

NANOMEDICINE

MORE THAN A MATTER OF RISK

THE GENERIC TENDENCY
TO FOCUS ON PUBLIC ACCEPTANCE AND RISK PERCEPTION

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About myself: reflecting on science and society

- University of Twente:
 - Physics (MSc)
 - biophysics, Gated Raman Spectroscopy
 - Philosophy of Science & Technology (MA)
 - political philosophy, scarcity
 - Sociology of Technological Change (PhD)
 - *Promising Technology* (1993)
- University of Utrecht
 - Associate Professor Innovation Studies
 - dynamics of emerging technologies
- University of Maastricht
 - Socrates Professor Philosophy of Sustainable Development
 - needs and novelty
- NanoNextNL
 - program director Technology Assessment

Central argument

- huge promises of nanotechnology to change society
 - for the better
- yet, efforts to anticipate such changes tend to get reduced
 1. the question of societal embedding is reduced to a problem of public acceptance;
 2. the problem of public acceptance is reduced to a matter of risk perception
- tendency is persistent
 - although non-reducing approaches exist

Public acceptance is more than 'risk'

- lay people will consider more than just the danger that something is poisonous or may explode
- moral arguments
 - “genetic screening is not fair”
- political arguments
 - “only the big companies profit from this”
- in general: many other associations



Societal embedding is more than public acceptance

- changing responsibilities and liabilities
- new roles and identities
- re-organization of economic structures
- new ethical dilemmas



societal embedding

public acceptance

risk (perception)



US: National Nanotechnology Initiative

- *After more than 20 years of basic nanoscience research and 10 years of focused R&D under the NNI, applications of nanotechnology are delivering in both expected and unexpected ways on nanotechnology's **promise to benefit society**.*
- *Nanotechnology is helping to considerably improve, even **revolutionize**, many technology and industry sectors: information technology, energy, environmental science, medicine, homeland security, food safety, and transportation, among many others.*
- source: www.nni.gov

The National Nanotechnology Initiative

With the advent of new technologies, including nanotechnology, one should consider the potential unintended consequences to human health and the environment that might accompany development and use of the technology. This assessment of the benefits to society and the potential hazards is called risk assessment.

source: www.nni.gov

The National Nanotechnology Initiative

The NNI is committed to fostering the development of a community of experts on ethical, legal, and societal issues (ELSI) related to nanotechnology and to building collaborations among ELSI communities, such as consumers, engineers, ethicists, manufacturers, nongovernmental organizations, regulators, and scientists.


*These stakeholder groups will **consider potential benefits and risks** of research breakthroughs and provide their perspectives on new research directions.*

*With its industry stakeholders, the NNI will also develop information resources for ethical and legal issues related to **intellectual property** and ethical implications of nanotechnology-based patents and **trade secrets**.*

Dutch 'roadmap' of nanotechnology

Not only the Dutch scientific and industrial landscape of nanotechnology, but also the social debate about the opportunities and risks of nanotechnology needs attention. It is important that society can form a balanced opinion of nanotechnology and its effects. As many social organisations as possible must become involved in this public debate. An open dialogue between social organisations, the government, academics and the business world should ensure that safety will always be a consideration in the applications of nanotechnology. [...], **it is the general acceptance of nanotechnology that needs to be focused on.** Therefore, emphasising the opportunities of the technology and the major social problems it might help solve, is an important part of this roadmap on nanotechnology in the top sectors.

To summarize



promises of
nanotechnology !

risk (perception)

Example: early diagnostics of Alzheimer's Disease

Expectations

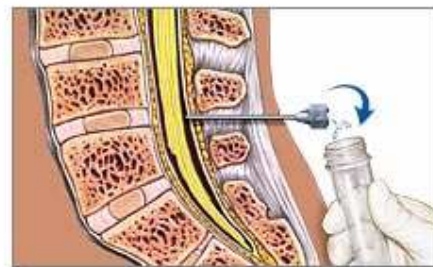
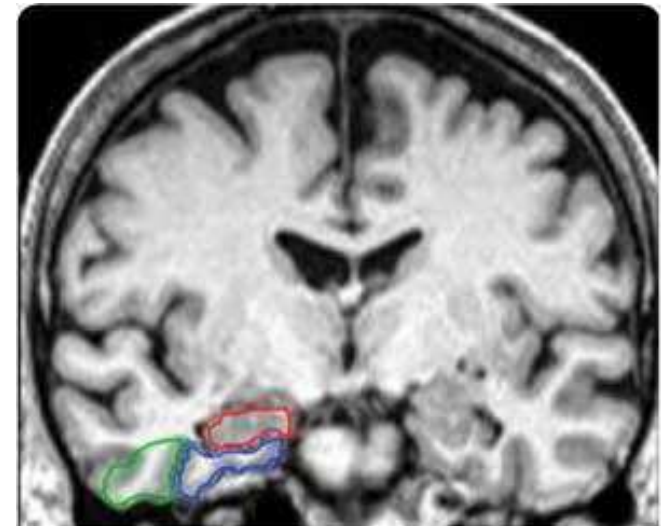
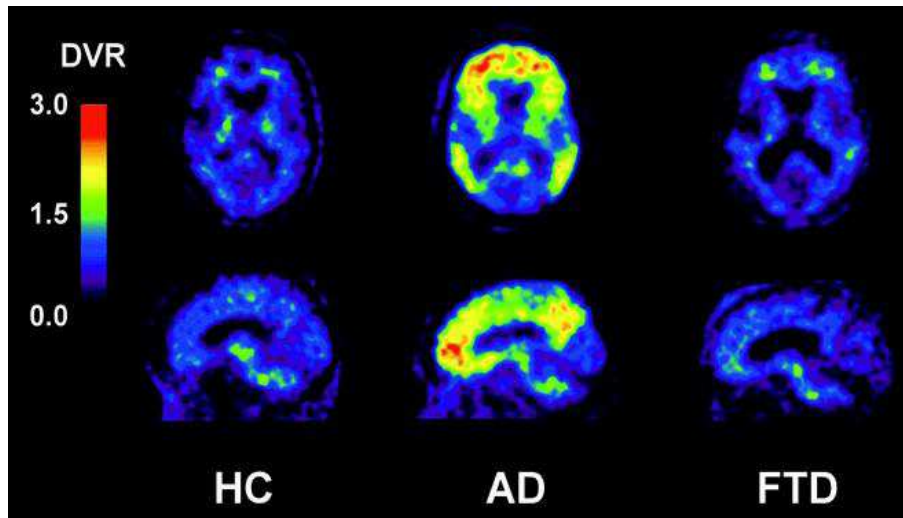
- Identify biomarkers
- Visualize or measure biomarkers
- Early diagnosis and treatment

source: PhD work of Yvonne Cuijpers
see Cuijpers, Van Lente and Moors
(forthcoming).

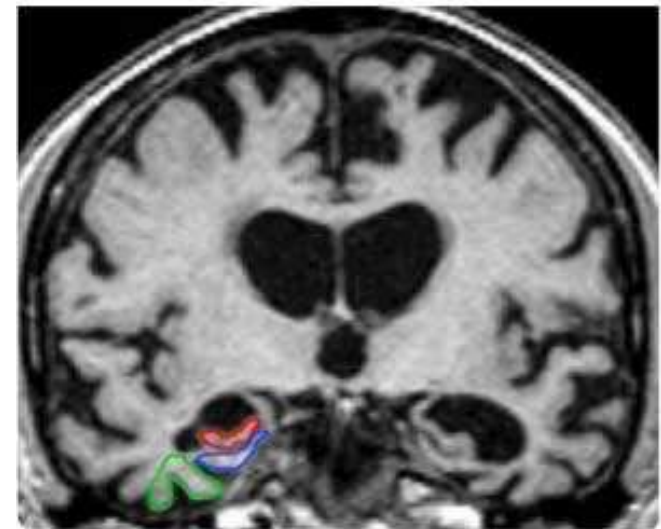
Uncertainties

- Causes of AD, normal /pathological aging?
- Will it indeed lead to earlier and more reliable diagnosis?
- How early is early?
- What is the value of an early diagnosis when treatment is lacking?
- How will other stakeholders, e.g. insurance companies, respond?

Early diagnostics of Alzheimer's Disease: biomolecular puzzles



Spinal fluid
is collected
for testing



Another setting: Alzheimer Cafes

- patients, family, caregivers, volunteers, local professionals
- monthly events
- local events, with local guest speakers



Topics in the Cafes

- **Apocalyptic demography.** AD is an increasingly important and problematic societal phenomenon.
 - “The number of persons with dementia is expected to double in the next decades, while the number of professional caregivers is expected to halve”
- **Timely diagnosis.** Biomedical puzzle solving leads to early diagnosis and a medication to stop or even cure the disease (long term) or provides a prognosis and access to care and support (short term)
 - Patients are being diagnosed at an increasingly early stage → the syndrome AD changes. Stigmatized condition: reduce taboo and culture understanding.
 - “The earlier the better”: early or timely diagnosis?
- **Diagnosis and care.** AD as a condition different in every individual, a tailor-made arrangement of care and treatment measures is needed. (There is no easy solution)

Questions of societal embedding

- Impact of a diagnosis
- Multiple futures
 - not mutually exclusive
- Early diagnosis to be assessed in relation to other expectations
 - Development of treatment
 - Pressure on health care system
 - Stigma on dementia
 - Availability of care and support
 - Meaning of AD for identity
 - Early or timely diagnosis?

Some insights from the Alzheimer's case

1. Alzheimer's Disease is not one thing but many, means different things is a multifaceted phenomena.
2. Diagnosis has different social meanings in different social practices.
3. Promises of early diagnosis using biomarkers is predicated on a particular future.
4. In Alzheimer Cafés we encountered many other futures: a mosaic of hopes, fears, expectations and uncertainties.

Technology Assessment

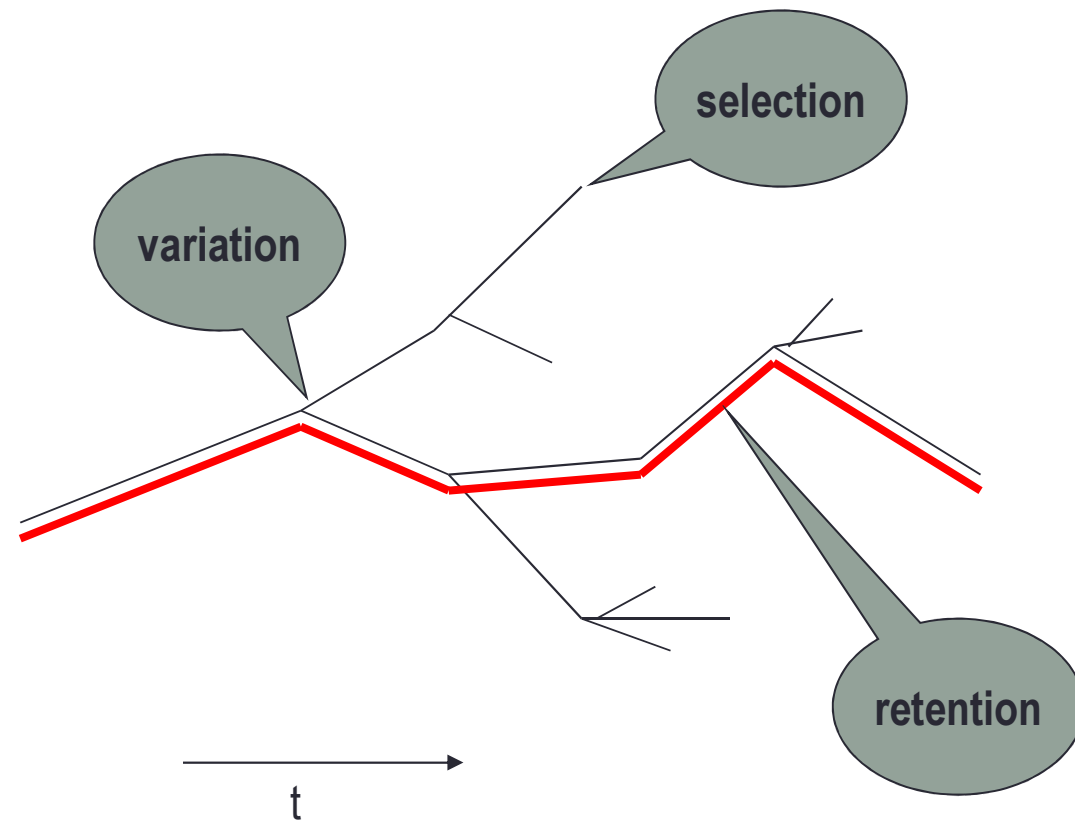
General idea of TA:

- ‘Reduce the costs of learning by trial-and-error, by means of anticipation of future developments and impacts, and by accommodating such insights in decision making and its implementation.’ (Rip 1986)

Constructive Technology Assessment:

- broaden and enrich technological development by including actors and factors
- ‘reflexive modernization’

better than linear: evolutionary model



NanoNextNL

- 2011-2016
- 300 PhD projects
- 10 universities
- 120 companies

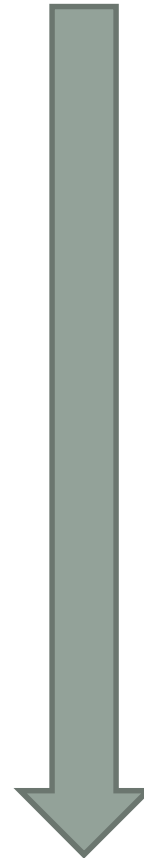


1. Risk Analysis and Technology Assessment (RATA)	2. Energy	3. Nano-medicine	4. Clean water	5. Food
6. Beyond Moore				
7. Nano materials				
8. Bio-nano				
9. Nano fabrication				
10. Sensors and actuators				

topic	location (and link)	CTA agent	goal
Lab-on-a-chip (4x)	Utrecht (NanoNed)	Rutger van Merkerk	methodology development
Lab-on-a-chip, -in-a-cell	Amsterdam (NanoNed)	Douglas Robinson	try out of methods, prototype for Network of Excellence Frontiers
Molecular machines	Toulouse (NoE Frontiers)	Douglas Robinson	insertion/modulation
siRNA drug delivery	Aarhus (NoE Frontiers)	Douglas Robinson	insertion/modulation
Deep brain implants	Louvain (NoE Frontiers)	Douglas Robinson	insertion/modulation
Risk and Responsible Innovation	Enschede (NoE Frontiers)	Douglas Robinson	insertion/modulation
BAN in health care (2x)	Delft (NanoNed)	Ali Parandian	methodology development
Organic Large Area Electronics	Eindhoven (NanoNed, Plastic Electronics Foundation)	Ali Parandian	methodology development
Organic Large Area Electronics	Heidelberg (NanoNed, Innovation Lab GmbH)	Ali Parandian	methodology development
Nano and food packaging	Gouda (NanoNed, Nederlands Verpakkings centrum)	Haico te Kulve	check forcefields
Nano and drug delivery	Utrecht (Nefarma, NIABA)	Haico te Kulve	check forcefields
Self tests (2x)	Groningen	Lotte Krabbenborg	Apply and add to methodology (Dewey)

CTA and other approaches

- Risk assessment
 - Hazard identification
 - Toxicity information
 - Exposure assessment
 - Risk characterisation
- HSE
 - Health Safety and Environment
 - an established procedure in firms
- ELSA
 - Ethical, Legal and Social Aspects
 - a common element in research programs
 - 'elsafication of science'
- Foresight
 - not the same as forecasting
 - scenarios
- CTA
 - Constructive Technology Assessment
 - enriching developments



risk (perception)

public acceptance

societal embedding



WHY?

societal embedding

public acceptance

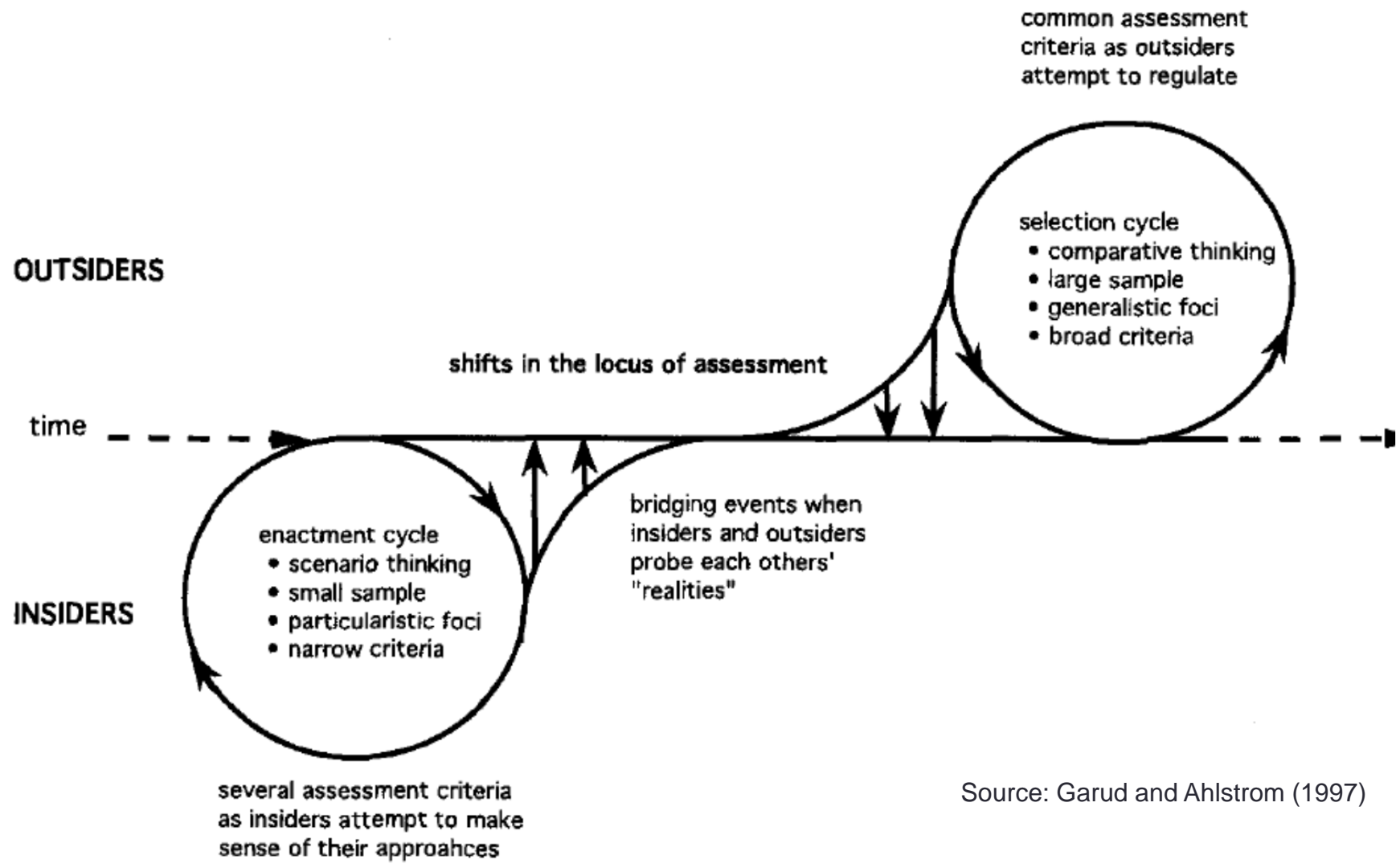
risk (perception)



Answer 1:

dominance of the developer's view

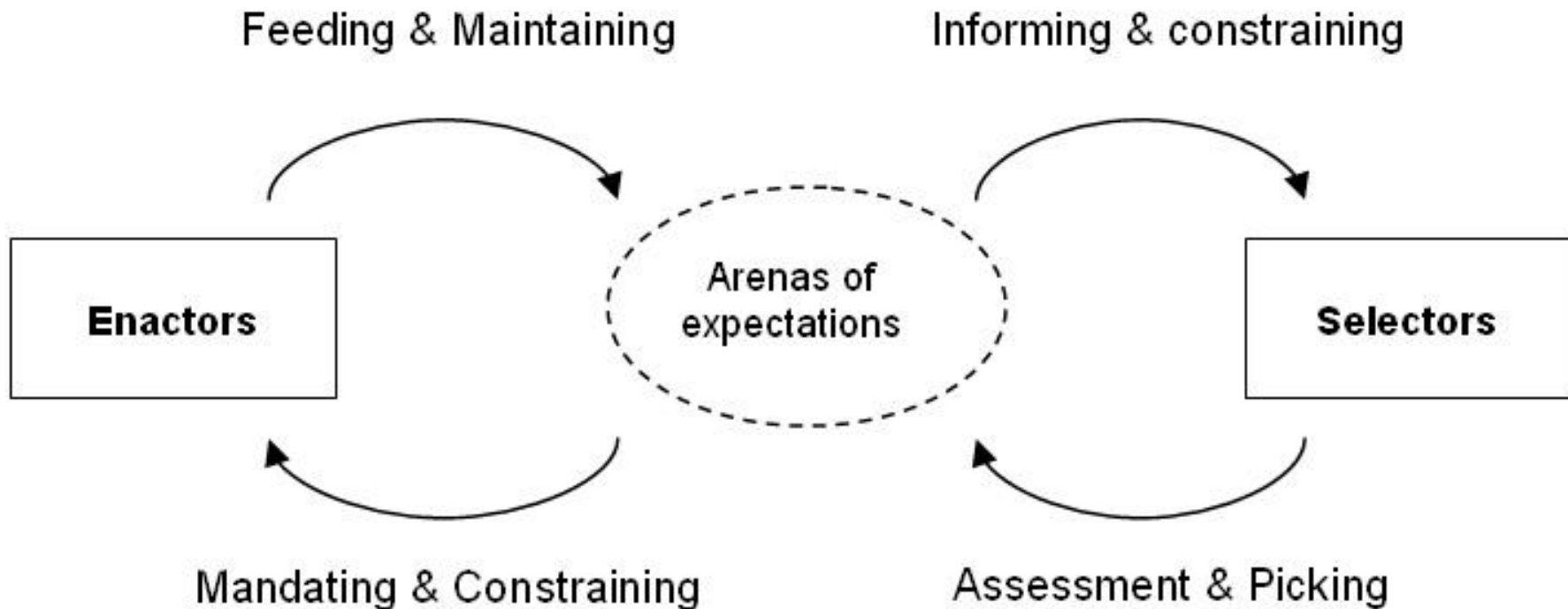
- Outsiders versus insiders
 - Garud and Ahlstrom (1997)
 - Bakker, Van Lente & Meeus (2011), Van Lente & Bakker (2010)
- Or 'enactors' versus 'comparative selectors'
 - enactors are committed to a particular solution
 - selectors are committed a particular problem
- In general: separation of promotion and "control" of technology in our societies, since industrial revolution.
 - Example: division of labour between government ministries.
 - Rip, Misa & Schot (1995).



Source: Garud and Ahlstrom (1997)

Fig. 2. Dynamics in the Constitution of the Technological Field.

Negotiating about promises



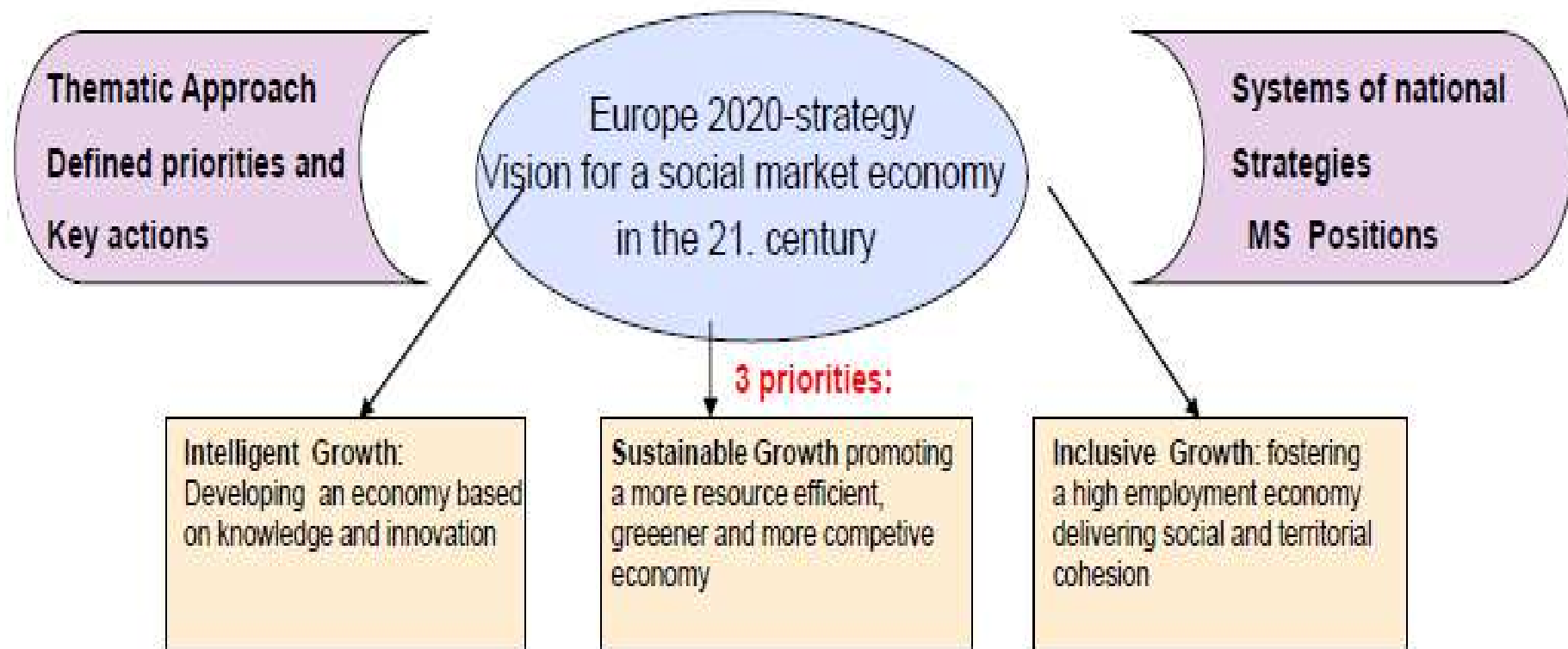
Van Lente, H. and S. Bakker (2010) 'Competing expectations: the case of hydrogen storage technologies', *Technology Analysis & Strategic Management*, Vol 22 (6), 693-709
Bakker, S, H. van Lente and M. Meeus (2011), 'Arenas of expectations for hydrogen technologies', *Technological Forecasting and Social Change*, Vol 78(1), 152-162.

Enactors see hurdles

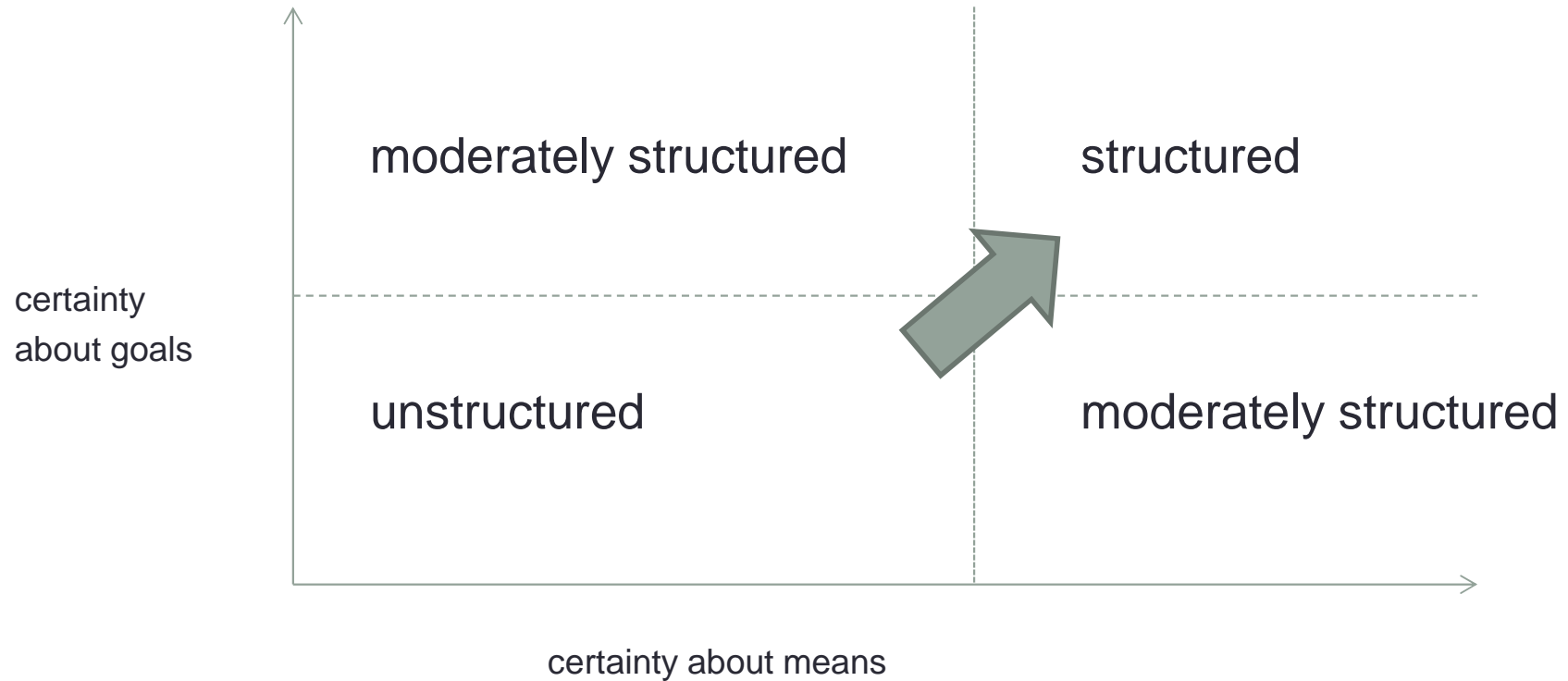
- Committed to a particular development, a particular future
- Prepared to act upon that future
- Disturbing factors then become 'hurdles' or 'challenges'
- Indeed, challenges are everywhere

EU: Grand challenges

Europe-2020-Strategy: Architecture and objectives



Answer 2: preference for structured problems



Hoppe, R., (2010). *The Governance of Problems. Puzzling, Powering, Participation*, Policy Press.

Risk society

“[risks] can thus be changed, magnified, dramatized or minimized within knowledge, and to that extent they are particularly open to social definition and construction” (Beck, 1992: 23). “

“There are always losers but also winners in risk definitions” (Beck, 1992: 23).

Beck, Ulrich (1992) *Risk Society: Towards a New Modernity*. New York: Sage.
(Translated from the German *Risikogesellschaft* published in 1986)



So, remember

BEWARE

Nanomedicine is more than a matter of risk