Microsystems and the Food Industry – A New Roadmapping Approach

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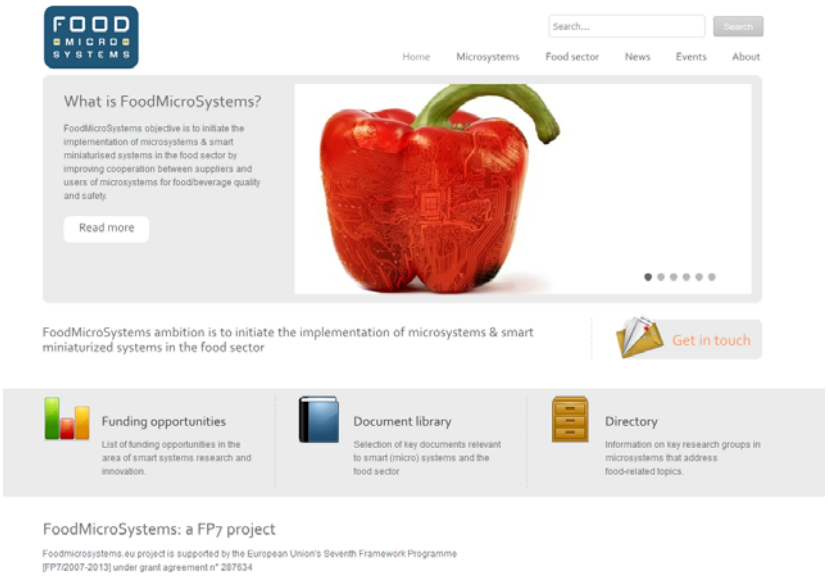
Project ID

FoodMicroSystems

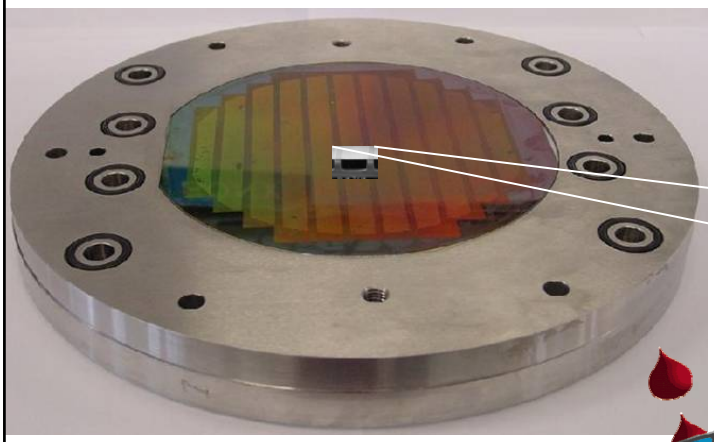
- ✓Support Action (798 K€ EC contribution)
- ✓September 2011 to August 2013
- ✓Coordination: ACTIA (France)
- ✓9 partners
- ✓Objective ⟹ initiate the implementation of microsystems in food and drink sector
- ✓Main results ⟹ 3 roadmaps

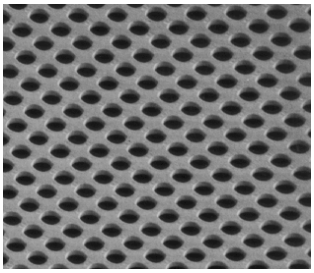
www.foodmicrosystems.eu

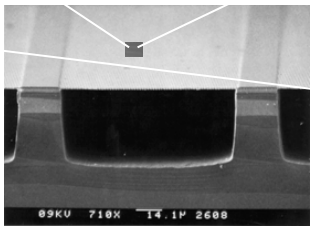


Filtration / Fractionation

Separation / Fractionation

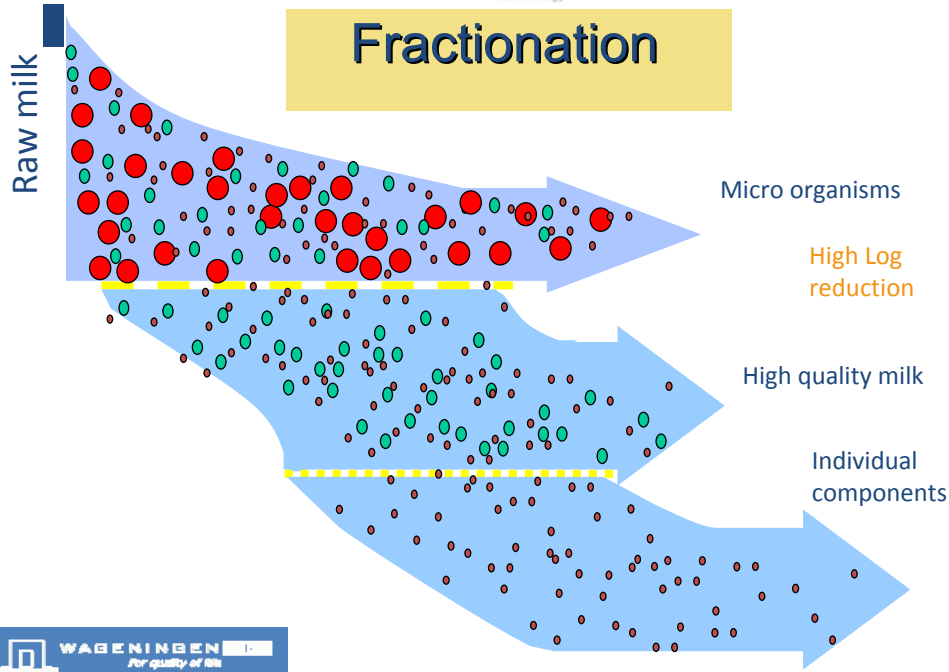






Cees van Rijn – Aquamarijn

Fractionation

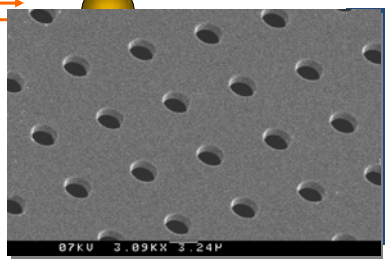


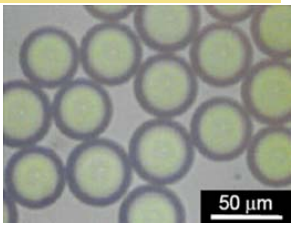
Emulsification

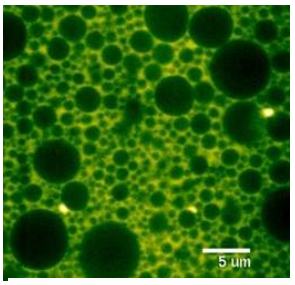
WAGENINGEN

Membrane emulsification

emulsion







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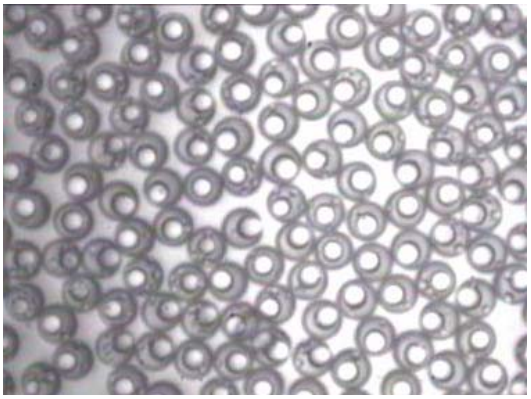
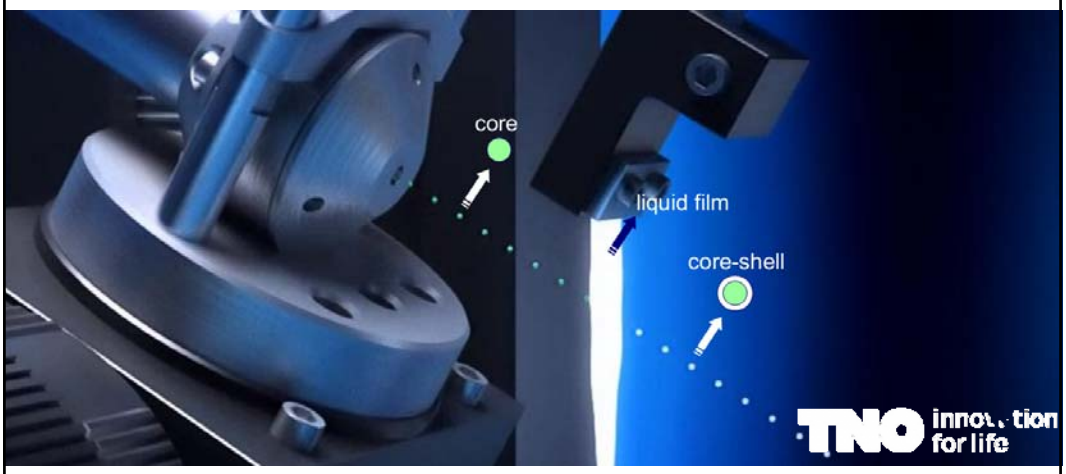
nanomi
emulsification systems

Double Emulsions



Remko Boom – Food and Bioprocess Engineering

Micro encapsulation



Micro encapsulation

well defined
200 µm encapsulates

TNO innovation for life

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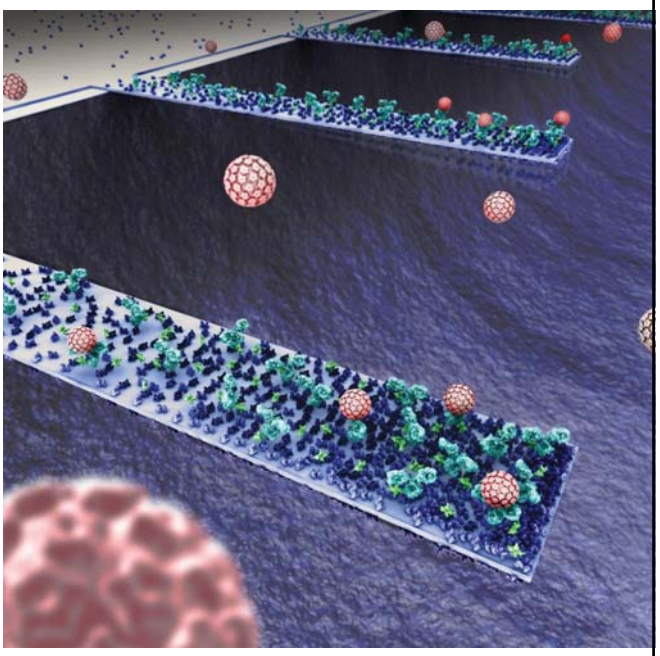
For quality of life

FOOD MICRO & NANO SYSTEMS

enabling MNT micro nano technology

Coordinator ACTIA

Biosensors



Bashir, Purdue University

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Use-by dates
ENJOY BY APR 29,2011 06:30
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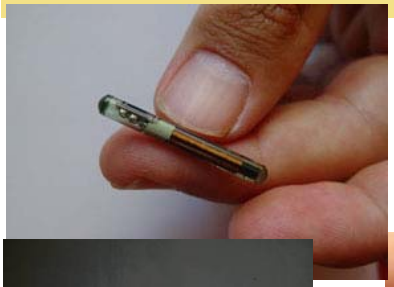
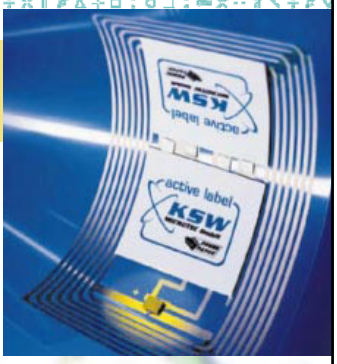


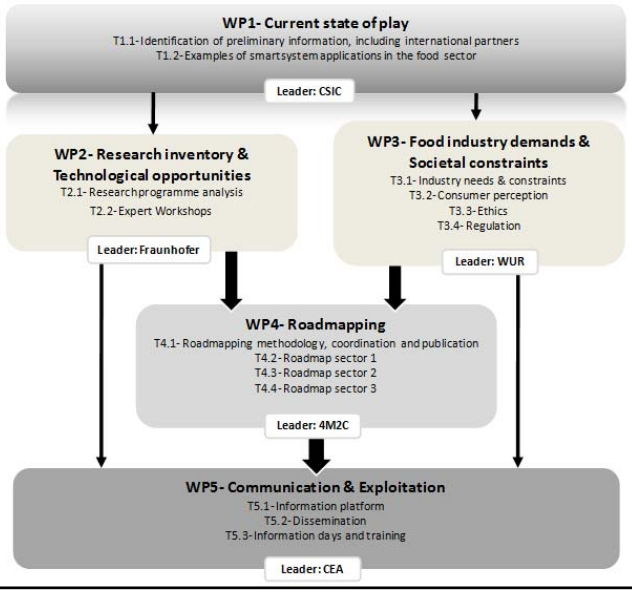


KSW Tempsense

Food safety

Food Quality and Safety

Approach



Roadmapping Methodologies

a. Traditional Technology Roadmapping:
ITRS roadmap – semiconductors, Moore's law

b. Roadmaps (part of Strategic Research Agendas) of ETPs (European technology Platforms) and EC projects:
Simple, straight-forward roadmaps; they usually describe technology opportunities, technologies, challenges

c. Disruptive technology roadmaps:
NEXUS Microsystems Roadmap 2000 and 2003
Mancef Roadmaps, e.g MEMS for Pharmaceutical Roadmap
Others?

International Technology Roadmap for Semiconductors (ITRS), updated annually

Table 4: Packaging Challenges through 2007

Difficult Challenges (Through 2007)	Summary of Issues
Improved organic substrates	Tg (Glass Transition Temp.) compatible with lead-free solder processing
	Increased wireability at low cost, substrates are a barrier to flip chip adoption
	Improved impedance control and lower dielectric loss to support higher frequency applications
	Improved planarity and low warpage at higher proce
	Low moisture absorption
	Low-cost embedded passives
Improved underfills for flip chip on organic substrates	Improve flow, fast dispense/cure, better interface ad absorption
	Higher operating range for automotive and Pb free s dispense underfills
	Improved adhesion, small filler size, and improved f underfills
Coordinated design tools & simulators to address chip, package, and substrate co-design	Chip, package, and system level co-design tools
	Educational programs required to train engineers in
	Faster analysis tools for integrated thermal mechani
	Higher accuracy, faster electrical simulation capabil design
Impact of Cu/low κ (dielectric constant) on packaging	Direct wirebond and bump to Cu (Copper)
	Bump & underfill technology to assure low κ dielec
	Improved Mechanical strength of dielectrics
	Interfacial adhesion
Pb (lead), Sb (antimony), and Halogen free packaging material	Lower cost materials and processes to meet new req higher reflow temperatures.

HIGH-LEVEL CHALLENGES AND RELATED ISSUES

Small, high pad count	Array I/O pitches below 80 microns
High Frequency die	Substrate wiring density to support >20 lines/mm
	Lower loss dielectrics
	Skin effect above 10Ghz

Table 93a Single-chip Packaging Technology Requirements—Near-term

Chip Size (mm²) [3]							
Low-cost	100	100	100	100	100	100	100
Cost-performance	140	140	140	140	140	140	140
High-performance	310	310	310	310	310	310	310
Harsh	100	100	100	100	100	100	100
Maximum Power (Watts/mm²) [4]							
Low-cost (Watts) [1]	2.5	2.7	2.8	3	3	3	3
Cost-performance	0.57	0.6	0.65	0.7	0.74	0.79	0.83
High-performance	0.48	0.51	0.54	0.58	0.61	0.64	0.64
Harsh	0.14	0.16	0.16	0.16	0.16	0.2	0.2
Core Voltage (Volts)							
Low-cost	1.2	1.2	1	0.9	0.9	0.9	0.9
Cost-performa							
High-performa							
Harsh							
Package Pinco							
Low-cost	112–408	122–500	134–550	144–600	160–660	180–720	180–800
ace	600–1462	500–1600	550–1760	550–1936	600–2140	600–2400	660–2800
ace	2400	3000	3400	3800	4000	4400	4600
	450	600	660	800	880	720	780

TECHNOLOGY DEVELOPMENTS NEEDED TO ADDRESS THESE CHALLENGES

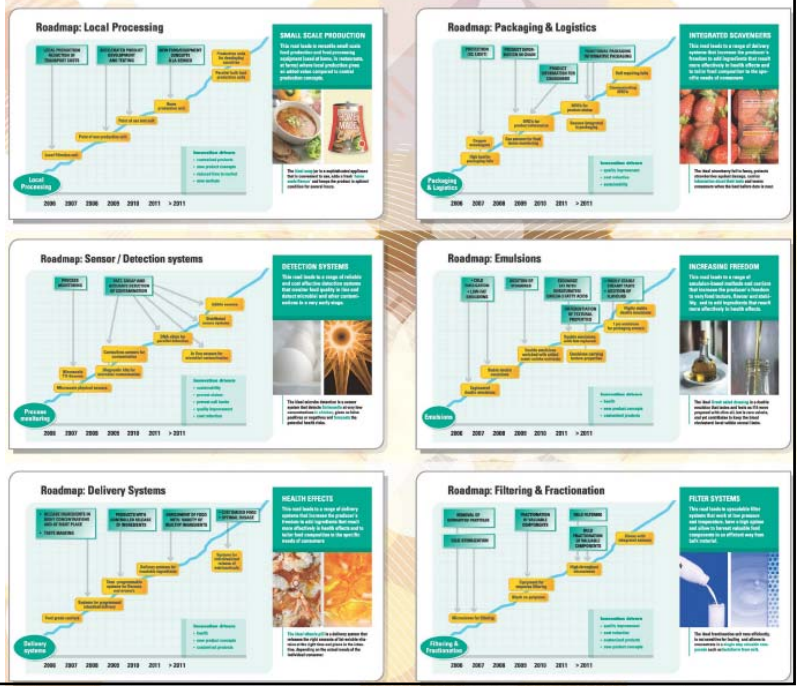
Source: www.itrs.net

Future for Food

ROADMAP MICROSYSTEMS & NANOTECHNOLOGY IN FOOD & NUTRITION

The Minacned Food & Nutrition Roadmap

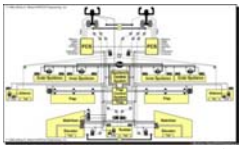
www.minacned.nl



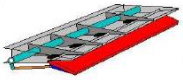
EPoSS – from the Strategic Roadmap on Aeronautics (draft)

The electrical aircraft

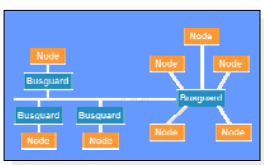
EPoSS
European Technology Platform on Smart Systems Integration



By-light functions
Next generation of optical components and optical sub-systems



Fuel cell APU
Sensors, process monitoring and control

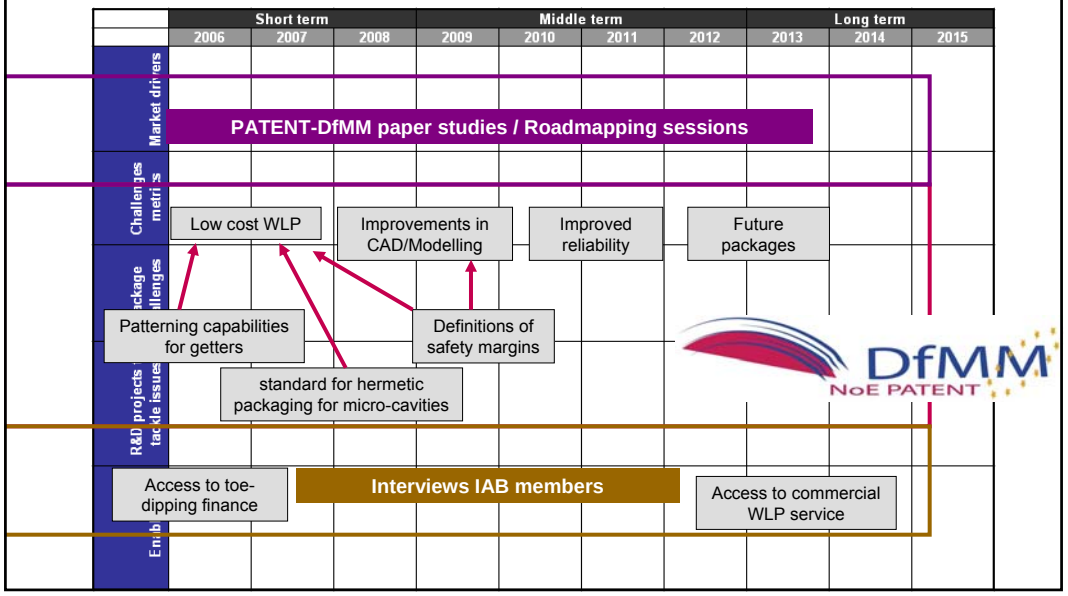


By-wire functions
Smart sensors and actuators

Electrical power management
Detection and control devices for power network

2005 2010 2015 2020

PATENT-DfMM Project: Packaging Roadmap



EC 4M Project: Application Requirements for 4M Manufacturing Technologies

Application requirement	Perceived Importance
A Low cost / volume production	
B Interdisciplinary, design, and process/technology knowledge	
C 3D features, surface properties	
D Technology / maturity / standards	
E Function and physical integration	
F Quality/reproducibility/reliability	
G New/improved/multi materials	
H Integrated process chains	
I Process / machine technologies	
J Assembly & packaging	
K Nano-micro or micro-meso integration	

Researchers
Industry

A roadmapping study in Multi-Material Micro Manufacture. S.S. Dimov, C.W. Matthews, A. Glanfield, P. Dorrington. To appear in: 4M2006 Second International Conference on Multi-Material Micro Manufacture Proceedings, eds. W Menz, B Fillon, and S Dimov, Elsevier, 2006.

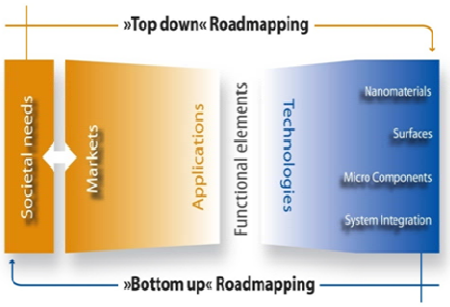
MINAM – the European Technology Platform on Micro Nano Manufacturing

Market/Application Pull (Technology Push) approach

→*application* related aspects (Markets, Applications, MN-Functional elements)

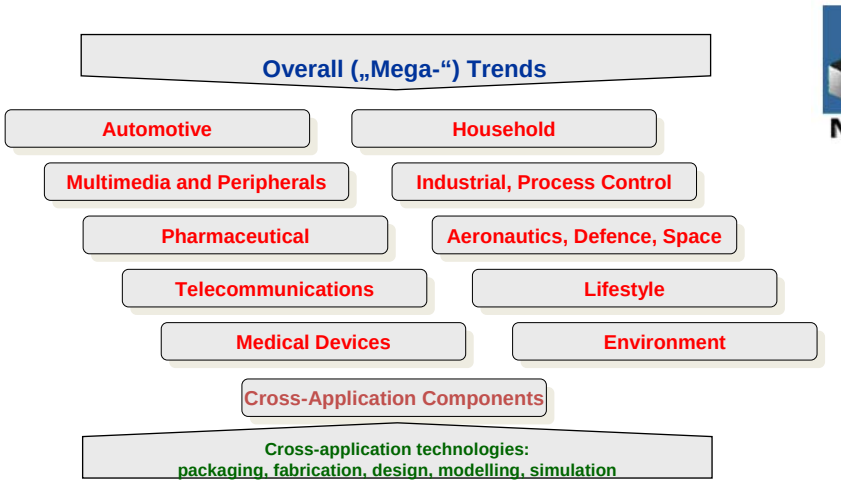
linked with

→*technology* related aspects (Production technologies, Production processes, Materials, System Integration aspects)



MINAM Roadmapping Approach, 2012

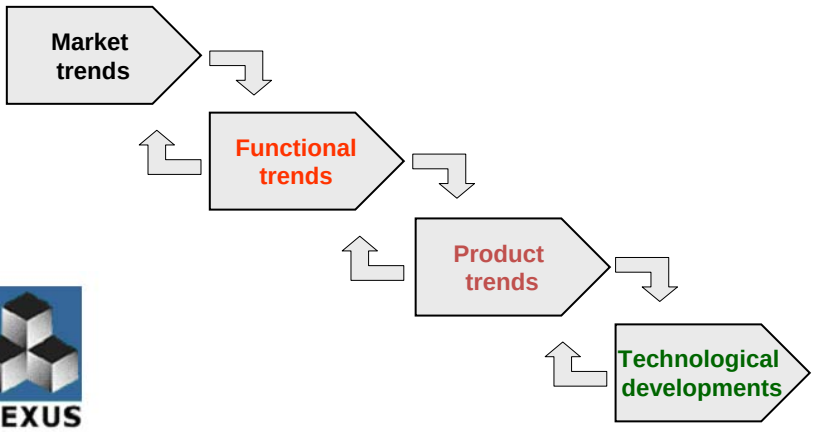
NEXUS Roadmap: Application Domains



Source: NEXUS Association, 2003

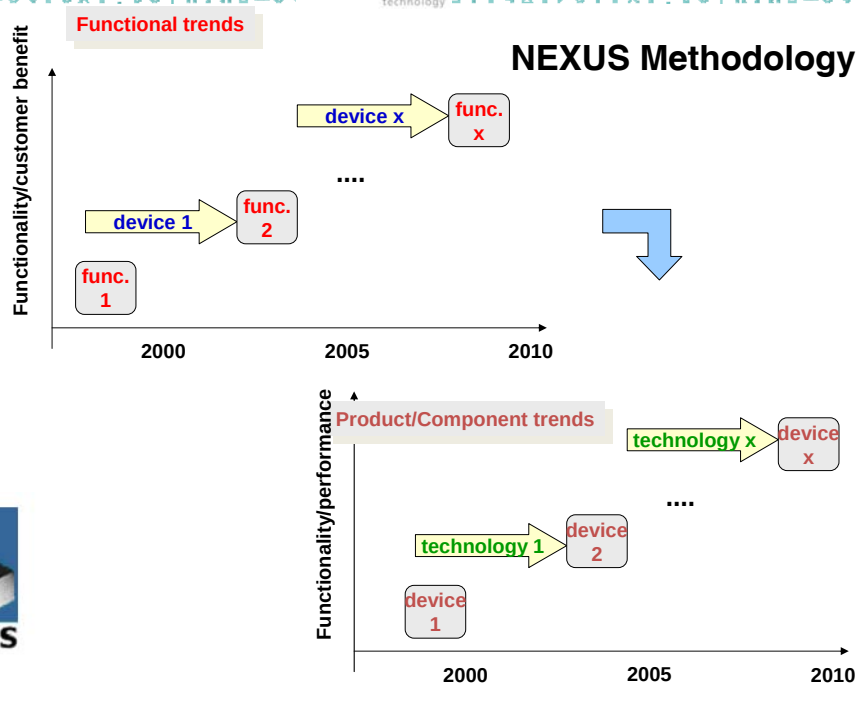
Content of the NEXUS Roadmap:

Product planning and Technology planning



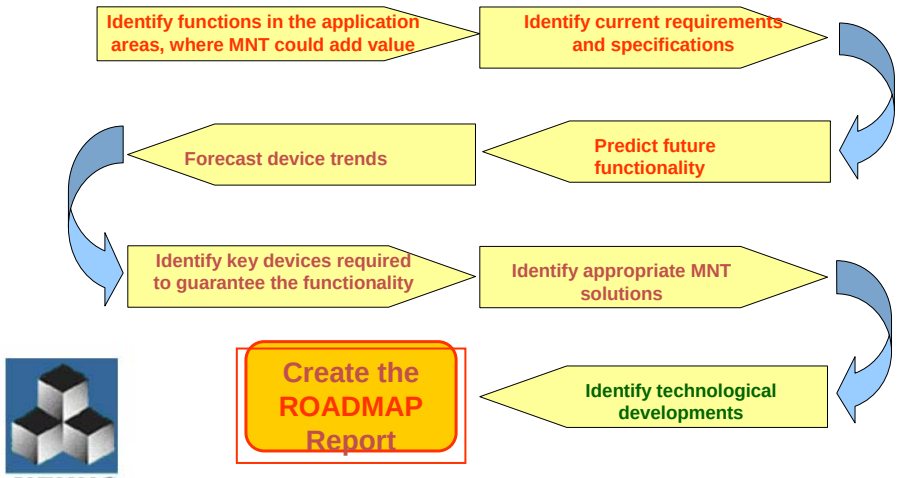
NEXUS

NEXUS Methodology



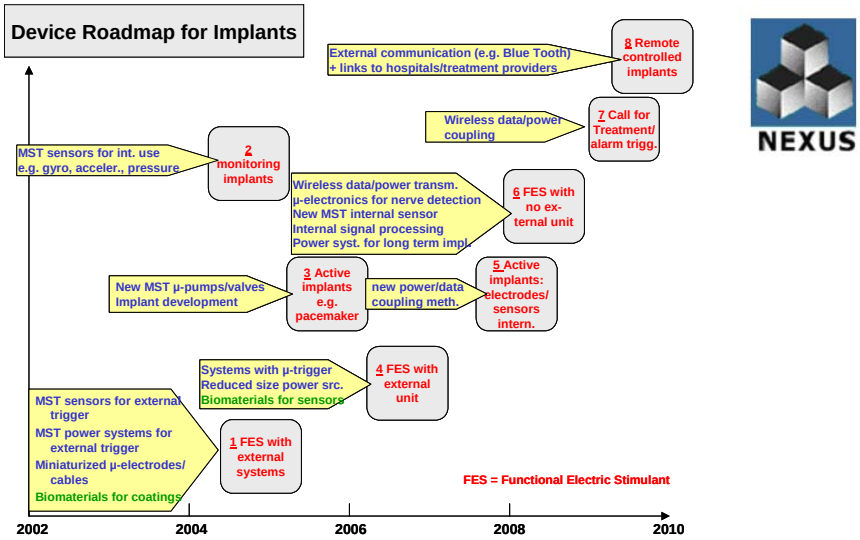
NEXUS

NEXUS Roadmap: Methodology



Source: NEXUS Association, 2003

NEXUS Roadmap: Medical Applications



Source: NEXUS Association, 2003

Task 4.1 Roadmapping Methodology

Analysis of the “Microsystems for Food” sector:
Existing products used in the food sector: Areas where microsystem-based products (sensors, filters/membranes, etc) exist and are used already or could replace non-microsystems products that are used.

→ The traditional technology roadmapping methodology (a) can be used…
- Ask users for wish list; future specifications (3, 5, 10 years) incl price, volumes, etc.
- Cross-check with technology providers (technologists and manufacturers), if, when and how these specs can be achieved, what is needed additionally (equipment, software, materials, etc)
- Back to users to verify if this is realistic and price targets are acceptable

Task 4.1 Roadmapping Methodology

Analysis of the “Microsystems for Food” sector:
New products / processes for the food sector: Areas where no microsystem-based products or similar are used but could enhance a product or process once their technology is developed further.

→ This sector needs a Disruptive Technologies methodology (c)
- Brainstorming with food industry; assess general problem / wish lists from food industry
- Brainstorming with technology providers; can they solve any of the above problems with their technologies? If so, what are their constraints?
- Workshop with food industry and technology providers to discuss these ideas

…then continue like “existing products”…

Task 4.1 Roadmapping Methodology

Analysis of the “Microsystems for Food” sector:

New technologies for the food sector: Areas where no microsystem-based products or similar are used and no technologies exist these days that could enhance a product or process. To include also **New Innovative Food Products** enabled my microsystems.

→ This sector needs a Disruptive Technologies methodology (c)

- Brainstorming with food industry; assess general problem / wish lists from food industry
- Brainstorming with technology providers; can they solve any of the above problems with their technologies? If so, what are their constraints?
- Workshop with food industry and technology providers to discuss these ideas

…then continue like “existing products”…

Milestone 3: Decision on 3 food chains

	Market potential	Technol. advantages	Consumer acceptance	Time to market	Overall ranking
Meat	**++**	**++**	**+**	**o-**	**2.**
Dairy	**++**	**++**	**o**	**+**	**1.**
Fruits & Vegetables	o	+	+	o+	5.
Beverage (beer&wine)	**+**	**+**	**+**	**o+**	**3.**
Packaging	+	+	o+	o+	4.

Based on questionaire filled by FoodMicrosystems partners and discussion on 15/05/2012;
Note: Packaging should be addressed in all 3 roadmaps as a horizontal topic.

Conclusion: how to participate?

Register in our directory

www.foodmicrosystems.eu

Join our events

6 roadmap workshops (Sept 2012 to June 2013)

+ 3 training on food for MST researchers

+ 4 info days on MST for food scientists

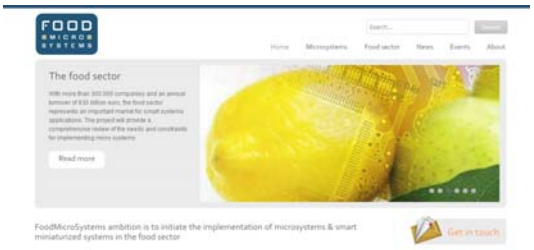
First Roadmapping Workshop:

Food sector: **Dairy Industry and Supply Chain**

Date/venue: **25/09/2012, Paris**

Responsible: **Patric Salomon, Henne van Heeren**

www.foodmicrosystems.eu



Thank you for your attention !

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