/politicians, scientists/researchers, celebrities/artists, blogs, social networks, TV/radio, corporate press, community press, fiction, books/movies, magazines, academic journals, foresight/futures, history/past event, interviews, workshops/meetings, community spaces, and other. Below the filter, it shows "total items: 6" and "showing items from: 1 to 6". Three result cards are visible, each with a thumbnail image, a title, a description, and a "View" button. The first card is titled "EU rules Member States tax policy" and features a European Union flag. The second card is titled "Cyber Crusade: Massive e-sabotage by 'hacktivists'" and features a person working on a laptop. The third card is titled "'Smart Specialisation' will reduce the risk of emerging subcritical systems..." and features a close-up of a fan. On the left side of the page, there is a sidebar with a search bar, a "quick scan" section, and a "Popular WI-WE Tags" section with a word cloud. The word cloud contains terms like "technology", "internet", "disease", "era", "innovation", "services", "economy", "regulation", "policy", "tax", "budget", "social justice", "standards", "youth", "movement", "protest", "pressure", "cyber", "underemployment", "IT", "era", "Smart specialisation", "uniformisation", "Pluralisation", "Distribution".

<http://wiwe.iknowfutures.eu/>

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Technology Trend Analysis

Aims

- short and medium term projections, esp. for
 - technometrical parameters
 - technology diffusion
 - market potentials
 - other quantitative figures

As Starting Point for Further Analysis

- Trend Implications
- Delphi Surveys
- Scenario Generation
- Roadmapping
- Strategy Building

Trend

Trend (tendance):

- Measurable or observable change
- with a given direction
- within a given system
- over a defined period of time
- having impact on the future dynamics of the system

Inspired by Philippe Gabilliet,
*Savoir anticiper, Les outils pour
maîtriser son futur*, 1999, p. 167

Characteristics:

- Phenomenological description
- Relatively stable
- Often no information about underlying forces
- Always within a given system

A trend is a trend is a trend.
But the question is, will it bend?
Will it alter its course
Through some unforeseen force
And come to a premature end?

(Sir Alec Cairncross, *Economic Journal* 1969)

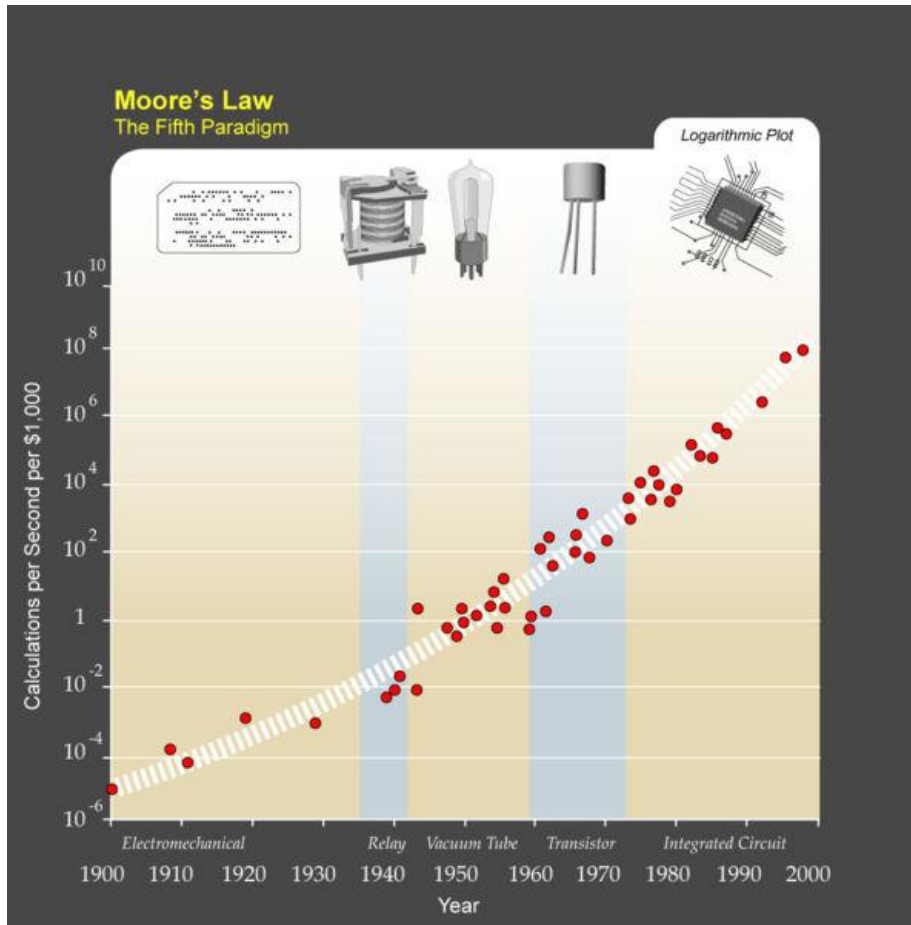
Trend Analysis: Procedure



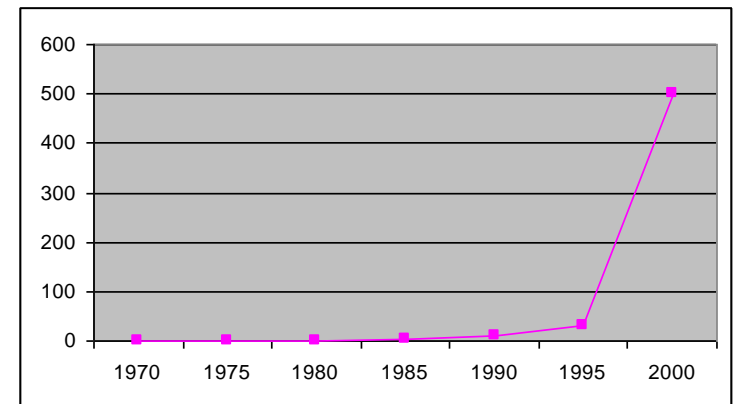
- What is the empirical evidence for the trend?
- What are conditions, prerequisites for the trend?
- How stable is the trend?
- Which kind of dynamics? Linear? Exponential? ...
- How long is the trend expected to continue?

Exponential Growth

Example: Moore's Law



Moore's Law:
twice the performance every
18 months



Logarithmic scale

Normal scale

Exponential Growth

Example: Cost per Genome

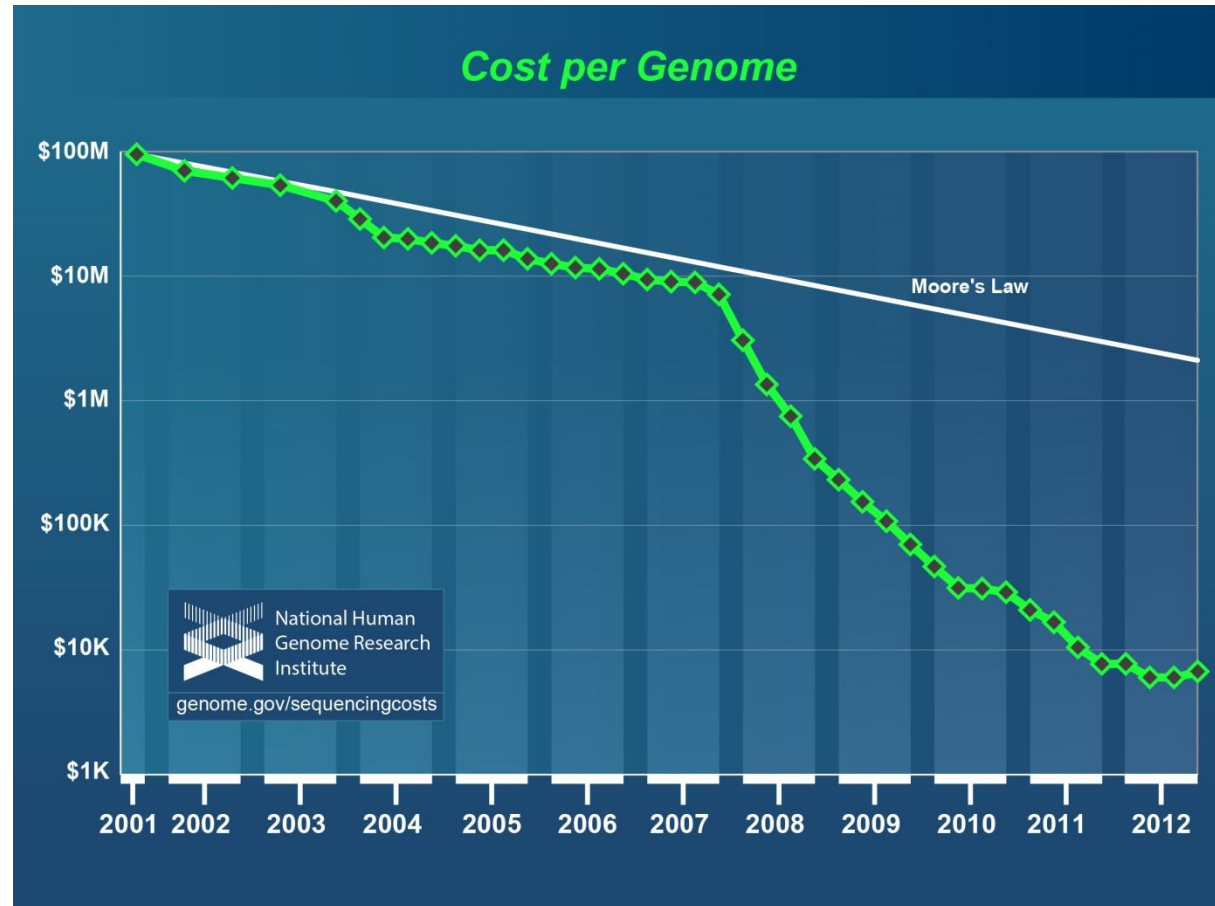
Today

- Genomics, Genetic engineering
- Proteomics, Metabolomics
- System biology

Tomorrow

- Synthetic biology
- Gene hacking
- Tissue Engineering

First mapping of the human genome (2000):
USD 3 BI.



<http://www.genome.gov/pfv.cfm?pageID=27541954>

Limits of Extrapolation

Subjective

- Bias of researchers
- Interest driven forecasts
- Hypecycles of public perception
- Conflicting interpretations

Objective

- Ruptures of trends
 - e. g. due to new breakthrough technologies
 - Due to qualitative, structural changes in the markets
- Insufficient data
 - Especially for emerging technologies, recent innovation etc. there are no sufficient data to fit the curves.

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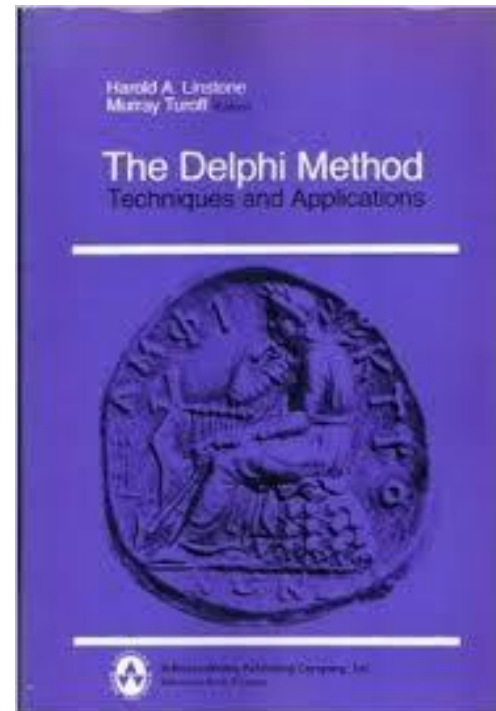
Delphi Studies

Delphi

is a procedure to
"obtain the most reliable
consensus of opinion of a group
of experts... by a series of
intensive questionnaires
interspersed with controlled
opinion feedback"
(Dalkey/Helmer 1963)

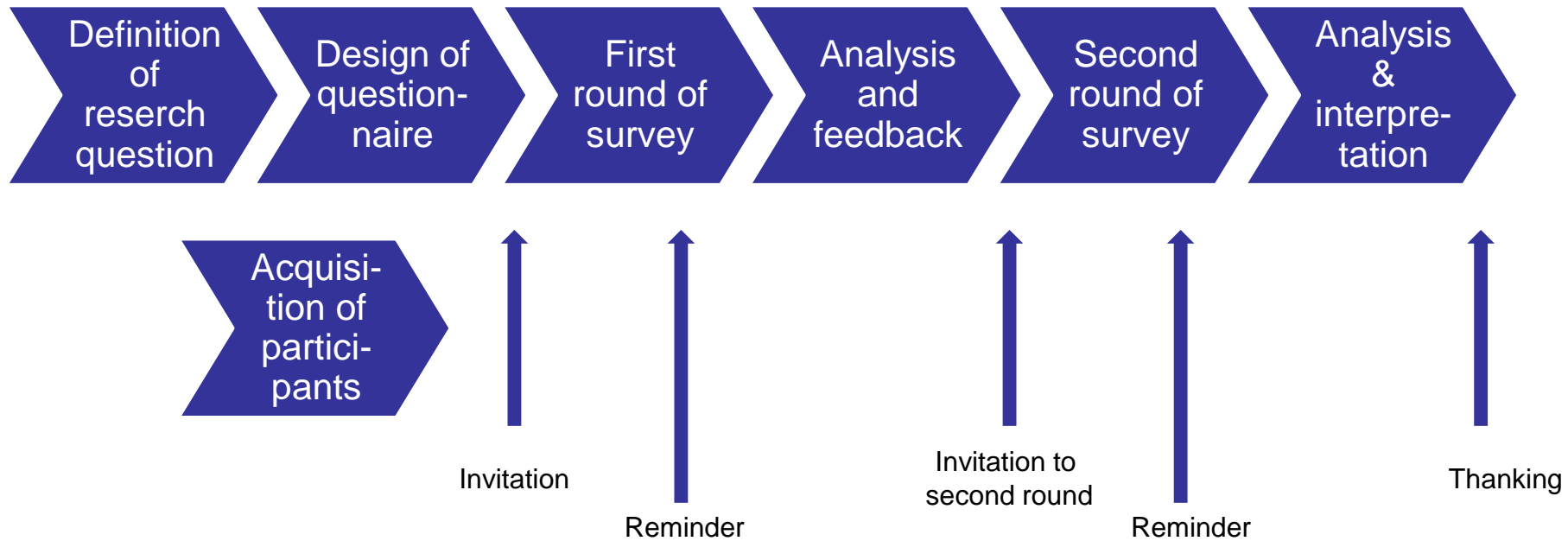
Uses, e.g.:

- estimation of times to technology breakthroughs
- establishment of roadmaps



„method of last resort“

Delphi Studies: Procedure



Real Time Delphi



The Millennium Project

4421 Garrison Street, N.W.
Washington, D.C. 20016
U.S.A.

Tel./Fax 1.202.686.5179
e-mail jglenn@igc.org
www.stateofthefuture.org

Global Expert Studies

Using Real Time Delphi

Advantages

- Online!
- Quick & flexible
- No separate rounds: participants may come back to the survey as often as they want

Attention

- Seed population of answers necessary
- Sample has to be large enough to avoid identification of participants

Real Time Delphi

Example: Feedback

Thesis 01, Round 2 –Your evaluations and arguments for the year 2025

0% 100%

2025: The problem of energy supply (e.g. scarcity of fossil energies, nuclear power) remains unsolved globally.

| | Group response | Your final answer | Your additional arguments for... | |
|----------------------------|---|--|--|---|
| Probability of occurrence | <div style="border: 1px solid red; padding: 5px;"> <p>1</p> <p>Ø: 60%</p> <p>You: 69% (Yellow)</p> <p>2</p> <p>See comments</p> </div> | <div style="border: 1px solid red; padding: 5px;"> <p>3</p> <p>69</p> <p>0-100%</p> </div> | <p>Low probability</p> <div style="border: 1px solid gray; height: 40px; width: 100%;"></div> | <p>High probability</p> <p>Political regulations will increase incentives strongly</p> |
| Impact on world economy | <div style="border: 1px solid red; padding: 5px;"> <p>Ø: 3</p> <p>You: 3 (Green)</p> <p>See comments</p> </div> | <div style="border: 1px solid red; padding: 5px;"> <p>1 2 3 4 5</p> <p>Very low Very high</p> <p>1 ● 2 ○ 3 ○ 4 ○ 5 ○</p> </div> | <p>Low impact</p> <div style="border: 1px solid gray; height: 40px; width: 100%;"></div> | <p>High impact</p> <p>Developing countries will face additional challenges</p> |
| Desirability of occurrence | <div style="border: 1px solid red; padding: 5px;"> <p>Ø: 3</p> <p>You: 4 (Red)</p> <p>See comments</p> </div> | <div style="border: 1px solid red; padding: 5px;"> <p>1 2 3 4 5</p> <p>Very low Very high</p> <p>1 ○ 2 ○ 3 ○ 4 ● 5 ○</p> </div> | <p>Low desirability</p> <div style="border: 1px solid gray; height: 40px; width: 100%;"></div> | <p>High desirability</p> <p>Growth opportunities cannot be realized by their full potential</p> |

Tutorial
Save & Return later
Proceed

Delphi Studies: Advantages and Challenges

Advantages

- Many ways to interpret results
- Pragmatic way to consensus
- Suited for organisations
- High impact, easy to communicate

Challenges

- Often: Lack of real experts
- Bias by popular images of the future
- Non-mainstream ideas filtered out
- Often: pro domo assessments
- No standards for Delphi studies

Delphi is no substitute for in-depth studies.

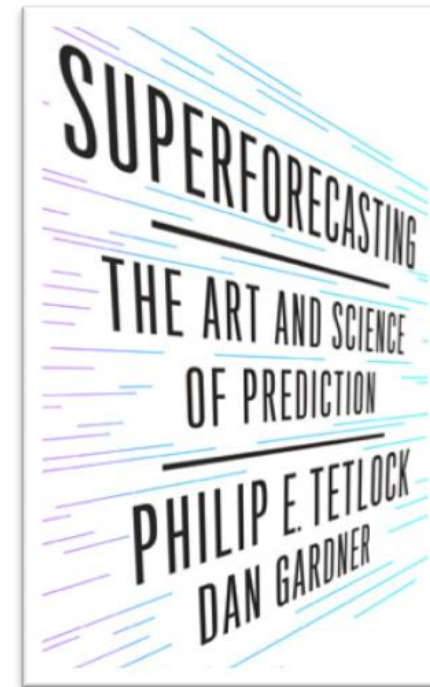
Comparison of Expert Based Methods

| | Group Discussion | Expert Interviews | Delphi Surveys |
|---------------------|--|--------------------------|---------------------------------------|
| Advantages | Intense & quick | Rapid & affordable | Comprehensive & Reliable |
| Disadvantage | Getting the group together | | Several rounds → time consuming |
| Feedback | During group discussion | No feedback | Anonymized feedback |
| Group Dynamics | Opinion leaders and conformity Consensus possible | No consensus possible | Less conformity Consensus possible |
| Cognitive Processes | During group discussion | None | By means of feedback |

The “Crowd” as Expert

Six Lessons about Crowd Prediction

- Forecasting accuracy is a matter of skill, not just luck.
- Forecasting training and teaming improve forecasting performance.
- Tracking top performers, and placing them in flat, non-hierarchical teams improves motivation, engagement and performance.
- Frequent, small belief updates are the marks of an accurate forecaster.
- Dispositional, behavioral and situational factors, as well as past performance, are highly predictive of individual accuracy.
- Probability prediction polls can produce more accurate crowd estimates than prediction markets.



(2015)



Since 2011: prediction competitions
www.goodjudgment.com/

Overview

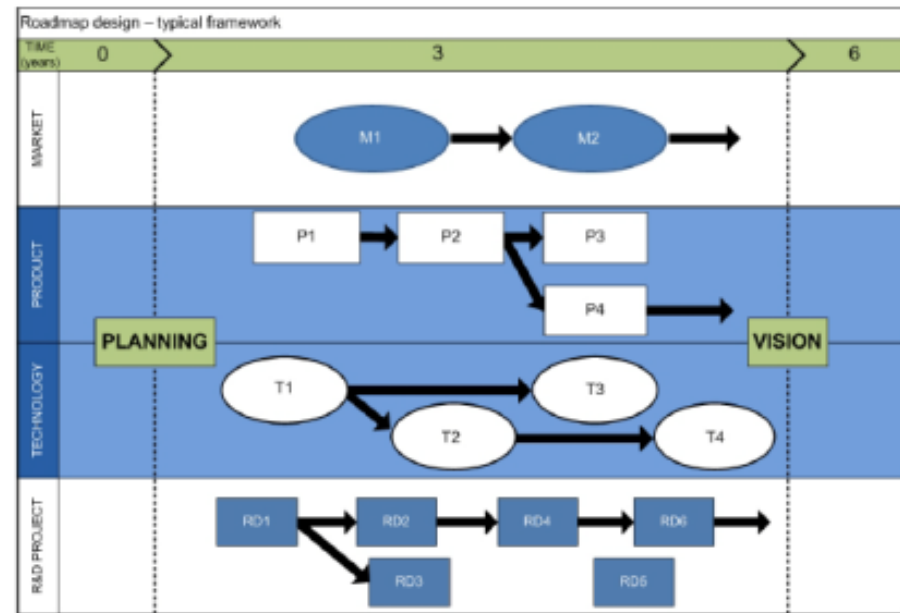
- Looking Back
- Technology Foresight
- Innovation Processes
- **Methods, Tools, Resources**
 - Horizon Scanning
 - Trend Analysis
 - Delphi Studies
 - Roadmapping
- **Conclusion**



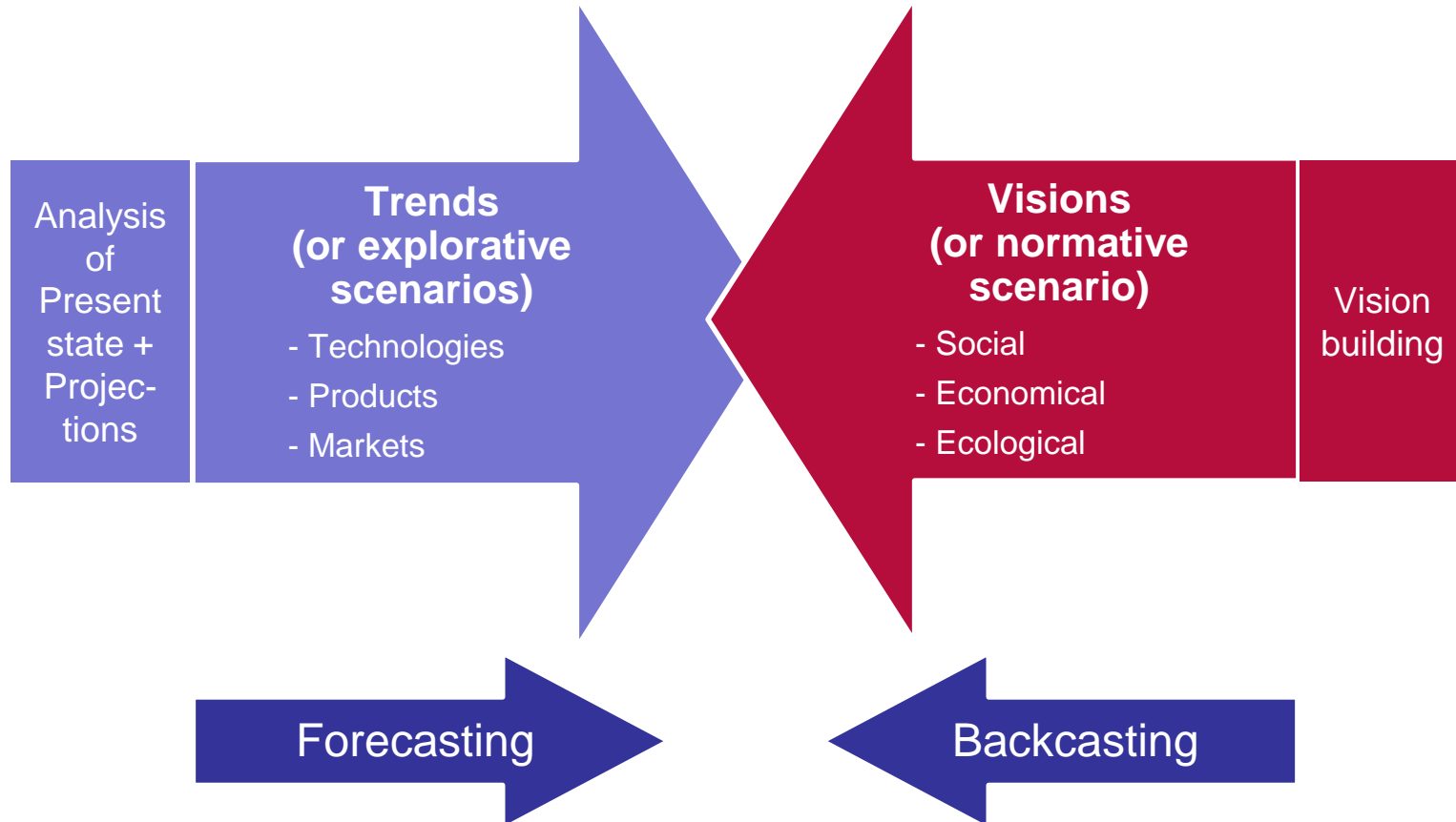
Roadmapping

Roadmap

- graphic representation of events, decisions, trends etc. which lead to a fixed future state
 - Used as planning technique
 - Mostly for R&D processes
 - constructed by back-casting: Starting with the fixed future state, you ask first for immediate preconditions or requirements for this state, then for preconditions for these conditions etc. till you can connect to the present state.



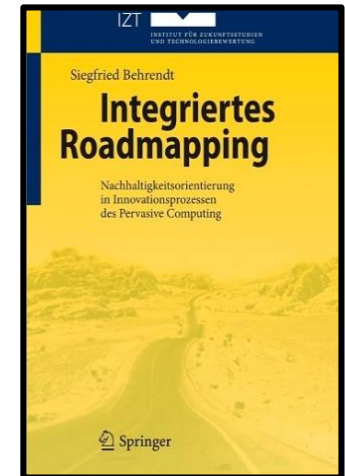
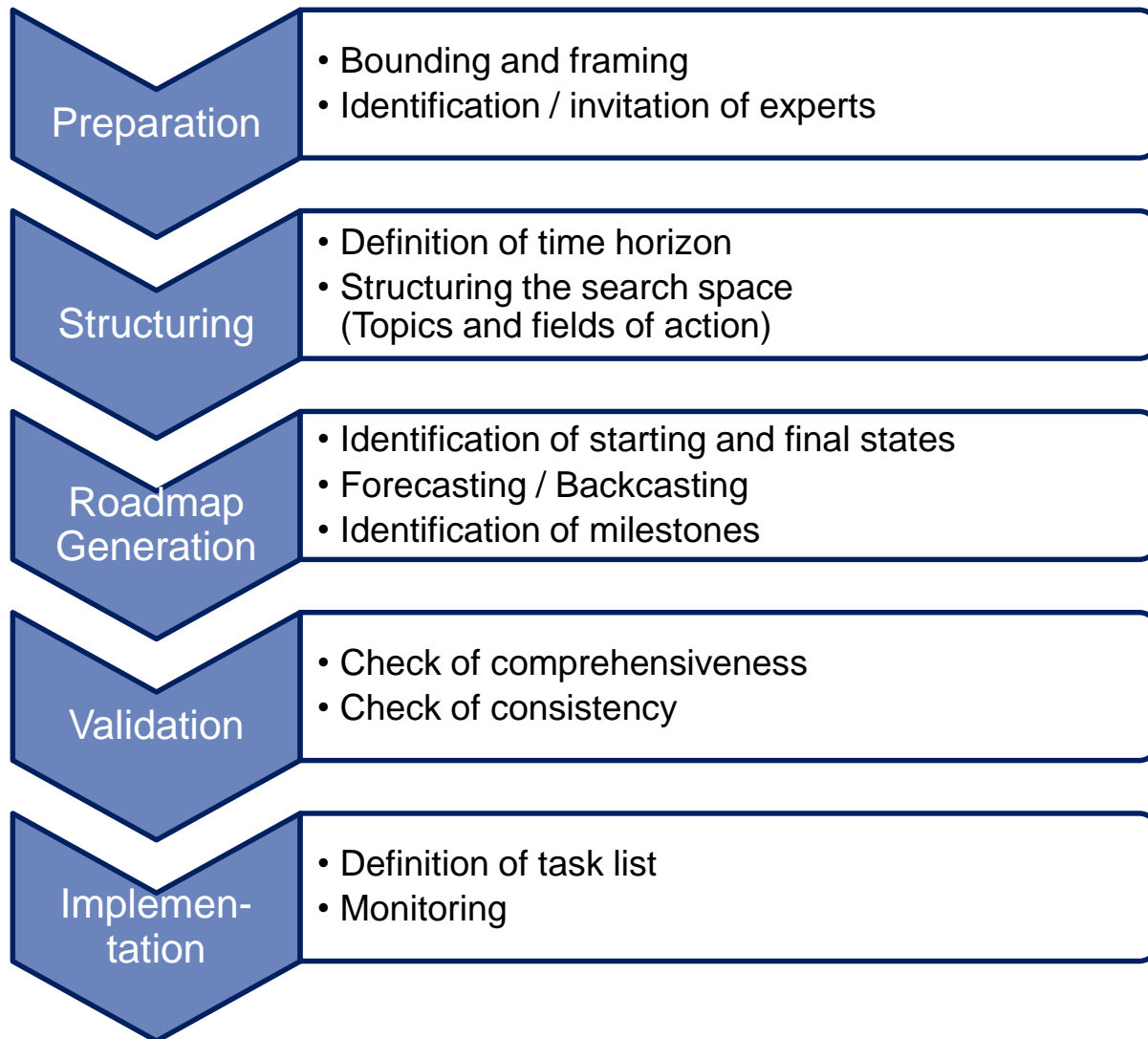
Roadmapping: General Idea



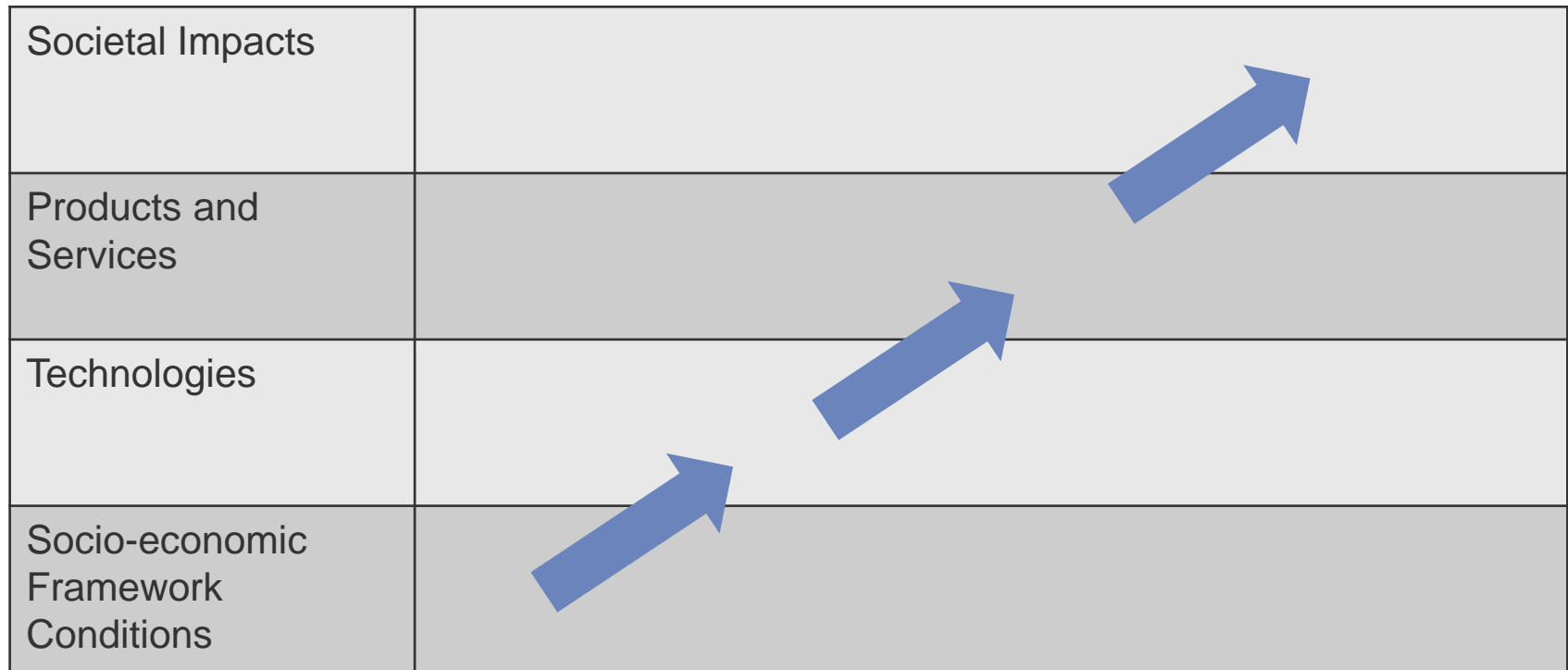
Roadmapping: Different Types

| | | | |
|-----------------------|---------------|-------------|-----------|
| Application | Planning | Foresight | |
| Time horizon | Short-term | Medium-term | Long-term |
| Quantification | Quantitative | Qualitative | |
| Normativity | Analytic | Normative | |
| Interactivity | Group Work | Desk Work | |
| Information gathering | Extrapolative | Explorative | |
| Learning | Individual | Collective | |

Roadmapping: Procedure



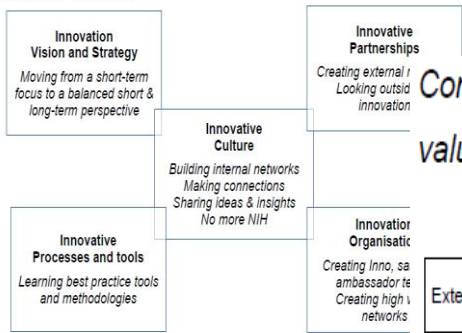
Roadmapping: Typical Fields



Arrows: Direction of impact

Innovation Process: Roadmapping Example

Inno Process – key elements



Connections between insights automatically (and systematically) lead to high value ideas

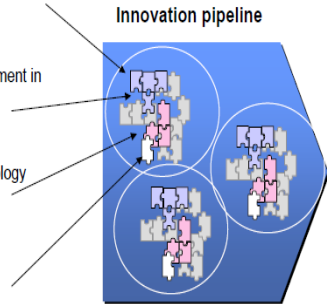


Public presentation of Henkel Innovation Team

| | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|--------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| External | [Yellow bar] | [Yellow bar] | [Yellow bar] | [Yellow bar] | [Yellow bar] | [Yellow bar] |
| Retail | [Yellow bar] | [Yellow bar] | [Yellow bar] | [Yellow bar] | [Yellow bar] | [Yellow bar] |
| Consumer | [Yellow bar] | [Yellow bar] | [Yellow bar] | [Yellow bar] | [Yellow bar] | [Yellow bar] |
| Competitor | [Yellow bar] | [Yellow bar] | [Yellow bar] | [Yellow bar] | [Yellow bar] | [Yellow bar] |
| Pipeline | [Blue triangle] | [Blue triangle] | [Blue triangle] | [Blue triangle] | [Blue triangle] | [Blue triangle] |
| Technology | [Yellow bar] | [Yellow bar] | [Yellow bar] | [Yellow bar] | [Yellow bar] | [Yellow bar] |
| Supply Chain | [Yellow bar] | [Yellow bar] | [Yellow bar] | [Yellow bar] | [Yellow bar] | [Yellow bar] |
| Brand | [Yellow bar] | [Yellow bar] | [Yellow bar] | [Yellow bar] | [Yellow bar] | [Yellow bar] |
| Company | [Yellow bar] | [Yellow bar] | [Yellow bar] | [Yellow bar] | [Yellow bar] | [Yellow bar] |

The WC Alessi Example

- Consumer**
 - „cheap“ rim block design identified to be main obstacle for further market penetration increase
 - Nicely scented rim blocks seen to be “daily / affordable luxury” (CEE)
- External**
 - Increasing importance of „design“ as marketing instrument in parallel industries
- Technology**
 - Henkel has leading knowledge in two chamber technology
- Supply Chain**
 - production in Hungary allows flexible and competition manufacturing
- Brand:**
 - WC Brands to be enriched emotionally



Innovation: WC Two-Chamber Rim block designed by Alessi

Roadmapping: Results

Advantages of Roadmapping

- Visualisation of complex processes
- Putting assumptions in concrete terms
- Definition of dimension, relation, events, milestones
- Focussing of complex relations and interdependencies on pivotal aspects
- Interdisciplinarity by participation of different expert groups

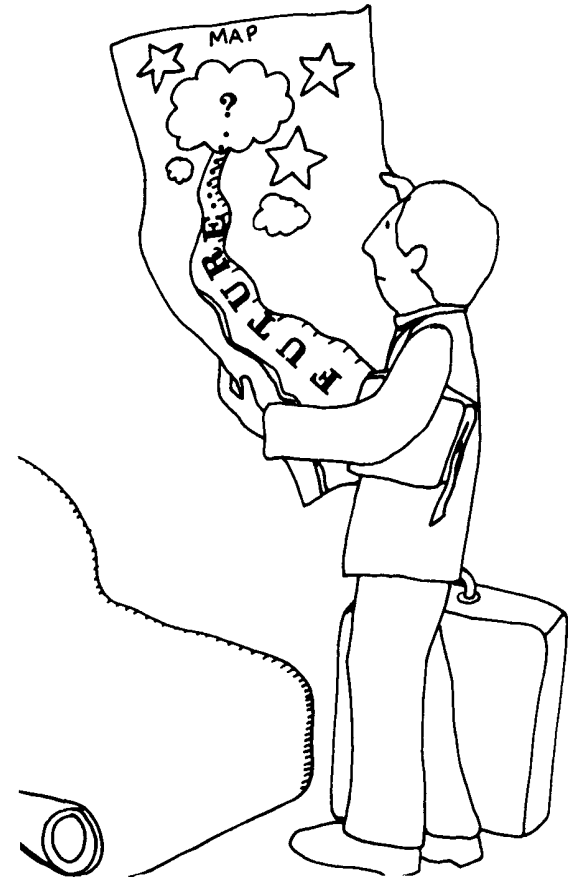
Results

- Identification of:
 - Important factors
 - Future developments (Trend analysis)
 - Critical path dependencies
 - Lock in situations (“Hen and egg problems”)
 - positive and negative impacts
- Definition of milestones
- Derivation of actions needed and tasks

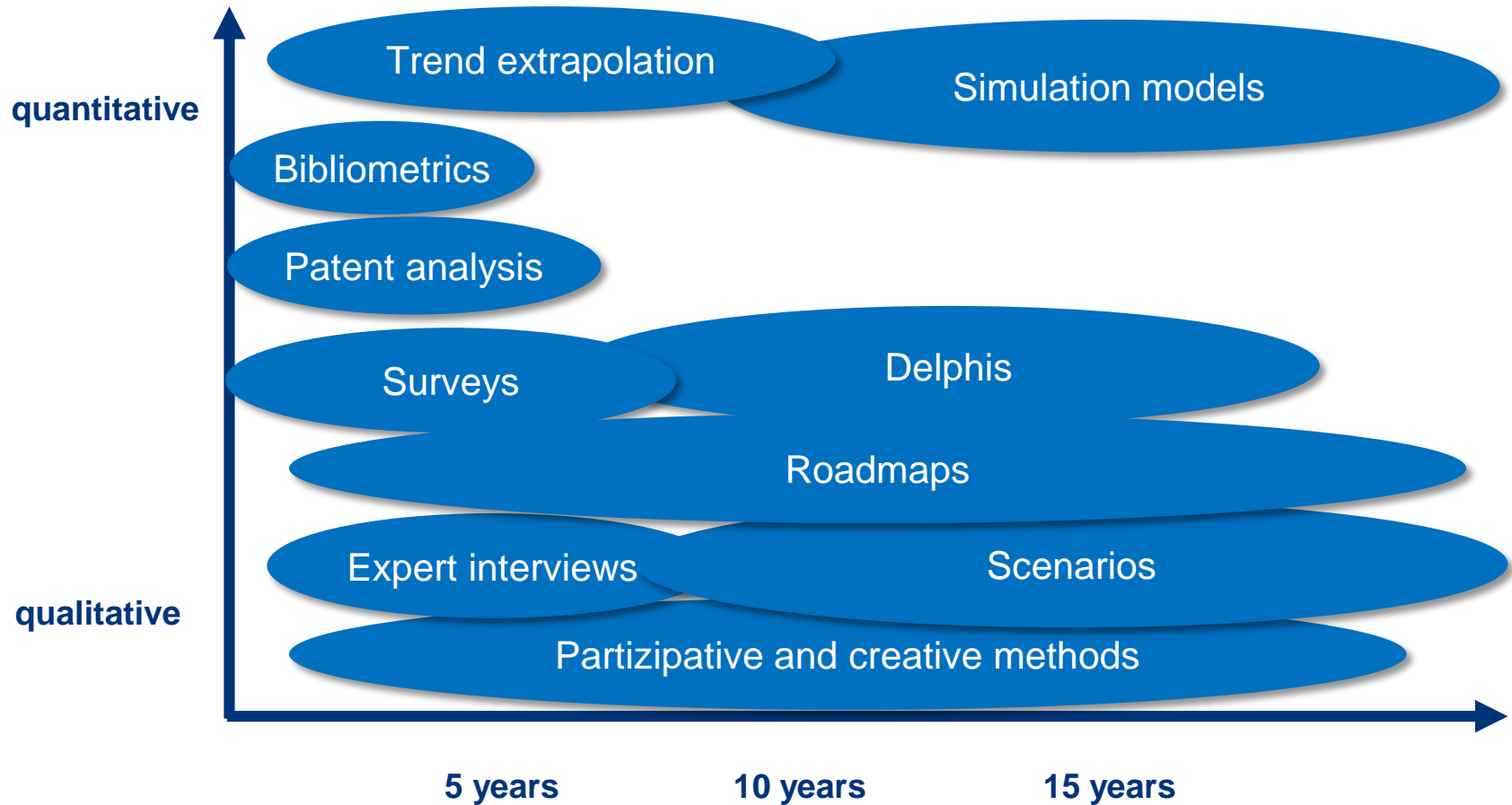
Looking from the present time into the future
versus
Looking from the future into the present day

Overview

- **Looking Back**
- **Technology Foresight**
- **Innovation Processes**
- **Methods, Tools, Resources**
- **Conclusion**



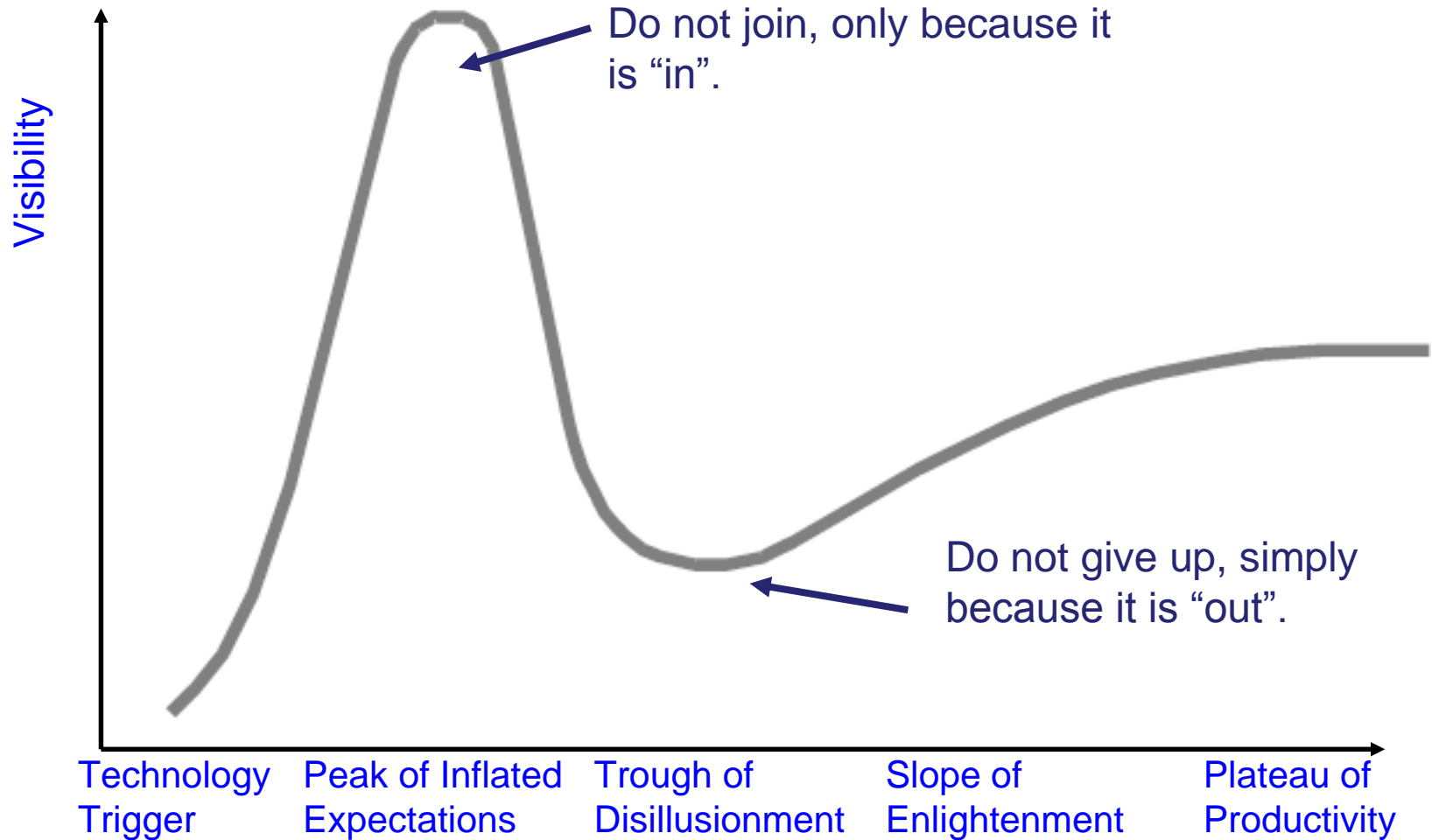
Many Pertinent Methods



Frequent Flaws in Foresight

- Linear extrapolation of trends
- Basic innovations: Underestimation of scope of applications
- Incremental innovations: Underestimation of time till market
- Technological feasibility mistaken for market demand
- No continuous monitoring
- Quantification, even where it is impossible or inappropriate
- Negligence of not quantifiable factors

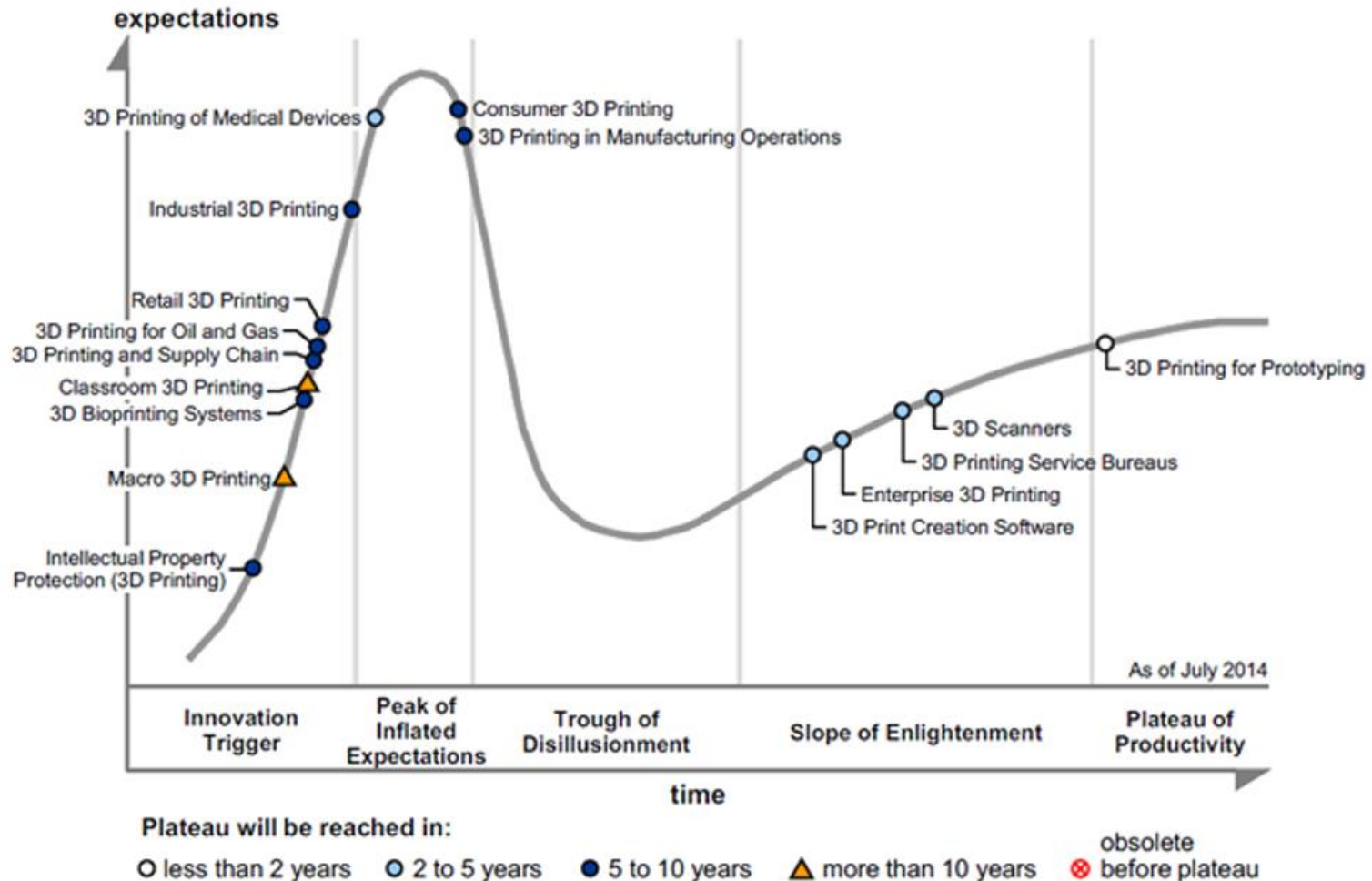
Hype Cycle: Insights for Innovation



<http://www.gartner.com/technology/research/methodologies/hype-cycle.jsp>

Hype Cycle – Example: 3D Printing

Figure 1. Hype Cycle for 3D Printing, 2014



Future: 3D Printing Everywhere



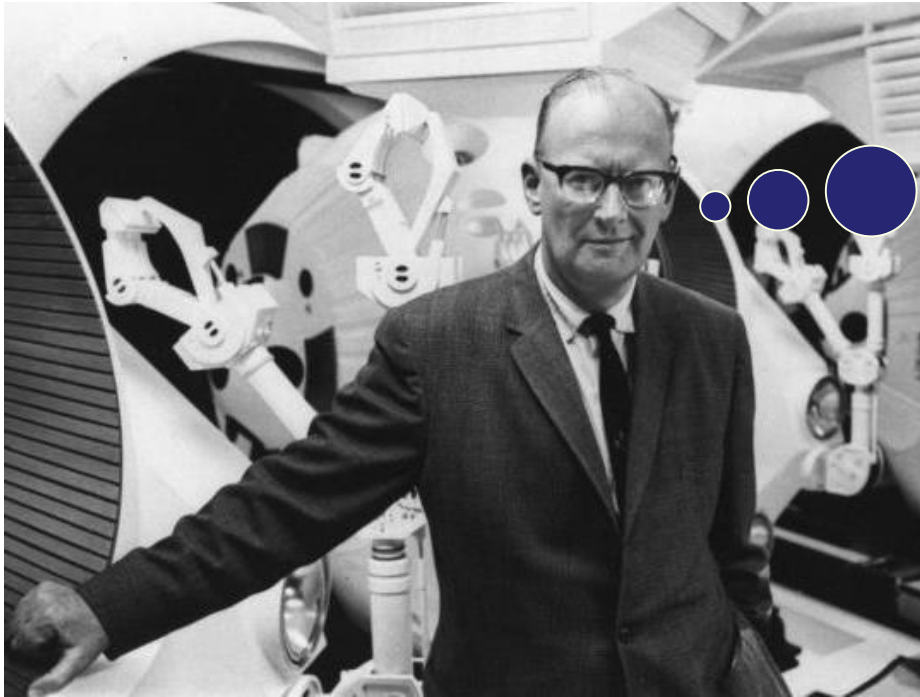
http://www.dhl.com/content/dam/Local_Images/g0/aboutus/SpecialInterest/Logistics2050/szenario_study_logistics_2050.pdf

Summary

- Technology foresight provides insights in technology trends, drivers and future potentials.
- Methods for TF include trend analysis, delphi, roadmapping etc.
- All methods have specific advantages and limitations.
- Horizon scanning provides the necessary basis for all other tools.
- Interpretation of scanning results is crucial.
- Beware of the hype cycle!



A Final Comment



Arthur C. Clarke
(1917 – 2008)

“The only way of discovering the limits of the possible is to venture a little way past them into the impossible.”

PART 2

EXERCISE

Sources & Resources

Example: Trendwatching

The screenshot shows the TrendWatching Premium website interface. The browser address bar displays the URL: <https://premium.trendwatching.com/?trend=&industry=&origin=&s=3D+PRINT+&save=0>. The navigation bar includes 'TrendWatching PREMIUM', 'TREND FRAMEWORK', 'INNOVATIONS DATABASE', 'REPORTS', 'APPLY TOOLKIT', and 'YOUR ACCOUNT'. The main content area is titled 'Search Results for "3D PRINT"' with 120 results. A sidebar on the left allows for filtering by 'Trends', 'Industries', and 'Regions', and lists various mega-trends such as 'STATUS SEEKERS', 'BETTERMENT', 'YOUUNIVERSE', 'LOCAL LOVE', 'PLAYSUMERS', 'EPHEMERAL', 'HELPFULL', 'JOYNING', 'HUMAN BRANDS', 'BETTER BUSINESS', 'UBITECH', 'INFOLUST', 'FUZZYNOMICS', 'PRICING PANDEMONIUM', 'POST-DEMOGRAPHIC', and 'REMAPPED'. The search results grid contains 12 items, each with an image and a title: 'Funeral parlor unveils 3D printing service', 'Minecraft tutorials inspire schoolchildren in digital design', 'Algorithms generate a completely new Rembrandt artwork', 'Nesting dolls help keep gym-goers motivated', '3D-printed cover helps cellphone addicts by restricting functionality', 'Twitter-powered bot generates friendly tweets', 'Beverage company creates cups from soundwaves', 'Personalized DIY apparel line made via 3D printing', 'Features of a 3D-printed phone case (Cut-outs for dialing, Opening for Touch ID)', 'The Nicebot (A blue robot-like device)', 'A stack of colorful 3D-printed cups', 'A woman looking at a 3D-printed item', 'A woman using a 3D printer', and 'The Microgravity Test (A glass of whiskey in space)'. The Windows taskbar at the bottom shows the time as 20:18 on 16.05.2016.

Sources & Resources

Example: Mapegy

scout.mapegy.org/scout.php

Suchen

mapegy

Your Searches Andreas Neef

Current search: / "additive manufacturing"

Search Overview Experts Companies Startups Research Technology Market

Last 10 years trend - Publications by Year | "additive manufacturing"

| Year | Inventions by 1st application year | Inventions by last publication year | scientific publications |
|------|------------------------------------|-------------------------------------|-------------------------|
| 2006 | 10 | 10 | 10 |
| 2007 | 10 | 10 | 10 |
| 2008 | 10 | 10 | 10 |
| 2009 | 10 | 10 | 10 |
| 2010 | 20 | 10 | 20 |
| 2011 | 40 | 10 | 30 |
| 2012 | 100 | 10 | 50 |
| 2013 | 250 | 50 | 100 |
| 2014 | 80 | 180 | 200 |
| 2015 | 10 | 280 | 240 |
| 2016 | 10 | 10 | 10 |

Top Publication Countries | "additive manufacturing"

| Country | Number of Publications |
|---------|------------------------|
| USA | 450 |
| China | 150 |
| UK | 120 |
| Japan | 50 |
| Germany | 30 |
| France | 20 |
| Italy | 15 |
| Spain | 10 |
| India | 10 |

Word Cloud | "additive manufacturing"

Top Technology Fields | "additive manufacturing"

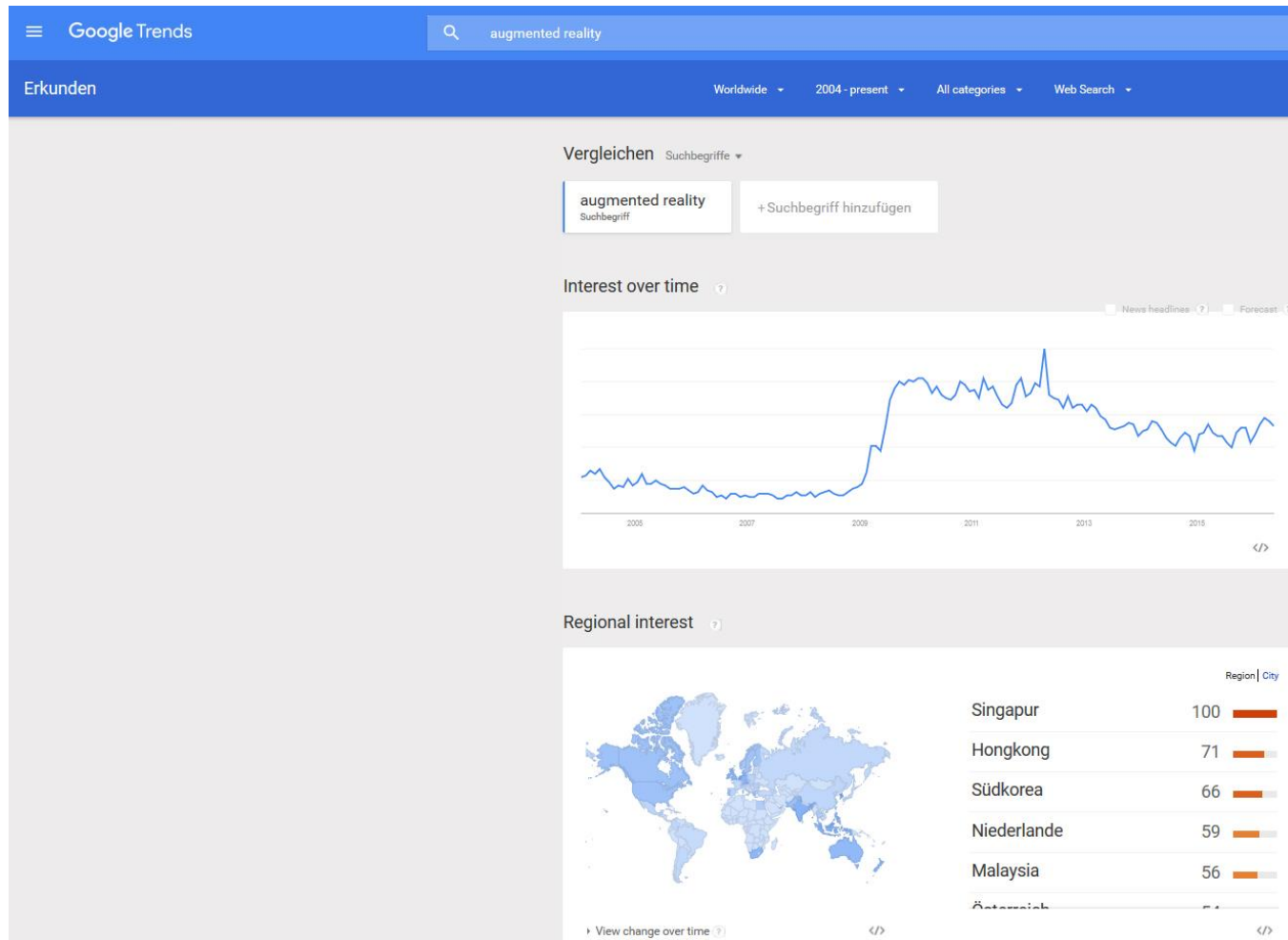
| Technology Field | Number of Publications |
|------------------|------------------------|
| B29C 07/00 | 450 |
| B22F 3/105 | 350 |
| B23K 26/34 | 150 |
| B22F 3/00 | 120 |
| G06F 17/50 | 100 |
| B22F 5/04 | 80 |
| F01D 5/14 | 70 |
| B23K 15/00 | 60 |
| B22F 7/02 | 50 |
| B28B 1/00 | 40 |

Public News Forecast | "additive manufacturing" | > 70

Chattanooga poised to capitalize on future trends
2015-11-19 Author : Source : Google Alert - computer technology

Sources & Resources

Example: Google Trends



Exercise

With Google Trends
(<https://www.google.com/trends/>)

1. Define start set of search words/concepts
2. Do search, collect main search findings
3. Look for searches with related or similar words/concepts
(proposed by Google Trends)
4. Interpret results