Assessment of Emerging Technologies

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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, and help embed nanoscience and technology in society (lubricant function?)

Part of a larger dynamic: reflexive co-evolution of nano-ST and society
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
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

OTA approach now EPTA peters out??

1990s: T-policy as receptor of TA

agenda building, broadens to include participation

strategic intelligence

further opening-up of idea of TA

product & market oriented TA

Medical & Health TA

environmental impact assessment, social impact assessment
By late 1990s: new governance of technology, technoscience

- Public engagement with new ST
- Broadening of product TA, medical TA
- Constructive TA
  - Assessment of emerging technologies
- Responsible development of new technosciences
- ELSA studies
- Sub-politics, neo-corporatism
- Globalisation of TA?
Anticipation?

• Conundrums of knowing about the future
• Occupational hazard of TA: reification 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 science fiction
- Consideration of effects/impacts of nanotechnology (up to third industrial revolution, human enhancement) is social science fiction
- 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 spaces for new options

• New options that will reconfigure the world? projections of future worlds

• 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”)
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)
1. Signalling of an ‘opportunity’
2. Promises, with diffuse stories/scenarios about possible ‘worlds’
3. Accepted promise = agenda for further techno-scientific work
4. Requirements: functions that the new technology must fulfill to meet the promises
5a) ‘Protected space’ for activities
5b) Activities to meet the requirements
6. Mini-cycles: detailed opportunities, promises/stories, requirements and activities
7. Certain technological outcomes and uses

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)

Basic idea: Van Lente, Rip (early 1990s); visualisation by Geels
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 ...
Plastic: a waterproof vision of the future
image of 2000 in 1957, from Corn and Horrigan (1996)

The materials of material culture: multiple narratives
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/legitimacy 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: first denial that there are risks; then 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?
nano-particles, esp. nanotubes, have wonderful new properties ongoing research, first & simple applications of nanotubes

ETC group: there might be risks

No, say nano-actors

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

HES becomes legitimate issue

discussion of regulation, agencies produce drafts

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

research and application dynamics prevail

recognition of broader concerns; and reluctance to flag nano

positioning and overall agenda building

broad and unfocused debates

gov. agencies sectoral org’s

2004

2006

2004

some actors criticize narrow focus

exclusive focus on HES, rather than uses of nanotubes

soft law?

proceed cautiously

some actors criticize narrow focus

forget about nano-tubes

recognize the importance of nano-actors

governance and overall agenda building
TA and deliberation (about risk)


• They emphasize *deliberation* as key input in governance of future generations of nanotechnology (present nano-particles etc. can be handled through *risk assessment*)

• Sounds nice, but deliberation isn’t the answer
1st Passive nanostructures (1st generation products)

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

~ 2000

2nd Active nanostructures

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

~ 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)
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

nano R&D  →  innovation  →  uptake in society

enacting nano-promises

upstream public engagement

outreach

ELSA, & Constructive TA

regulation

acceptance

perceptions, culture

society
coordination, soft (and hard) governance

upstream public engagement

nano R&D

innovation

uptake in society

enacting nano-promises

perceptions, culture

acceptance

co-learning

soft law

soft structures

ELSA, & Constructive TA

anticipation

soft structures
coordination, soft (and hard) governance

upstream public engagement

ELSA, & Constructive TA

perceptions, culture

regulation

acceptance

co-learning

soft law

soft structures

lock-in – TA follows?

nano R&D

innovation

uptake in society

enacting nano-promises

anticipation

co-learning

soft structures

society
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 site to trace new developments in TA (TA+)
- TA is not a tool, but part of reflexive co-evolution of science, technology and society
- And making 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 **entangled** 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?)