

Future Areas of Technology Convergence

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Medilink Yorkshire & Humberside, 8 December 2005

Technology For Industry



**Bridging the gap
between industry and
revolutionary technology
from academia and
research institutes**



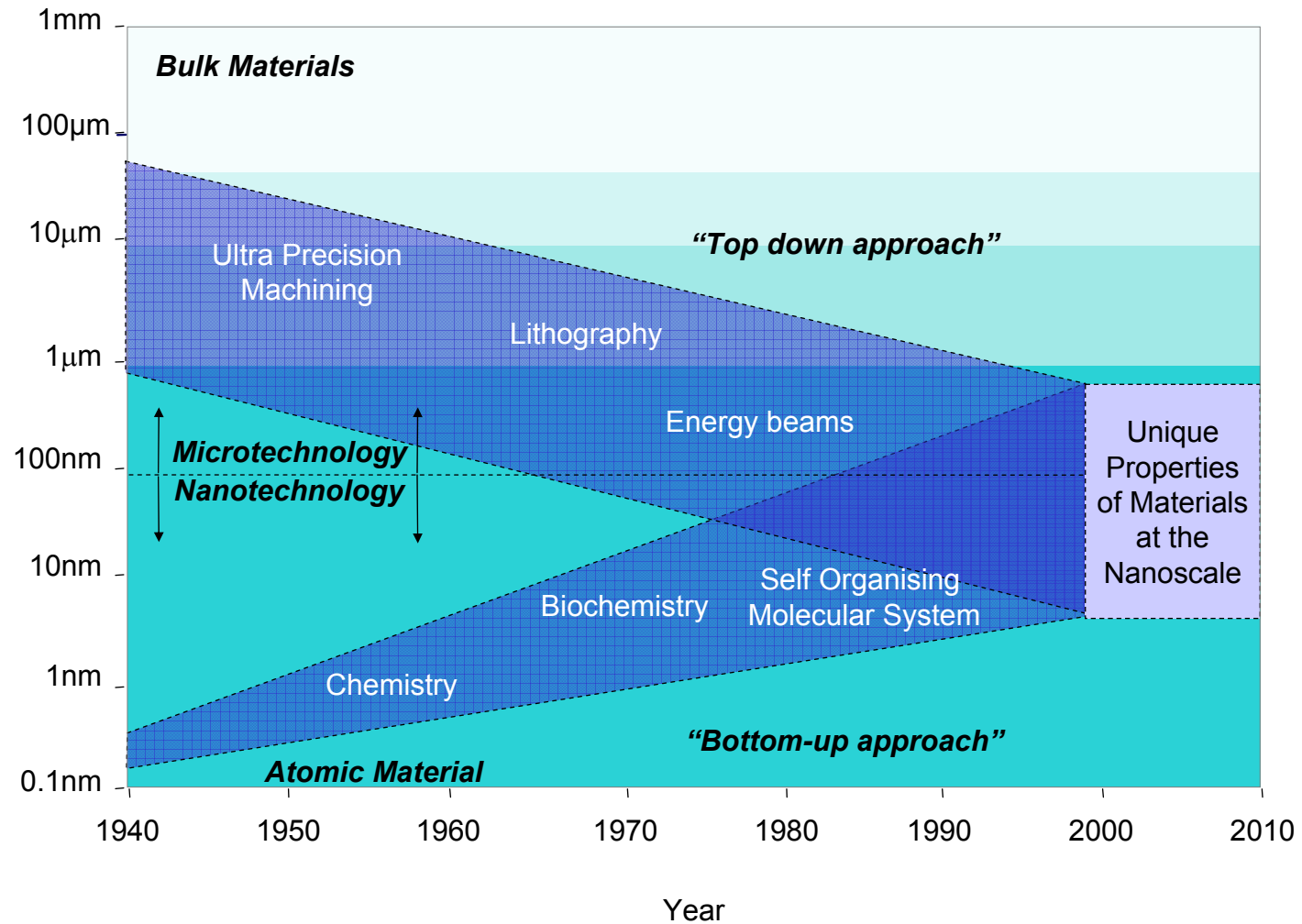
Convergence or Divergence?

What does it mean to your organisation?

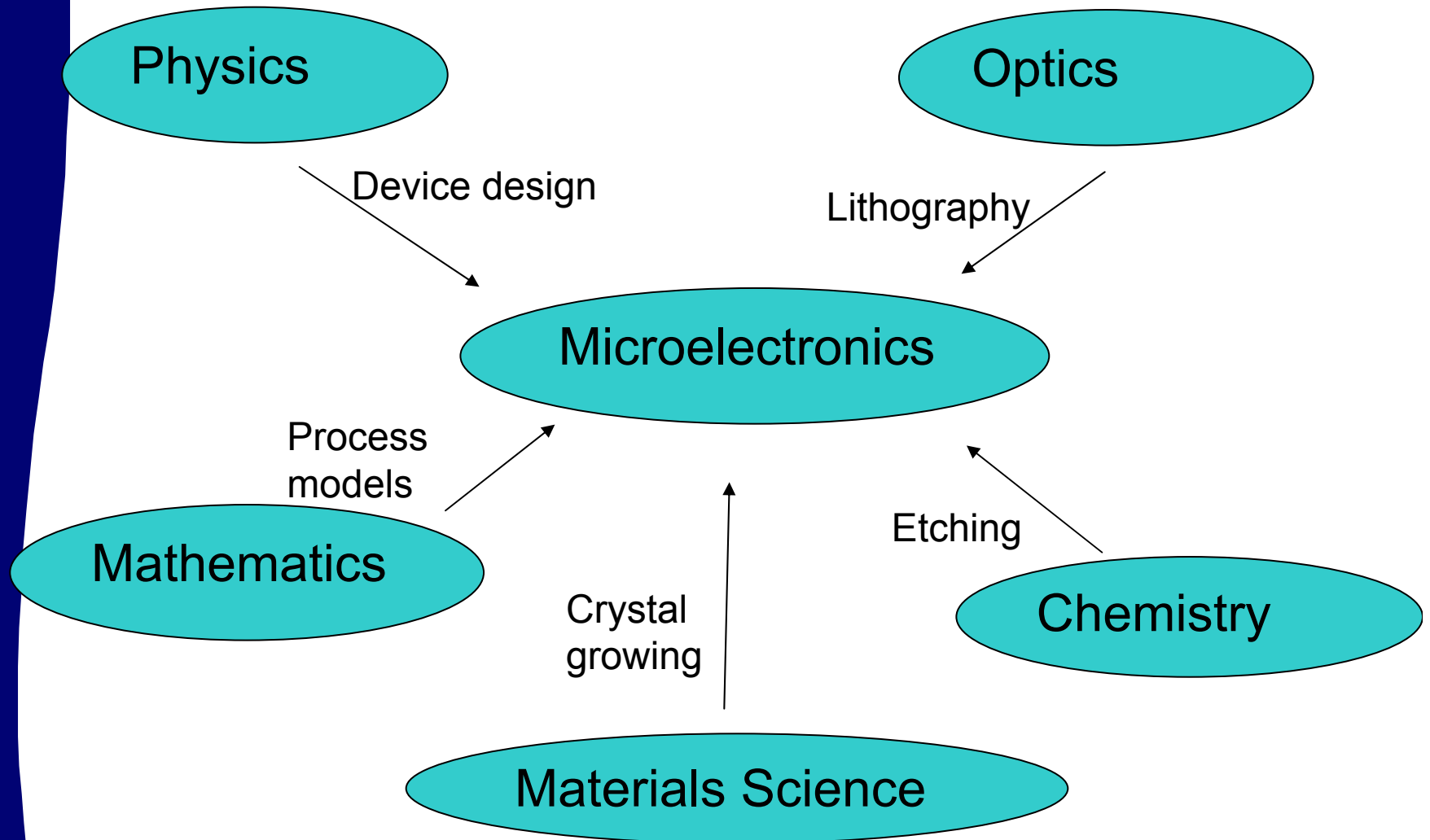
- Opportunities – new ways to add value
- Threats – your staff will need to learn new skills
- The supply chain will change – new suppliers and customers

...before we get out the crystal ball to try to look in to the future let us see what we can learn from the past

Two routes to the Nanoscale



Technology Convergence in Microelectronics



Technology Convergence in Microelectronics

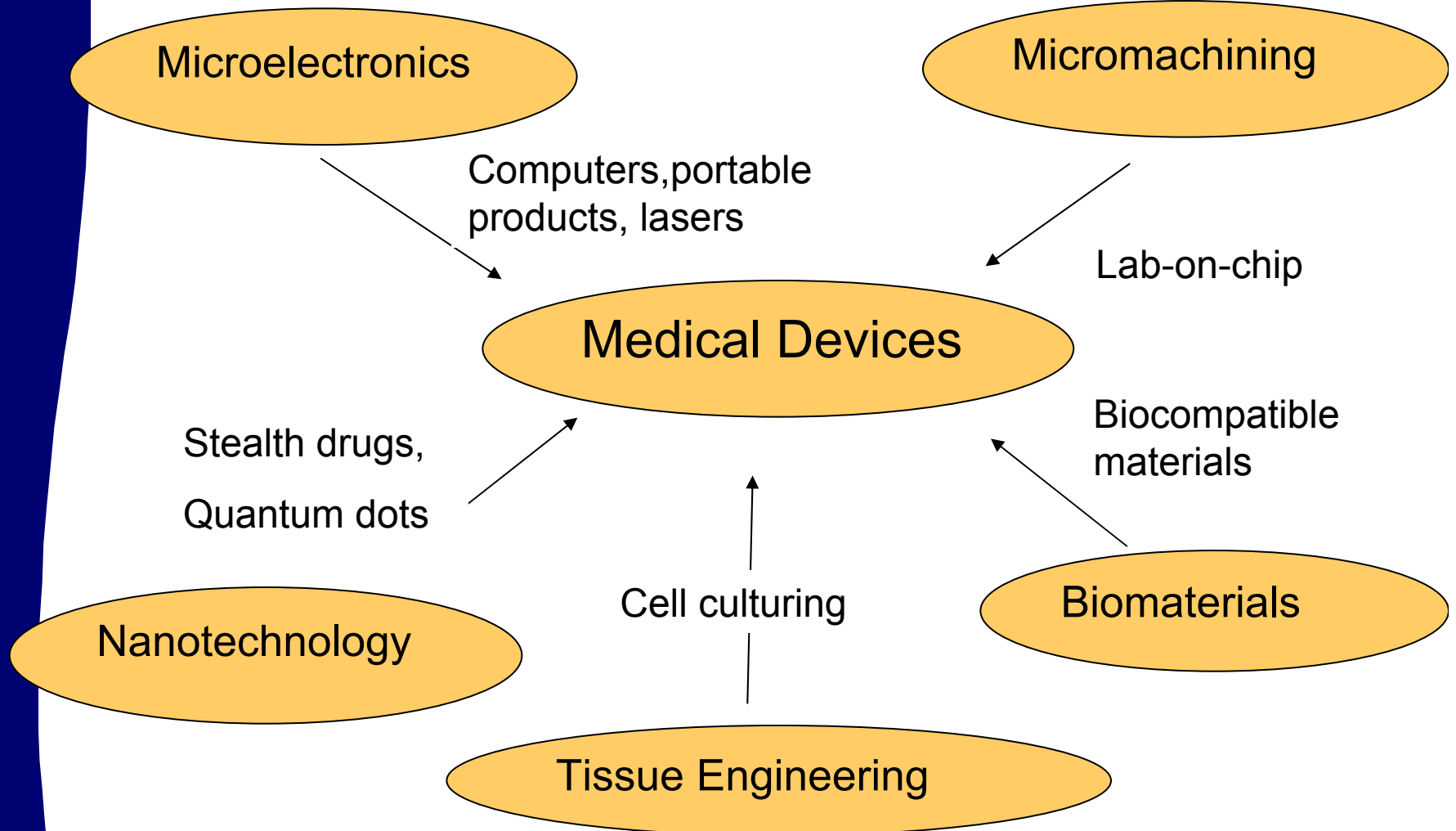


Results:

- Valve manufacturers put out of business
- A \$200 billion components business created
- The IT revolution enabled

...a whole new industry has been created by convergence creating a new platform technology

Technology Convergence in Medical Devices



Technology Convergence in Medical Products



Results:

- Lots of interesting product innovations but no platform technology
- The supply chain is complex and immature
- Medical product markets grow relatively slowly

...no major disruptive technology has emerged as yet, so we need to look on an application by application basis

Diagnostic Imaging

Discipline

Photography

Computers

Nuclear Physics

Materials Science

Semiconductors

Photonics

Technology

X-rays

Image processing

NMR

Piezoelectric effect

Infra-red detector

Quantum dot markers

Impact

Non invasive imaging

CAT Scanning

Material differentiation

Ultrasound images

Thermal images

Contrast, organ
and tissue selectivity

NanoParticles -Optical Contrast Agents

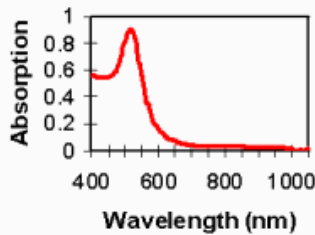
Optical Properties of Metal Nanoparticles

Strong Optical Resonance known from Antiquity
(stained glass windows, 12th Century)

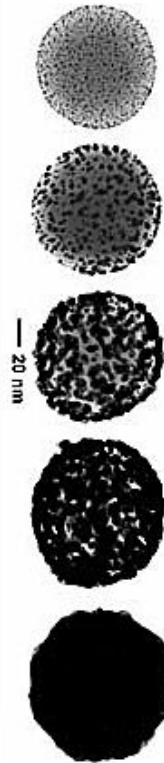


$$\alpha = 4\pi\epsilon_0 R^3 \frac{\epsilon(\omega) - 1}{\epsilon(\omega) + 2}$$

At resonance, $\omega = \frac{\omega_p}{\sqrt{3}}$ when ω_p = bulk plasma frequency

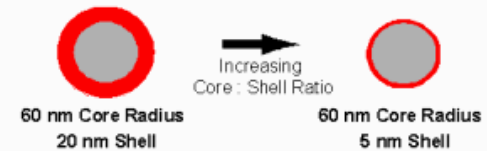
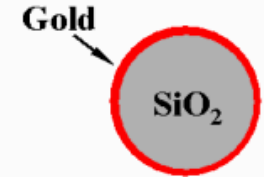


G. Mie,
Ann. Physik 25, 377 (1908)



Tunable Absorption Resonances

A metal nanoshell is a composite nanoparticle that consists of a dielectric core surrounded by a thin metal shell.



- Allows precise control of optical properties
- Biocompatible
- Optically triggered drug delivery
- Contrast Agent for NIRF Imaging
- Photoacoustic contrast agent
- Need to be biocompatible

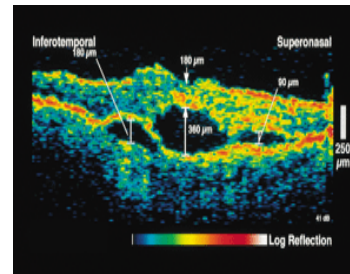


Medical Application of Photonics

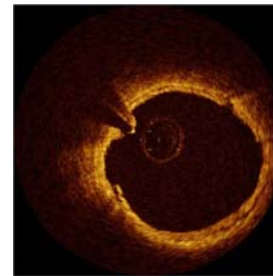


Clinical Imaging

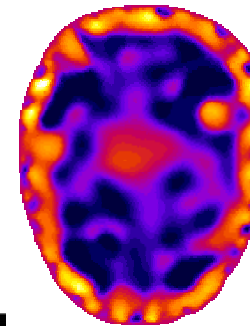
- Ophthalmology – OCT
- IV-OCT
- IVD
- OB/GYN
- Dermatology
- Microvascular
- Intraoperative
- Breast Tomography
- Brain Tomography



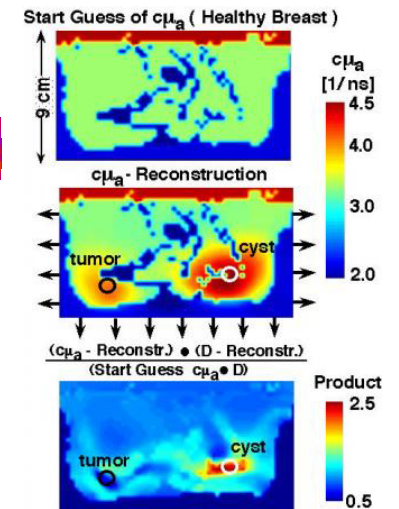
iredex



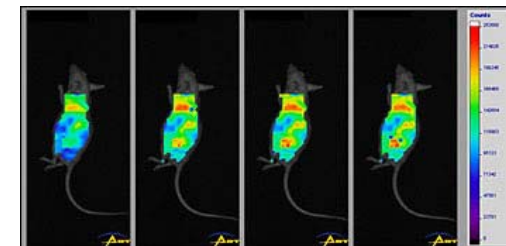
Light Labs



David Boas



Columbia



ART

Pathogen detection

- Raman spectroscopy

PACS

- Optical data transmission

Patient monitoring

- Pulse oximetry

Genomics

- Micro array readers
- FISH

Pre-Clinical Imaging

- Small Animal
 - Pharmacokinetics
 - Biodistribution
 - Drug Efficacy

Diagnostic Imaging

- Technology convergence creates product innovations
- Most of the products are large and expensive
- The large incumbents control this market and are adept at technology acquisition from the smaller innovative companies
- No sign yet of the 'Star Trek' hand held universal diagnostic device

Point of Care Diagnostics



Discipline

Technology

Impact

Biology +
Microfluidics

ELISA
Lateral flow devices

Pregnancy test kits

Microelectronics +
Microfluidics +
Biology

ISFET's
Microembossing
Glucose oxidase

POC Blood Tests

Photonics +
Microelectronics +
Software

Lasers
Low cost computing
Algorithms to unscramble
data from noise

Non-invasive blood
glucose monitoring

Point of Care Diagnostics

- Technology convergence is creating some potentially disruptive products
- Small companies are innovating
- Who owns the channels to market?
- Many of the small players do not have the marketing muscle or cash reserves to change the way diagnosis is done

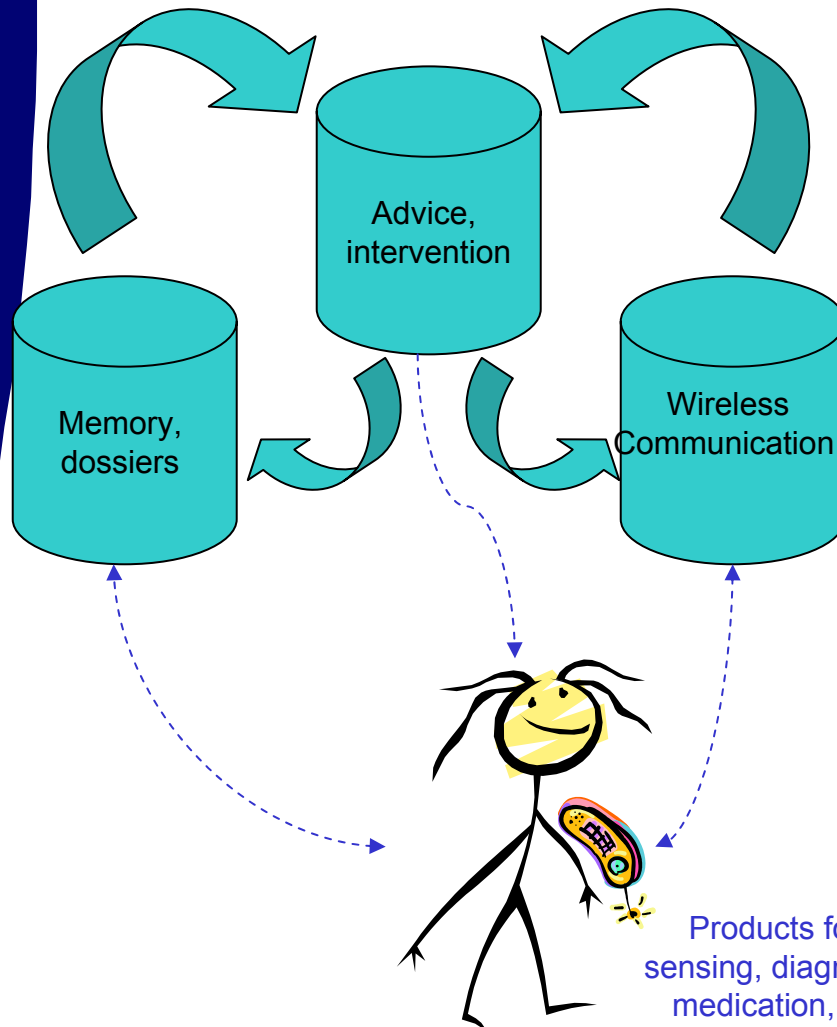
Patient Monitoring



Patient Monitoring



Future Concepts in Patient Monitoring



Products for sensing, diagnosis, medication, etc



Health system



R&D system



Product developers and IT companies

With acknowledgements to Kees Eijkel MESA+

Example: Health Buddy ®



General Comment

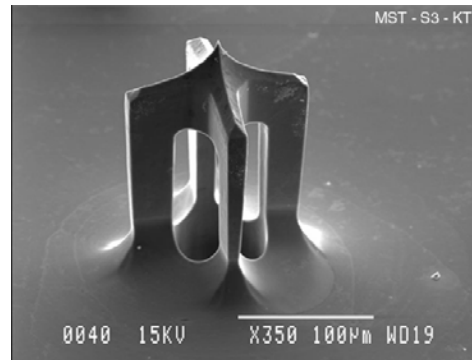
- Even if the technology works, will the patient accept it?
- Consider the case of the 'GlucoWatch'
- Regulatory concerns
- One size doesn't fit all

Drug Delivery



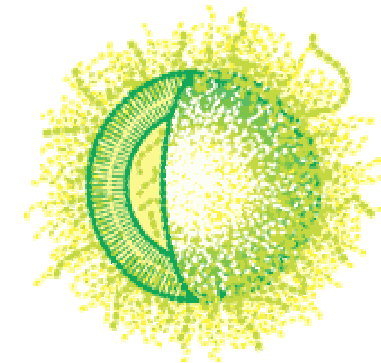
MICROPARTS

Micronozzle in nebuliser, Microparts



KTH

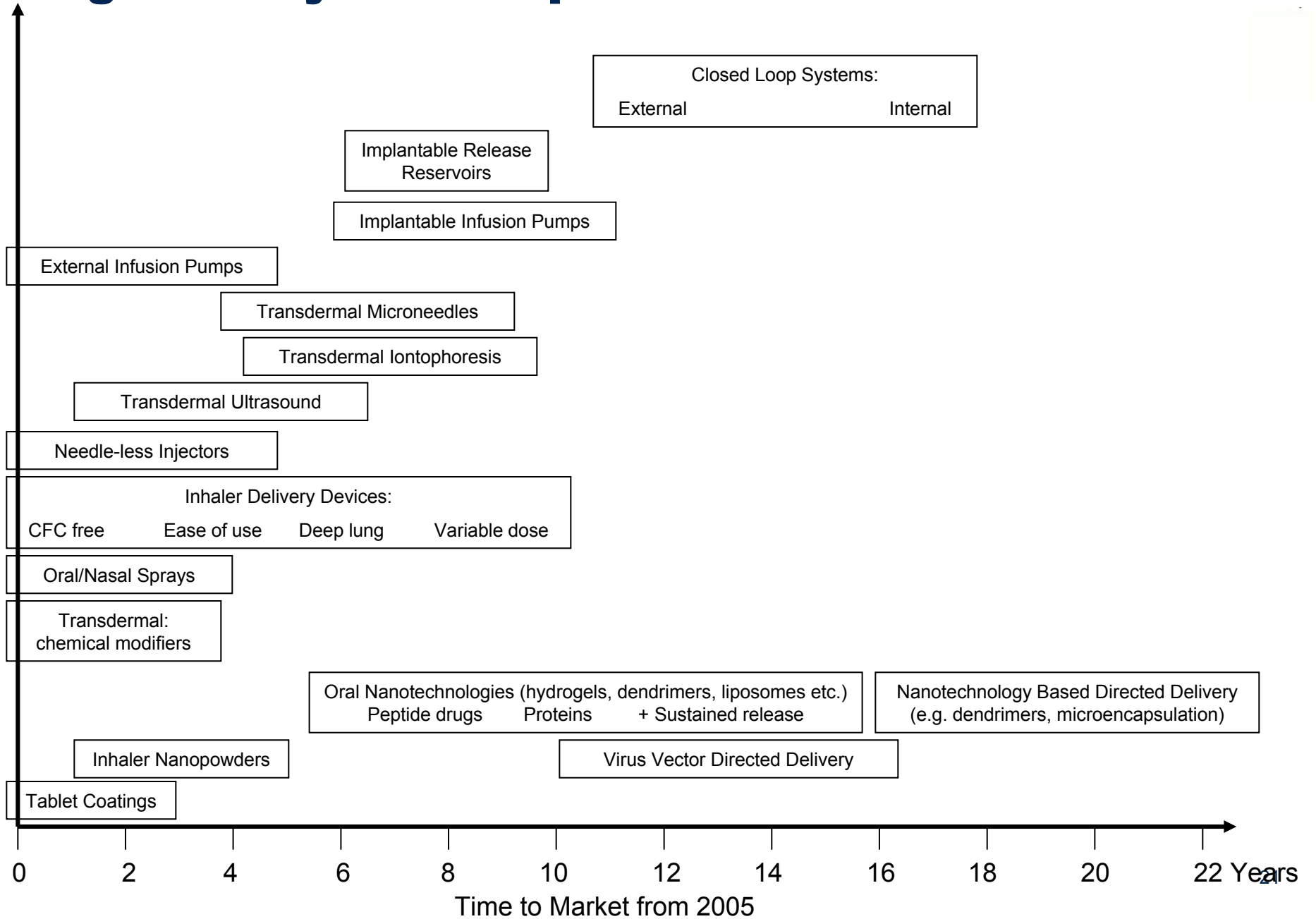
Microneedles development, KTH



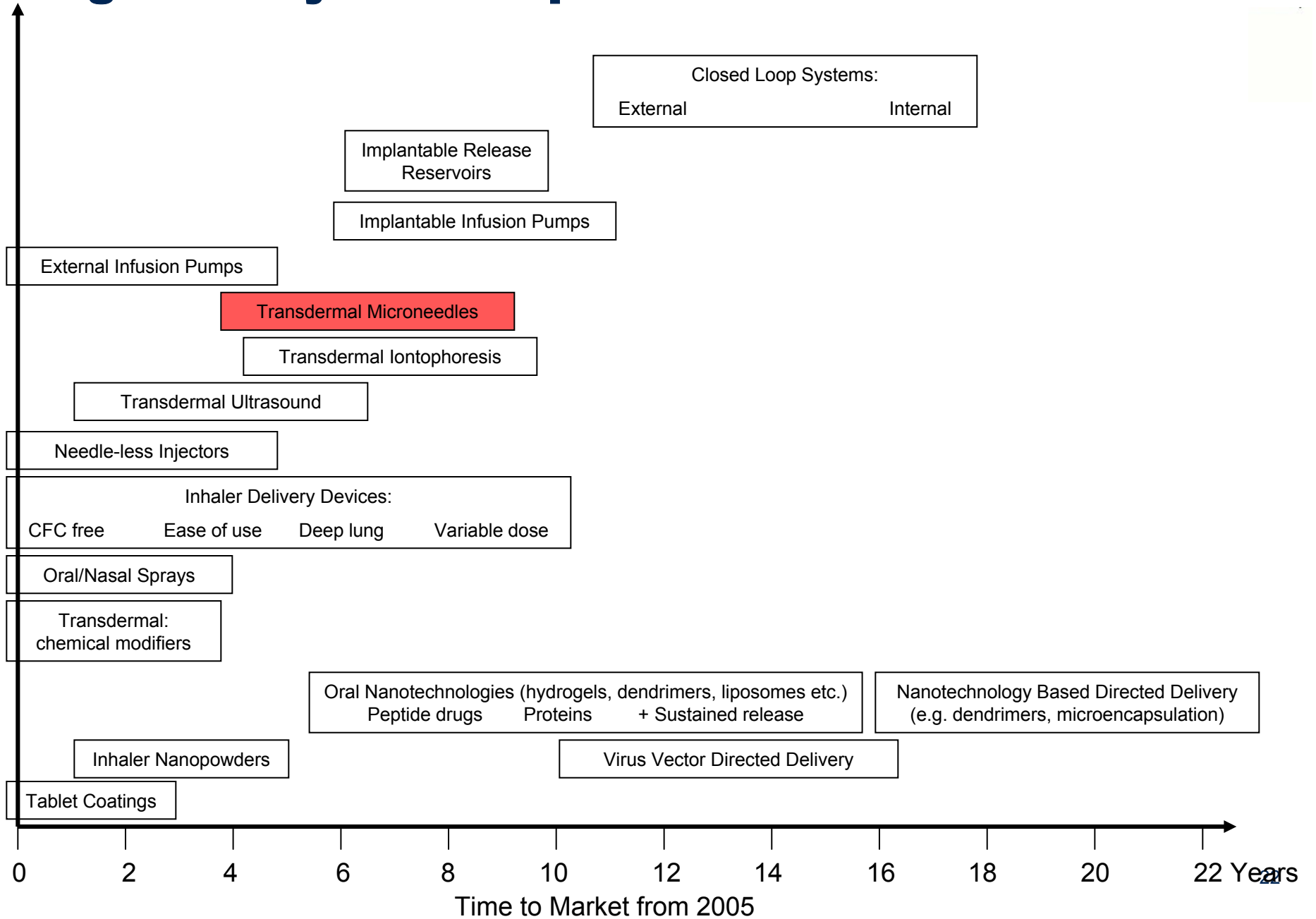
ALZA CORP

Stealth technology, lipid nanoparticle, Alza Corp.

Drug Delivery Roadmap for MNT



Drug Delivery Roadmap for MNT



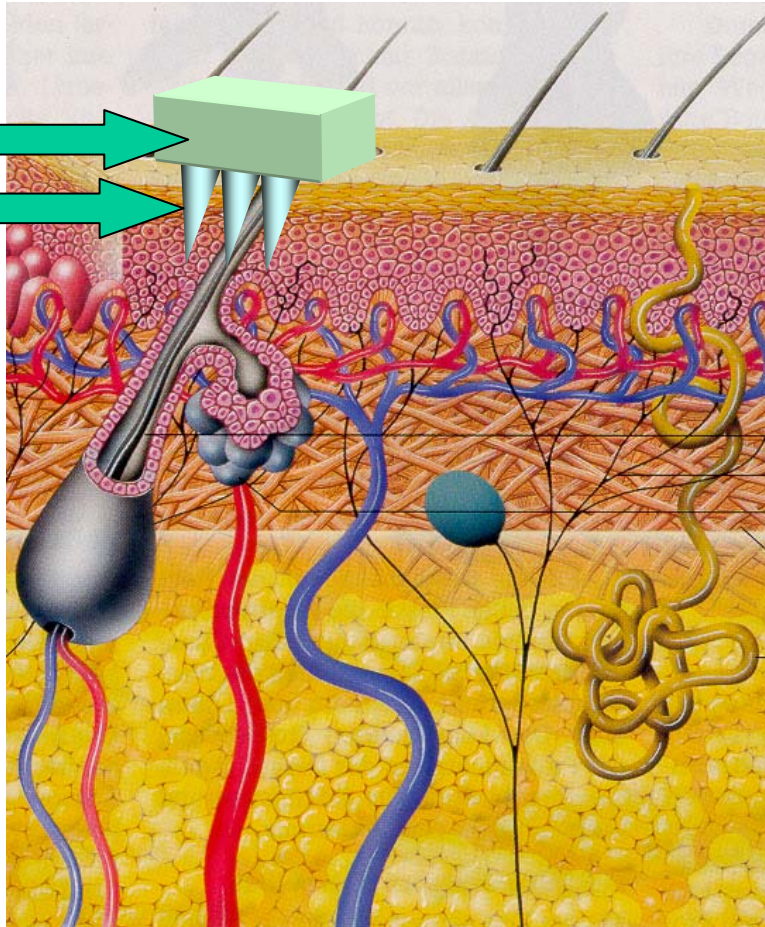
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Transdermal DD or sampling

Diagnostic sensor or
drug container



Micro hollow
injectors



NanoPass Inc.

Conclusions

- Technology convergence is creating product innovation
- Convergent technology is not necessarily disruptive
- Creation of multidisciplinary centres can facilitate technology convergence (work in progress)



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