

Socio-economic dynamics of innovation and uptake

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What are the key points?

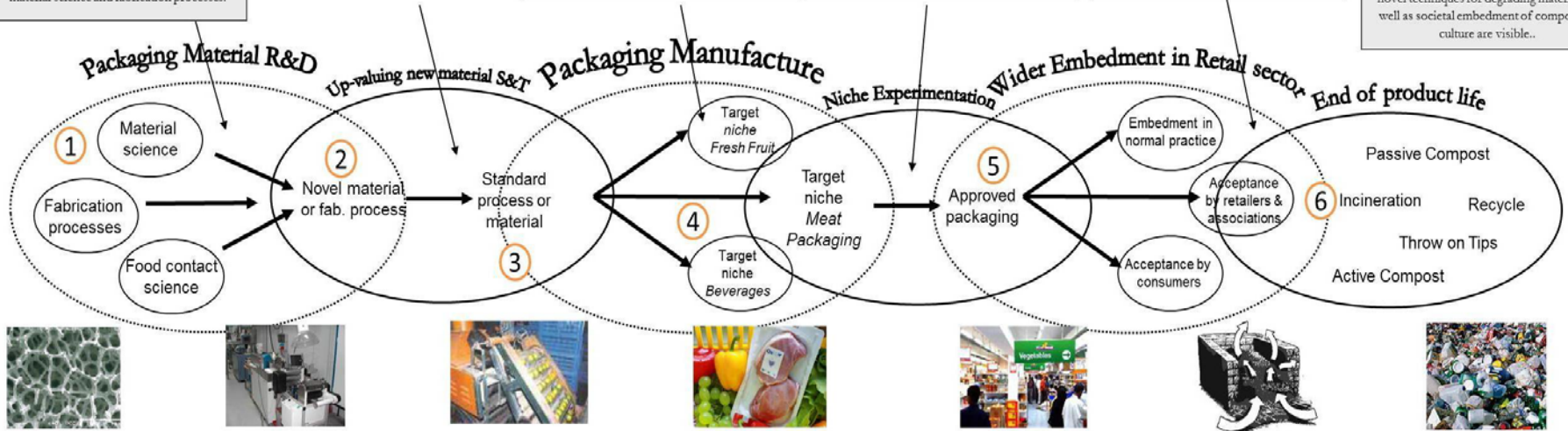
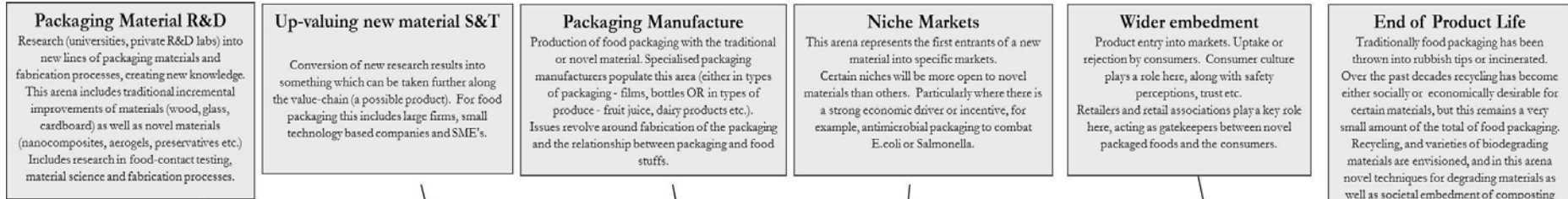
- Nanotechnology is an enabling technology, so value chain dynamics are important
- Impacts are not there yet, and simple economic indicators are an illusion
- Need to add bespoke indicators related to innovation and embedment pathways
- **This is possible!** Qualitative indicators, for example through Constructive TA scenarios

Enabling nanotechnologies

- Nano can play a role in many sectors (both products and manufacturing processes) and to a varying degree of intensity (see O'Rourke paragraph 14)

Nano-element	Function/role	Enabled innovation	Envisioned product
Nanomaterial	⇒ Antibacterial coating	⇒ Food processing	⇒ Safe Jam / Jelly
Nanocrystal	⇒ Photon conversion	⇒ Photo-voltaics	⇒ Competitive solar cell options
Nanobiosensor	⇒ Improved detection	⇒ Medical diagnostic	⇒ Disease detection
Nanobiopolymer	⇒ Biopolymer with Rigid and fluid impermeable	⇒ Food and drink packaging	⇒ Biodegradable and biosourced packaging

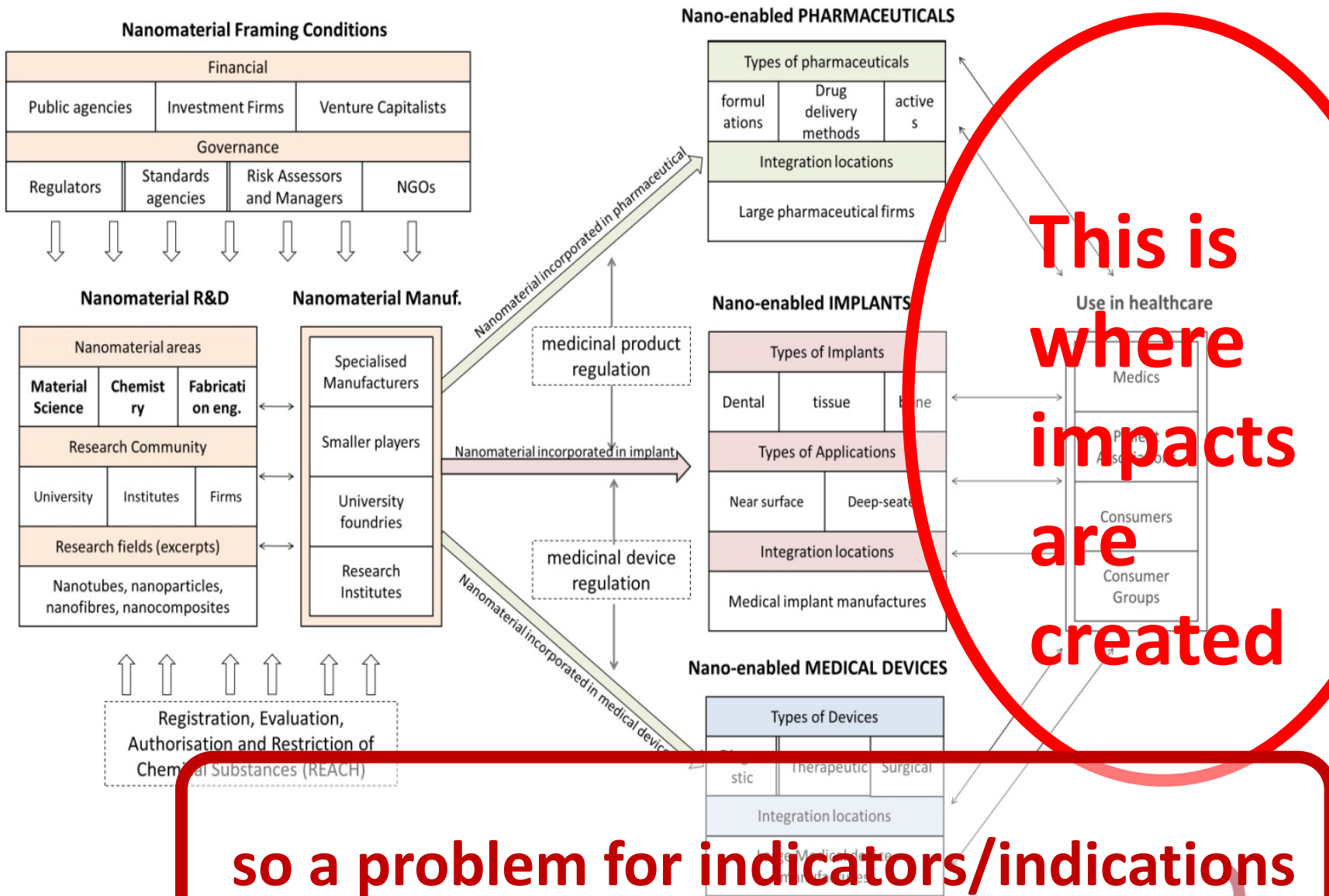
lots of nano-options enabling innovations across the food packaging life cycle (production to waste management)



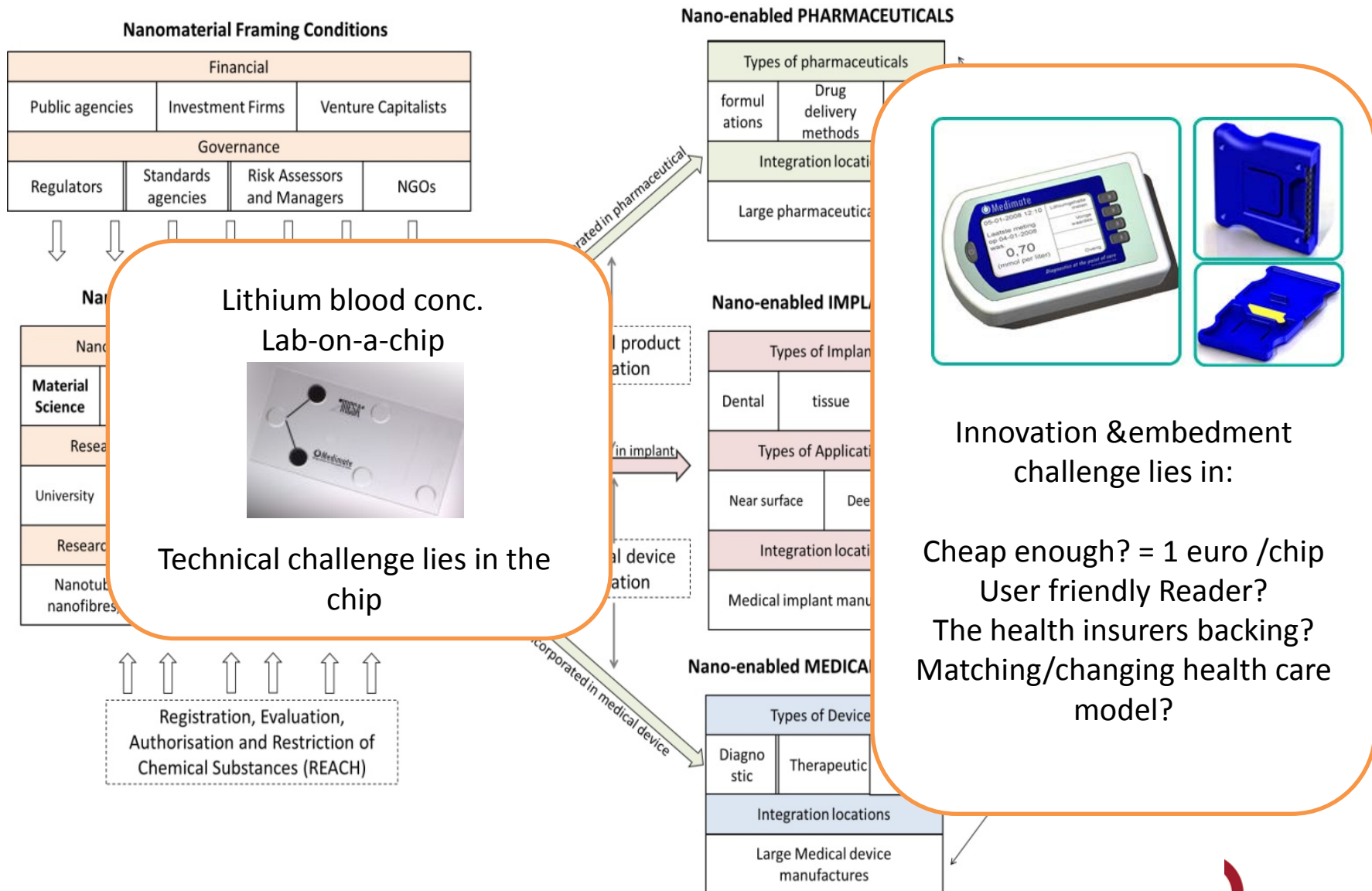
Issues and dynamics effecting potential packaging innovation journeys through the IC+

Bioplastics R&D funding Funding calls for bioplastic innovations are increasing, with some linked to nanomaterials. This provides resources but little guidance in R&D choices.	Novel food regulation The recent collapse of the Novel Food Regulation in March 2011 means that nano-foods remain unregulated and are not subject to European labeling requirements.	Food Contact Regulation Plastic Implementation Measure (PIM) - 14262/10 The regulation on plastic materials and articles intended to come into contact with food, comes into force May 2011.	Nanomaterial toxicity? Limited knowledge of fate of nanomaterials in the body and environment, including toxicokinetics. Some guidance exists (EFSA 2011).	Specific Economic Challenge As the cost of fossil fuels rises, so does the production of petrochemical based plastic packaging. In addition, fines and penalties on food packaging waste in various countries.	Diffuse Societal Demand A broader more diffuse notion of sustainability and environmentally friendliness., Affecting consumer choices and increasing demand for alternatives.
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Conclusions 1

- **simple indicators of socio-economic impact are an illusion**
 - This is put very strongly; the modest version is that they are at best a first step.
 - *Cf. background papers and outputs of the break out sessions yesterday*
- **The key value added may occur at quite a distance from the laboratory where the technoscientific knowledge originated**
 - *But as was said in the opening session: we have lots of tools and approaches already. We can move forward (in spite) of the complexity and do better.*
- **HOW?** – recognise and act on the fact that innovation and uptake (therefore impacts of nanotechnologies) are distributed!

Both innovation and uptake are distributed

- Fact of life, well-known, but difficult to take up in analysis.
- **Implication 1:** options may not be realized, and/or work out in a different direction than intended
- **Implication 2:** uptake and eventual impact depend on many other actors than technology developers and producers (up to 'third parties' like health insurance companies in nanomedicine)
- Our work on Constructive Technology Assessment provides examples that illustrate this.....

Organic Large Area Electronics – to replace silicon-based electronics, at least for low performance applications

Open-ended promises, leading to **waiting games** within the value chains and in interaction between producers and customers/users

too uncertain to invest
in options, without
clear demand

no articulation of
demand because no
clear product options



A waiting strategy

- Interview with Martin Schmitt-Lewen, manager of functional printing at Heidelberg Company

there is no point in developing a printing kit or system when there are no existing customers ready to buy them, considering very few companies in the printed electronics market are scaling up production. Particularly in RFID and active packaging space, there is no requirement for large print press systems. (...) We want to avoid speculatively developing equipment or printed electronics products until the technology and the market are more mature". (p. 37)

Between the lines: what is Heidelberg's real plan for printed electronics? *Plastic Electronics Magazine* (2009) 1: 6, 32-39

Business models have to change:

- **Printing firms** making inroads in electronics sector?
- **Electronics Manufacturers:** If moving to OLAE, cannibalisation of existing product portfolios
- **Material suppliers:** are proactive, but forward integration will compete with own clients
- **Printer Manufacturers:** Change present business model (profits based on inks) to profits based on equipment and service
- **New types of firms** like design houses of OLAE materials

Business models have to include users

- Example of Lab –on-a-chip. High expectations in 90s, dominant vision of Total analysis systems and point of care diagnostics.
- Large initial Investment, Little return, withdrawal of private capital.
- Demand side was poorly articulated (articulated based on technology developers visions of what a demand could be)
- Articulation necessary. Medimate's sensor now has a business model with direct interaction with stakeholders (insurance company, medical practitioners), plus end-users in an advisory committee

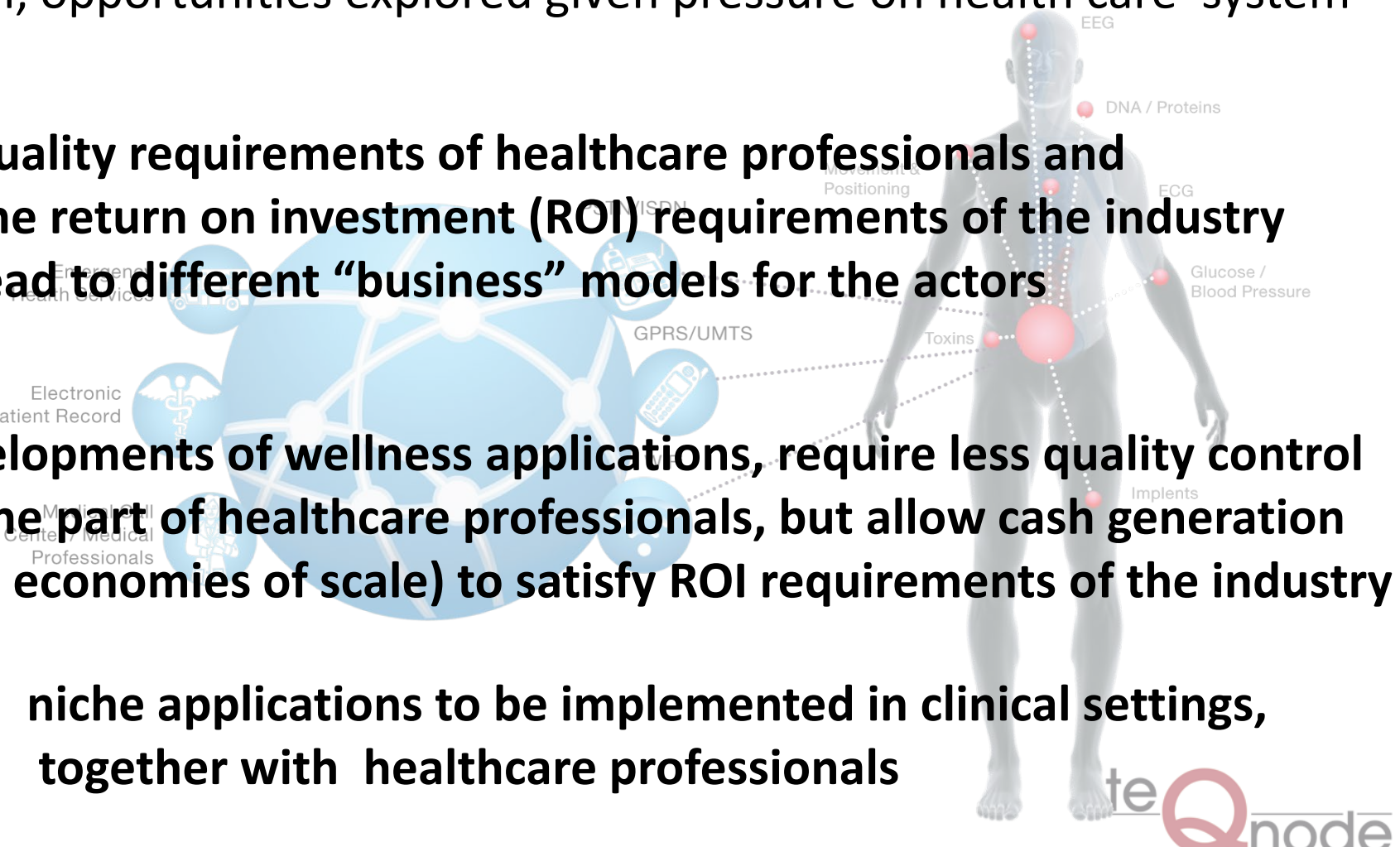
Body Area Networks in health care

Wait-and-see positions with developers as well as problem-owners; still, opportunities explored given pressure on health care system

quality requirements of healthcare professionals and the return on investment (ROI) requirements of the industry lead to different “business” models for the actors

developments of wellness applications, require less quality control on the part of healthcare professionals, but allow cash generation (and economies of scale) to satisfy ROI requirements of the industry

niche applications to be implemented in clinical settings, together with healthcare professionals



Conclusions 2

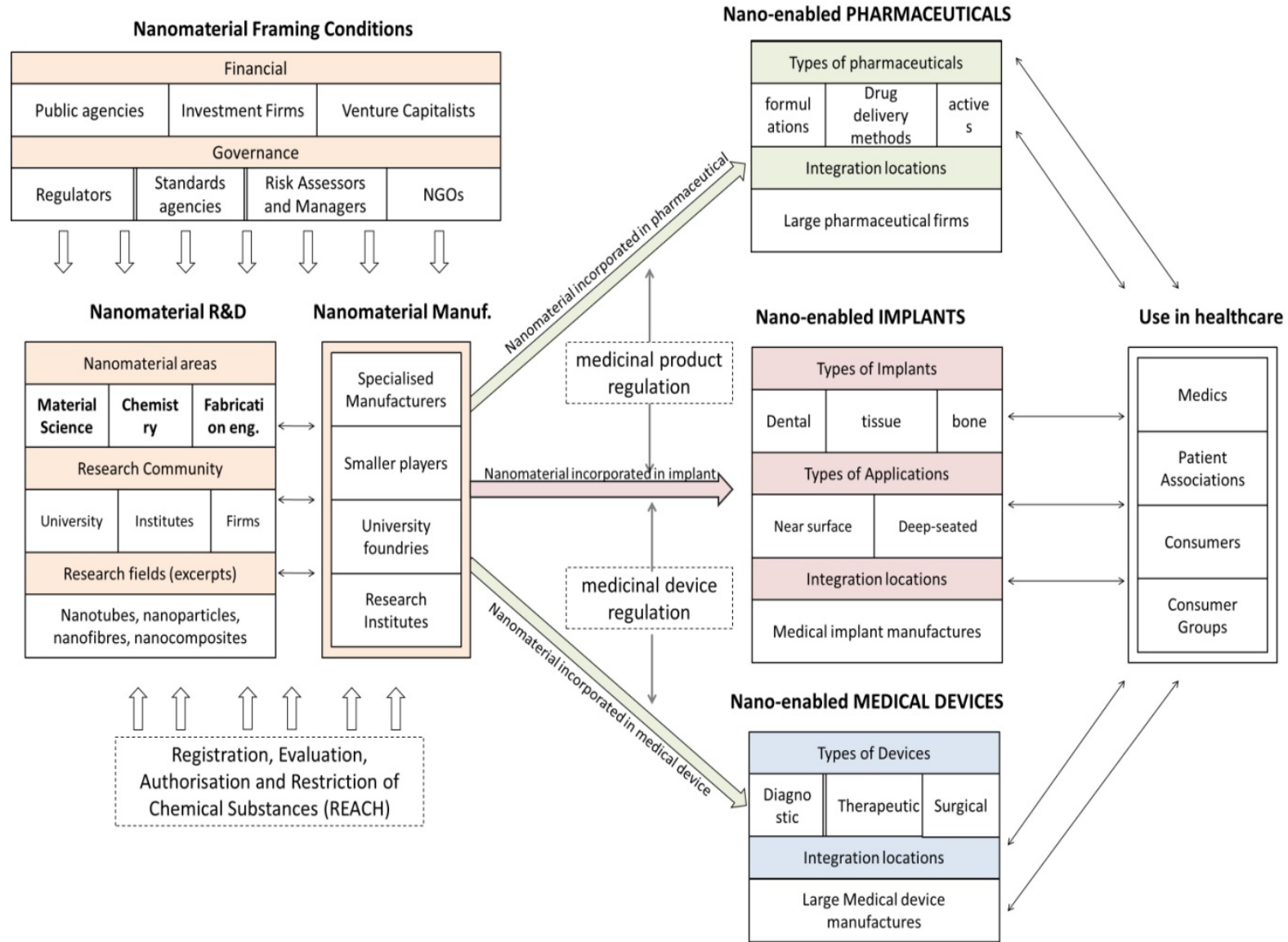
- Actors other than the initial nanotechnology developers become important, and **their positions and perspectives have to be taken into account** by technology developers and producers. Already now? To avoid trial & error learning?
 - Cf. present meeting. One example is the call (and action!) to include Life-Cycle Analysis early in the design of products
- Claims about expected socio-economic impact have to be accompanied by assessment of **changing business models** and **evolving value chains + framing conditions (regulation, investment landscape, policy)**, as intermediary variables, otherwise these claims remain empty

 These are not nano specific but are domain specific and implication specific, so **bespoke indicators are needed.**

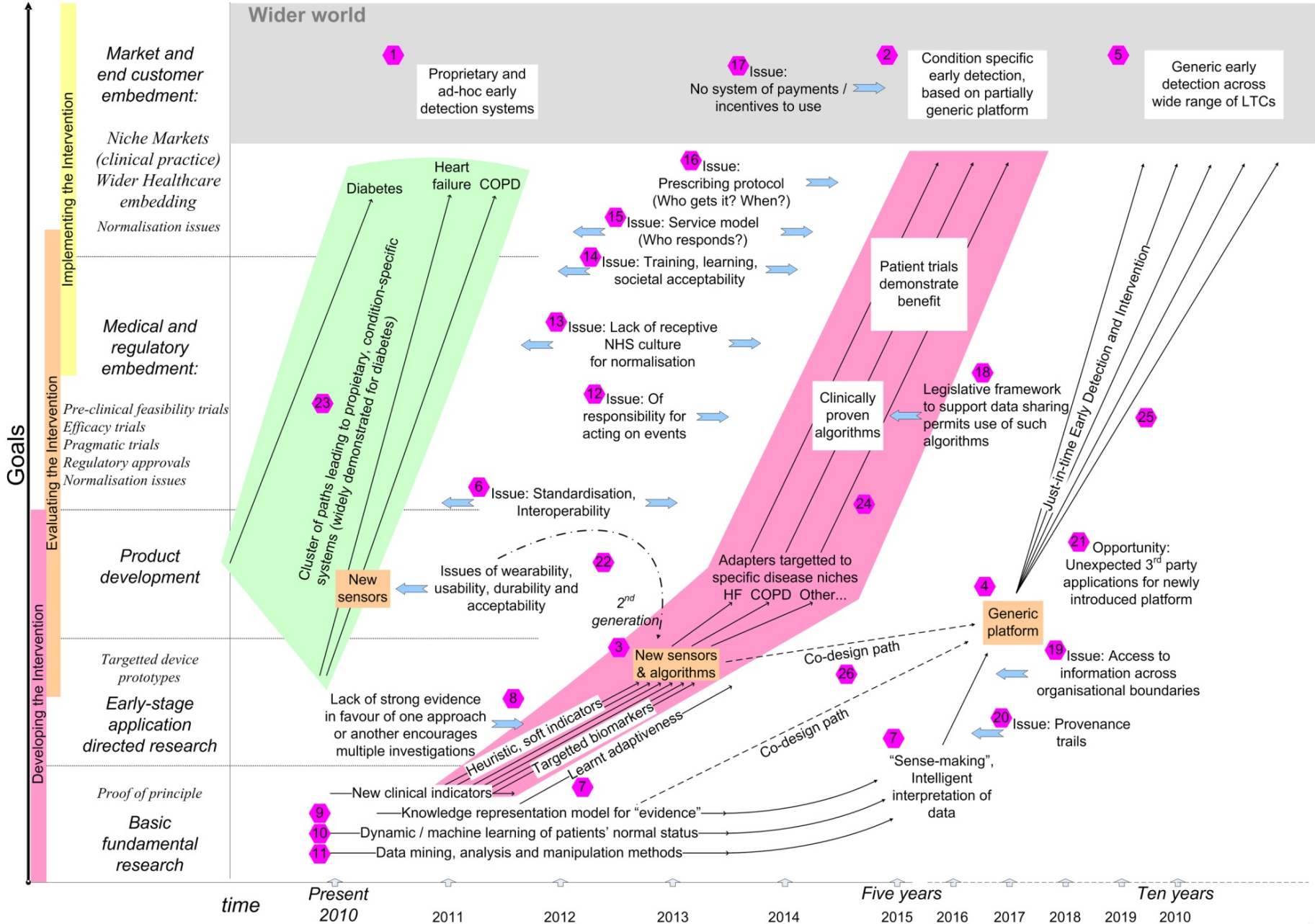
develop “**bespoke**” indicators based on Innovation and embedding pathways

- Embedding is where final success and final impact is realized.
- Embedding is out of the hands of the technology developers (although they can anticipate and augment– and I make a suggestion on how to do so).
- One can trace innovation, uptake and embedding processes retrospectively (in innovation studies and technology studies)
- Also **prospectively**, because there are general patterns.
- Requires input from actors and factors across value chains
 - Cf. the discussions of the results of the breakout sessions yesterday

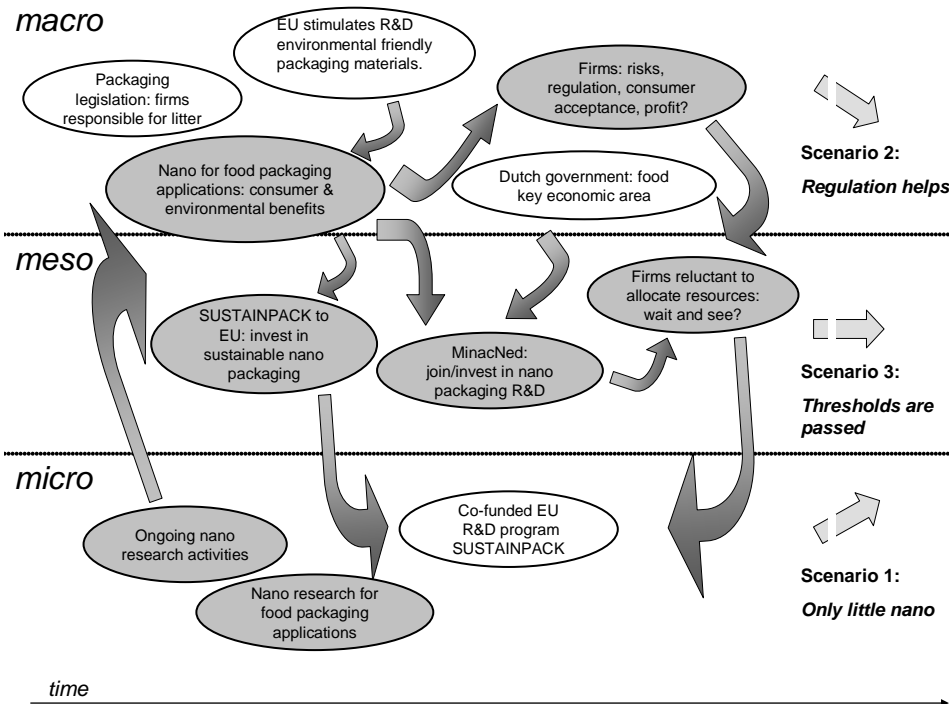
Actors & factors across value chains (inc expectations)



Innovation and embedment pathways



Innovation and embedment scenarios



- Ongoing dynamics, forcefields, strategic games
- Evolving value chains, industry structures
- Three possible interventions, scenarios about repercussions
- In the scenarios, bespoke indicators of positive/negative impacts can be determined

Scenarios based on
CONTROLLED SPECULATION
 Through robust methods
 & high quality data

Bespoke indicators

- The pathways have to be embedded concretely in business models (also for uptake), extended value chains, actual evolving industry structures
- **Narratives of impact (indicators)** are conditional on what's happening in the **concrete** pathways
- So *narratives of impact* are themselves dynamic: will be further articulated and perhaps shifted when the pathway continues
- Thus bespoke indicators based on value chains and innovation & embedment pathways will evolve
- Requires structured engagement
 - *> adv Mat. Break Out: “Value-Chain Consortia” as a location for developing scenarios as narratives of impact*

Conclusions 3

- **BESPOKE indicators are possible.** have to be developed with input from those who will be involved in the **innovation** and **embedment** pathways
- **Always to some extent indicators of expected impacts** (so good data on expectations & methods for controlled speculation are a requirement)
- Development of bespoke indicators can be done at the level of consortia and industry associations

Overall conclusions



- Innovation and uptake is distributed
- Eventual socio-economic impacts are co-produced by the users and third parties
- Developers can anticipate and work towards desired socio-economic impacts, productively but never conclusively because key value is realized later and the situation evolves.
- For indicators (indications) to be useful in strategy and decision making, they have to take into account expected impacts, which introduces speculation.
- **bespoke indicators based on dynamics** are a necessary addition anyway, and can control the speculation

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THANK YOU FOR YOUR ATTENTION