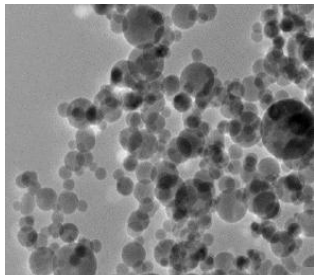
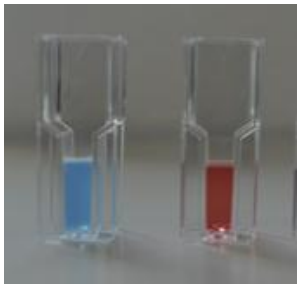
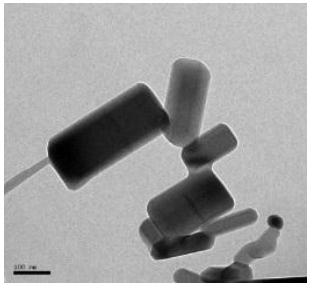
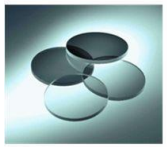
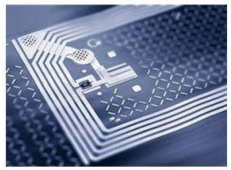
Nanosafety Cluster Review meeting

Industry and Market impact



Carlos Fito (NanoMICEX), Anna Costa (SanoWork), Jesus López de Ipiña (Scaffold) and Andreas Falk (EURO-NanoTox)

Brussels, December 11th, 2014

Nanosafety Cluster Review meeting
"Industry and Market impact"

NanoSafety Cluster

Outline

1. Market drivers and impact of the cluster projects in the EU Industry
2. Experiences from Industrial oriented projects: research to market
   - NanoMICEX: Pigment, inks and paint industry
   - SanoWork: PNCs, textiles, ceramics and water treatment
   - Scaffold: construction industry
3. Closer to the market Roadmap (EURO-NanoTox)
4. Round table – Questions

nanoMICEX Sanowork Scaffold EURO nanotox

Nanosafety Cluster Review meeting
"Industry and Market impact"

NanoSafety Cluster

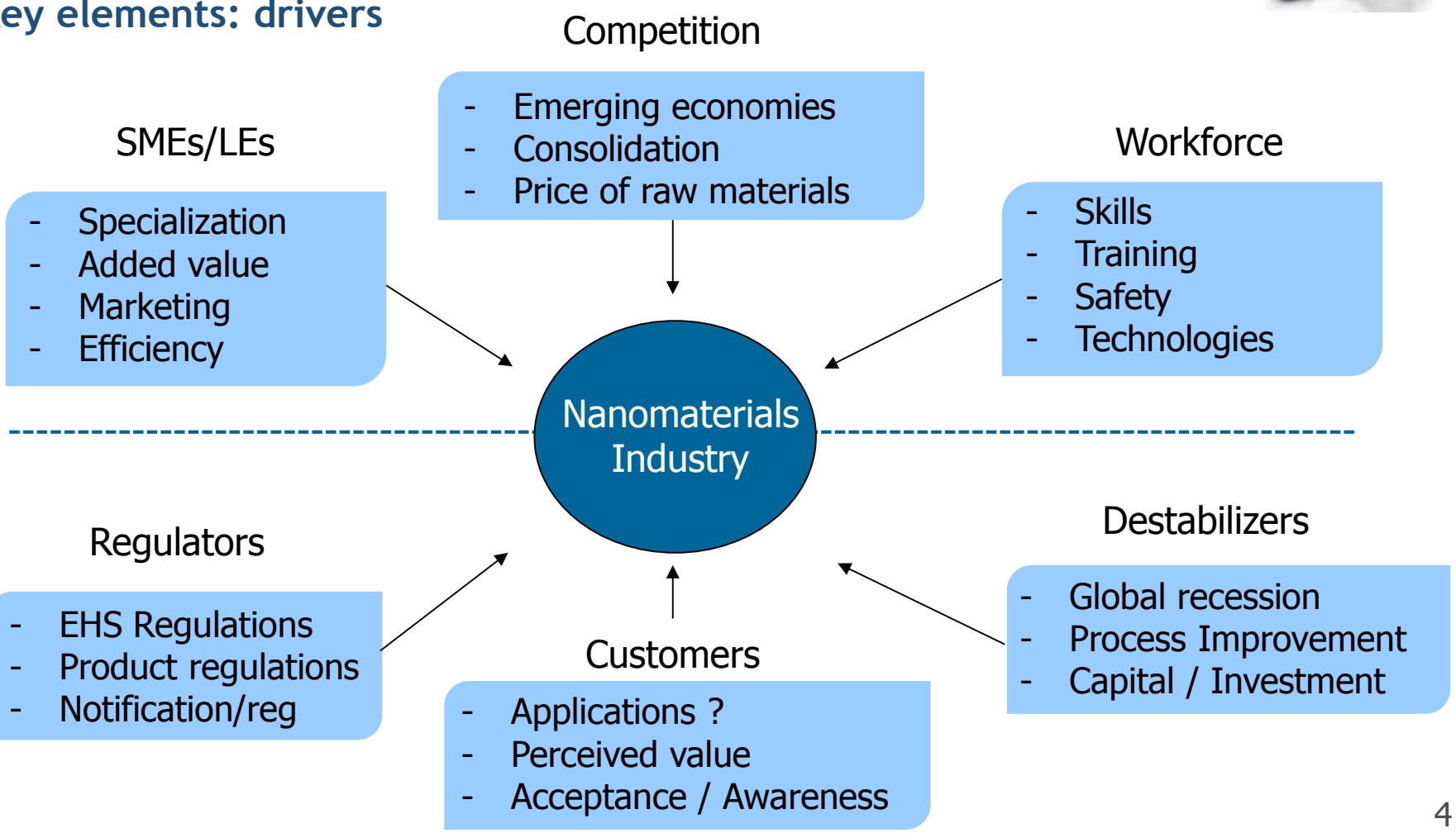
1. Market drivers and impact of the cluster projects in the EU Industry

nanoMICEX Sanowork Scaffold EURO nanotox

Nanosafety Cluster Review meeting "Industry and Market impact"

1. Market drivers and impact of the cluster projects in the EU Industry

❑ Key elements: drivers



Nanosafety Cluster Review meeting "Industry and Market impact"

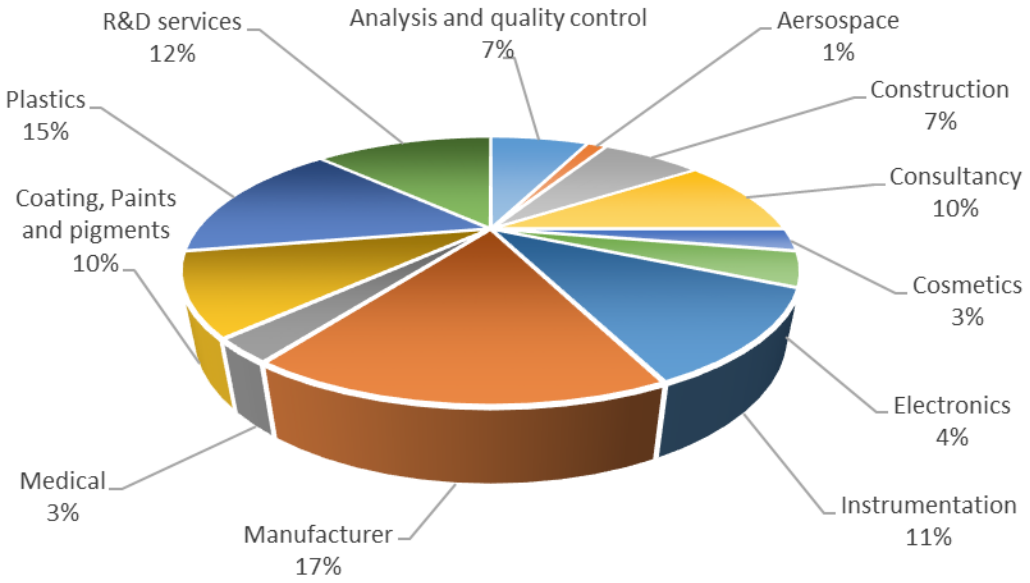
1. Market drivers and impact of the cluster projects in the EU Industry

❑ Key elements: Cluster impact

- Number of enterprises: 147
- Percentage of industrial partners: 28 %
- Total Budget allocated to Enterprises: €40.140.571 (22%)
- Total Budget allocated to SMEs: €31.857.302 (18 %)

❑ Sectors represented by SMEs

- **Main Sectors**
  - Manufacturers
  - Plastics
  - Coatings
  - Paint and pigments
  - Construction
- **Projects scrutinized:** 50

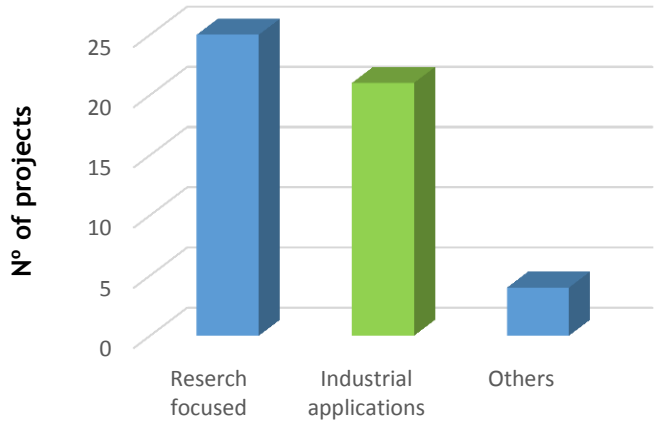


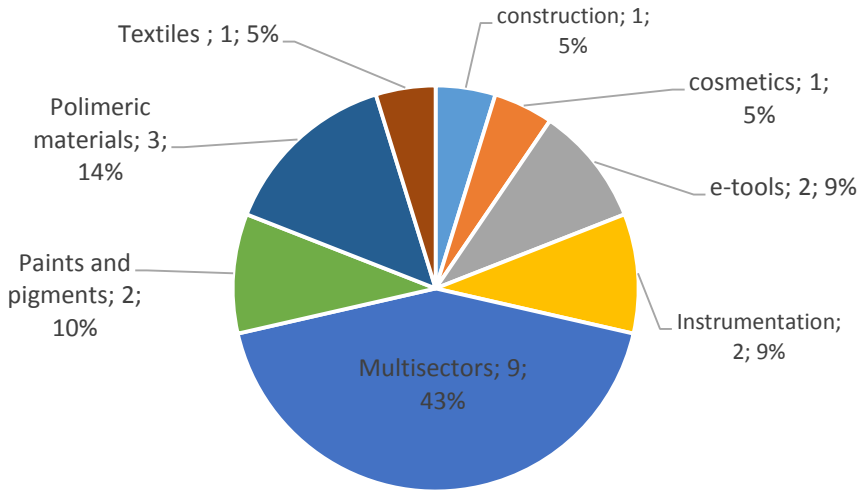
Nanosafety Cluster Review meeting "Industry and Market impact"

1. Market drivers and impact of the cluster projects in the EU Industry

Projects and sectors

- **21 Projects considering industrial applications**
- **25 Research focused projects (+4)**
- 9 Projects with a multisectorial approach
- 3 Projects developing e-tools to support decision making
- 4 Projects focused on paints and pigments
- 5 Projects considering buildings / constructions
- 6 Projects considering polymeric materials





Nanosafety Cluster Review meeting "Industry and Market impact"

1. Market drivers and impact of the cluster projects in the EU Industry

❑ Key elements: "Cluster services"

Main solutions to the industry

- A big amount of data on the PC, toxicological and ecotoxicological properties of ENMs
- New formulations: coatings, paints and inks
- New materials: nanocomposites, textiles and concrete
- Safer by design NMs (case by case)
- E-tools to support decision making

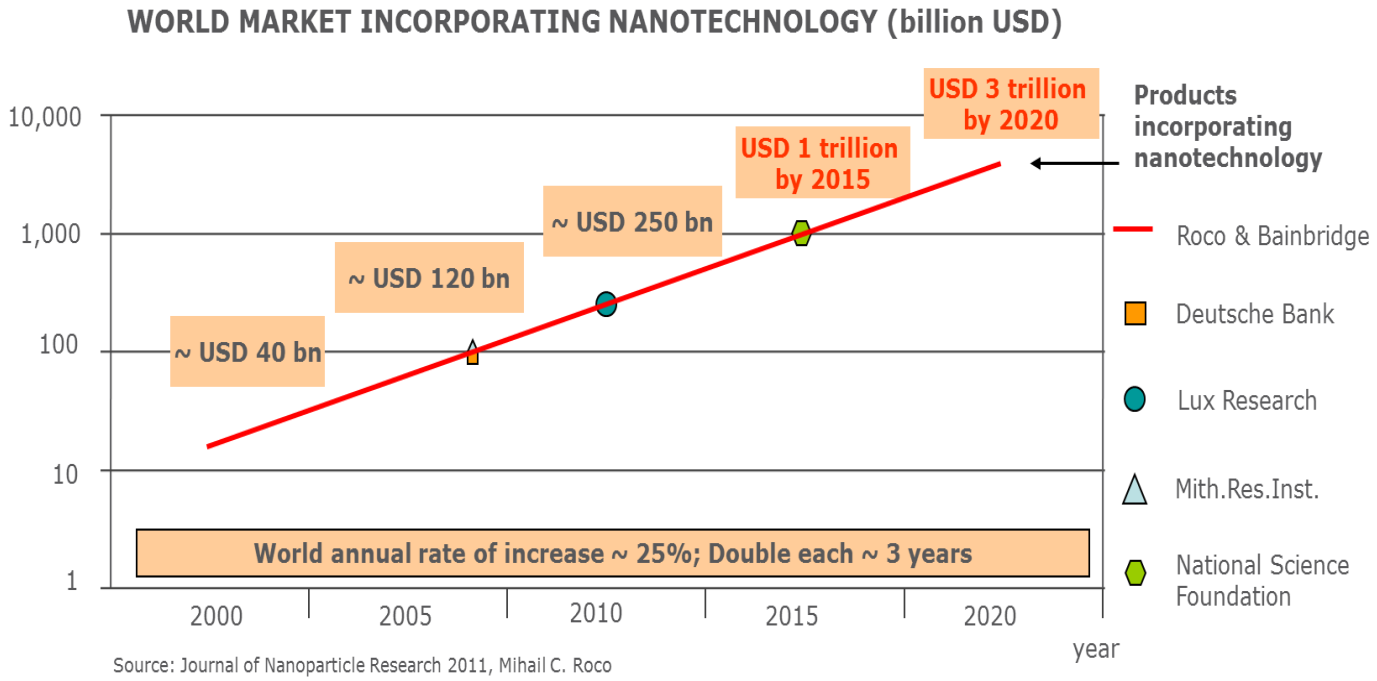
Main Particles

- Ag – NPs
- SiO2, ZnO, TiO2 (different size, shape and surface charge), CeO2
- Al2O3 and Fe3O4
- Graphene / other carbon-based ENMs including MWCNTs o SWCNTs
- Nanoclays & Nanocellulose

Nanosafety Cluster Review meeting "Industry and Market impact"

1. Market drivers and impact of the cluster projects in the EU Industry

❑ Market Situation: market share



Commission's 2nd Regulatory Review:

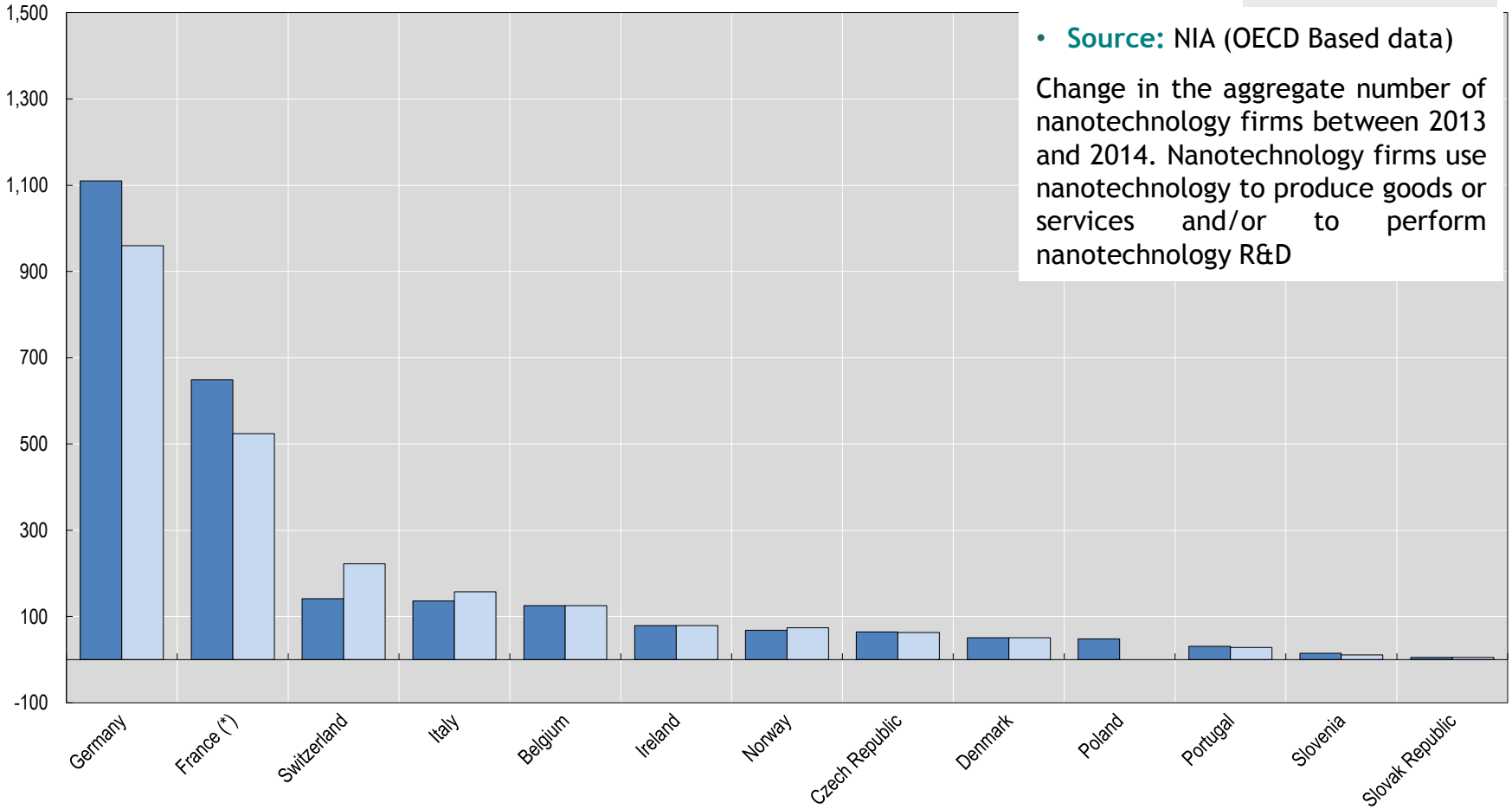
Global market of **11 million tonnes**

World Nanomaterials to 2016 - Industry Market Research, Market Share, Market Size, Sales, Demand Forecast, Market Leaders, Company Profiles, Industry Trends.

Nanosafety Cluster Review meeting "Industry and Market impact"

1. Market drivers and impact of the cluster projects in the EU Industry

❑ Market Situation: : Nanotechnology related companies



- **Source:** NIA (OECD Based data)

Change in the aggregate number of nanotechnology firms between 2013 and 2014. Nanotechnology firms use nanotechnology to produce goods or services and/or to perform nanotechnology R&D

Nanosafety Cluster Review meeting "Industry and Market impact"

1. Market drivers and impact of the cluster projects in the EU Industry

❑ Market Situation: EU Production volumes (tonnes / year)

NMs	Piccino et al, 2001	Keller et al, 2013	ANSES, 2013	Sun et al, 2014
TiO2	550	20,000	92,000	10,000
Ag	6	100	0,006	30
ZnO	55	7,900	1,900	1,600
CNTs	550	740	-	380
Fullerenes	0.6	-	< 100	20
CeO2	55	2,300	700	-
AlxOy	550	8,100	15,000	-
FexOy	550	9,700	6,100	-
SiO2	5,500	22,000	990,000	-
NClays	-	2,400	< 100	-
Cu	-	46	<100	-
QDs	0.6	-	-	-
Total (t)	7,817	53,486	1,106,000	12,030

Commission's 2nd Regulatory Review:

Global market of **11 million tonnes**

Extrapolation -EU:

EU market of 2,5 million tonnes

No reliable information available due to the lack of information on products on the market containing NMs

*** Source:** Bernd Nowack oral presentation – NanoSafe 2014

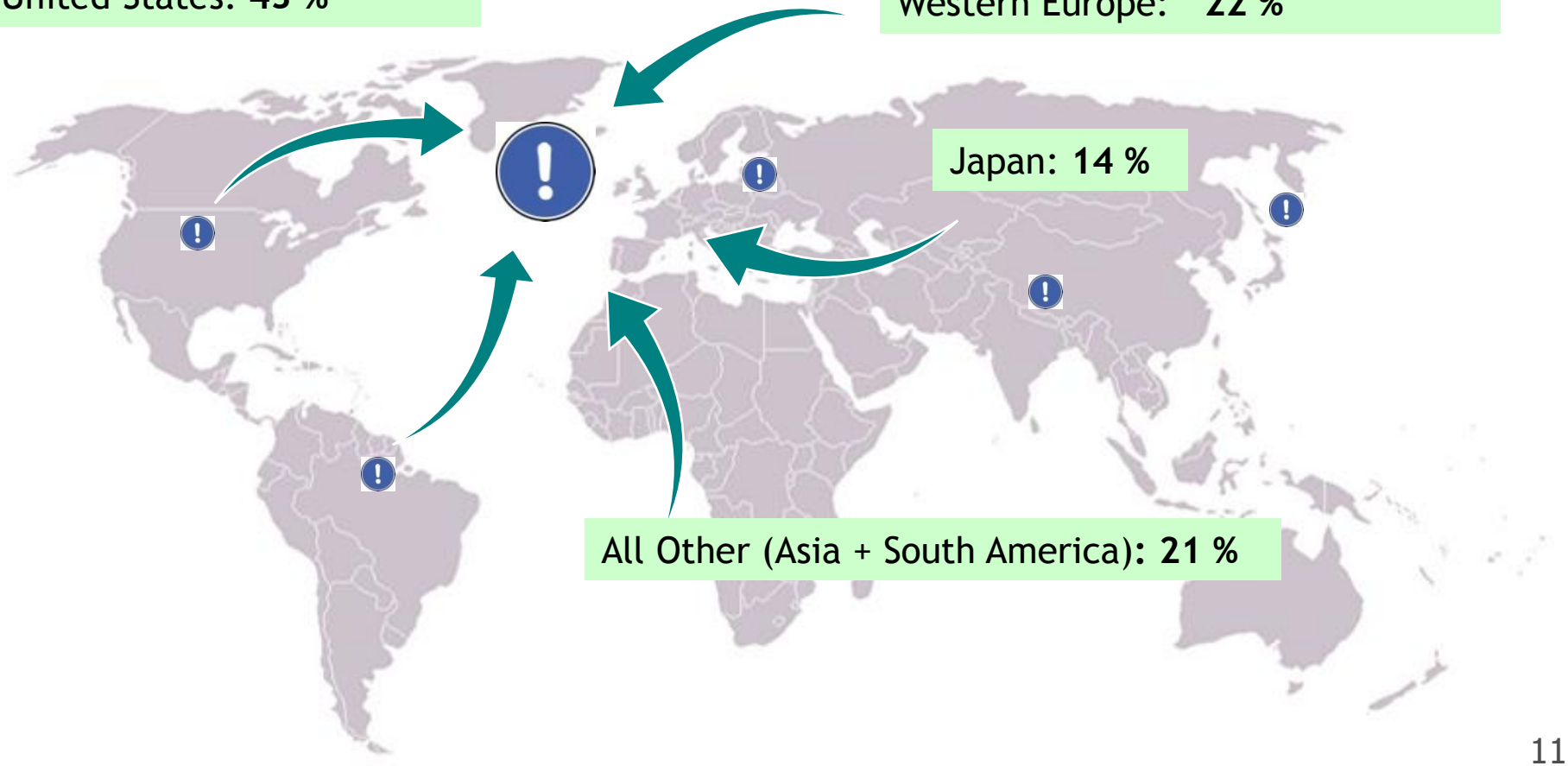
Nanosafety Cluster Review meeting "Industry and Market impact"

1. Market drivers and impact of the cluster projects in the EU Industry

❑ Market Situation: Geographical breakdown (Global production)

United States: **43 %**

Western Europe: **22 %**



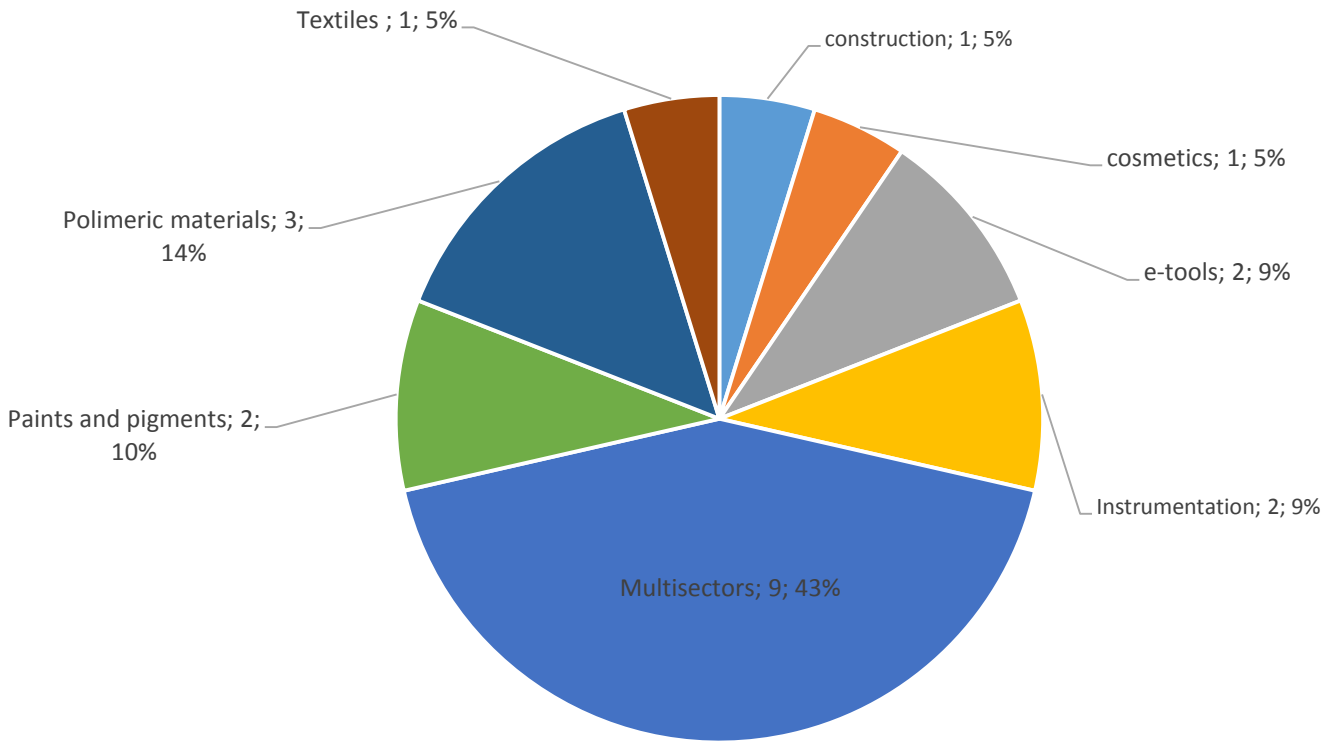
Japan: **14 %**

All Other (Asia + South America)**: 21 %**

Nanosafety Cluster Review meeting "Industry and Market impact"

1. Market drivers and impact of the cluster projects in the EU Industry

❑ Market Situation: Applications



Key Markets

- Coatings
- Paint & pigments
- Electronics
- Cosmetics
- Energy
- New materials in automotive and aerospace

Nanosafety Cluster Review meeting "Industry and Market impact"

1. Market drivers and impact of the cluster projects in the EU Industry

❑ Market Situation: : Applications

- Medical Devices & Pharmaceuticals **
- Cosmetics **
- Chemicals & Raw Materials ***
- Mining
- Energy
- Machinery
- Electronic & Electrical Equipment **
- Security
- Defence
- Transport
- Manufactured Goods
- Recycling & Waste **
- Water & Wastewater
- Agriculture ***
- Construction
- Food & Feed **
- Food Contact & Packaging **
- Textiles *

Popular Markets

- Chemicals / RM
- Med & Pharma
- Agriculture
- Electronics
- Cosmetics
- Food /FPM
- Textiles

Source: NIA

Nanosafety Cluster Review meeting "Industry and Market impact"

1. Market drivers and impact of the cluster projects in the EU Industry

❑ Potential Impact of the cluster activities

Main solutions to the industry

- 9 Projects with a multisectorial approach
- 3 Projects developing e-tools
- 4 Projects focused on paints and pigments
- 5 Projects considering buildings / constructions
- 6 Projects considering polymeric materials

→

> 200 million €

> 5000 SMEs at EU level

> 50.000 workers

> 100 million of consumers

Main Particles

- Ag – NPs
- SiO2, ZnO,CeO2
- Al2O3 and Fe3O4
- Graphene / MWCNTs o SWCNTs
- Nanoclays & Nanocellulose

→

> 1 million tonnes of NPs

Main sectors reprented

- Paints and pigments industry
- Buildings / constructions
- New materials (composites)

→

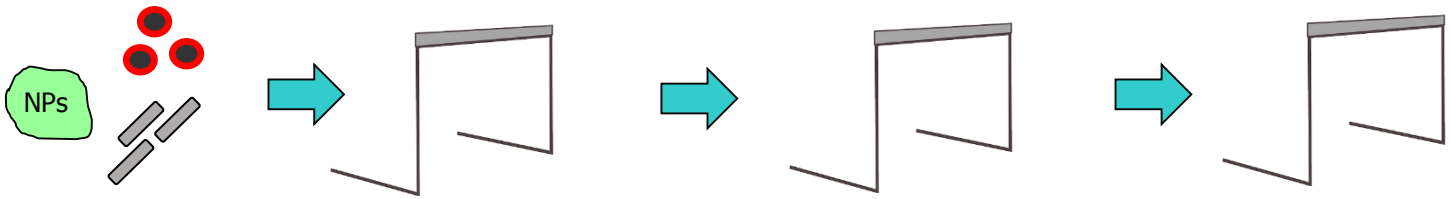
> 200,000 tonnes of Nano-enabled products on the market

Nanosafety Cluster Review meeting "Industry and Market impact"

1. Market drivers and impact of the cluster projects in the EU Industry

❑ Key Questions about the "Cluster services"

- Time to Market "?¿"



Right NPs

Case by case?
Grouping?

Application of the nanotechnology at industrial level:

Investment
Applications
Process
Cons. Acceptance
Cost of Raw Mat.

Regulation: EHS, use in the market and limitations.

REACH / CLP
Food / FCM
Cosmetics

Consumer safety and applicability:

FDS / Labelling
Env. Impacts (LCA)
Price (€)

Nanosafety Cluster Review meeting "Industry and Market impact"

1. Market drivers and impact of the cluster projects in the EU Industry

❑ Key Questions about the "Cluster services"

- Main solutions to the industry: we need a dialogue

Hi, let me check with my colleagues from the Cluster:

- I can provide you with some REL
- I have lots of information on the PC and eco(tox) properties, but, which are the specifications of your NPs?
- I "think" you can use FPP3 Mask and use LEVs
- Procesability (?¿), What do you mean?

Hi, I need some help. Can you please give me advice on:

- Occupational Exposure Levels
- PPE and Engineering controls
- PC and eco(tox) properties
- Procesability of the NMs
- Best Practices

?

Nanosafety Cluster Review meeting "Industry and Market impact"

1. Market drivers and impact of the cluster projects in the EU Industry

❑ Key Questions about the "Cluster services"

- Main solutions to the industry: we need a dialogue

I will really appreciate to know what the cluster can provide to the industry

1. e-tools to support risk assessment & best practices
2. Reliable data on examples of applications of NMs at industrial level (Promoting Nanotechnology as KEY?)
3. Information to support the compliance with regulation, specially on human health and environmental endpoints
4. A compendium of projects, events calendar and strategic documents (SRA + Road Maps)

Nanosafety Cluster Review meeting "Industry and Market impact"

1. Market drivers and impact of the cluster projects in the EU Industry

❑ Key Questions about the "Cluster services"

- Main solutions to the industry: we need a dialogue

Thank you, I would like to suggest the cluster members the following actions

1. Definition of a dedicated WG: Industry and Market
2. Increase the visibility of the cluster: How?
3. Industry on Board: Incorporation of companies and industrial needs analysis in our meetings
4. Collaboration with the Industry: Placements?
5. Insurance: incorporation of the EHS thinking into the company and health surveillance

Be closer to the Market

NanoSafety Cluster

2. Experiences from Industrial oriented projects: research to market

nanoMICEX Sanowork Scaffold EURO nanotox

Nanosafety Cluster Review meeting "Industry and Market impact"

2. Experiences from Industrial oriented projects

❑ A complete definition & IPR agreement is mandatory

Foreground	Use	IP Strategy	Exploitation potential
Surface modifiers and surface modification protocols specifically designed and developed to reduce the toxicity of the target nanoparticles	Free use by consortium members	Patent	Both, surface modifiers and protocols will be used by the industrial partners to manufacture safer NPs and Nano-Products
Scale up surface modification process of ZnO NPs (Ceramic applications)	Restricted to TORRECID	Trade Secret	Manufacture of non-toxic ZnO NPs: new business lines
Scale up surface modification process of ZnO NPs (Paint applications)	Restricted to Tec Star	Trade Secret	Manufacture of non-toxic ZnO NPs: new business lines
New Printer Ink Cartridges based on QD formulations	Restricted to Tec Star	Trade Secret	New business lines: anti-counterfeiting solutions based on ink-jet printing
New paints formulations based on the combiantion of ZnO + TiO2	Restricted to Tec Star	Trade Secret	New added value prodcuts on the market: UV resintant paints for outdoor use
Designs and specifications of new Industrial Inkjet Print heads	Restricted to Ardeje	Trade Secret	Potential commercial agreement with ink jet printers manufacturers – License agreement

IPR

NANOMICEX is a collaborative project funded by the European Community´s Seventh Framework Programme (FP7/2007 – 2013) under G.A. n. 280713

Nanosafety Cluster Review meeting "Industry and Market impact"

2. Experiences from Industrial oriented projects

❑ Market analysis recommended

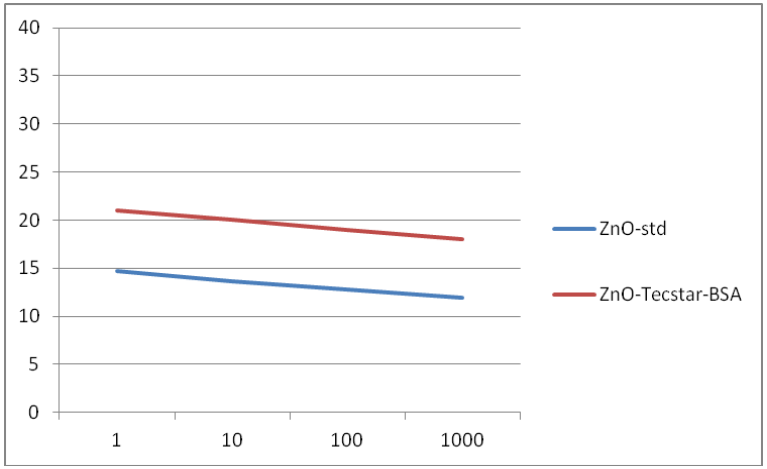
Description of the Result	Scale up surface modification process of ZnO NPs
Innovativeness	These surface modification protocols are highly innovative per se, being performed to reduce the toxicity of both pristine nanoparticles and nano- formulations. The surface modification process has been scaled up to support the development of functional ENMs at industrial scale by each industrial partner in the consortium.
Product/Service Market Size	The scaling up of the protocols will enable to produce new and safer nanomaterials. The market share is directly related with the markets where the industrial members of the consortium are currently present, including nano-pigments , Ag / QDs based formulations, paints and nano-additives in plastic/inks applications.
Market Trends/Public Acceptance	The market trend is the development and commercialization of safe added value products such as conductive inks or self-cleaning paints. The public acceptance of the new protocols rely on the capacity of this protocols to reduce the hazardous properties of the final products placed on the market.
Customers	SMEs and Large Companies manufacturing nanomaterials for multi-sectorial applications, and specifically pigments, inks or paints manufacturers
Cost	A small increase in the process due to the addition of new raw materials is expected. This increase is calculated on the basis of the production rates of each company.
Time to market	Immediate
Foreseen Product/Service Price	The partners in the consortium are scaling up the protocols to evaluate the cost of implementation, and hence, calculate the market price of the new safe by design products.
Status of IPR: Foreground	The foreground rely on industrial partners scaling up the process
Status of IPR: Exploitation Forms	Trade Secret

"Got a few problems going from lab scale up to full-scale commercial."

NANOMICEX is a collaborative project funded by the European Community´s Seventh Framework Programme (FP7/2007 – 2013) under G.A. n. 280713

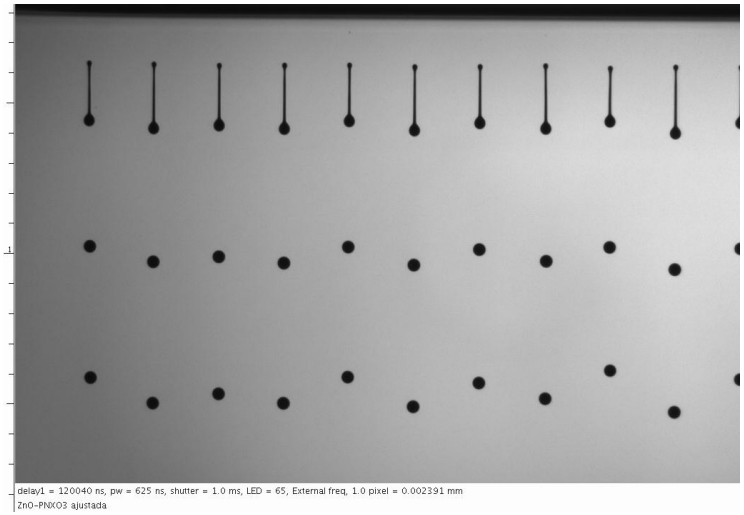
2. Experiences from Industrial oriented projects

❑ Examples of products on the market: Safer Inks based on NMs-S



The **novel ink** is characterized by higher viscosity, and similar particle size. Particle size is still in the working parameters for the ink, whereas viscosity requires increase in jetting temperature.

In order to test the jetting behaviour the prepared inks were tested in a Jet Xpert system. Inks were adjusted for proper printing. It was observed that composition with modified ZnO required adjustment of voltages to get right printing behavior.



NANOMICEX is a collaborative project funded by the European Community´s Seventh Framework Programme (FP7/2007 – 2013) under G.A. n. 280713

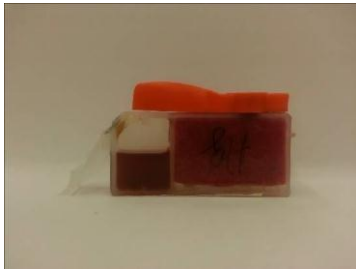
2. Experiences from Industrial oriented projects

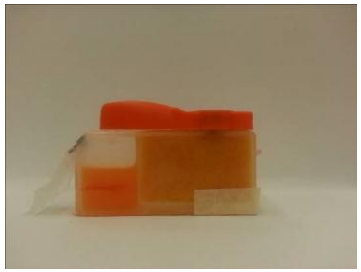
❑ Examples of products on the market: new QDs / Ag based Inks

Silver ink was formulated from hydrophilic silver nanoparticles

QDs inks were obtained by the modification of the QDs surface through the in situ anchoring of PEG-thiol to the growing ZnS shell. The resulting aqueous solution of QDs is stable for over 1 month, and keeps ca.70% of the original luminescence intensity. Ink was formulated from this material.

The formulated inks were filled into empty PGI525 cartridges and used on a Canon Pixma iP4850 printer and print-outs with a 100% and 5% coverage were done.





Cost Effective analysis recommended ¡

NANOMICEX is a collaborative project funded by the European Community´s Seventh Framework Programme (FP7/2007 – 2013) under G.A. n. 280713

2. Experiences from Industrial oriented projects

❑ Key exploitable results: NMs based stable solutions

Partners developed standard procedures to create TiO2 and ZnO stable water based nanofluids (to avoid direct airborne nanoparticles exposition).

Procedures includes chemical stabilizers definition and mechanical processes to have stable dispersions

The paint manufacturers developed a photocatalytical paint using TiO2 and ZnO stable water dispersion-

A classical Outdoor test using outdoor exposure racks → 45°, South orientation in Valencia, was used for validation

After 2 months on outdoor exposure racks:
- Sample 1: (DE = 14.5)*
- Sample 2 (Nanofluids): (DE = 3)*
- Control Sample: (DE= 14)*

These data refers to the discoloration for every sample*

NANOMICEX is a collaborative project funded by the European Community´s Seventh Framework Programme (FP7/2007 – 2013) under G.A. n. 280713

2. Experiences from Industrial oriented projects

❑ Key exploitable results: Viability?

- ✓ The preparation of surface modified ZnO were scaled up. The obtained material was used to develop new in ink-jet inks.
- ✓ **ZnO coating procedures increase process cost.**
- ✓ The technical validation has shown that ZnO-BSA can used in ink-jet applications according with current quality standards.
- ✓ The market acceptance has to be studied
- ✓ An increase in the price is expected, being needed a reduction in the costs of the raw materials used

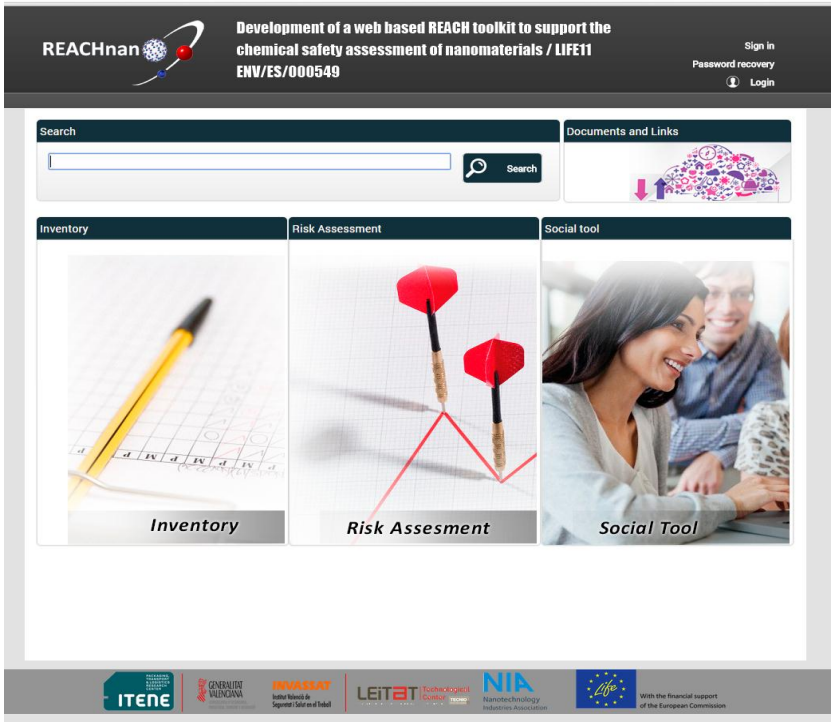
Costs type	Qty.	Costs
Solvents	distilled water	0,1
	toluene	0,1
	acetonitrile	0,1
	chloroform	0,62
Reagents	aminoprpyltriextosilane	2,25
	water peroxide	0,1
	Glucose	0,47
	disuccinimidyl carbonate	6,13
	triethylamine	3,86
SUBTOTAL		EUR 13,73
carbohydrate activation	electricity+equipment+ labour force	1,05
hydroxilation and silica coating	electricity+equipment+ labour force	1,25
carbohydrate modification	electricity+equipment+ labour force	1,4
TOTAL cost treatment		**EUR 17,43**
Product and yield	ZnO-carbohydrate	1000 gr
	percentage of cost increase	**34,86**
COST	ZnO-carbohydrate	**EUR 67,43**

NANOMICEX is a collaborative project funded by the European Community´s Seventh Framework Programme (FP7/2007 – 2013) under G.A. n. 280713

Nanosafety Cluster Review meeting "Industry and Market impact"

2. Experiences from Industrial oriented projects

- Key exploitable results: what is new?



NANOMICEX is a collaborative project funded by the European Community´s Seventh Framework Programme (FP7/2007 – 2013) under G.A. n. 280713

2. Experiences from Industrial oriented projects

Conclusions

- A close collaboration with the industrial partners is key to ensure the application of the project results in a large number of companies.
  - Surface modification techniques
  - Specific surface modifiers to the ink/pigment industry
  - PPEs and Engineering Controls custom designed

- An improvement on the production methods is key to ensure the scaling of the results of all NMP industrial related projects, including reduce the polydispersity and variations in the surface chemistry
- A better understanding of the workplace, consumer and environmental exposure will provide the stakeholders with scientific and consensuated data to conduct **regulatory actions**

NANOMICEX is a collaborative project funded by the European Community´s Seventh Framework Programme (FP7/2007 – 2013) under G.A. n. 280713

2. Experiences from Industrial oriented projects

Conclusions

- According with the information decribed previously, the cluster projecst will have a **direct impact on the EU Industry,** workers and consumers, providing the industry with solutions to support the use of nanotechnologies in the near term.

- The main results identified in projects include:

  1. EHS Supporting actions: proven surface modifiers and surface modification protocols, exposure data, scaling up protocols and technical specifications to develop cost effective risk management measures are now available

  2. New formulations and materials: < 10 % on the market

- The main IPR mechanism designed are patent, trade secrets and licensing. The application of these mechanism and business plan of each company have to be reported by each project, being key to support the evaluation of the real impact of the project activities.

NANOMICEX is a collaborative project funded by the European Community´s Seventh Framework Programme (FP7/2007 – 2013) under G.A. n. 280713

Nanosafety Cluster Review meeting

Industry and Market impact

NanoSafety Cluster

¡THANK YOU FOR YOUR ATTENTION!

SEVENTH FRAMEWORK PROGRAMME

nanoMICEX Sanowork Scaffold EURO nanotox