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Theme 4: Nanoscience, Nanotechnology, Materials and new Production Technologies

Perspectives in FP7

Improve the Competitiveness of Industry in Europe

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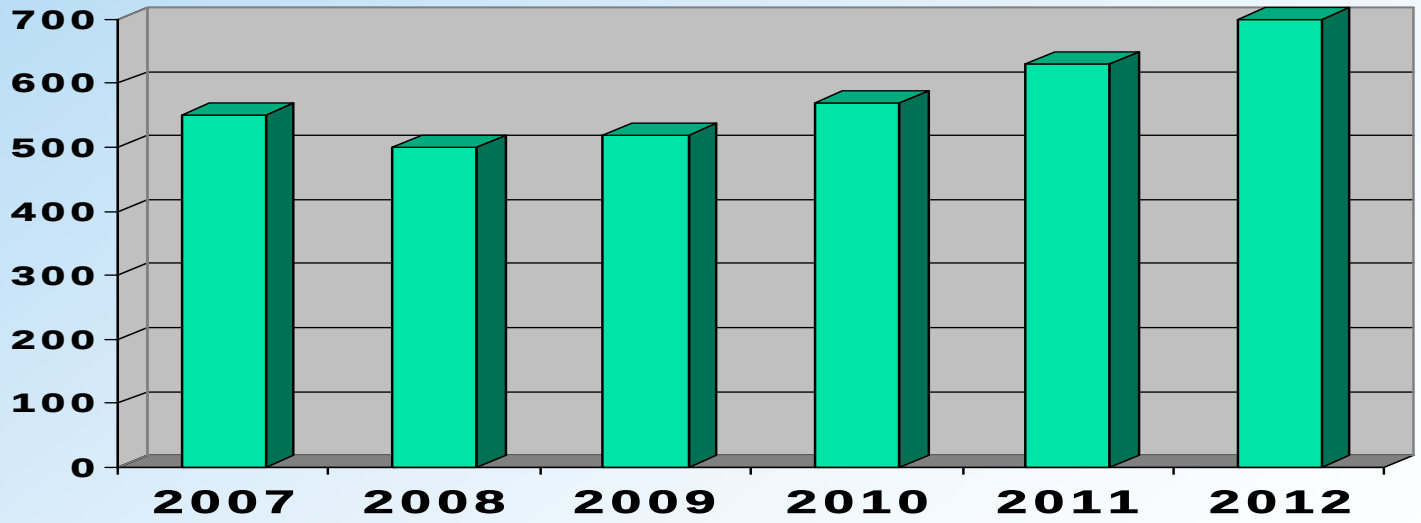
SEVENTH FRAMEWORK PROGRAMME

Financing 2007 to 2013

- Budget increase to approximately 3.5 Billion Euros
- Increase in real terms is about 40%



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Strategy

- Industrial transformation as a single objective
- 4 Activity areas (NMP + Integration)
- Inclusion of the needs identified by the ETPs
- Clear choice of instruments

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Instruments

1. *Collaborative Projects*
   - Small/medium scale (former STREP)
   - Large scale (former IP)
   - SME dedicated (former IP-SME; minimum budget for SMEs, SME leadership and SME decision making in consortium)
2. *Networks of Excellence* (restricted use)
3. *Coordination and support actions*

   (including *ERA-NET, ERA-NET+ and JTI*)

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Project Financing

Research and technological activities – 50 % of eligible costs except that for:

- SMEs – 75%
- Public bodies – 75%
- Secondary and higher education establishments – 75%
- Research organisations (non-profit) – 75%

Demonstration activities – 50 % of eligible costs

- For all organisations

Management, audit costs, etc. – 100 % of eligible costs

Coordination and support actions – 100 %

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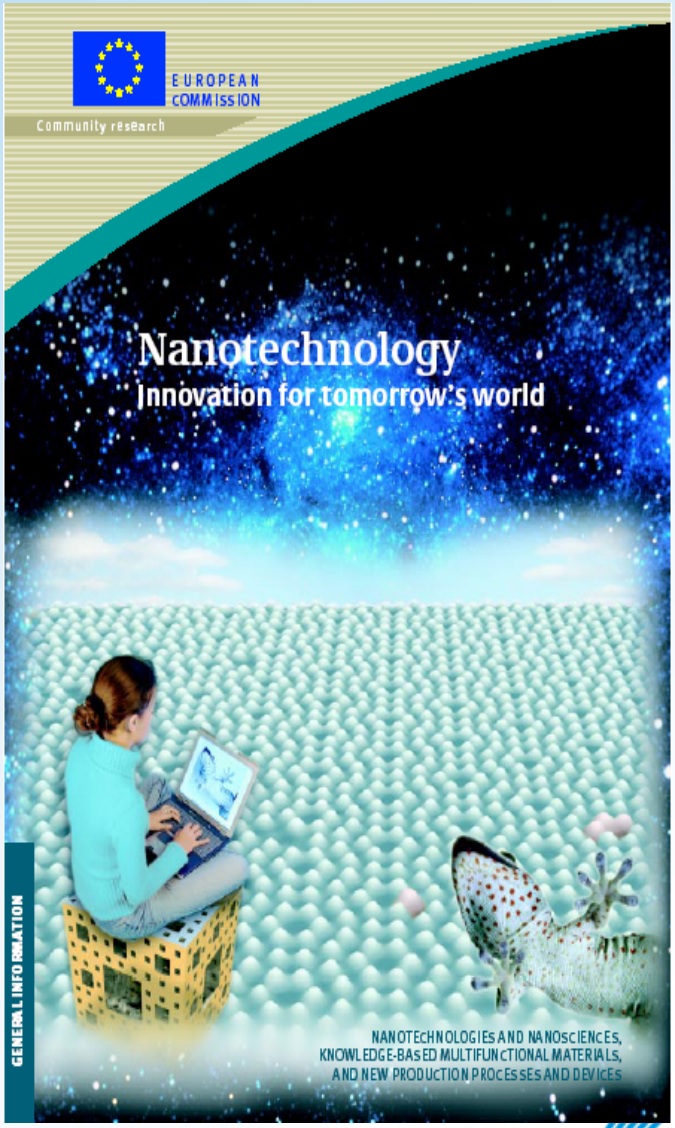
1. Nanosciences & Nanotechnologies

Objective:

Increase and support the take-up of knowledge generated in this revolutionary field for all industrial sectors;



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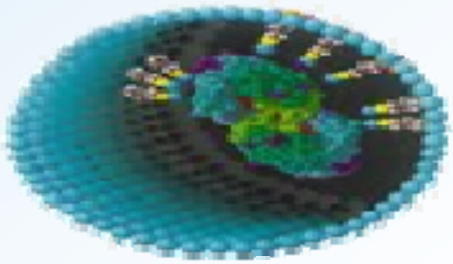
Nanosciences & Nanotechnologies (i)

- **NANOSCIENCE**
  - Expanding knowledge of size, dimension and geometry dependent phenomena;
  - Extending the limits of control and material properties for micro-,macro-applications;
  - Study the integration of technologies for self-assembly etc…;
  - Developing models, … for characterisation and manipulation;



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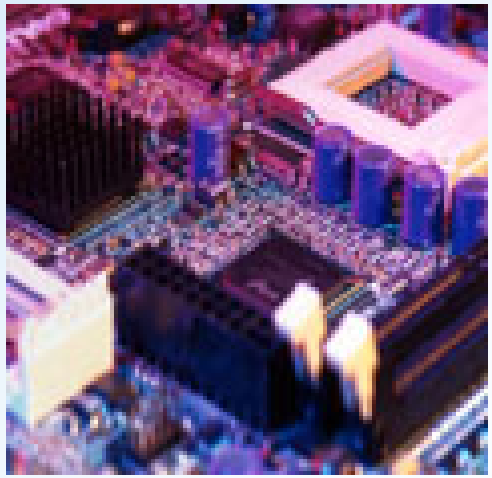
Nanosciences & Nanotechnologies (ii)

- **NANOTECHNOLOGIES**



- **Nano- and high-precision technologies for chemistry;**
- **Impact of nano-scale entities on human safety, health and the environment, standards etc…**
- **Expanding knowledge to support new evolutions in medicine, electronics, transport…**

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4.1.1 Nanosciences and converging sciences (5 topics)

4.1.1-1 Nano-scale mechanisms of bio/non-bio interactions – SM

The objective will be to explore the interaction mechanisms at the nano-scale between biological systems and nanostructures (including surfaces).

4.1.1-2 Self assembling and self organisation – SM

The objective will be to deliver systems with predictable and controllable properties in particular composition and physico-chemical structure.

4.1.1-3 Support to ICPC researchers in Nanotecnhology and creation of a free and open European electronic archive of nanosciences and nanotechnologies scientific and technical publications - SSA

4.1.1-4 Development of methodology, collection and elaboration of scientific-technical and socio-economic data and studies on nanosciences and nanotechnologies, including risk assessment, and establishment of an observatory – SSA

4.1.1-5 Support to Member States' research programmes in nanosciences – ERAnet+

4.1.2 Nanotechnologies and converging technologies (5 topics)

4.1.2-1 Pilot lines to study and develop and up-scale nanotechnology-based processes from laboratory – LA

The goal is thus to facilitate the transfer from laboratory-scale activities to larger scale processes that would open the way for industrial production lines thereby enhancing European competitiveness

4.1.2-2 Equipment for nanotechnology - LA

The research projects should focus on the development of instrumentation and methods for measurement, analysis and operations at the nanoscale, based on novel approaches or novel combinations of approaches.

4.1.2-3 Analysis of the ethical, regulatory, social and economic environment of nanomedicine - SSA

4.1.2-4 Coordination in nano-metrology – CA

4.1.2-5 Examining capacity building in nanobiotechnology - SSA

4.1.3 Health and Environmental Impacts (5 topics)

4.1.3-1 Specific, easy-to-use portable devices for measurement and analysis – LA

.The objective of the expected collaborative projects would be to develop and validate affordable, portable, adequate sampling and measurement equipments for monitoring working environments (i.e. quantification and characterization of airborne nanoparticles in particular).

4.1.3-2 EU/USA coordinated call "impact of nanoparticles on health and environment" – SM

Projects under this call should be related to engineered nanoparticless and should address one or more topics in the following areas: toxicology of nanoparticles; monitoring/detection of engineered nanoparticles in the various environments (excluding the development of equipment); environmental and biological fate, transport, and transformation of nanoparticles.

4.1.3-3 Critical review on the data and studies on the potential impact on environment and health of (i) "fullerenes", (ii) nanotubes and their derivates, (iii) metals and (iv) nano-oxides -SSA

4.1.3-4 Realisation of a critical and commented database on the impact of nanoparticles – SSA

4.1.3-5 Coordination in studying the environmental and health impact of nanoparticles and nanotechnology based materials and products - CA

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2. Materials

Objective:

Generate new knowledge to enable new industrial products and processes to be achieved,
exploiting the potential of interdisciplinary approaches in materials research.

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Materials

- Knowledge-based materials with tailored properties and enhanced processibility
- Reliable design and simulation for material engineering
- Integration at nano-molecular-macro levels in the chemical technology and materials processing industries
- New nano-,bio-,hybrid-,materials including their process design and control

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4.2.1 Mastering nano-scale complexity in materials (3 topics)

4.2.1-1 Nano-structured composite materials – LA

Approaches are expected to consider the combinations of matrices and potential reinforcing nanoelements with different chemistry, size, shape and properties, as well as the processing techniques, in order to obtain radically enhanced mechanical and physical performance, based on a thorough understanding of the fundamental mechanisms.

4.2.1.2 Nanostructured coatings and thin films – SM

The projects should consider the development of novel nanostructured coatings and thin films with markedly enhanced properties such as high hardness, chemical inertness (e.g. oxidation, corrosion), UV resistance, bioresistance and improved wear behaviour, as well as the study of novel structures, surface modification, multilayers, and a new generation of solid lubricants and tribological materials

4.2.1-3 Characterisation of nano-structured materials – CA

European-wide efforts are needed to compile the characterisation techniques that are in use or should be developed to support further nanomaterial development.

4.2.2 Knowledge-based smart materials with tailored properties(3 topics)

4.2.2-1 Organic materials for electronics and photonics – LA

Projects should aim at the development of nanostructured organic multifunctional materials with tailored electronic, optical and sensing properties, to be used in applications such as flexible organic devices for electronic labels, electronic paper, optoelectronic devices, light emitting diodes, solar cells, displays and stimuli-responsive materials (sensors and actuators).

4.2.2-2 Nano-structured materials with tailored magnetic properties - SM

Research should deliver solutions beyond the current state-of-the-art in technology areas such as spintronics, magnetic data storage/processing, photonics and sensors for medical applications.

4.2.2-3 Advanced material architectures for energy conversion - SM

Research should aim at radically new materials and synthesis approaches based upon the control of complex architectures, e. g. made with quantum dots, nanocomposites, thin-films, mesoporous 3-D architectures, carbon and inorganic nanotubes, aerogels and ionogels.

4.2.3 Novel material and bio-inspired materials (1 topic)

4.2.3-1 Highly porous bioactive scaffolds favouring angiogenesis for tissue engineering – LA

The focus should be on advanced bioactive scaffolds enabling internal growth of tissue and the site specific delivery of bioactive signalling factors (temperature, pH, concentration, internal stimuli, etc). The approaches are expected to include issues such as delivery devices (e.g. injection), remodelling of large bone defects and improved tissue-biomaterial interfaces .

4.2.4 Advances in chemical technologies and materials processing(3 topics)

SME

4.2.4-1 Flexible efficient processing for polymers - LA for SMEs

The projects should focus on finding flexible and energy-efficient processing approaches with a smart use of materials (saving resources and tailored to the application) in an environmentally friendly manner.

4.2.4-2 Nano-structured catalysts with tailor-made functional surfaces – SM

Development of a new generation of catalytic materials with tailored functionality at e surface. Interdisciplinary efforts including from advanced characterisation and modelling to reactivity and kinetics, are expected to enable the mastering of highly complex catalytic processes on the basis of a controlled sequence of surface reactions and of active sites.

4.2.4-3 Renewable materials for functional packaging applications – SM

The focus should be on the design and processing of innovative, renewable packaging materials as well as on the interactions between different types of renewable materials, e.g. in multilayer packaging, using the latest developments in nanotechnology.

4.2.5 Using engineering to develop high performance knowledge-base materials (2 topics)

4.2.5-1 Novel materials tailored for extreme conditions and environments – LA

Research should focus on radical innovations in the properties and processing of bulk or surface treated materials designed for extreme environments, based on an enhanced understanding of materials degradation.

4.2.5-2 Modelling of microstructural evolution under work conditions and in materials processing - SM

Modelling approaches are expected to build on the link between microstructural evolution and specific macroscopic material properties and take advantage of the new multi-scale approaches.

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3. New Production

Objective:

Create <u>continuously innovating</u> production capabilities to achieve leadership in industrial products & processes in the global marketplace

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4.3.1 Development and validation of new industrial models and strategies (3 topics)

4.3.1-1 Beyond Lean Manufacturing – New industrial models for products and process life cycle - LA

The main objective is to develop a new European production model, which takes the Lean Manufacturing paradigm further by incorporating the relevant parts from the European manufacturing culture (including sustainability objectives), standards and technology.

4.3.1-2 New added-value user-centered products and product services – LA for SMEs

SME

The markets increasingly demand customised products that fulfil not only one but several criteria for customisation ranging from strict technical functionality to emotional aspects, to improved quality of life, health and environment, while imposing short delivery times.

4.3.1-3 Integrated risk management in (plants, industrial parks,) industrial systems (and networks) - LA

The main target is the development of integrated methodologies for risk assessment and management addressing complexity (including multi-hazard and natural-technological hazard situations), multifunctional use of space and increasing population densities with the aim of reducing overall risk to society.

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Integrated Risk Management in Industrial Systems

Technical Content/Scope: **Development of integrated risk assessment and risk management methods. Integration of new safety concepts with the aim of reducing overall risks and achieving total safety management of industrial systems and networks**

Funding Scheme: **Large-scale integrating projects**

Special Features: **Industrial leadership; demonstration elements; covering multiple sectors**

Expected Impact: **Directly supporting the successful implementation of the strategic research agenda of the European Technology Platform on Industrial Safety.**

www.industrialsafety-tp.org

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4.3.2 Adaptive production systems (2 topics)

4.3.2-1 Rapidly configurable machines and production systems – SM

The main objective is to achieve optimal production system performance under varying conditions through the creation of radically new self-adaptive machine structures.
Key development targets are:
(1) "adaptronic" modules and interfaces integrating sensors, actuators, control and mechanical structures;
(2) mechatronic modelling and simulation tools for rapid and optimised system configuration.

4.3.2-2 Process intensification in chemicals production – SM

Research should initially target a new generation of extremely flexible, high–performance process equipment, developed through integration of self–adapting materials (shape–change alloys to create 'intelligent' valves, piezo–electric components, etc.), having the long-term goal of developing programmable chemical reactors

4.3.3 Networked production (1 topic)

4.3.3-1 Innovative custom-driven product-service design in a global environment – SM

The expected deliverables are:

•validated tools for cost-effective and rapid creation, management and use of complex knowledge-based product-services that combine the customer-driven approach with enablers for competitiveness at internationally networked locations;

•tools facilitating collaborative design in temporary partnerships; and

•new business and management processes in virtual company networks around the world.

4.3.4 Rapid transfer and integration of new technologies into the design and operation of manufacturing processes (2 topics)

4.3.4-1 Rapid manufacturing concepts for small series industrial production – LA for SMEs

SME

The research should focus on innovative RM processes with integrated materials design and simulations to be run prior to building the actual personalised part to guarantee functionality, process optimization, repeatability and "first time right", sustainable manufacturing.

4.3.4-2 Innovative pathways in Synthesis – improving efficiency by smart synthesis, design and reduction of the number of reaction steps – SM

The development focus should be given to the reduction of the number of intermediate reactions steps. Aiming at ecoefficiency and optimal use of intermediate reageants, the reduction of reaction steps could for example be tackled using the latest state-of-the-art synthetic routes, such as introducing catalytic steps.

4.3.5 Exploitation of the convergence of technologies (2 topics)

4.3.5-1 Processes and equipment for high quality industrial production of 3-dimensional nano-surfaces – LA

The objective is to up-scale and stabilise "surface functionalisation" processes with respect to throughput, yield, quality and cost efficiency. The focus is on 3-dimensional nanostructuring at the surface or the fabrication of surface structures with typical dimensions or phases smaller than 100nm on various solid materials, e.g. metals, ceramics, glasses, semiconductors and polymers.

4.3.5-2 Production technologies and equipment for micro-manufacturing – LA

The research focus should be on developing and characterising high throughput processes for length scale integration (micro/nano) and the manufacture of components and devices with complex 3D features.

Example technologies to be investigated either individually or in combination are:
technologies for direct- or rapid manufacturing;
micro-injection moulding;
microtooling production;
single part manufacturing;
energy assisted machining and;
micro-replication technologies.

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Integration of technologies for industrial applications

Objectives :

Several cross-cutting dimensions could be considered while handling the vast array of sectors and applications and could further inspire the emergence of topics:

- **Transforming traditional industry, which faces the challenge of low-cost competition. It should increase its productivity through new processes, high-added value products and new business models;**

Forest-Based Sector
Technology Platform

- **Fostering scale-intensive and specialized suppliers industry through the adoption and integration of new advanced technologies thus enabling the improvement of its leadership in the global market;**

- **Promoting Science-based Industry which will play a key role in establishing a high-value European industry.**

- **Towards a sustainable supply industry is another key objective in supporting product & productivity innovation, especially for sectors with a large environmental footprint.**

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Activity 4.4 Integration of technologies for industrial applications (6 topics + ERA-net)

4.4.-1 Advanced wood-based composites and their production - LA

The research should concentrate on bulk fibres with new or significantly improved properties, novel fibres with tailored functionalities for special applications, natural fibres and bio-based fibres; new processing and production concepts including the development of environmentally friendly and energy-efficient processing and surface modification of fibres, yarns and fabrics to enhance manufacturing of textile- and composite-based innovative products.

4.4.-2 Application of new materials including bio-based fibres in high-added value textile products – LA for SMEs SME

These new multifunctional materials, developed in particular with the help of modelling methods, would combine classical with new properties, such as self healing of damage caused by abrasion and wear, variable strength or sensor properties, may contain micro-encapsulated inclusions and would be able to self-adapt their range of properties depending on the requirements during application.

4.4.-3 Multifunctional materials for the future vehicles – LA

These new multifunctional materials, developed in particular with the help of modelling methods, would combine classical with new properties, such as self healing of damage caused by abrasion and wear, variable strength or sensor properties, may contain micro-encapsulated inclusions and would be able to self-adapt their range of properties depending on the requirements during application

Activity 4.4 Integration of technologies for industrial applications (6 topics + ERA-net)

4.4.-4 Substantial innovation in the European medical industry: Development of nanotechnology-based smart multi-tasking targeted agents for diagnosis and therapy ("theranostics") – LA

The aim of developing nanotechnology-based targeted multi-purpose systems for diagnosis and therapy for cardiovascular diseases, neurodegenerative conditions and/or cancer. They should demonstrate high specificity and efficacy, biocompatibility, and the capacity to cross biological barriers.

4.4.-5 Resource efficient and clean buildings – LA

The main development issues and targets are: new concepts, technologies, design tools and business models for "intelligent buildings", able to significantly reduce or even meet their own energy consumption; improvement of the building energy performance (through cladding and ventilation technologies, sensors and pervasive computing systems, utilisation of embedded renewable energy sources…) at building and at district levels.

4.4.-6 Innovative added-value construction product-services – LA for SMEs SME

The main development issues and targets are: development of knowledge-based construction processes and products deployable by SMEs (in terms of investment costs and human resources), especially for the retrofit, refurbishment and maintenance of buildings; new manufacturing systems (e.g. robots and automation) and ICT infrastructures and tools to develop ubiquitous SMEs access to competitive knowledge; development of new "full" services with a high added value for clients

4.4.-7 ERA-Net on Construction – ERA-net

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Evaluation Criteria

- Scientific and technical quality
- Implementation (in stage 2 only)
- Impact expected

- Threshold stage 1: 8/10
- Threshold stage 2: 12/15

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Future proposals
CONCENTRATE ON:

- ✓ Real industrial needs as determined by the market demand and by sustainability objectives
- ✓ Active and strong industrial participation
- ✓ Real pilot cases on new production models
- ✓ Complementarity of contributions and roles of the actors in the value chain
- ✓ Collectively covering a number of distinct discrete manufacturing sectors (eg. White goods, automotive, machinery, …..)

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Future proposals

WHAT SHOULD BE AVOIDED ?

- ✓ Pure SW development with no research,
- ✓ Pure methodology with no research and innovation on technology and/or pilot cases,
- ✓ Consultancy activities, without any real/proven industrial participation (both solution providers and end users)
- ✓ No 'local' applications with no added value at European level (Point and Partial solutions)

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Nanosafety strategy
Industrial risk management

- What is acceptable/allowable:
- Impact, thresholds, exposure limits, environment

- How to achieve it:
- Detection, measurement, characterisation, dosimeters
- Safe industrial processes, recycling
- Transport, handling and consumer safety

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Coordination needs
EU, national and private projects

- Toxicity data of functionalised particles (protocols, references, public/private data, validation)
- Test centres networks, competences
- International dimension (USA, Japan, Canada, China)
- Standardisation (ISO, CEN)
- Best practices (grainsize based MSDS?)

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Summary

Value proposition as defined action

- **Continuity with past activities**
- **Support industrial change;**
- **Collaborative research with industrial relevance;**
- **Multi-annual research planning linked to innovation;**
- **SME responsive;**

Transfer function
Role of FP7

Knowledge
Value Chain
Capacity
Continuous Cost Evaluation
Management systems
Human Resources
...

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