# Assessment of Emerging Technologies

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nano TA

# TA/Societal Aspects of Nanotechnology

**Bridging the Gap Between Innovation and ELSA**

nano TA

One of the Flagship programs in NanoNed consortium, 2005-2009

7 PhD students and 2 postdocs, in four universities.
first PhD in December 2007 (Rutger van Merkerk, *Expectations and Constructive TA of nanotechnology*)

**Has a dual position: must do high quality social science and humanities research,**
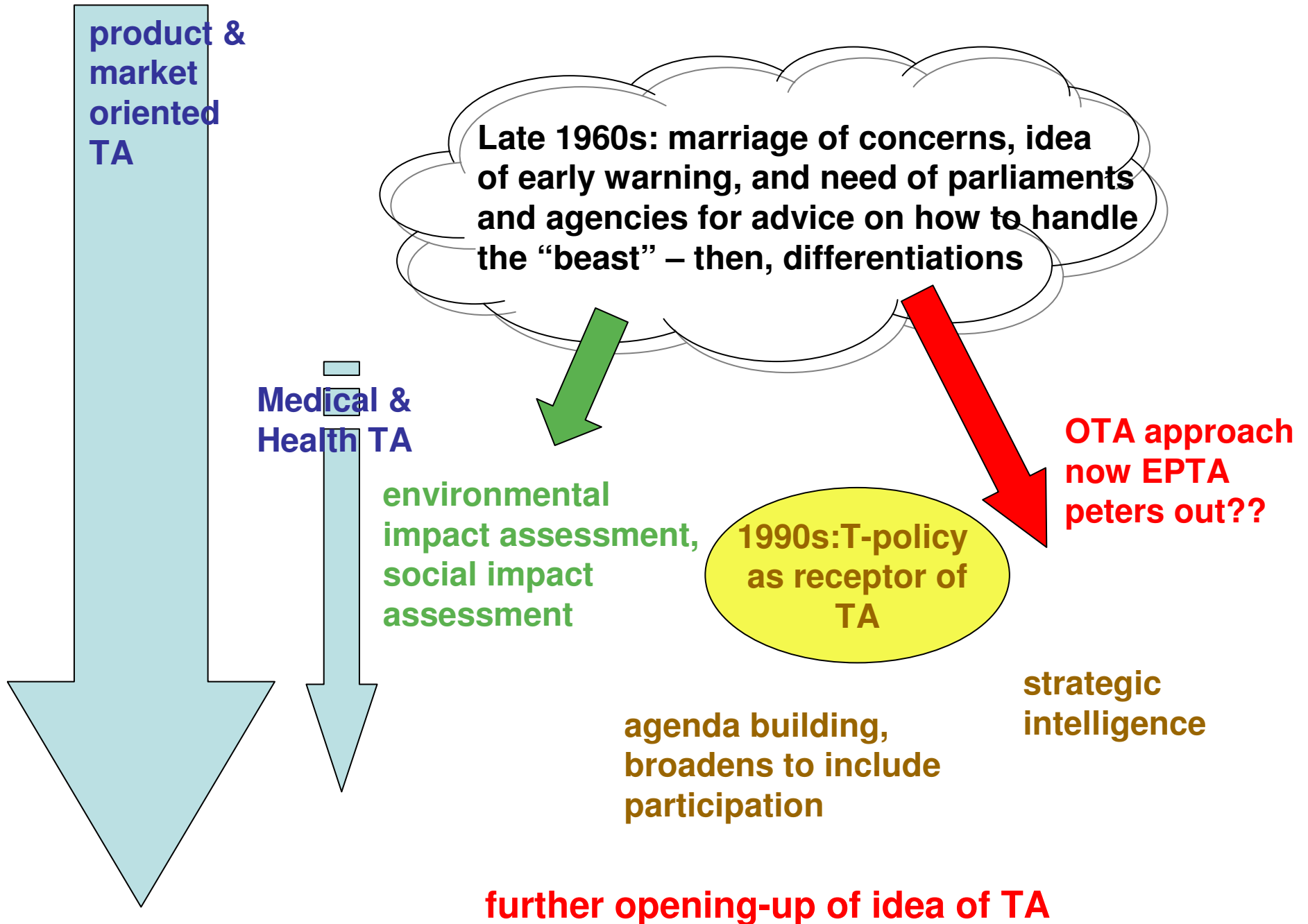
**<u>and</u> help embed nanoscience and technology in society (lubricant function?)**
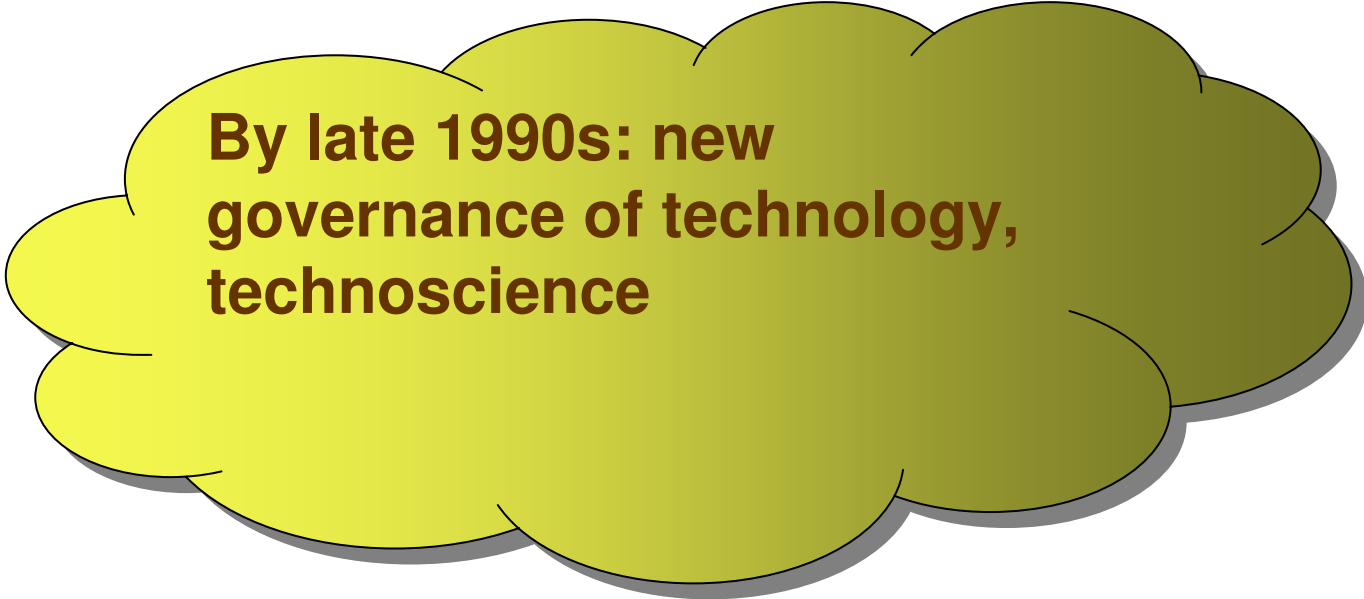
**Part of a larger dynamic:**

<span style="color:red">**reflexive co-evolution of nano-ST and society**</span>

# TA as a patchwork of practices, tools and procedures

- Since late 1960s; now also includes:

- TA as a form of strategic intelligence (next to TF, R&D evaluation, cf. ASTPP)

- And informal, *de facto* TA (e.g. through controversies)

- Plus: the philosophy of TA: anticipate on impacts and feedback such anticipations in ongoing processes, including decision making, in order to reduce human and social costs of learning how to handle technology in society by trial and error

   **and work towards better technology in a better society**

**product & market oriented TA**

**Medical & Health TA**

Late 1960s: marriage of concerns, idea of early warning, and need of parliaments and agencies for advice on how to handle the "beast" – then, differentiations

environmental impact assessment, social impact assessment

1990s:T-policy as receptor of TA

**OTA approach now EPTA peters out??**

strategic intelligence

agenda building, broadens to include participation

**further opening-up of idea of TA**

**By late 1990s: new governance of technology, technoscience**

public engagement
with new ST

ELSA studies

broadening
of product TA,
medical TA

Constructive TA

assessment of
emerging technologies

sub-politics,
neo-corporatism

responsible development
of new technosciences

globalisation of TA?

# Anticipation?

- Conundrums of knowing about the future
- Occupational hazard of TA: <span style="color:red">reification</span> of futures
- The "if" turns into a "when" – especially when ethicists start speculating about ethical impacts (cf. Alfred Nordmann's critique)
- "The key point is to move away from a focus on our limited knowledge of the nature and extent of impacts (which will remain full of uncertainties) to the process by which they come about, starting with the here and now." (STRATA Report 2002)

# TA of emerging technologies is doubly fictional

- Don Eigler (IBM): There's lots of nanoscience going on, but nanotechnology is mostly <span style="color:red">science fiction</span>

- Consideration of effects/impacts of nanotechnology (up to third industrial revolution, human enhancement) is <span style="color:red">social science fiction</span>

- Promises serve a purpose (mobilising resources, support and legitimacy), but should not be taken at face value

# Start with 'assessments'

- **ongoing** assessments (including **expectations**) and their **improvement**
- These **project** a future (incl. work towards it)
- Embedded in evolving structures and patterns which imply "endogenous futures"
- Up to **processes** of reification

- Role of TA analyst/agent in them, e.g. by doing TA of Nano-ST one reinforces its existence and importance

# Endogenous futures

- Can be analyzed, developed in scenarios, and fed back to actors
- Analysis & scenario-building in terms of:
- Emerging irreversibilities (cf. trajectories, industry standards, regimes); forks/dilemmas
- Against the backdrop of an evolving socio-technical landscape (shaping what happens as well as being transformed by the new developments)
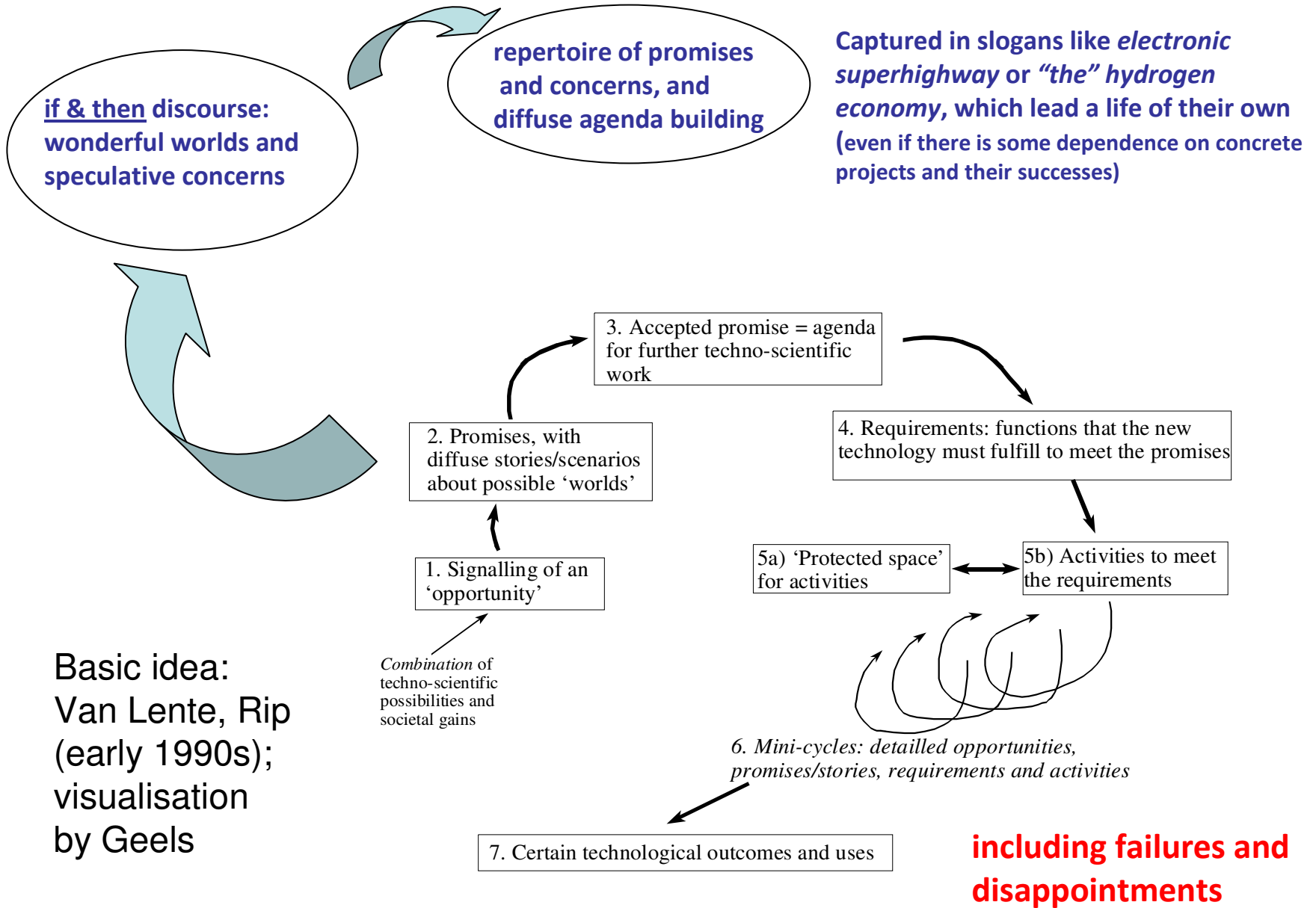
# Emerging Technologies

- Newly emerging S&T (NEST) open up <span style="color:red">spaces for new options</span>

- New options that will reconfigure the world? <span style="color:red">projections of future worlds</span>

- Projections (promises) happen all the time, but emerging S&T are an occasion to outline wonderful futures. For nanotechnology: "a third industrial revolution"; "letting the blind see and the deaf hear".

- Big promises can evoke big concerns …

- Contested futures

# Focus on NEST, but ...

- In general, distributed innovation
- Two main patterns:
- Regime of techno-scientific promises
- Regime of collective experimentation (implying "slow innovation")

- Joly, Rip & Callon 'Reinventing Innovation', Ch. 2 in Ulrike Felt, Brian Wynne, et al., *Taking European Knowledge Society Seriously. Report of the Expert Group on Science and Governance, to the Science, Economy and Society Directorate, Directorate-General for Research, European Commission*, Brussels: European Communities, January 2007. EUR 22700

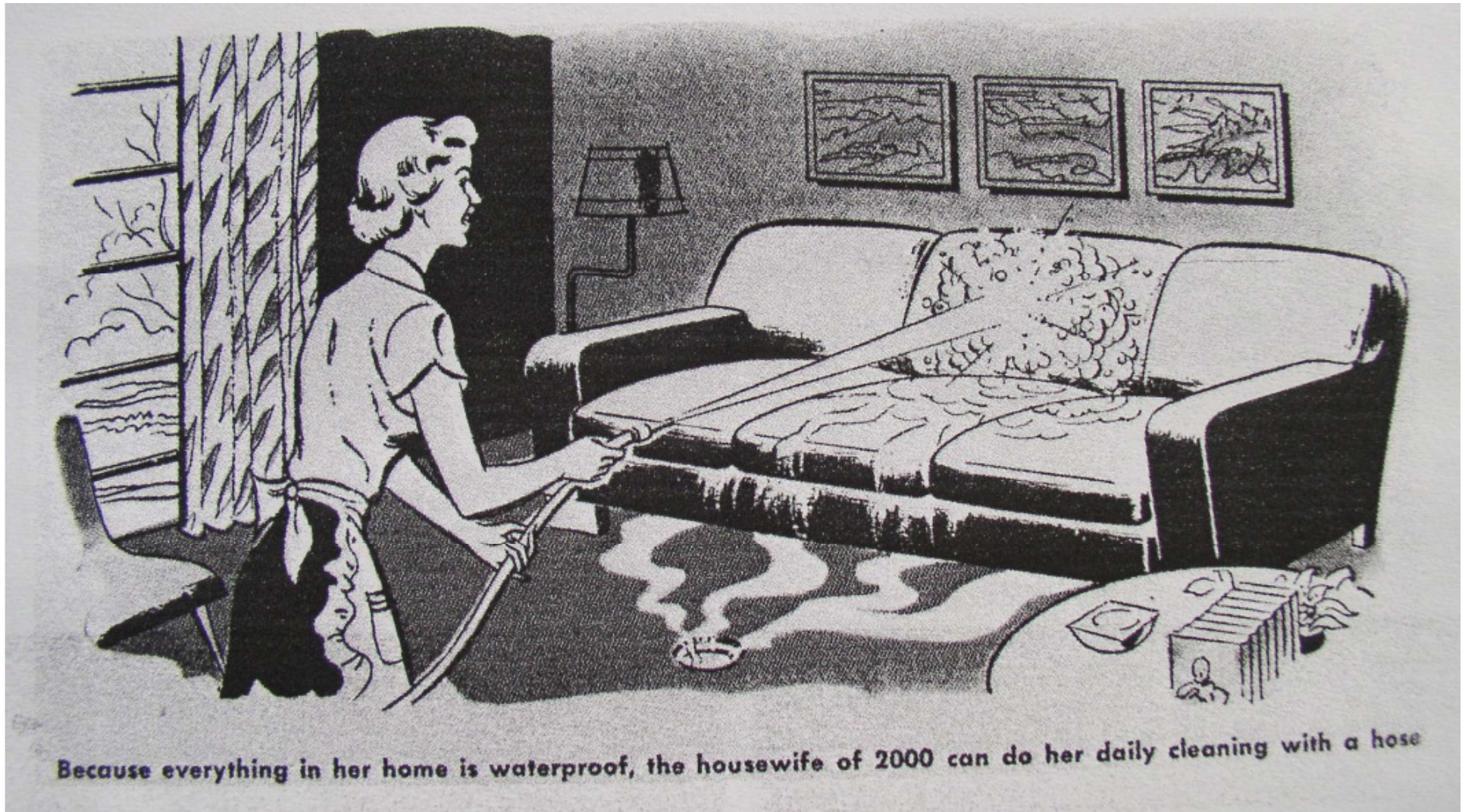# For emerging technologies, two dynamics of promises

- (1) Promise-requirement cycles, narrowing down to realizing specific technological options (or failing to do so)

- (2) Broad agenda-building (including the "if & then" discourse) largely independent of concrete developments

- Example of 'electronic superhighway', early 1990s: continued as a slogan in spite of project failures (analysis by Kornelia Konrad)

repertoire of promises and concerns, and diffuse agenda building

**if & then** discourse: wonderful worlds and speculative concerns

**Captured in slogans like** *electronic superhighway* **or** *"the" hydrogen economy*, **which lead a life of their own** (**even if there is some dependence on concrete projects and their successes**)

3. Accepted promise = agenda for further techno-scientific work

2. Promises, with diffuse stories/scenarios about possible 'worlds'

4. Requirements: functions that the new technology must fulfill to meet the promises

1. Signalling of an 'opportunity'

*Combination* of techno-scientific possibilities and societal gains

5a) 'Protected space' for activities

5b) Activities to meet the requirements

Basic idea:
Van Lente, Rip (early 1990s); visualisation by Geels

*6. Mini-cycles: detailled opportunities, promises/stories, requirements and activities*

7. Certain technological outcomes and uses

**including failures and disappointments**

# Early example: plastics

- "I just want to say one word to you: Plastics. There's a great future in plastics!" (from the movie *The Graduate*)
- A life lived in a world "**free from moth and rust and full of colour**" (1941)
- These are projections, but related to concrete products, and driven by big incumbents (chemical companies)
- Plus effect of World War 2: technology was developed to produce substitutes
- So they are for real ...

The materials of material culture: multiple narratives



Because everything in her home is waterproof, the housewife of 2000 can do her daily cleaning with a hose

Plastic: a waterproof vision of the future

image of 2000 in 1957, from Corn and Horrigan (1996)

A life lived in a world
**"free from moth and rust and full of colour"**.
Yarsley and Couzens (1941)

and as he gets old, he will be wearing **silent** plastic teeth; playing chess with moulded chessmen on a plastic board "until at last he sinks into his grave **hygienically** enclosed in a plastic coffin" (158).

This coffin is believed to be the largest phenolic moulding in the world. Designed by James Doleman and made by the Ultralite Casket Co Ltd, it was manufactured from imitation walnut phenolic resin with a wood flour filler devised by the Bakelite Company Ltd of London. 1938

http://www.ingenious.org.uk/See/?s=S2&target=ctx&DCID=10276584

# Present-day nanoST and converging technologies

- 'Umbrella terms' carry the promise (and draw outside interests, esp. from policy makers, and also from critical civil-society groups), while actual developments have their own dynamics

- A two-level, and largely uncoupled, development (ex. human enhancement)

- Which of the two levels will a TA exercise focus on?

- Their interaction?

# De facto assessment of emerging technologies

- Is part of emerging (de facto) governance in a situation of uncertainty/ignorance
  - I use a broad definition of governance: All structuring of action that has some authority/legitimity to it can count as governance
- One such process: societal agenda-building
- Can be more important than dedicated TA exercises ["dual dynamics": iTA vignes]

# Societal agenda-building

- Occurs in multi-actor, multi-arena debates
- Example of risks of nano (as an emerging technology)
- Uncertainty – but  this need not be an occasion for precaution.
- Link with recent move towards "responsible innovation" and voluntary codes

# Health risks of nano-particles

- Nano-size (e.g. of nanotubes) produces interesting effects and technological options, but also (possibly) risks, e.g. in the lungs, in passing the blood-brain barrier. So a moratorium? (ETC proposal July 2002)

- Responses of enactors: <u>first</u> denial that there are risks; <u>then</u> calling for research on effects while applications continue. Some regulatory agencies start to move.

- Enter Swiss Re (re-insurance company): wants to limit its financial risks (learning from the experience with asbestos!) August 2004, workshop December 2004

- Risk issue becomes generally legitimate, lots of work is done

- Too exclusive a focus now?

**positioning and overall agenda building**
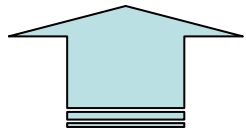
**nano-particles, esp. nanotubes, have wonderful new properties**
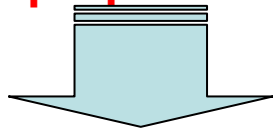
**ongoing research, first & simple applications of nanotubes**

broad and unfocused debates

ETC group: there might be risks

No, say nano-actors

Swiss Re 2004 intervention (financial interest of (re-)insurance companies)

discussion of regulation, agencies produce drafts

some actors criticize narrow focus

exclusive focus on HES, rather than uses of nanotubes

HES becomes legitimate issue

**gov. agencies sectoral org's**

more risk research is done (small percentage of nano-budgets)

**soft law?**

**research and application dynamics prevail**
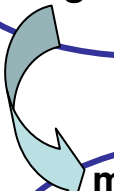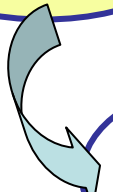
**recognition of broader concerns; and reluctance to flag nano**

proceed cautiously

forget about nano-tubes

**2004**

**2006**
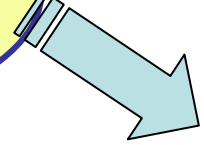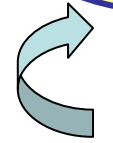
# TA and deliberation (about risk)

- Renn & Roco White Paper (for International Risk Governance Council), *Nanotechnology Risk Governance*, June 2006. Discussed in Zürich, high-level conference organized by Swiss Re.

- They emphasize <span style="color:red">deliberation</span> as key input in governance of future generations of nanotechnology (present nano-particles etc. can be handled through <span style="color:red">risk assessment</span>)

- Sounds nice, but deliberation isn't the answer
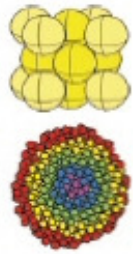
**1st  Passive nanostructures     (1st generation products)**

a. Dispersed and contact nanostructures     Ex: aerosols, colloids
b. Products incorporating nanostructures     Ex: coatings; nanoparticle reinforced
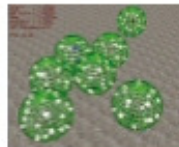   composites; nanostructured metals, polymers, ceramics

Frame 1

~ 2000
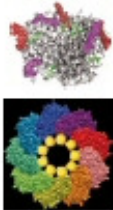
**2nd  Active nanostructures**

a. Bio-active, health effects     Ex: targeted drugs, biodevices
b. Physico -chemical active     Ex: 3D transistors, amplifiers, actuators,
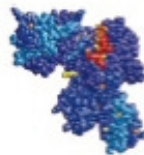   adaptive structures

Risk Governance Frame 2

~ 2005

**3rd  Systems of nanosystems**

Ex: guided assembling; 3D networking and new hierarchical
architectures, robotics, evolutionary biosystems

~ 2010

**4th  Molecular nanosystems**

Ex: molecular devices 'by design', atomic
design, emerging functions

**Source: Mike Roco (he modifies the text, but does not change the structure and timing)**

~ 2015- 2020

# Why 'deliberation' isn't the answer

- From passive to active (nano-)structures, and (later) to systems

- This implies delegation of agency to the smart technology, which can intervene to some extent (Such delegation happens again and again, ex. speed bumps ("sleeping policemen"), but then to passive structures.) Think also of smart weapons on the battlefield, & ambient intelligence making decisions.

- While not specific to nanotechnology (it enables), it must be part of its assessment
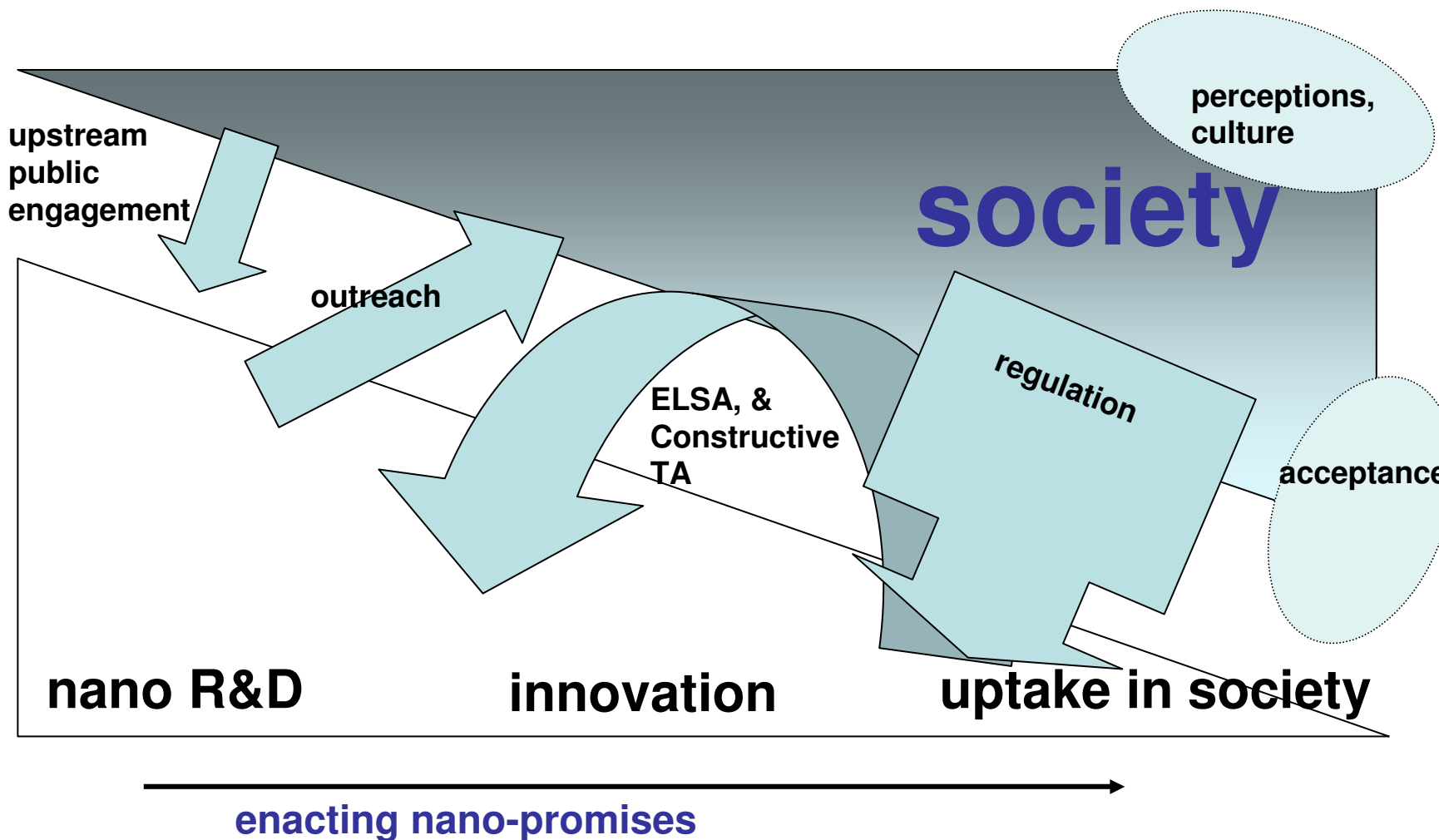
# The broader picture

- TA does not stand on its own, is part of broader changes (late-modern risk society, delegation of governance, politicking by other means)
- Doing TA, having assessments of emerging technologies – is it more than symbolic reassurance, while technological developments continue to be pushed?
- Enactors do change their ways. There is learning over the last four decades, from chemistry, to biotechnology, and now nanotechnology,
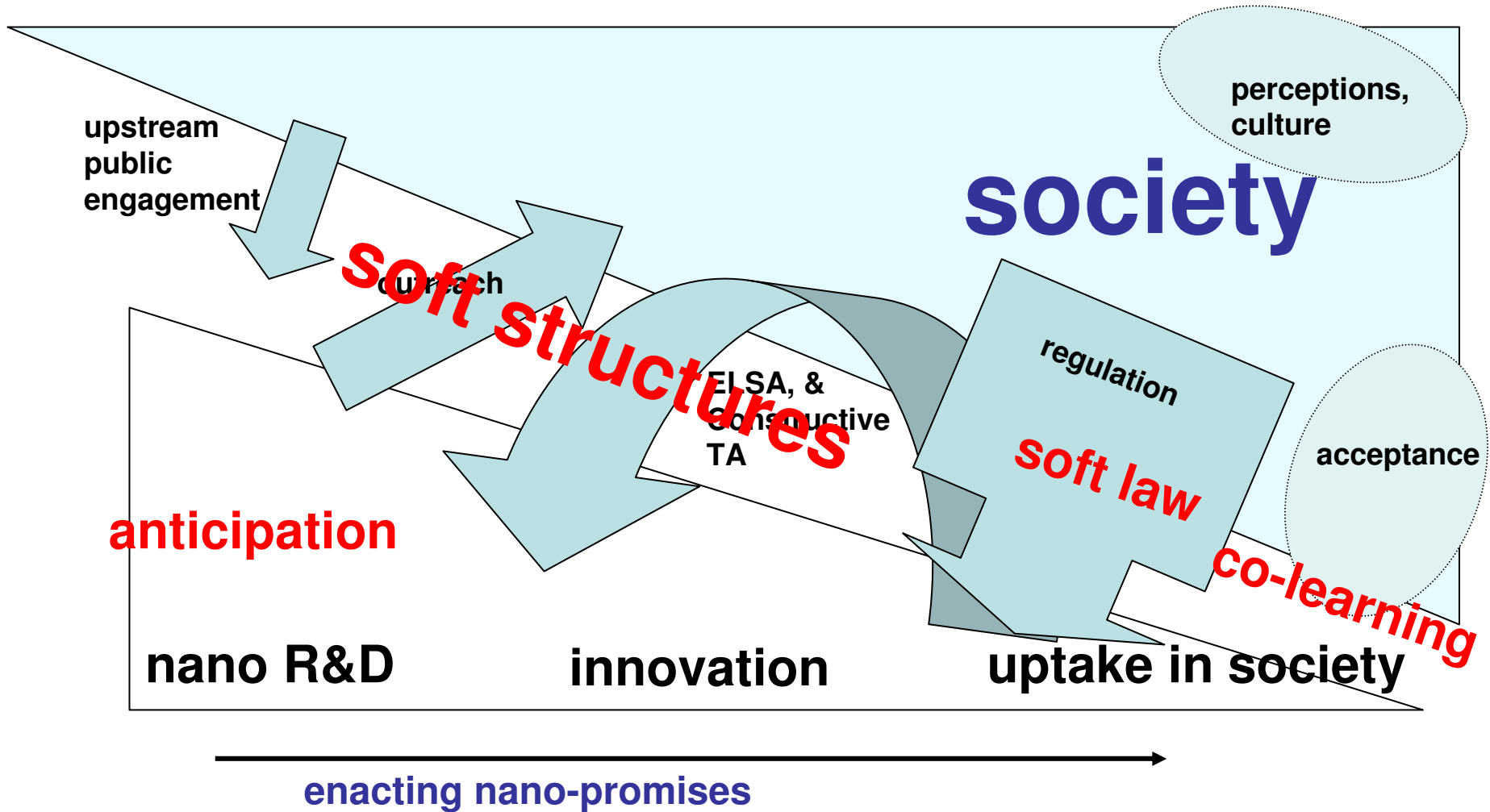- Reflexivity is here to stay?

# institutionalisation

- Of TA, as symptom of late-modern (risk) society, really only in Europe.

- Other phenomenon: emergence of structures of which TA practices (including ELSA) are an integral part

- Esp. "responsible innovation" as a trend, may become a path

- And then, for emerging technologies: how far "upstream" should one go?

# responsible development of nanotechnology

coordination, soft (and hard) governance

upstream public engagement

perceptions, culture

society

outreach

soft structures

ELSA, & constructive TA

regulation

soft law

acceptance

anticipation

co-learning

nano R&D

innovation

uptake in society

enacting nano-promises

coordination, soft (and hard) governance

society

perceptions, culture

upstream public engagement

lock-in – TA follows?

soft structures

outreach

ELSA, & constructive TA

regulation

soft law

acceptance

co-learning

anticipation

nano R&D

innovation

uptake in society

enacting nano-promises

# In conclusion

- Five themes which I see as significant, and assess as important/desirable
- Focus on (anticipatory) assessment
- Two levels of promise in/of emerging technologies
- De facto assessment in societal agenda-building
- Deliberation? Analysis of delegation!
- Discourse and practice of responsible innovation

# There's more to say

- Value-sensitive design as pro-active TA
- Ethics of new and emerging ST: analysis of patterns of moral argumentation
- Emerging technologies as a <u>site</u> to trace new developments in TA (TA+)
- TA is not a tool, but <u>part of reflexive co-evolution</u> of science, technology and society
- And <u>making</u> it more reflexive

# Future of TA?

- Part of reflexive co-evolution, making it more reflexive – how exactly?
- Patterns in co-evolution (result from entanglements); dynamics of technological development and its embedding in society
- TA exercises contribute, modulate co-evolution
- TA analysts?

# The <span style="color:red">entangled</span> analyst

- In our (C)TA of nano, we move about, and engage, intentionally or unintentionally (soft intervention)

- Constructive/critical anthropologists of the nano-world?

- This contributes to the defining and ordering of the social (and so its stabilization) – *pace* Latour

- But can also create openings, irritations (have a division of labour for analysts?)