



Identifying and Mapping European Standardisation and Metrology Needs

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Nano-strand project



- EC call FP6-20046-NMP –TI-4 of December 8, 2004
- Closure date : September 15, 2005 at 17:00
- Evaluation results sent on December 5, 2005
- Opening of contract negotiation on February 6, 2006
- **Start of the project : August 1st, 2006**
- Duration : 18 months
- **Project ended on January 31st, 2008**

Objectives

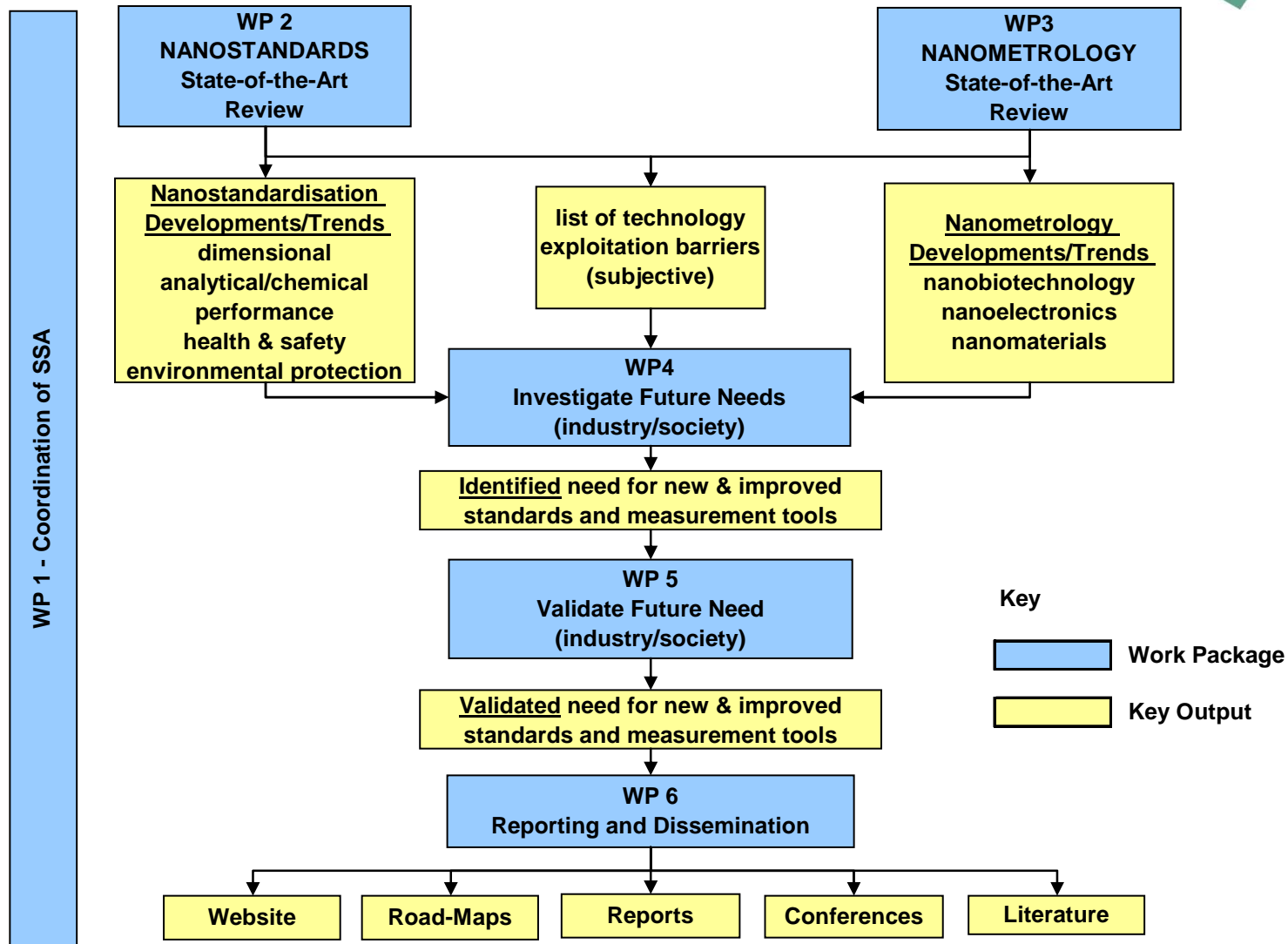


- **To facilitate industrial development and exploitation of nanotechnologies by**
 - ✓ **Identifying:**
 - **Barriers and societal needs**
 - **Needs for measurement tools and standards**
 - **Priorities for pre-normative research**
 - ✓ **Providing**
 - **a standards foresight and roadmap for nanotechnologies**

- **To enhance integration and bridge the gaps between**
 - ✓ **Research and production fields in nanotechnologies**
 - ✓ **Different aspects of industrial safety related to nanotechnologies**

- **To provide information on the needs of the different stakeholders involved in nanotechnologies**

Approach



Survey of Future Needs

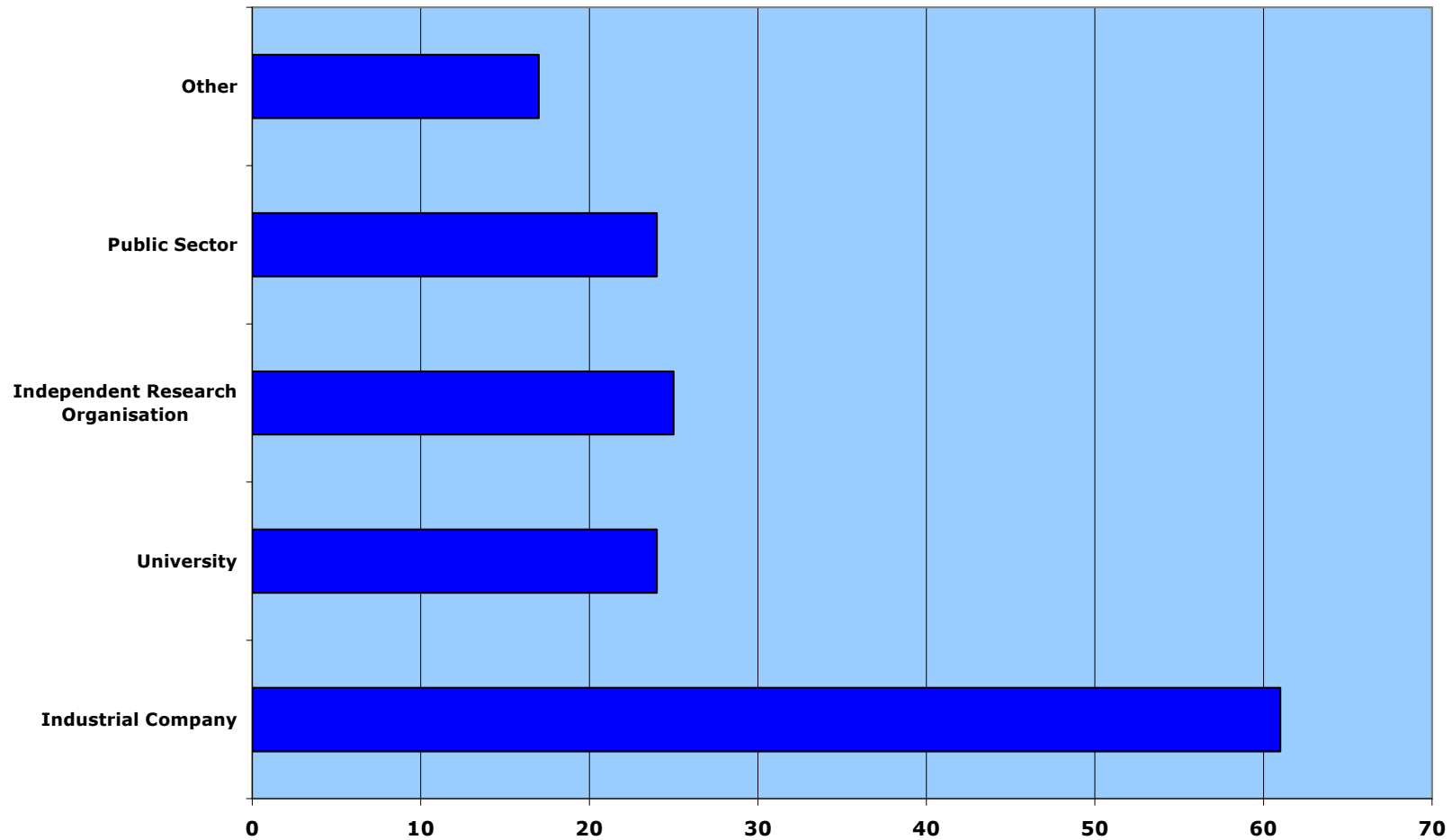


- Based on a combination of
 - ✓ Face to face and telephone interviews
 - ✓ On-line and email survey
- Over 150 responses to date
- Some key points
 - ✓ Focus is on development and application of techniques rather than standards development
 - ✓ Some issues identified in state of the art reviews reinforced, e.g.
 - Particle size and shape (morphology)
 - To understand performance benefits of nanoparticles
 - To support H&S assessment
 - Feature shape and size in sub-micron structures
 - Defect analysis on surfaces and thin films
- Survey has been closed early in October 2007

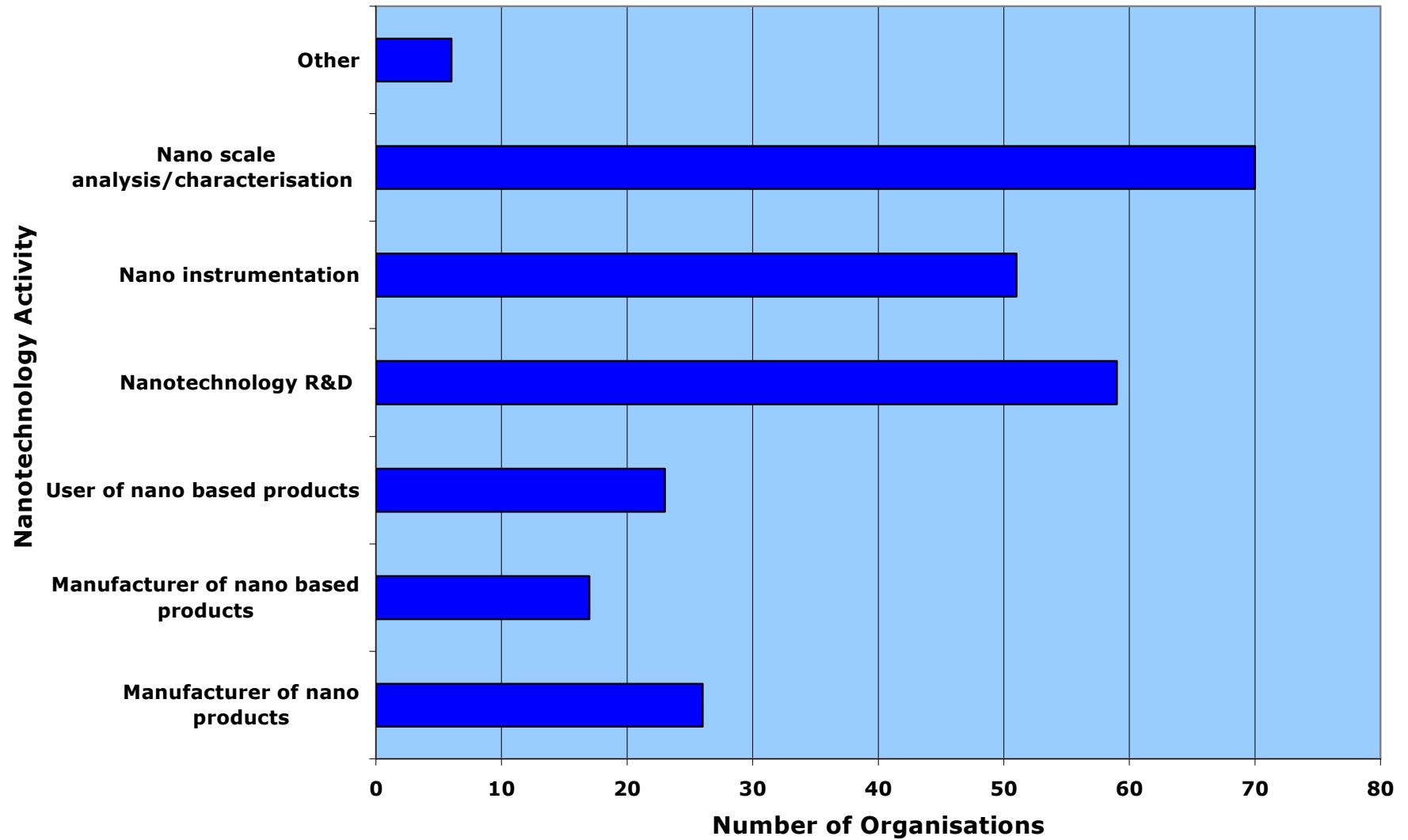
Participants



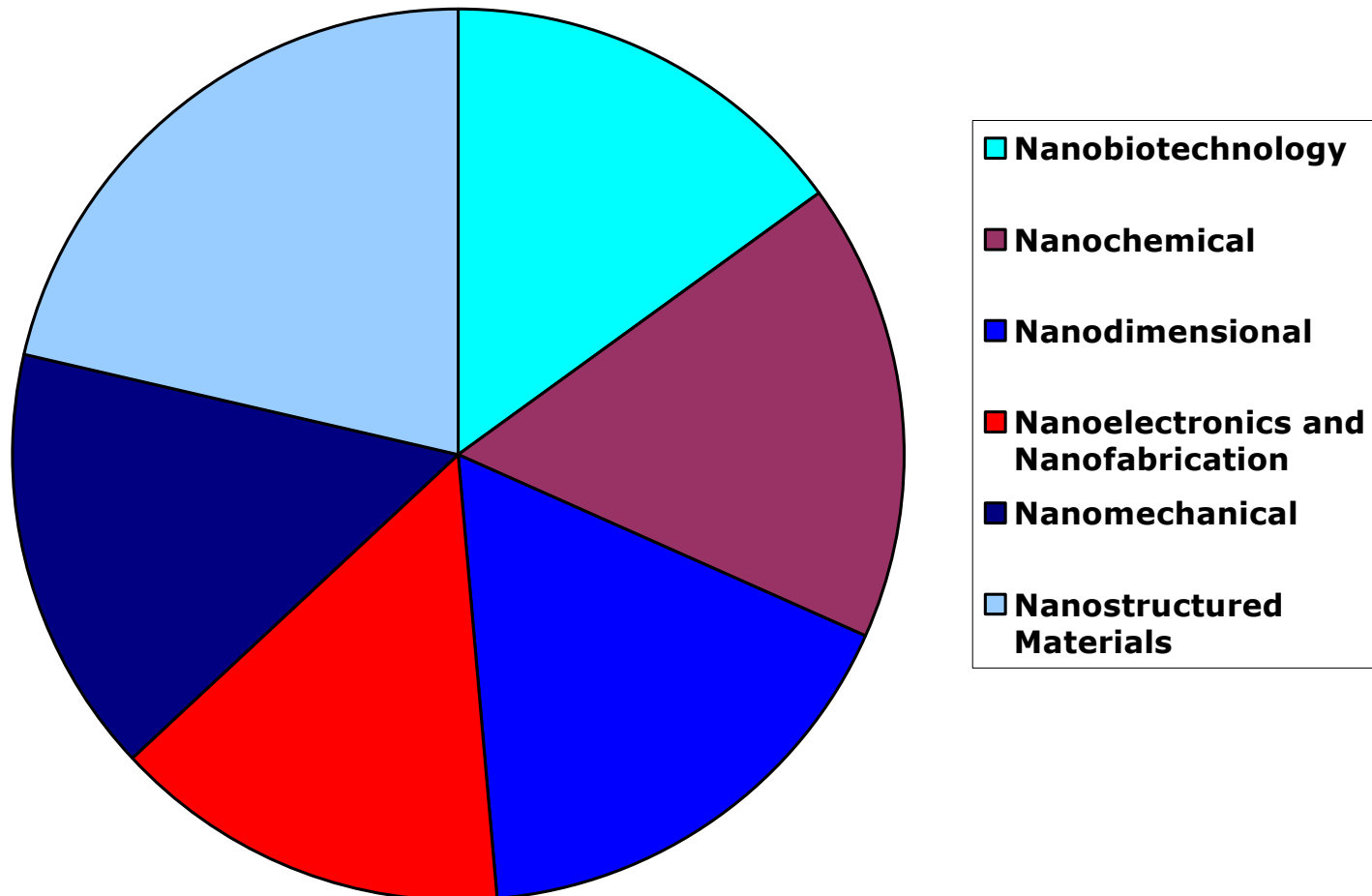
■ Over 150 participants



Main Nanotechnology Activity



Nanotechnology Theme



Use of Standards

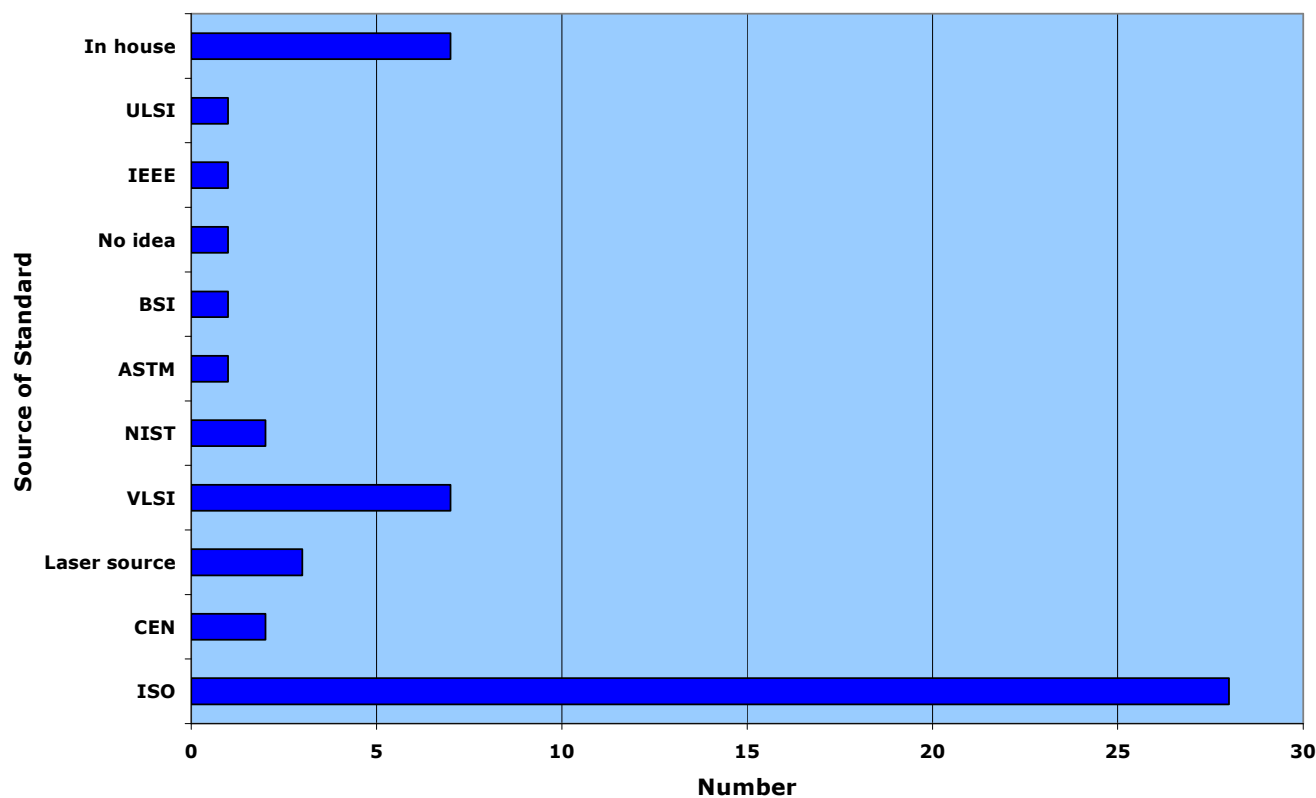


■ Do you use standards?

✓ Yes 51

✓ No 74

■ Standards used



Use of Physical Artefacts/RMs



■ Do you use?

- ✓ Yes 78
- ✓ No 45

■ Source

- ✓ In-house 30
- ✓ Purchased 55

■ Certified

- ✓ Yes 52
- ✓ No 31

■ Who Certified?

- ✓ NMI 30
- ✓ Inst Supplier 5
- ✓ Various 2
- ✓ ISO/CEN 2
- ✓ ASTM 1
- ✓ UKAS 1
- ✓ Other 6

Need for New/Improved Measurement Techniques

Measurement Needs (1)



- **Measurement needs but techniques not available at reasonable cost**

Surface characteristics	24
Nanoparticulates	32
Materials structure	7
Physical / mechanical properties	13
Optical properties	3
Chemical analysis	16
Biological analysis	1
Microscopy/spectroscopic techniques	25
Instrument calibration	3
General comments	12

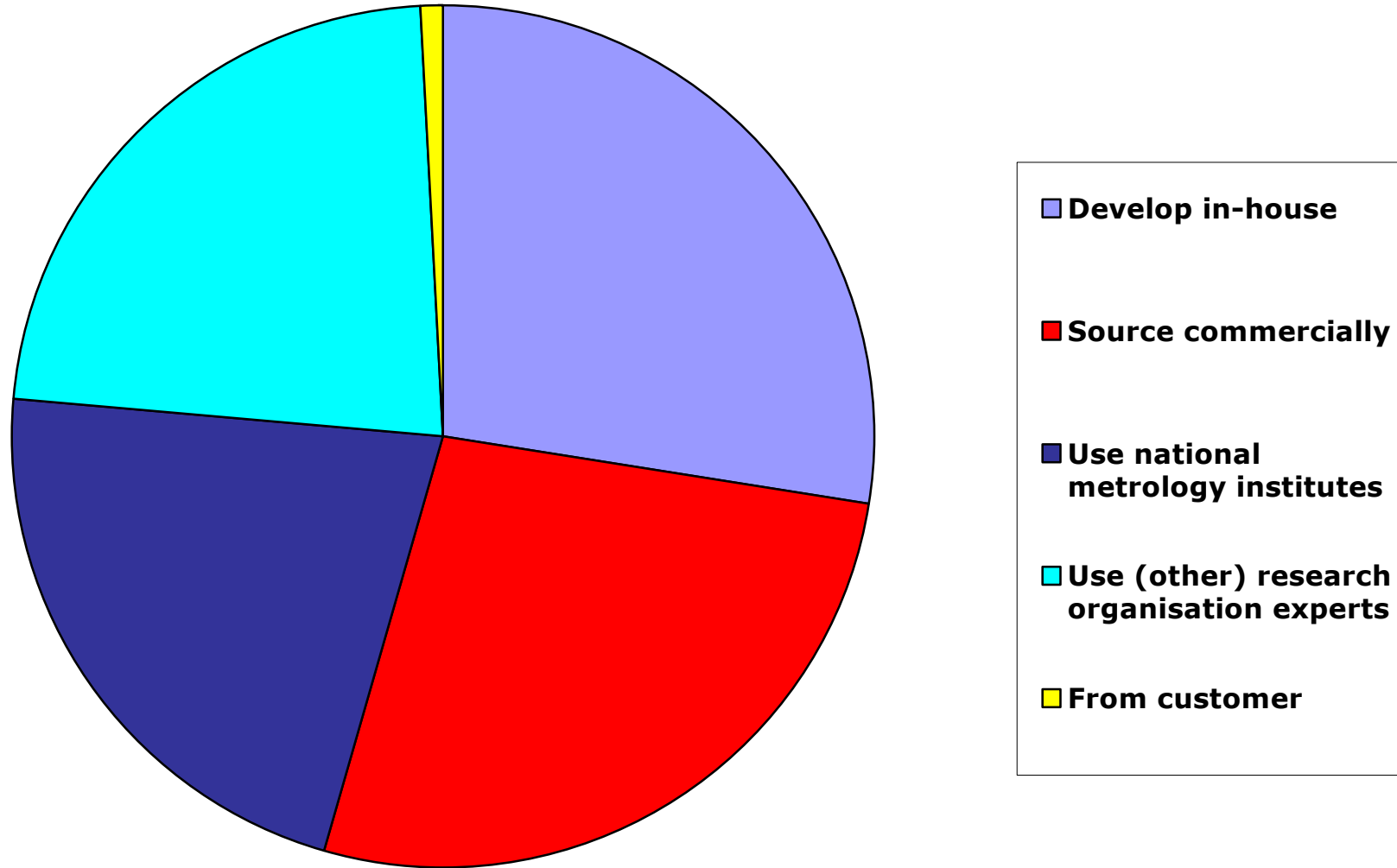
Measurement Needs (2)



- Measurement needs but techniques not available at any cost

Nanoparticulate sizing	19
Optical	2
Chemical	9
Microscopy	3
Physical	4
Optical	1
Surface analysis	5

Obtaining New Techniques



Need for New Nanotechnology Standards

New Nanotechnology Standards

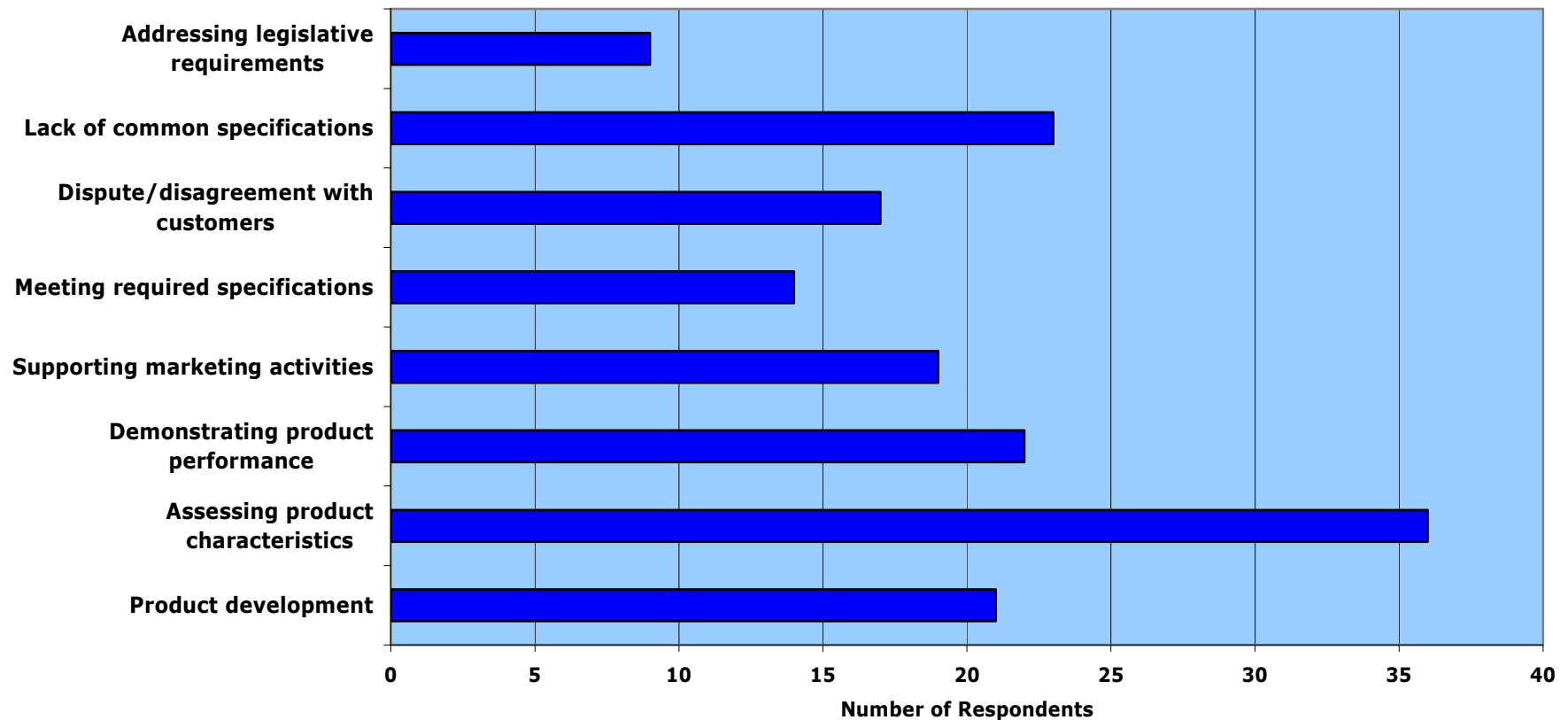


■ Is the lack of standards affecting your business?

✓ Yes 58

✓ No 51

■ Problems caused



Where Are Standards Required?



■ Surface characterisation	26
■ Particle size / size distribution	16
■ Gas adsorption	3
■ Dispersion/agglomeration	2
■ Physical/mechanical properties	21
■ Electronic properties	1
■ Chemical properties	10
■ Environmental/health monitoring	3
■ Microscopy	21
■ Vocabulary	1
■ Other	18
■ Need to agree/develop methods first	3

- **Two key reports**
 - ✓ **Roadmap on priorities for standardisation**
 - ✓ **Roadmap on research priorities for nanometrology**
 - ✓ **Delivered in January 2008 to :**
 - **EC DG Research and CEN TC 352 mandate group**
 - ✓ **Disseminated later on to :**
 - **DG Enterprise and FP7 projects, such as Co-nanomet**

**These gave an important contribution
to future policy and funding decisions**

Triggers

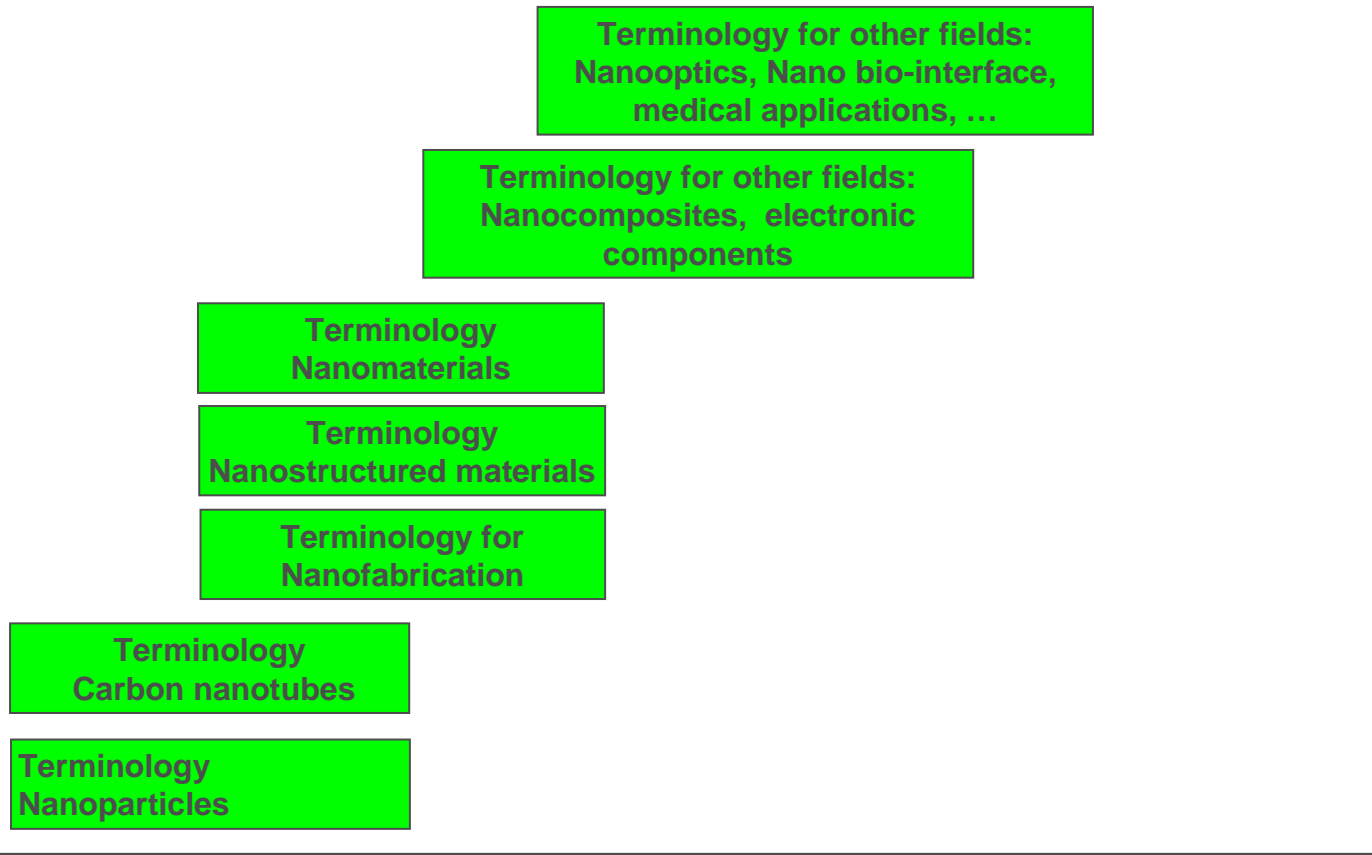
DEVELOP NANOTECHNOLOGY PRODUCTION AND MARKET

Targets

Create reliable basis for production

Avoid expensive misunderstandings

Generic Standards



2008

2010

2015

June 1-5, 2009

EuroNanoForum 2009 - Prague

19/30

ROADMAP FOR NANOSTANDARDIZATION: MATERIALS



Triggers

DEVELOP NANOTECHNOLOGY PRODUCTION AND MARKET

Targets

Create reliable basis for production

Ensure confidence in products from users

Provide fundament for health, security, and environmental management

Standards for nanoparticles

**Nanoparticles:
as carriers for medicine**

**Nanoparticles:
surface and reactivity**

**Other characteristics of NP:
electrical, optical, magnetic, ..**

**Nanoparticles:
purity, sampling**

**Nanoparticles:
agglomeration, dispersion**

**Nanoparticles:
size, size distribution**

Other Nanostructures

**Characterization of other nanomaterials:
Fullerenes, nanorods, ...**

**CNT: basic characterization by TEM, SEM, EDXA,
NIR, UV, ...**

Nanocoatings

**Nanocoatings: measurements of compositions,
geometrical, morphological and physical properties**

2008

2010

2015

June 1-5, 2009

EuroNanoForum 2009 - Prague

20/30

ROADMAP FOR NANOSTANDARDIZATION: NANOCOMPOSITES



Triggers

DEVELOP NANOTECHNOLOGY PRODUCTION AND MARKET

Targets

Create reliable basis for production

Ensure confidence in products from consumers and users

Provide fundament for health, security, and environmental management

Standards for nanocomposites

Particle release from nanocomposites, aging

Nanocomposites: barrier properties

Nanocomposites: bond strength with matrix

Nanocomposites: characterization of dispersion of nanocomponents

Nanocomposites: volume fraction



ROADMAP FOR NANOSTANDARDIZATION: HEALTH + SAFETY



Triggers

DEVELOP NANOTECHNOLOGY SAFELY

Targets

Ensure confidence in products from consumers and users

Secure safety and health of NT working places, users and consumers

Protect environment

Workplaces

Additional guidelines for workplace safety

General guidelines for workplace safety

Consumers, trade, transport

Toxicology tests, screening methods

Methods to determine hazards and toxicity of nanomaterials

Disposal, environment

Environmental risk assessment

Guidelines for safe disposal

Exposure determination - ambient air, water, soil

Risk assessment

2008

2010

2015

June 1-5, 2009

EuroNanoForum 2009 - Prague

22/30

ROADMAP FOR NANOSTANDARDIZATION: PERFORMANCE



Triggers

DEVELOP NANOTECHNOLOGY PRODUCTION AND MARKET

Targets

Promote innovation

Ensure confidence in products from consumers and users

Promote competition

Product performance

Test standards for products improved by nanotechnological components or treatment

Test standards for products improved by nanotechnological components or treatment

Test standards for products improved by nanotechnological components or treatment

Test standards for products improved by nanotechnological components or treatment

2008

2010

2015

June 1-5, 2009

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23/30

Nano Metrology Roadmaps

Corresponding to disciplinary areas identified in Nanometrology - the state of the art

Work Package 3 - Deliverable No 7

1. Dimensional Nanometrology
2. Nano Mechanical metrology
3. Nano Chemical metrology
4. Nano Structured Materials
5. Nano Biometrology

Metrology for Nano-electronics is covered in the International Technology Roadmap for Semiconductors (ITRS)

ROADMAP FOR NANO DIMENSIONAL METROLOGY



Triggers

Wide-scale use of precision engineered, improved functionality devices and components

Targets

Rapid traceable measurement of high aspect ratio structures

Measurement of surfaces and coatings with sub nanometre precision over 100 mm range

Nanoscale dimensional characterisation of 3D structures

Microfluidic structures

Biofunctional surfaces

Precision engineered 3D nanoscale structures

MEMS and NEMS

Nanoscale patterned surfaces

Metrological application of basic science & technology

Fast AFM technology

Measurement of large area surfaces

Coating thickness measurement and uniformity

True 3D AFM

Non invasive measurement of 3D nanostructures

High aspect ratio AFM

Fast areal surface measurement

Fast 3D scanning technology

Metrological AFM

High aspect ratio probes

Fast 2D scanning technology

Optimised AFM operation

Probe / surface interaction

Nanostructured standards

2D nm precision positioning

3D nm precision positioning

Tomography by X-ray or electrons

Reference surfaces and structures

AFM tip shape calibration

Optical topography measurement

X-ray or electron materials interaction

X-ray / Optical Interferometer

Nanonewton force metrology

Areal surface roughness standards

Well controlled active materials

Enabling measurement science & technology

2008

2018

2008

2018

2008

2018

June 1-5, 2009

Relative priority order
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25/30

ROADMAP FOR NANO MECHANICAL METROLOGY



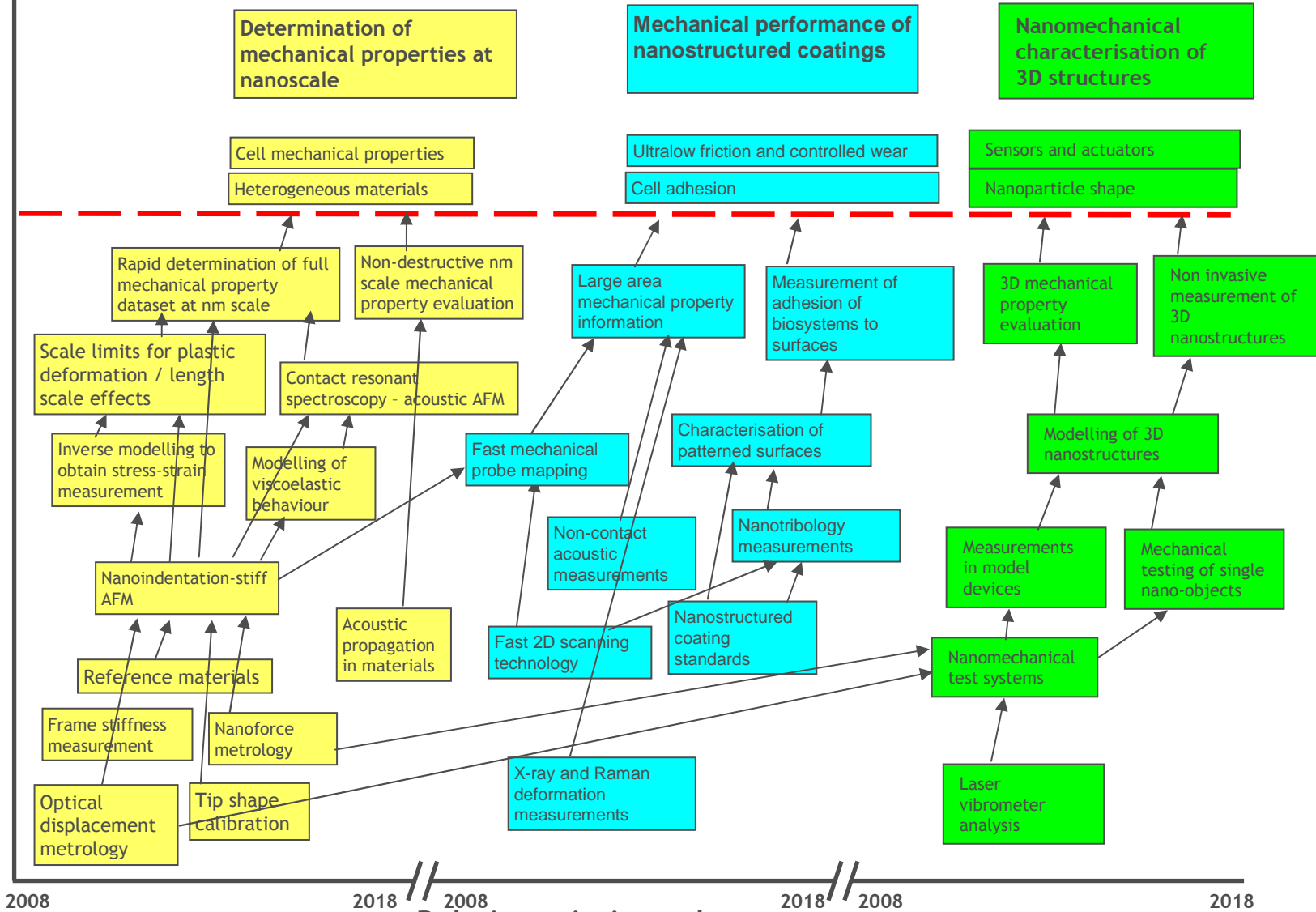
Wide-scale use of mechanically robust, improved functionality devices and components

Triggers

Targets

Metrological application of basic science & technology

Enabling measurement science & technology



2008

2018

2008

2018

2008

2018

June 1-5, 2009

Relative priority order
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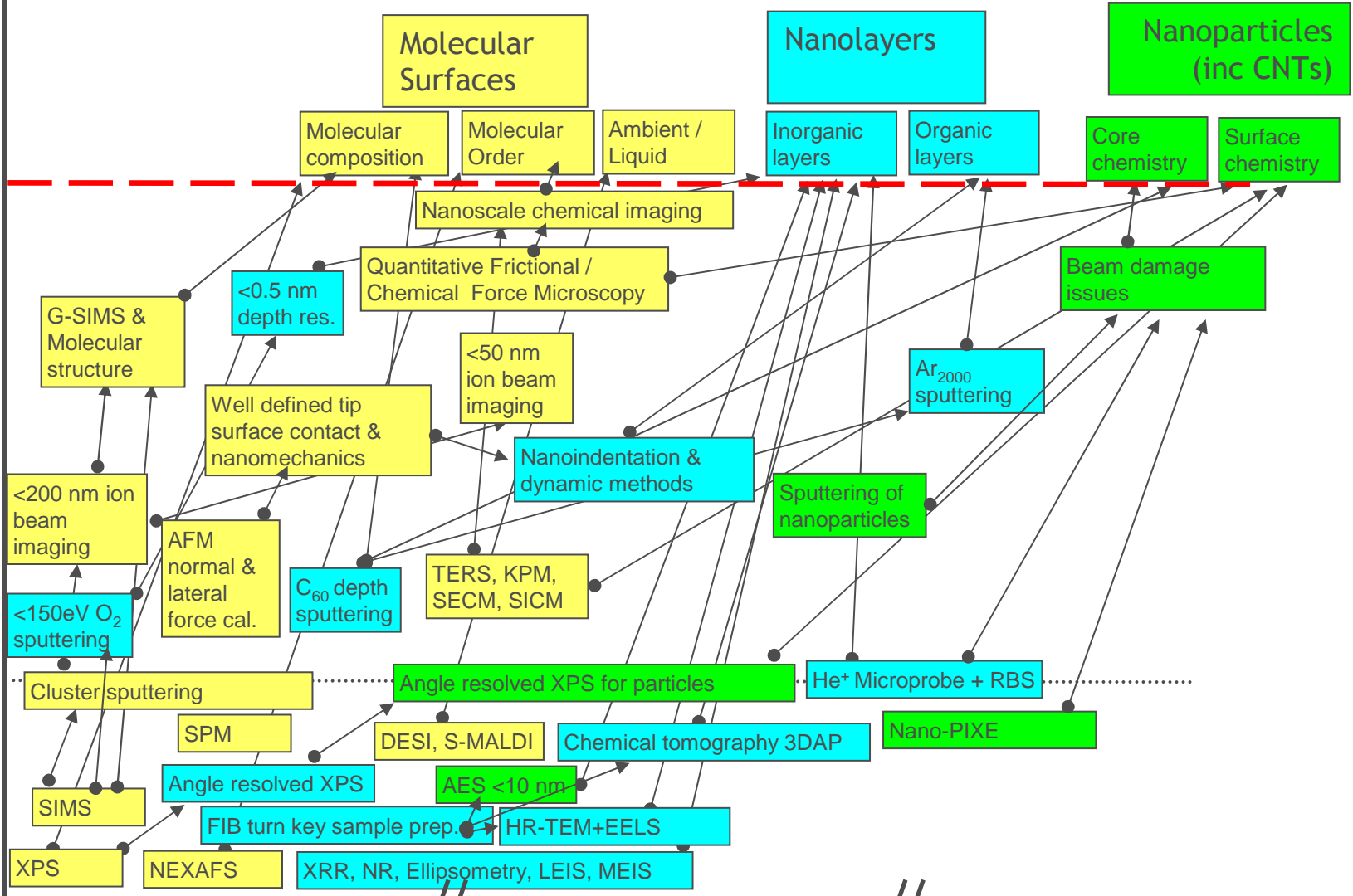
ROADMAP FOR NANO-CHEMICAL



Healthy society with an ageing population, Innovation and competitiveness
Intelligent and connected world, Sustainability

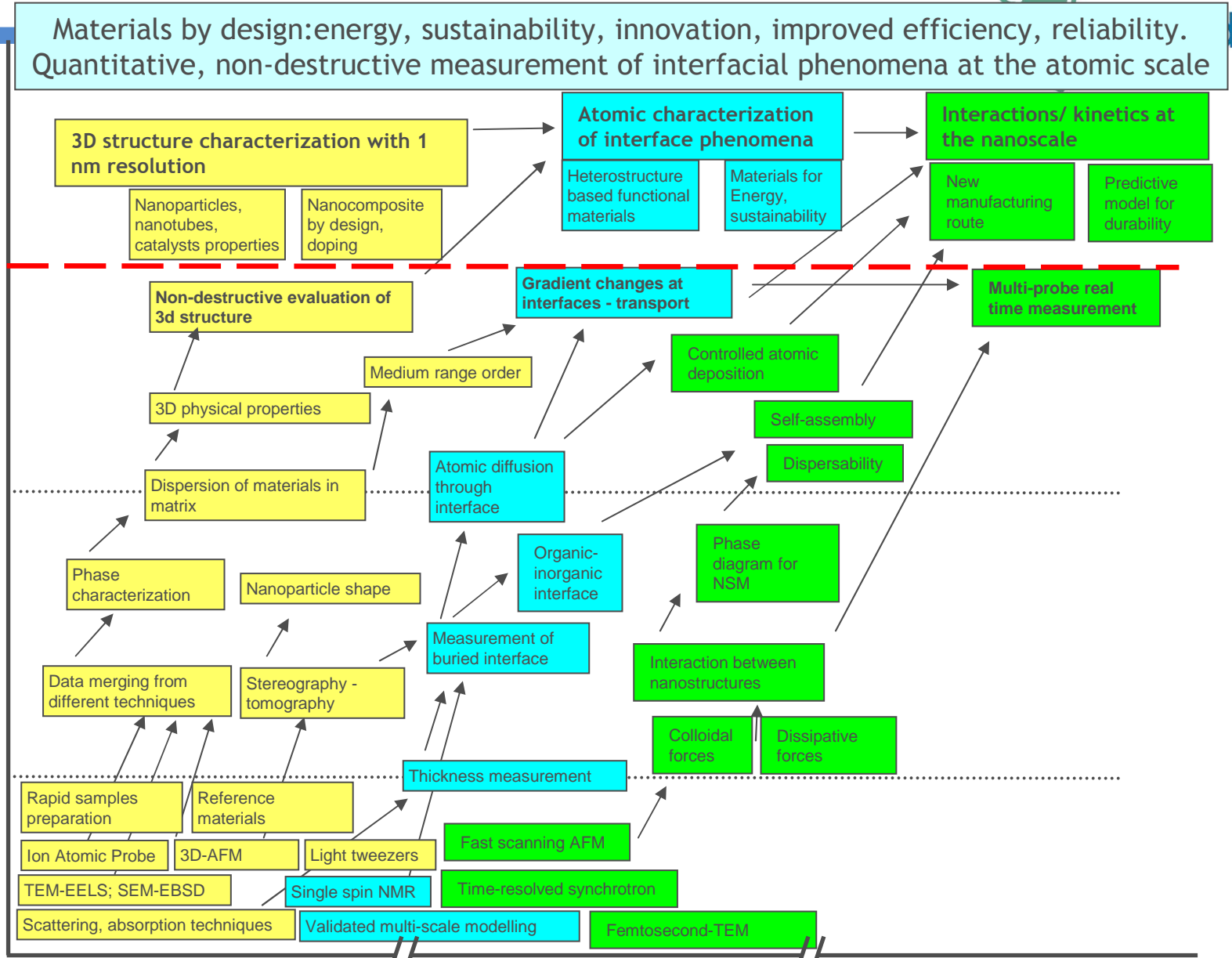


Drivers
Targets
Metrological application of basic science & technology
Underpinning measurement science & technology

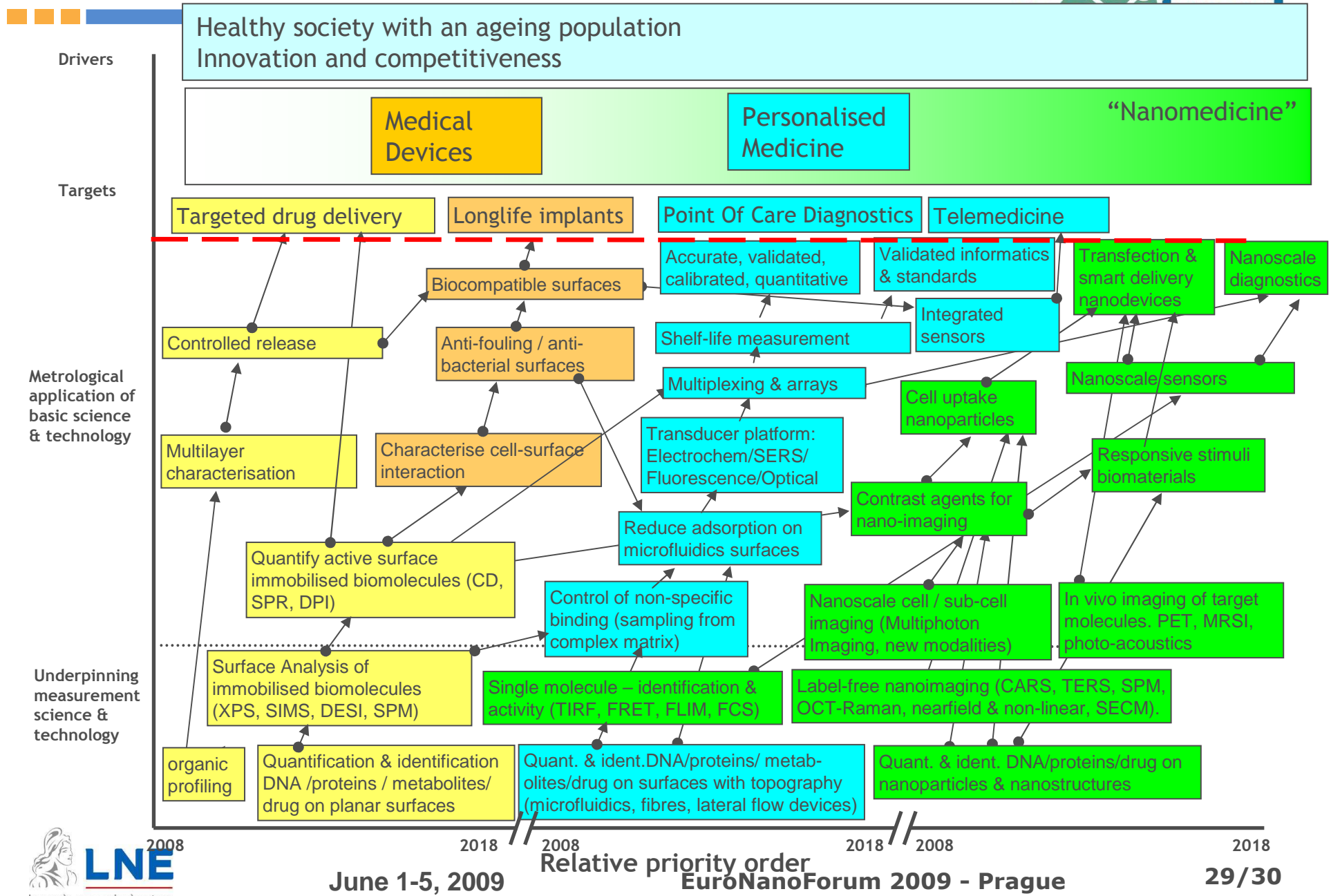


2008 // 2008 // 2008 // 2008 // 2008
Relative priority order
June 1-5, 2009 EuroNanoForum 2009 - Prague 27/30

ROADMAP FOR NANO-STRUCTURED MATERIALS



ROADMAP FOR NANOBIO-METROLOGY (Healthcare)



Thank you for your attention!

