



Dual Dynamics of technological promises
&
waiting games
around nanotechnology

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29 October 2010

Tentative Governance In Emerging Science & Technology

How much actual nano innovation?

- There are new products, but not many, and quite **mundane** (compared with the breakthrough promises)
- **‘Waiting games’** occur:
 - Nano-enabled drug delivery (“magic bullets”) is pushed by researchers but Big Pharma is not interested (or waits)
 - Organic [semi-conducting polymers] large-area electronics: interesting but unclear whether there will be a demand – because it is unclear what producers will develop (and the producers wait for signals from users)
 - Nano in food packaging: the industry is nervous about consumer acceptance
- To understand waiting games in NEST: Include **dual dynamics of promises**

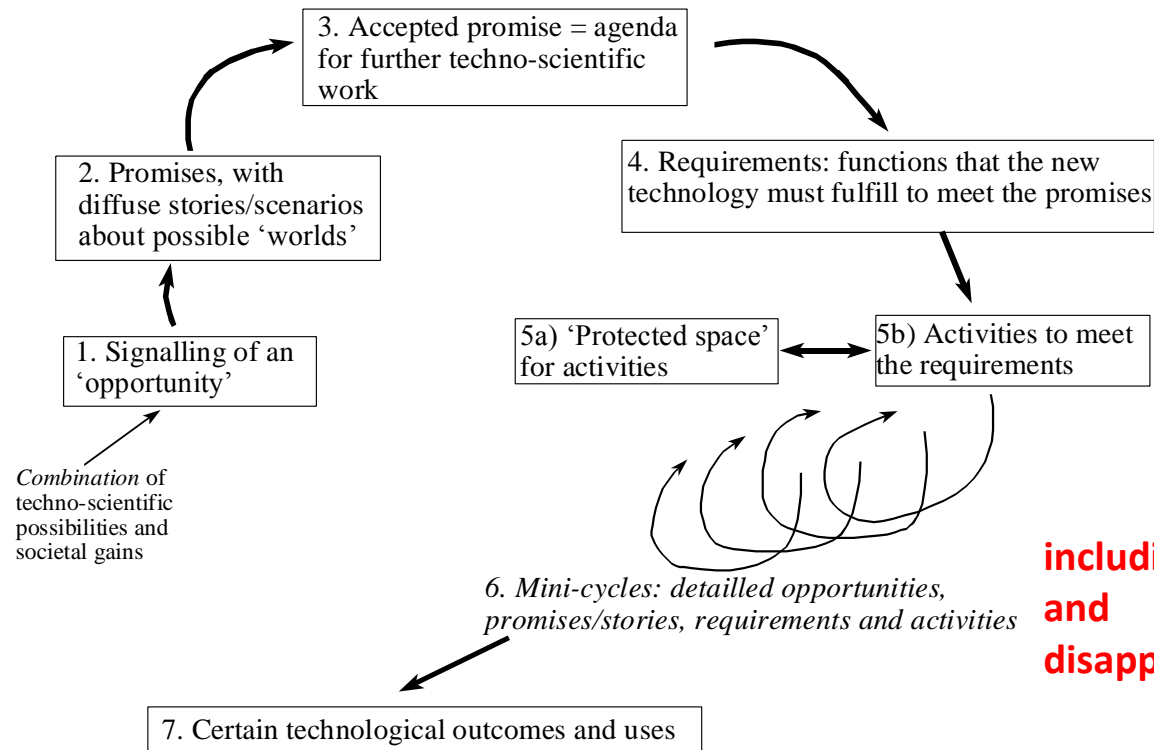
Dual Dynamics of Promises

Umbrella promises

Repertoire of open-ended promises and concerns, and diffuse agenda building

Remain general:
Nanotechnology bringing the next industrial revolution.
Link up to general challenges captured in fancy slogans like "Green electronics" which lead a life of their own.

Promise-requirement cycles



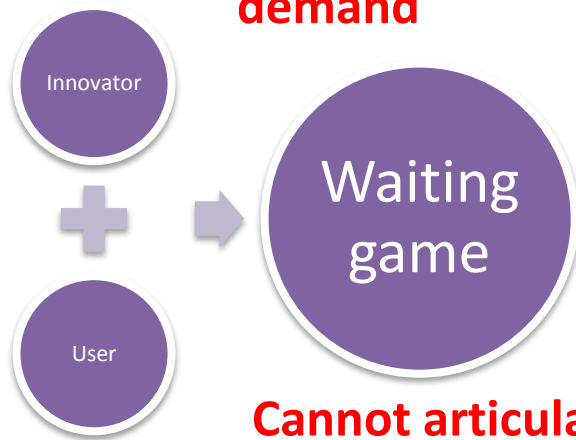
Basic idea:
Van Lente, Rip
(early 1990s);
visualization
by Geels

including failures
and
disappointments

Why do waiting games emerge and continue?

- Umbrella promises: Too Uncertain for actors to Initiate concrete product requirement cycles

Reluctant to invest because there is **no clear demand**



Cannot articulate demand because it is not clear what might be offered

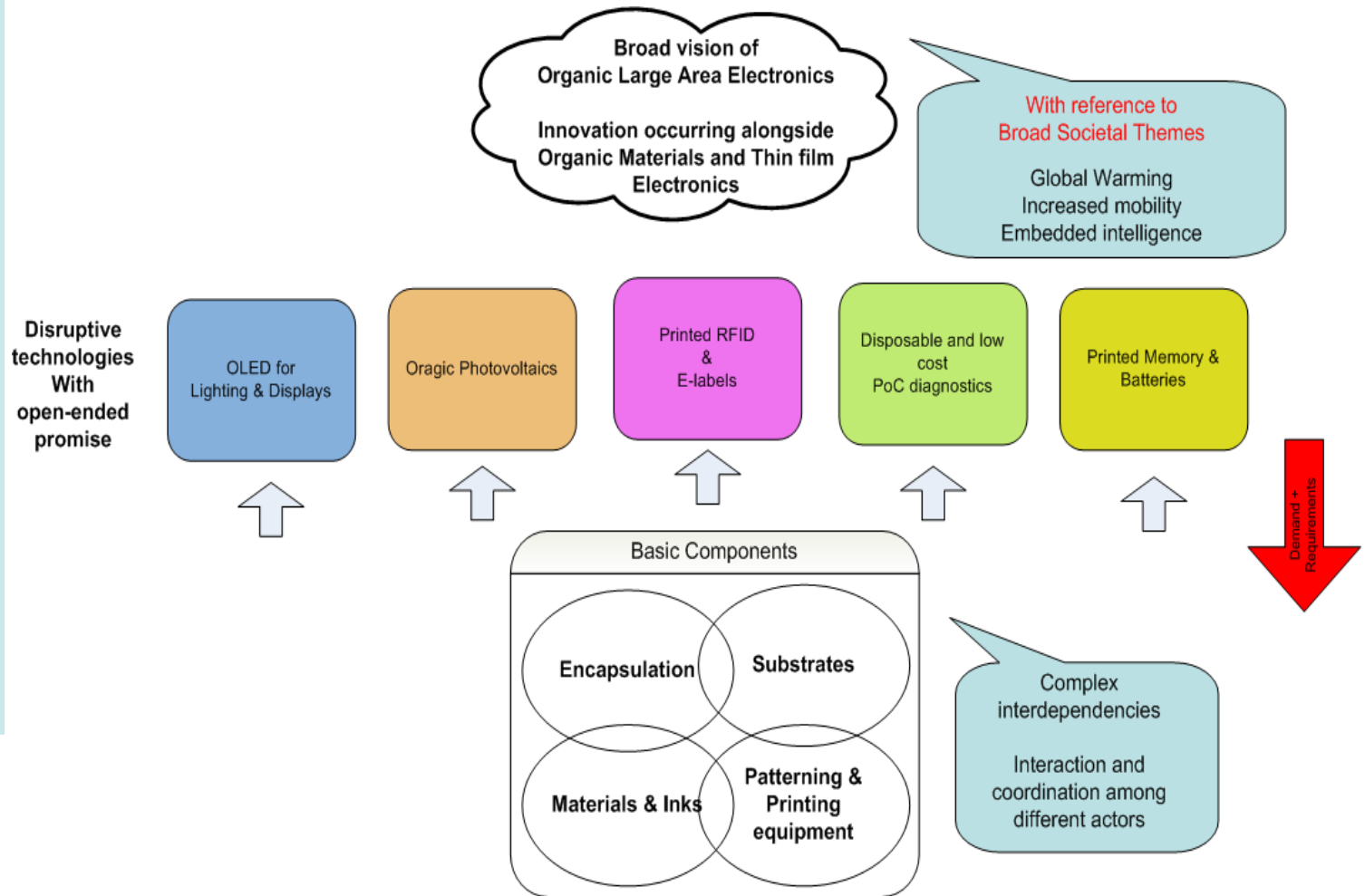
While there are **generic promises** “Out there” that assume that this demand will be realized. **Somehow!**



Organic Large Area Electronics

Umbrella Promise

Absence of promise requirement cycles



Organic Large Area Electronics

Umbrella Promise

- Normative reference captured in slogans like: **“Towards Green Electronics in Europe”**
- Taken up in SRA and policy documents.
+ reference to a future demand! **A \$ 300 billion industry by 2027**
- Economic interest: **Forecast reports** (cf. Nanomarkets & IDTechex)

Absence of
promise
requirement
cycles

The numbers make an interesting reading
“Printed electronics” will exceed \$7 billion by 2010
Disposable electronics will be \$40 million by 2010

Organic Large Area Electronics

Umbrella Promise

Absence of promise requirement cycles

- Up to the point – **Cintelliq warns for inflated expectations** (news article on Cintelliq.com, 2009)

“Setting market expectations ahead of what industry realistically can achieve will not accelerate technological development nor quicken the adoption rate. Failure to do so will lead to Disappointment, Disillusion and difficulty to access investments”

“We believe that at this point in the evolution of the industry it is pointless to expend time and effort on estimating the future market demand for products that do not yet exist”
- **Industry analysts warn that Europe might be loosing the race** (see IDTechEx, is Europe loosing the race)
- **Rhetorically very powerful** – suggesting that the region will miss junction with huge market potential

Organic Large Area Electronics

Umbrella
Promise

Transition from laboratory to products is inhibited by:

- **Novel and unproven technologies + complete new markets**

Strategic uncertainty: Technology/product paths

**Absence of
promise
requirement
cycles**

- **OPREA** vision paper 2008:
 - Organic large area electronics has grown autonomously without coherent strategy: **No Articulated Directions and implementation strategies**
- **OEA Roadmap** 2008:
 - Not able to identify **“Killer Application”** nor a **“Moor’s Law”**

Organic Large Area Electronics

Umbrella
Promise

Stakeholder meeting report EU commission 2007

- “End-users do not know enough about possibilities of the technology due to high complexity” and suggests to educate end-users.
- End-users are not willing to take risks, So: (Device, equipment, materials manufacturers) have to take risks. They suggest more funding is required especially for manufacturing and demonstration.

Absence of
promise
requirement
cycles

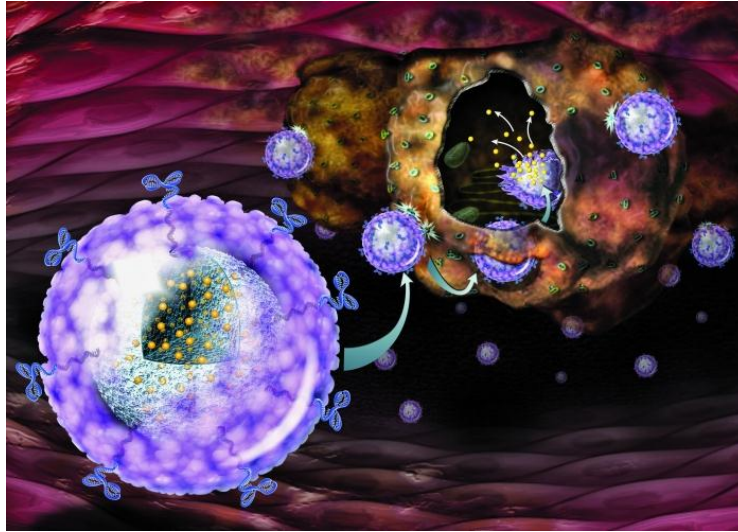
Reaction of Heidelberg (a leading printing press manufacturer)

“I can't see Heidelberg commercially printing electronics or developing the equipment for a long while yet and there is no point in developing a printing kit or system when there are no existing customers ready to buy them..... We want to avoid speculatively developing equipment or printed electronics products until the technology and the market are more mature”

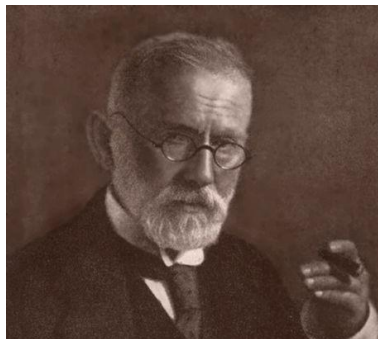
Nano-enabled drug delivery system

Umbrella Promise

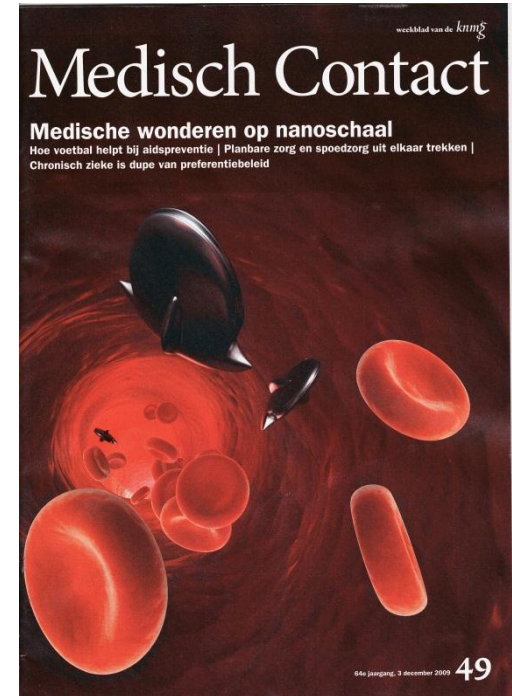
Absence of promise requirement cycles



- Targeted drug delivery as a magic bullet



- Paul Ehrlich's 'Zauberkegeln' - early 20thC.



- “Medical wonders at the nano scale”

Nano-enabled drug delivery system

Umbrella Promise

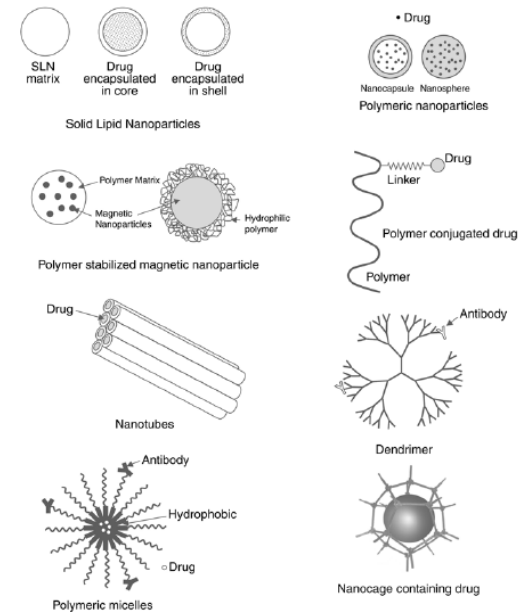
- 'Magic Bullet' constitutes an Umbrella Promise
- Nano-sized' targeted drug delivery carriers & more specific promises

Umbrella promise at work: (ETP Nanomedicine 2005 vision paper)

- contribute to important challenges: **patient acceptability**, reduction of **health care costs**, and delivery of (difficult to deliver) **novel classes of drugs**.

Absence of promise requirement cycles

Problem	Effect of DDS
Poor solubility	DDS such as lipid micelles or liposomes provide both hydrophilic and hydrophobic environments, enhancing drug solubility.
Tissue damage on extravasation	Regulated drug release from the DDS can reduce or eliminate tissue damage on accidental extravasation.
Rapid breakdown of the drug in vivo	DDS protects the drug from premature degradation and functions as a sustained release system. Lower doses of drug are required.
Unfavorable pharmacokinetics	DDS can substantially alter the PK of the drug and reduce clearance. Rapid renal clearance of small molecules is avoided.
Poor biodistribution	The particulate nature of DDS lowers the volume of distribution and helps to reduce side effects in sensitive, nontarget tissues.
Lack of selectivity for target tissues	DDS can increase drug concentrations in diseased tissues such as tumors by the EPR effect. Ligand-mediated targeting of the DDS can further improve drug specificity.



Source: Allen & Cullis (2004)

▪ Sahoo et al. 2008

Nano-enabled drug delivery system

Umbrella
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Lack of investments

- Reluctance of large pharma companies towards nano-drug delivery. indicated in a review of tech & commercial developments (Couvreur and Vauthier, 2006)

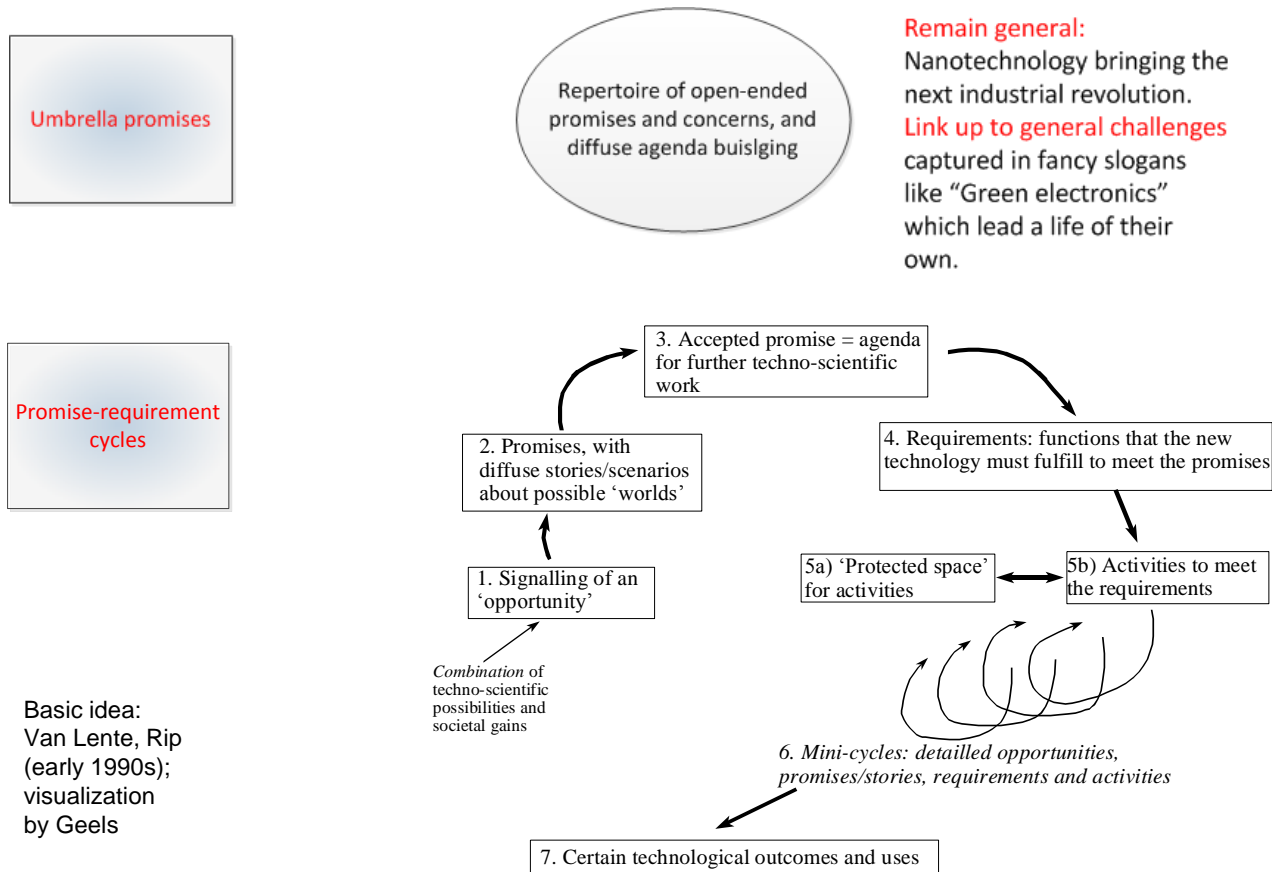
“Today, most **developments** are **carried on by small entrepreneurial firms** including **many spin-ups** that cannot support themselves as yet on current revenues, whereas **big pharmaceutical companies seem still awaiting for more successes.**”

Lack of articulated demand

- Indicated by difficulty to involve pharma companies in R&D projects or broad stakeholder fora such as the ETP Nanomedicine.
- MediTrans (EU funded consortium) argues: Lack of involvement of pharma companies will impede introduction of nanotechnology in clinics.

Waiting games - a structural challenge for NEST

- Despite differences between sectors, there is a **general pattern**, coupled with **dual dynamics promise**.
For **NEST** this is **structural**: it lives on promises. Thus, vulnerable for waiting games.



Other explanations for the waiting games

- **Drug Delivery: Intersection of two value chains**

- **Carrier development** and production & **Drug development** and use in treatments
- Big Pharma waits for innovative startups and Innovative startups wait for investors (including big pharma)

Regulatory issues may reinforce waiting games

- **Uncertainties about standards and methodologies** for assessments of new nano enabled technologies

- **Organic electronics: Intersection between many value chains**

- Material suppliers + printer manufacturers are serious
- **Device and system producers are reluctant**- No demand articulated
- So no way to choose among different product development options

Two issues reinforce the waiting game situation:

- There is also huge technological uncertainty: **Existence of reverse sailent**
- Anticipation on changing business models

In conclusion

- Other explanations for waiting games derive their force from the existence of a diffuse promise.
- So, waiting games are predicated on the existence of a diffuse promise about the potential of a technology which circulates in relevant sectors

The absence of promise requirement cycles in dual dynamics of promises has the net effect:

- Promises may remain on the radar of the various actors, even when little (successful) developments take place.

How to break through waiting games?

- In a waiting game situation: **No strong initiatives!**

The question is what initiatives can breakthrough such difficult situation?
And more importantly what might happen then?

Our contribution in CTA-workshops:

- Socio-technical scenarios: actors try-out different possibilities.

Added value to Roadmaps and actors own analysis:

- Reduce uncertainty** to show initiatives to break through
- Then, add complexity (**non-linear effects, shifts and repercussions**)

