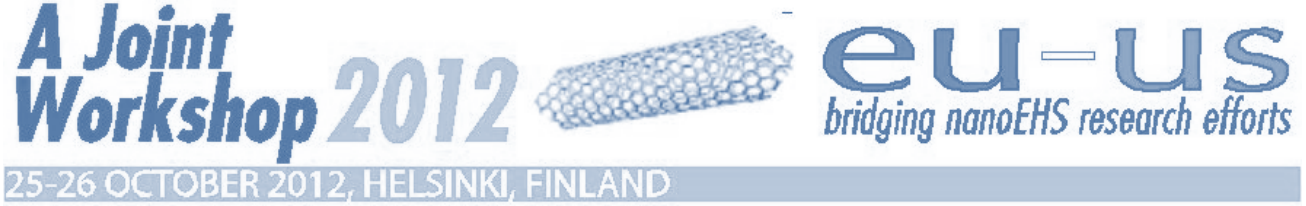


Industrial perspective on emerging risks and safety of nanotechnologies: Results from the EU projects

A. Jovanovic

EU-VRi / Steinbeis Advanced Risk Technologies. Germany / University of Stuttgart, Germany

Abstract

The paper deals with different possible perspectives onto the issue of emerging risks and safety of nanotechnologies, including the nano-toxicology-oriented perspective, the risk assessment oriented perspective and the industrial safety oriented perspective. The latter, is the perspective taken in the a number of EU projects dealing with nanotechnology, especially engineered nanomaterials, on industrial scale. The following issues are tackled more in detail:

(a) recognizing emerging risks, incl. early warnings and managing the available information and knowledge

(b) interdependencies among the risks related to nanotechnologies and other emerging risks, incl. to risk-risk tradeoffs, application of precautionary principle and identification of possible gaps in the research and safety improvement activates related to nanotechnologies

(c) exploring public acceptance and the possibilities model it upfront

The approaches applied in the research projects are reviewed and demonstrated in the presentation. Standardization aspects are tackled in the context of transfer of the research results towards innovation.

Main message:
1+1 could be more than 2!

a. The great investment in nanotechnology R&D projects in the EU should payoff not only in terms of single projects but also at the level of “swarm intelligence”

b. There has not been a “master plan” of R&D projects and/or of the investment in nanotechnology projects, projects approved on case-by-case basis

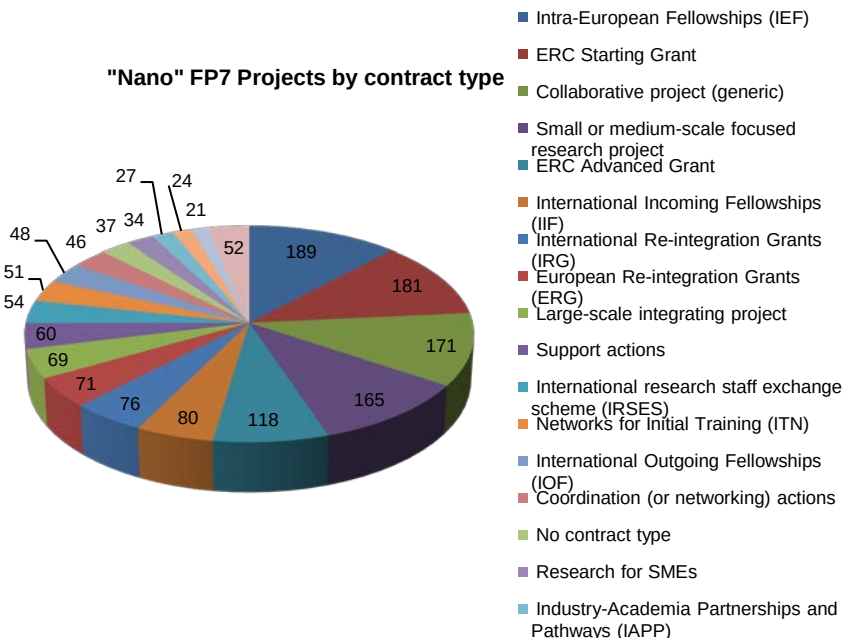
c. There is no such a thing as “100% nanotechnology project”

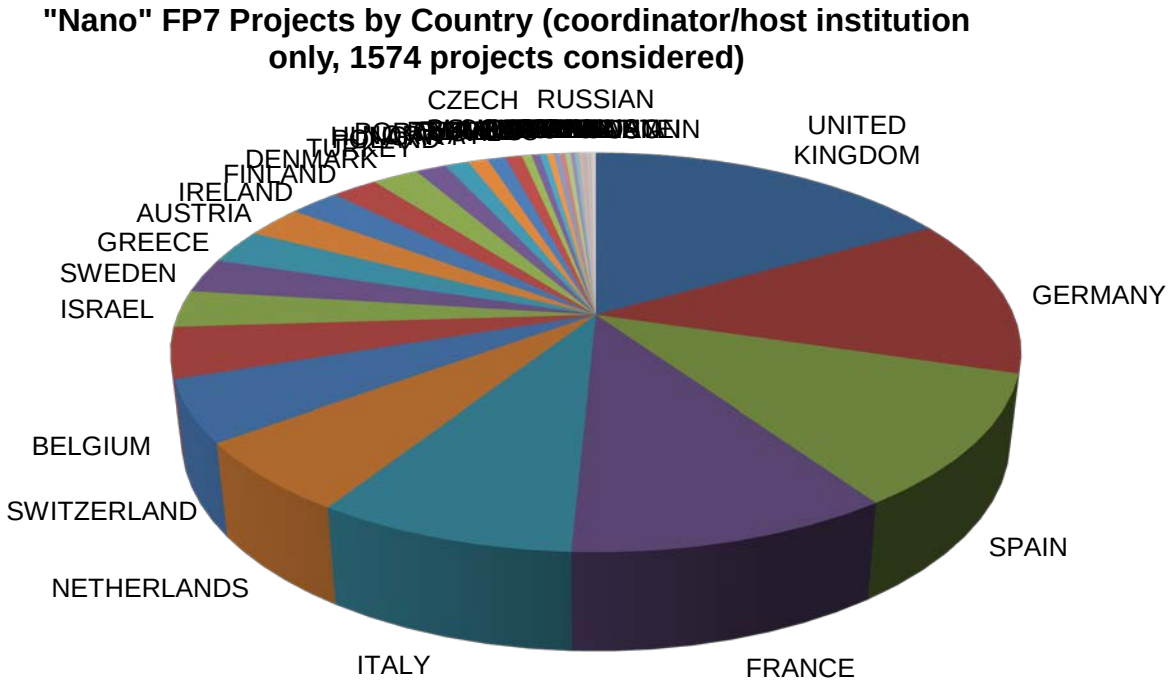
ContractType	counts
Intra-European Fellowships (IEF)	189
ERC Starting Grant	181
Collaborative project (generic)	171
Small or medium-scale focused research project	165
ERC Advanced Grant	118
International Incoming Fellowships (IIF)	80
International Re-integration Grants (IRG)	76
European Re-integration Grants (ERG)	71
Large-scale integrating project	69
Support actions	60
International research staff exchange scheme (IRSES)	54
Networks for Initial Training (ITN)	51
International Outgoing Fellowships (IOF)	48
Coordination (or networking) actions	46
No contract type	37
Research for SMEs	34
Industry-Academia Partnerships and Pathways (IAPP)	27
Collaborative Project targeted to a special group (such as SMEs)	24
Coordination and support actions	21
Other	52
Support for training and career development of researcher	8
Research for SME associations/groupings	5
Joint Technology Initiatives - Coordination and Support Acti	5

Baseline

d. There are over 1,500 projects in CORDIS dealing with of at least partly tackling nanotechnologies (“value”: ~ 3,000 M€?)

e. We have extracted the information about these projects from CORDIS and analyzed it by means of:
   - conventional statistics
   - data mining and
   - semantics





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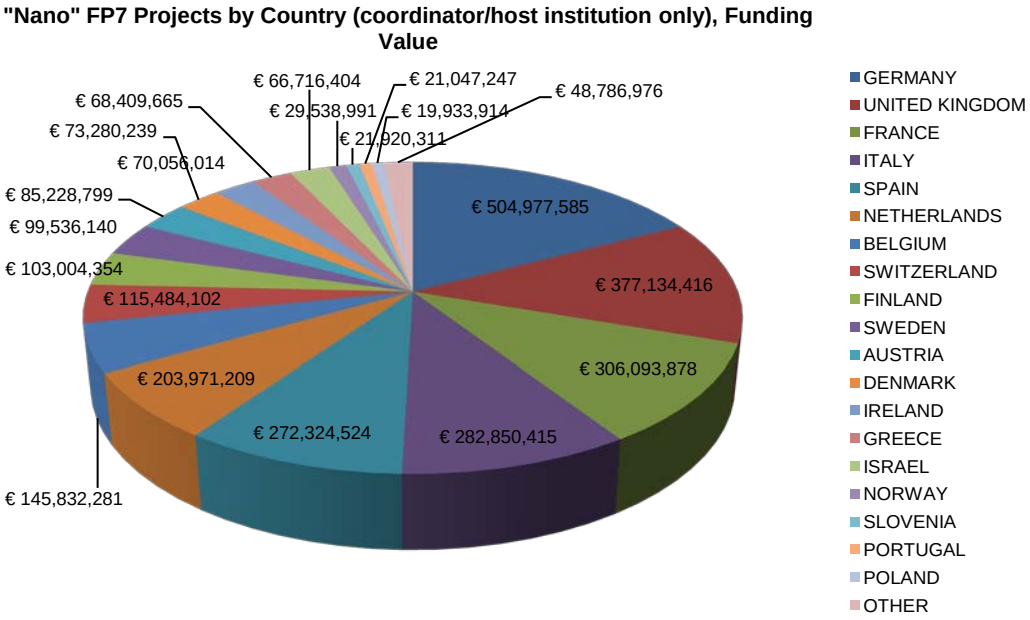
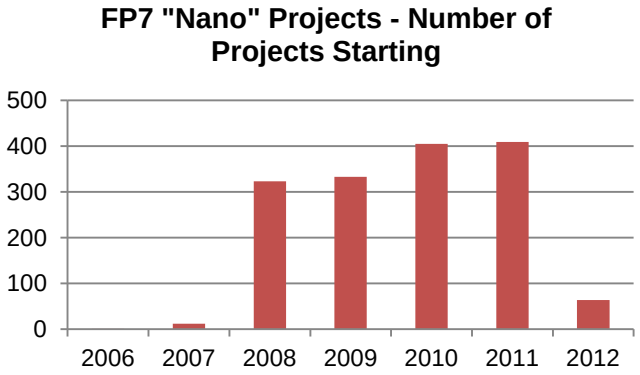
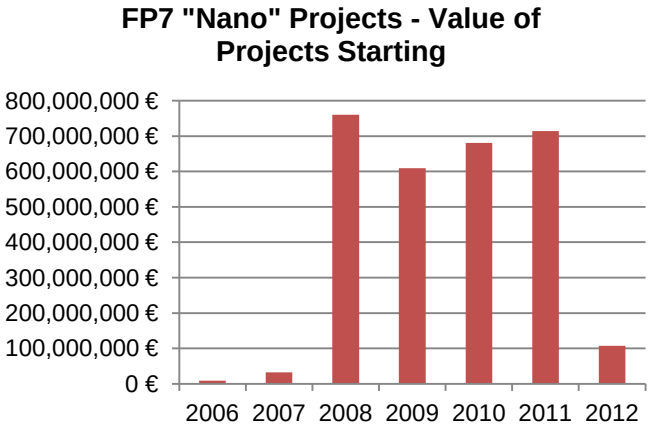




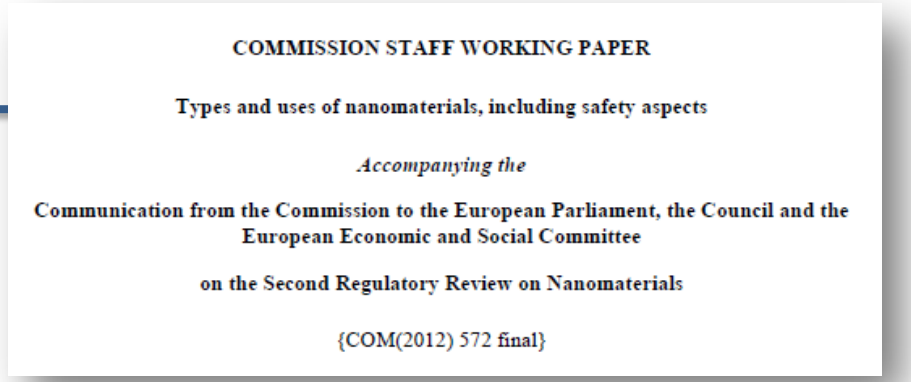


0. governance perspective

Possible perspectives

Different Possible perspectives onto the issue of emerging risks and safety of nanotechnologies

1. the nano-toxicology-oriented perspective
2. the risk assessment oriented perspective and
3. the industrial safety oriented perspective.


COMMISSION STAFF WORKING PAPER

Types and uses of nanomaterials, including safety aspects

Accompanying the

Communication from the Commission to the European Parliament, the Council and the European Economic and Social Committee

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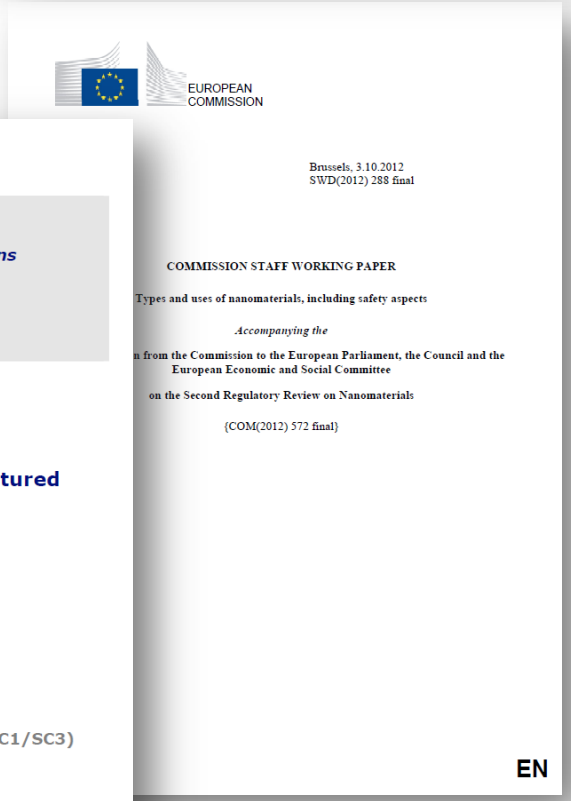
{COM(2012) 572 final}


EUROPEAN COMMISSION

Brussels, 3.10.2012
SWD(2012) 288 final

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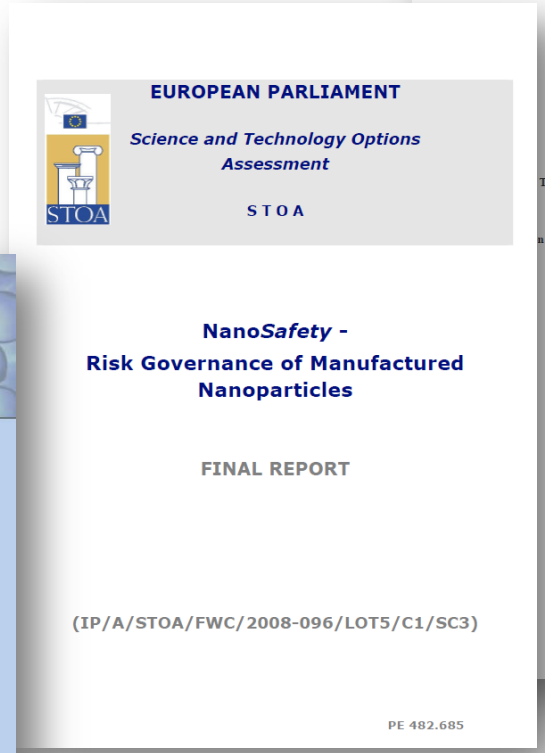
EUROPEAN PARLIAMENT

Science and Technology Options Assessment

STOA

STOA

Nano*Safety* -
Risk Governance of Manufactured Nanoparticles

FINAL REPORT

(IP/A/STOA/FWC/2008-096/LOT5/C1/SC3)

PE 482.685


Policy Brief

Nanotechnology Risk Governance

Recommendations for a global, coordinated approach to the governance of potential risks

0. governance perspective

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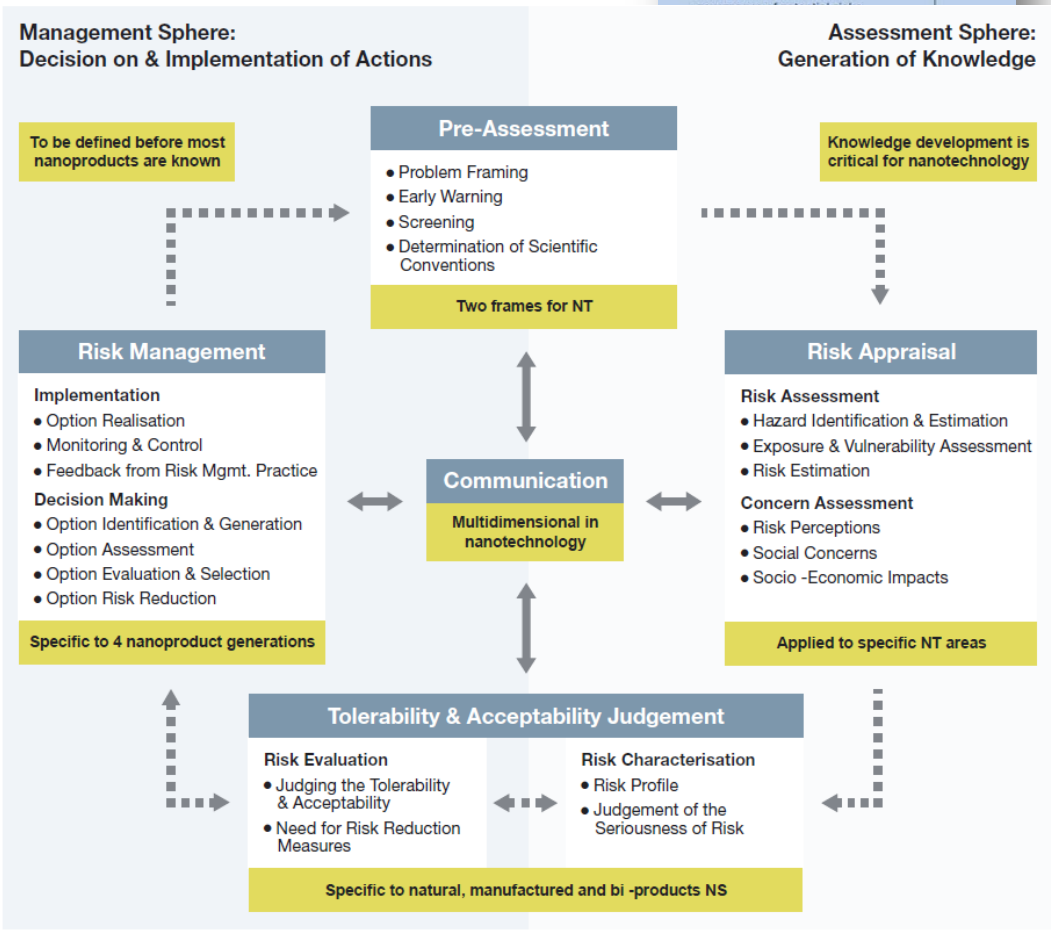


The industrial safety oriented perspective

The latter, is the perspective taken in the a number of EU projects dealing with nanotechnology, especially engineered nanomaterials, on industrial scale.

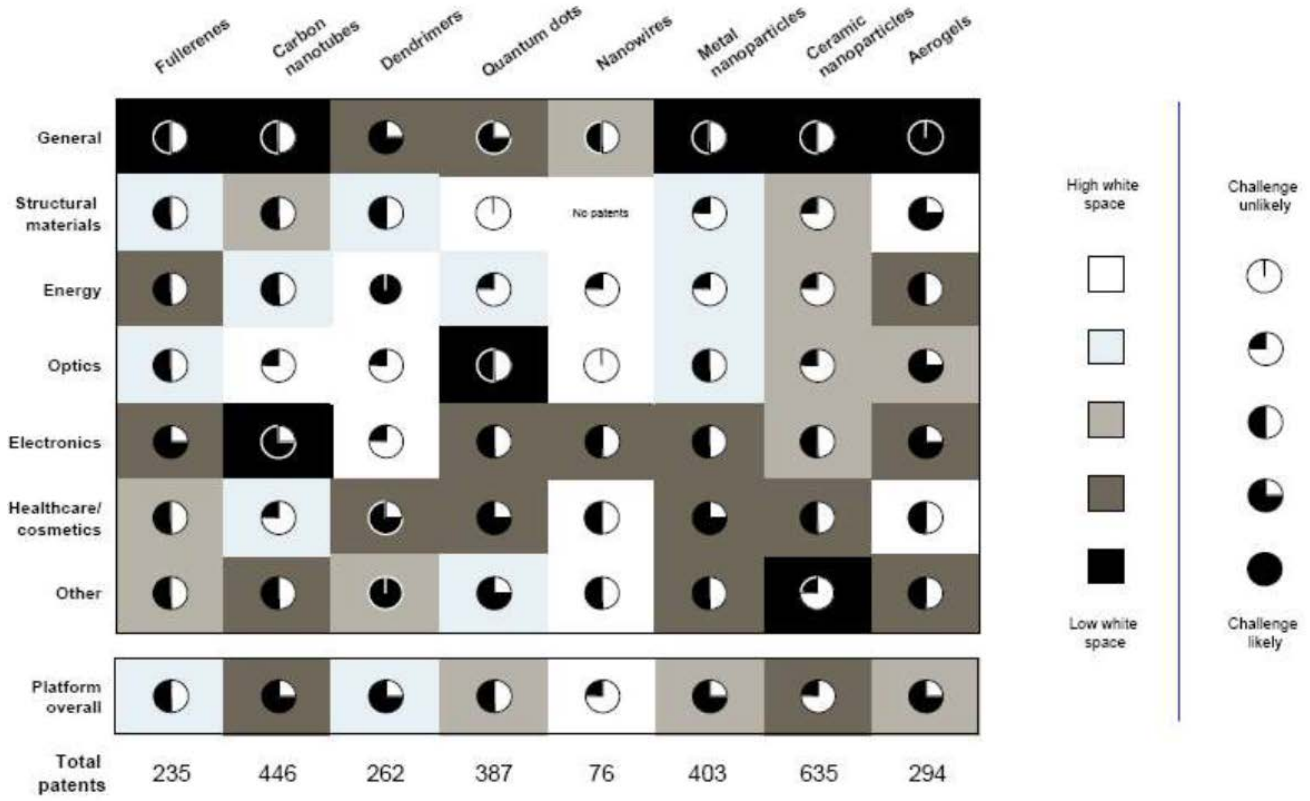
Examples:

iNTeg-Risk:	Early Recognition, Monitoring and Integrated Management of Emerging, **New Technology Related** Risks
Particoat:	New Multipurpose Coating Systems based on Novel Particle Technology for **Extreme Environments at High Temperatures**
MATRANS:	Micro and Nanocrystalline Functionally Graded Materials for **Transport Applications**
M-RECT:	Multiscale Reinforcement of Semi-Crystalline Thermoplastic Sheets and Honeycombs
MUST:	Multi-level Protection of **Materials For Vehicles** by Smart Nanocontainers
Fire-Resist:	Developing Novel **Fire-Resistant High Performance Composites**
HELM:	High-frequency Electro-magnetic Technologies for Advanced Processing of Ceramic Matrix Composites and Graphite Expansion
Exomet:	Physical Processing of Molten Light Alloys under the Influence of External Fields
NanoSTAIR:	A Platform to Support **Standardization**, Innovation and Research in the Field of Nanotechnologies
POEMA:	Production of Coatings for New Efficient and Clean Coal **Power Plant Materials**
NanoDEVICE	Novel Concepts, Methods, and Technologies for the Production of Portable, easy-to-use Devices for the Measurement and Analysis of Airborne Engineered Nanoparticles in **Workplace** Air
SCAFFOLD:	Innovative Strategies, Methods and Tools for Occupational Risks Management of Manufactured Nanomaterials (mnms) in the **Construction Industry**

All of them involve risks, but look at them from "PERFORMANCE point of view"…

The industrial safety oriented perspective

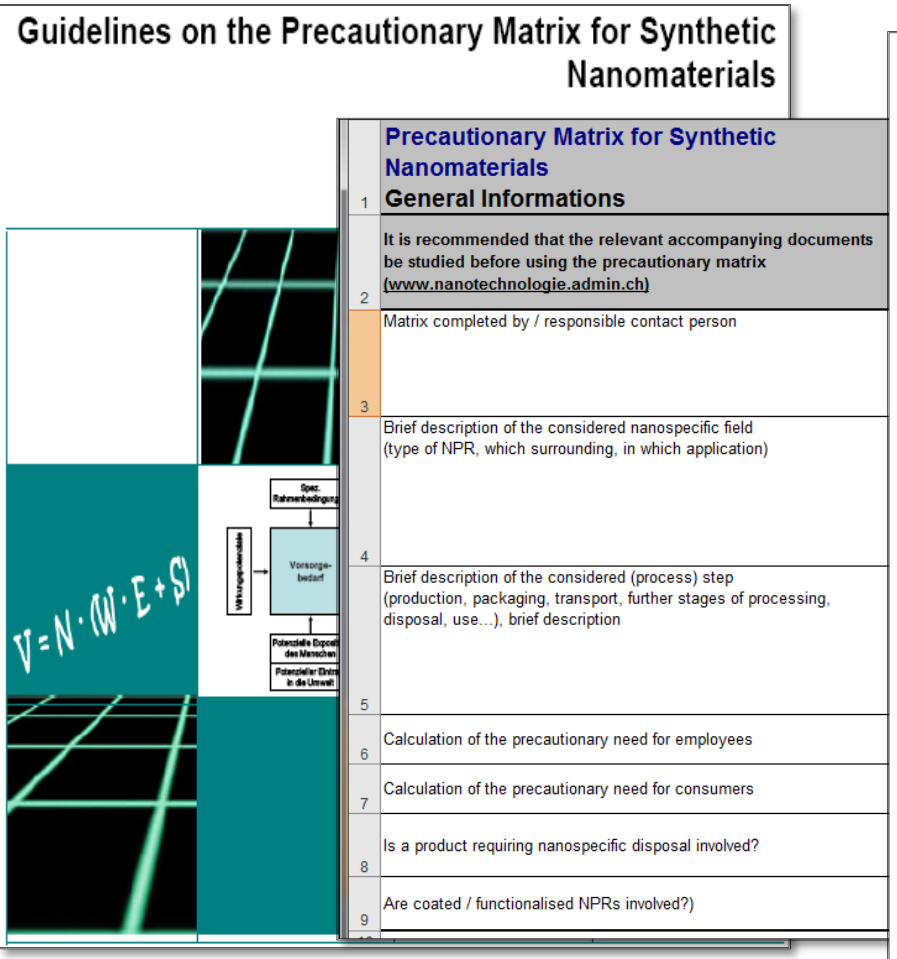
patent = (likely) industrial application?

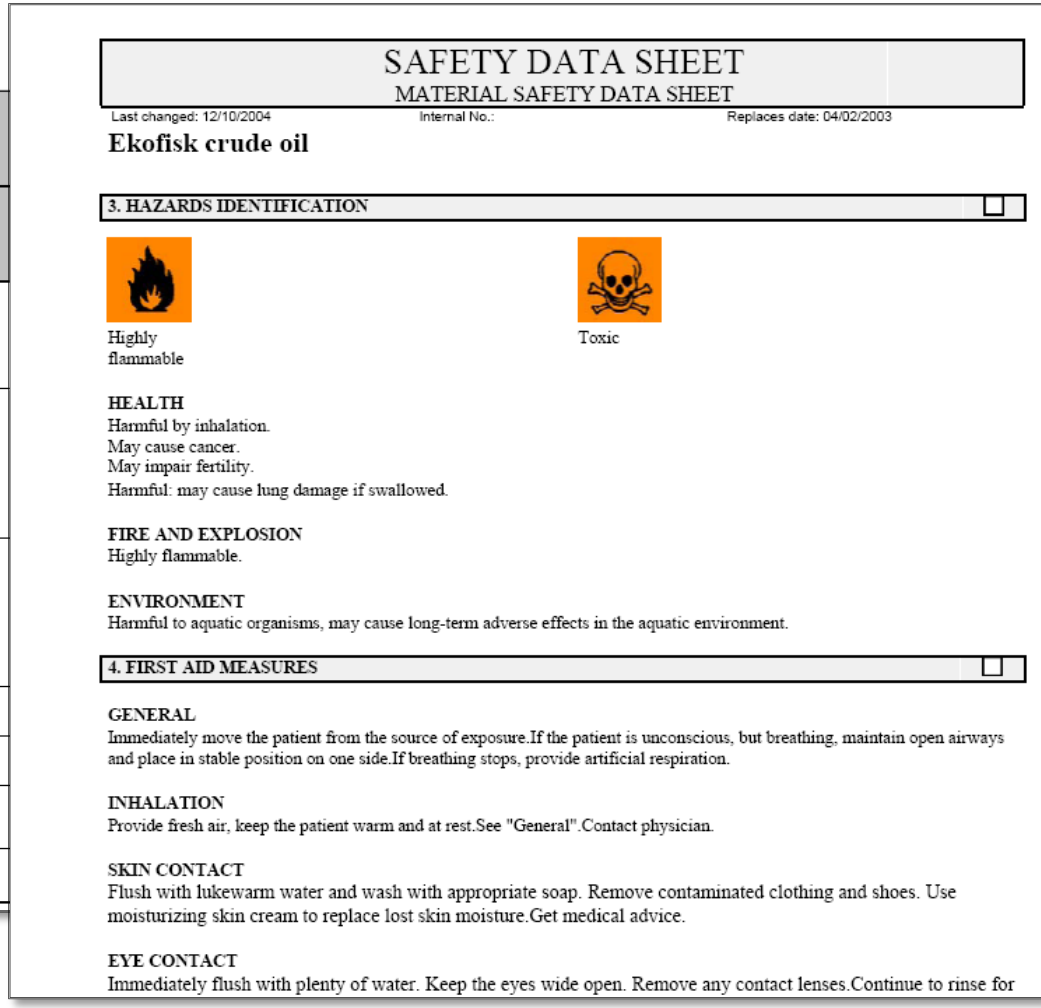


… or, from a "WILL-I-HAVE-PROBLEM-THERE" point of view…

“MUST HSE Material Risk Data Sheets”

Based on:





SAFETY DATA SHEET
MATERIAL SAFETY DATA SHEET

Last changed: 12/10/2004 Internal No.: Replaces date: 04/02/2003

Ekofisk crude oil

3. HAZARDS IDENTIFICATION

Highly flammable

Toxic

HEALTH
Harmful by inhalation.
May cause cancer.
May impair fertility.
Harmful: may cause lung damage if swallowed.

FIRE AND EXPLOSION
Highly flammable.

ENVIRONMENT
Harmful to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

4. FIRST AID MEASURES

GENERAL
Immediately move the patient from the source of exposure.If the patient is unconscious, but breathing, maintain open airways and place in stable position on one side.If breathing stops, provide artificial respiration.

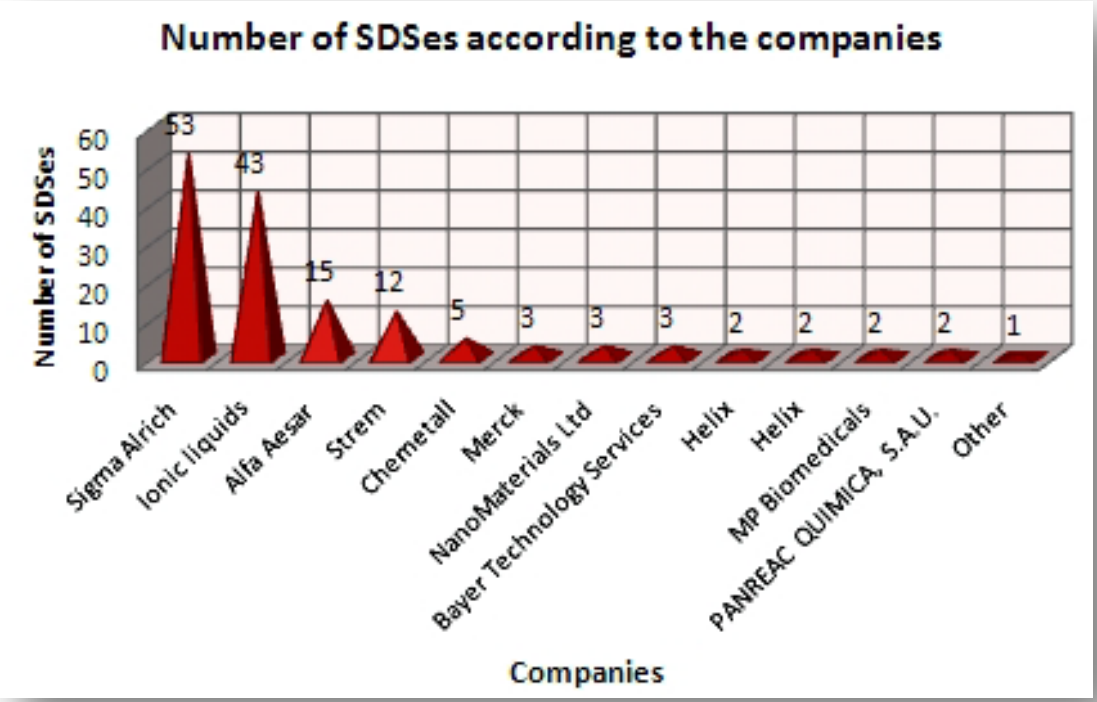
INHALATION
Provide fresh air, keep the patient warm and at rest.See "General".Contact physician.

SKIN CONTACT
Flush with lukewarm water and wash with appropriate soap. Remove contaminated clothing and shoes. Use moisturizing skin cream to replace lost skin moisture.Get medical advice.

EYE CONTACT
Immediately flush with plenty of water. Keep the eyes wide open. Remove any contact lenses.Continue to rinse for

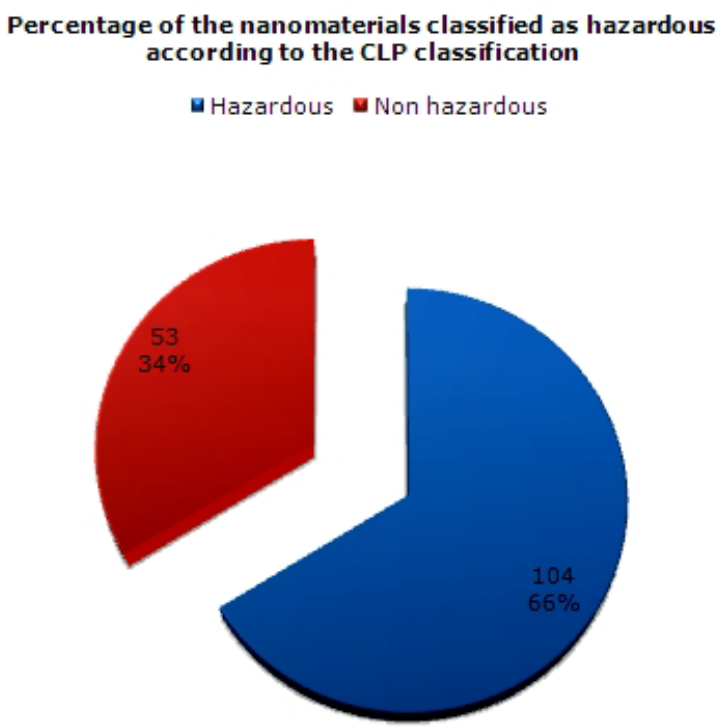
R-Tech MSDS information in the database

- MSDSs were obtained from 26 different manufacturers from 9 countries.
- Most of the European manufacturers implemented new classifications from the Regulation No.1272/2008 (CLP)
- There was a non-conformity issue in classifications and labeling statements especially in those originated from outside Europe.



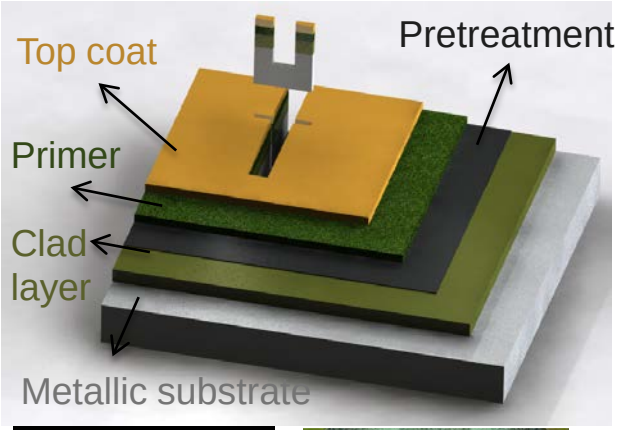
R-Tech MSDS information in the database

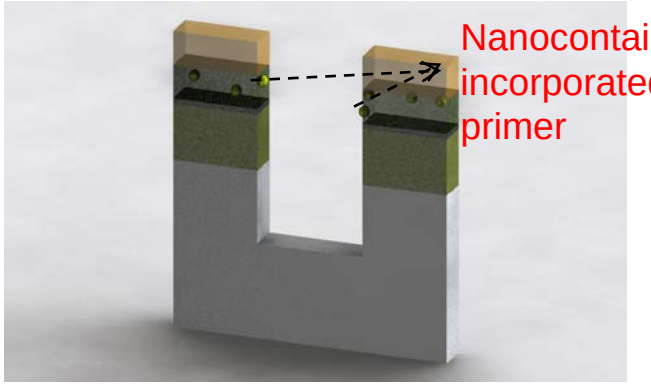
- 66 % of the materials in the database were classified as **hazardous**
- The most frequent hazard classification are for **known hazards**, e.g., for ENM was flammable solid-category 1 and 2 (H228) and health hazard category was serious eye damage/eye irritation (H319)

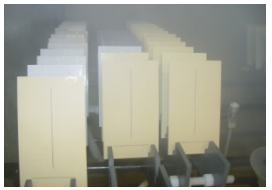


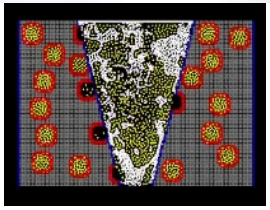
The industrial safety oriented perspective

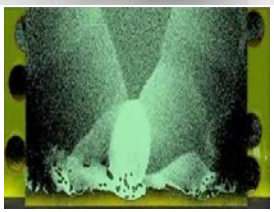
Upscaling = measure of real innovation and industrial applicability?

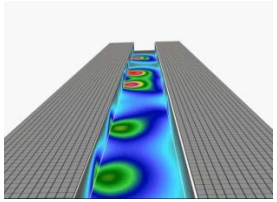


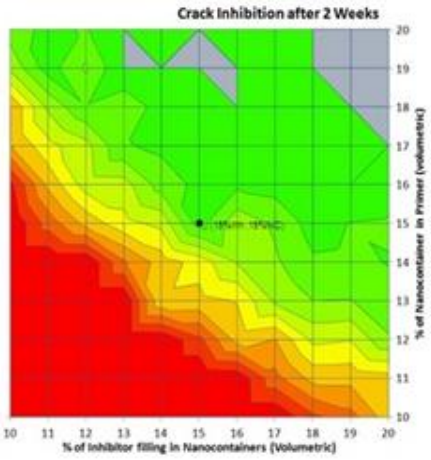


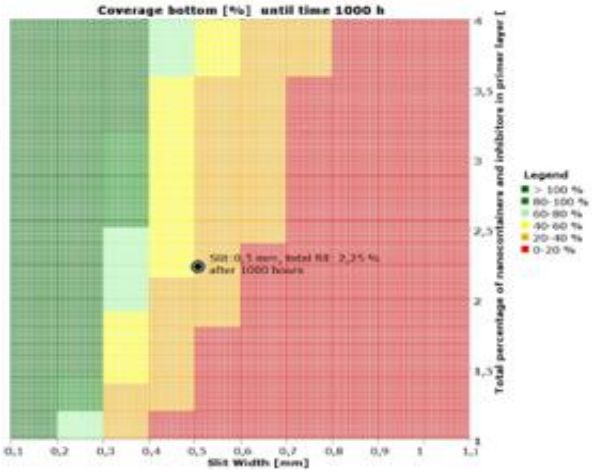








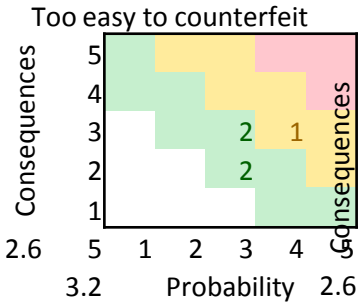


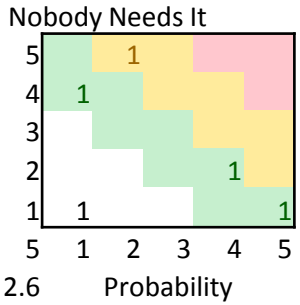


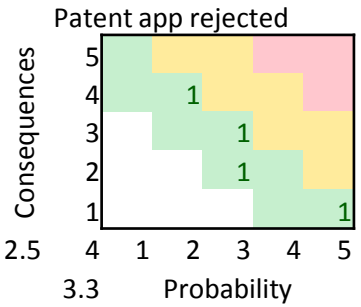
… or, from a “WILL-IT-WORK-AT-ALL” point of view…
And, often, it does NOT!

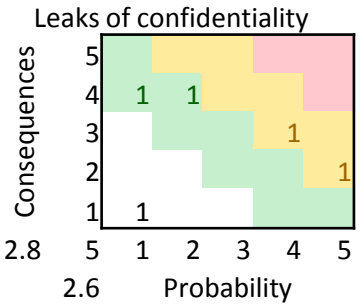
The industrial safety oriented perspective

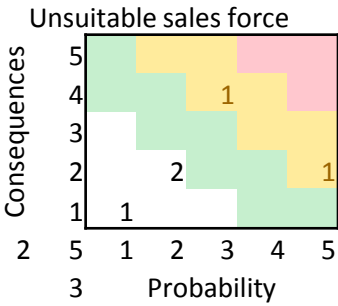
Nanoproduct = measure of innovation applied?

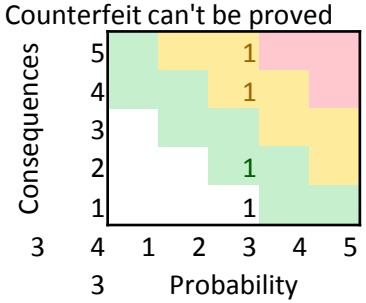


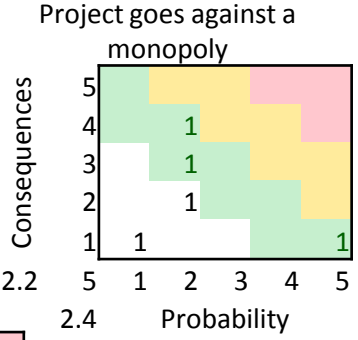


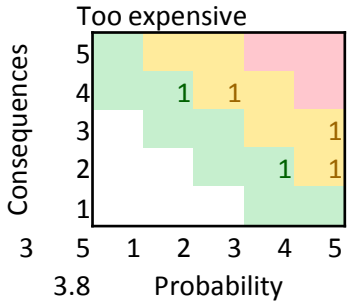


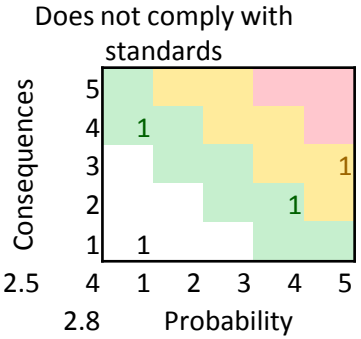


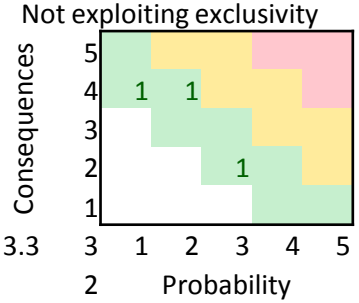


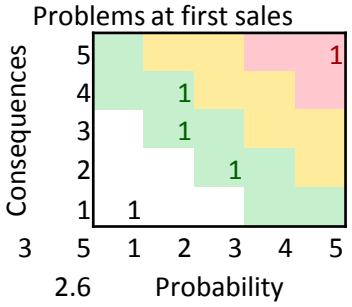


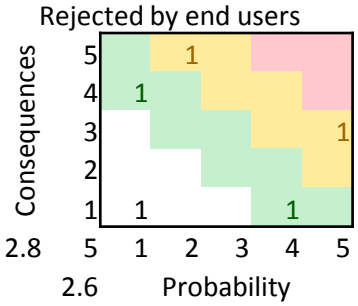


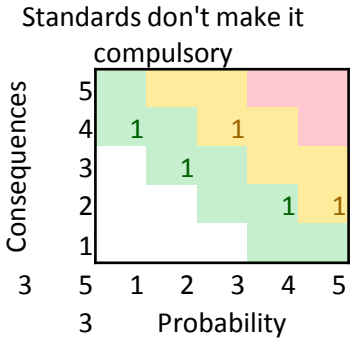












… or, from a "CAN-I-SELL-IT" point of view…

The issues

The following issues are tackled more in detail:

(a) recognizing emerging risks, incl. early warnings and managing the available information and knowledge

(b) interdependencies among the risks related to nanotechnologies and other emerging risks, incl. to risk-risk tradeoffs, application of precautionary principle and identification of possible gaps in the research and safety improvement activates related to nanotechnologies

(c) exploring public acceptance and the possibilities model it upfront

NotionIl	Title	Short Name	Status	Description	Ed
813	Data fraud/loss			Major accidental loss of data or fraud triggers backlash aga...	
812	Nanoparticle toxicity			Studies reveal health impairment due to exposure to widely-u...	
689	(b3.14) Lack in current legal/regulatory systems may involve increasing of emerging environmental, social and technological risks.	Lack of regulation - advanced materials		Since the market of new materials developed very rapidly the...	
688	(b3.13) Advanced materials produced using new vacuum coatings processes including side products with a strong face on materials with dimensions in the nanometer scale	Lack of measurement techniques		The risk is emerging because of lack in measurement techniqu...	
684	(b3.09) Lack of data on environmental impacts of nanomaterials and nanoproducts might cause serious problems.	Lack of data - nano materials & products		Existing standards for carrying out Life Cycle Assessments a...	
683	(b3.08) Mechanisms of nanomaterial induced DNA damage	Nanomaterial induced DNA damage		The nanomaterials coming in contact with the nucleus interac...	
682	(b3.07) Effect of size, shape and surface area of nano-materials on human health	Nano-based advanced materials		The sub-100 nm size of nanomaterials is one of the primary f...	
680	(b3.05) Use of Advanced material which has new physical and chemical properties may cause undesired results	Unknown use cases of advanced materials		Engineered nanomaterials raise particular concerns because o...	
	(B3) Emerging risks related to				

The issues

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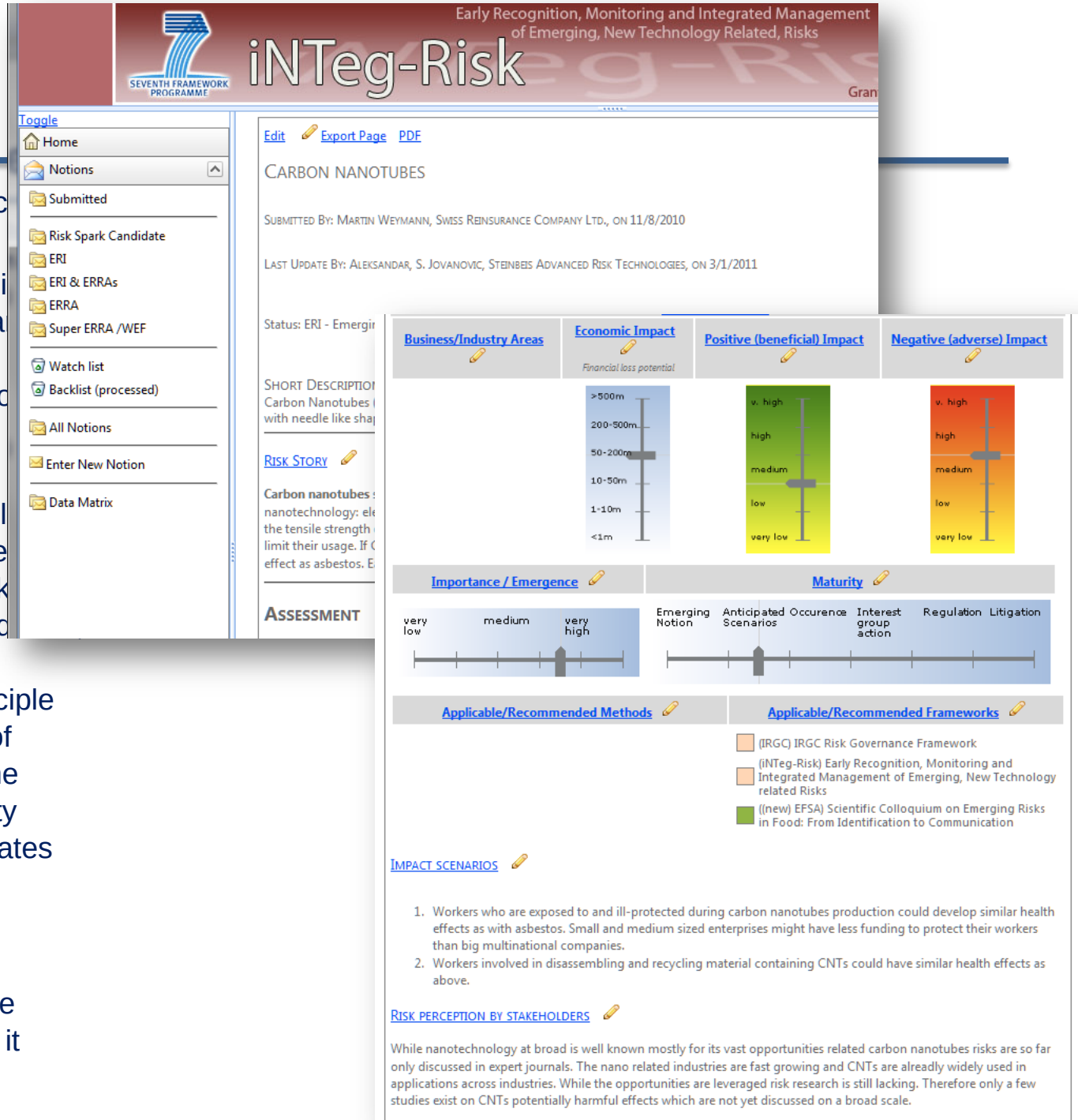
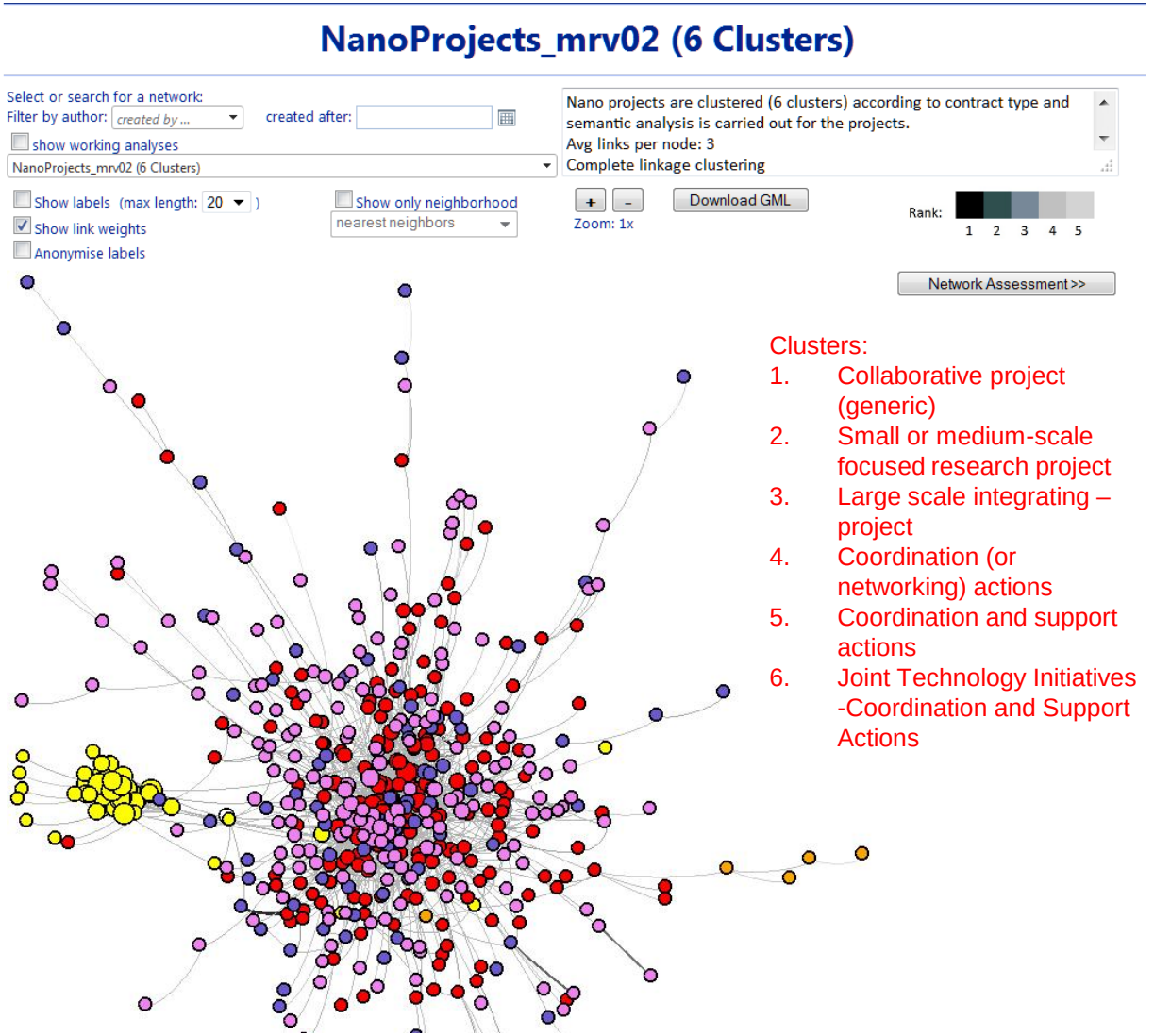


Multi-risk, interdependencies & tradeoffs

- Interdependencies among the risks related to nanotechnologies and other emerging risks
- Risk-risk tradeoffs
- Application of precautionary principle
- Identification of possible gaps in the research and safety improvement activates related to nanotechnologies



Multi-risk, interdependencies & tradeoffs

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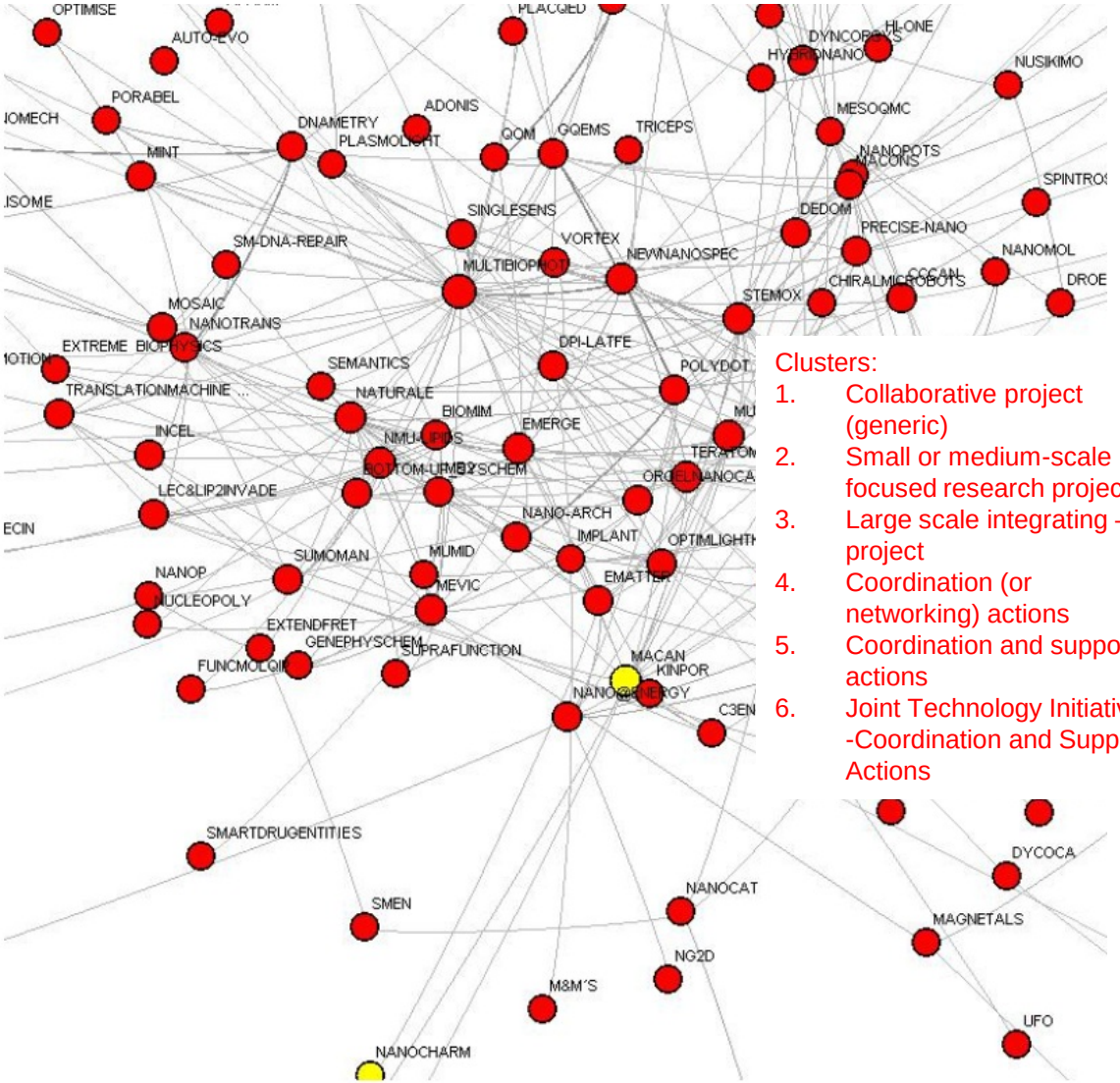
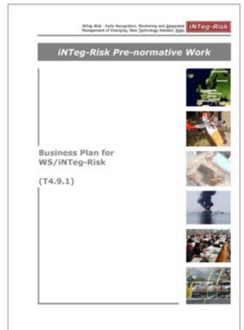
- Identification of possible gaps in the research and safety improvement activates related to nanotechnologies



Clusters:

1. Collaborative project (generic)
2. Small or medium-scale focused research project
3. Large scale integrating – project
4. Coordination (or networking) actions
5. Coordination and support actions
6. Joint Technology Initiatives -Coordination and Support Actions

From R&D to innovation (via standardization!)



Main document

“Managing emerging technology-related risks”

based on the iNTeg-Risk Emerging Risk Management Framework

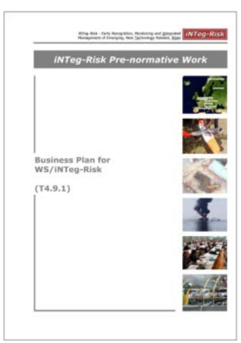
Informative Annex A :
Emerging Risks in New Technologies

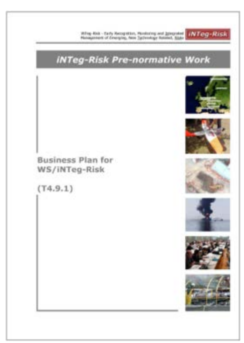
Informative Annex B:
Emerging Risks in New Materials and Products

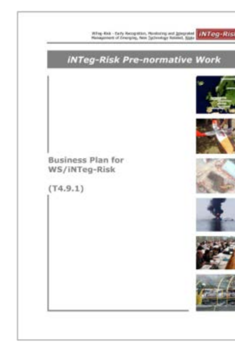
Informative Annex C:
Emerging Risks in new Production Networks

Informative Annex D:
Emerging Risk Policies

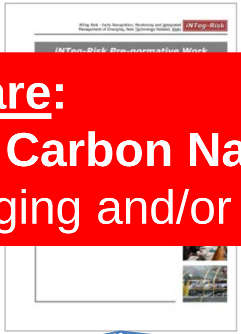
Informative Annex E:
Emerging Risks in Testing Procedures







Structure and content of the CWA 67



Main document

risks”

Management Framework

<u>Application examples are</u>:

- Materials & Products: **Carbon Nanotubes** (CNTs)
- Policies: Risk of changing and/or unstable **Nano-Regulation** in Europe

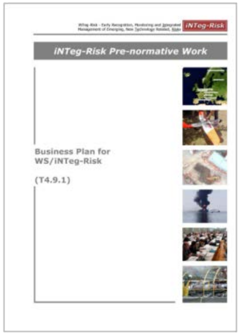
Informative Annex A : *Emerging Risks in New Technologies*

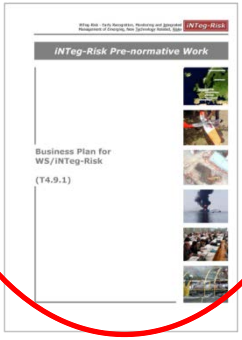
Informative Annex B: *Emerging Risks in New Materials and Products*

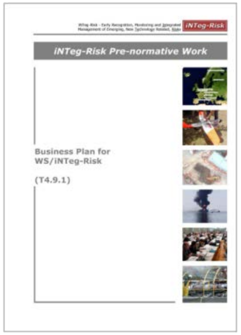
Informative Annex C: *Emerging Risks in new Production Networks*

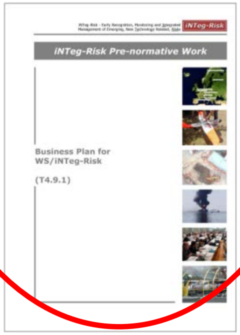
Informative Annex D: *Emerging Risk Policies*

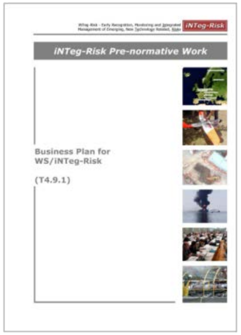
Informative Annex E: *Emerging Risks in Testing Procedures*



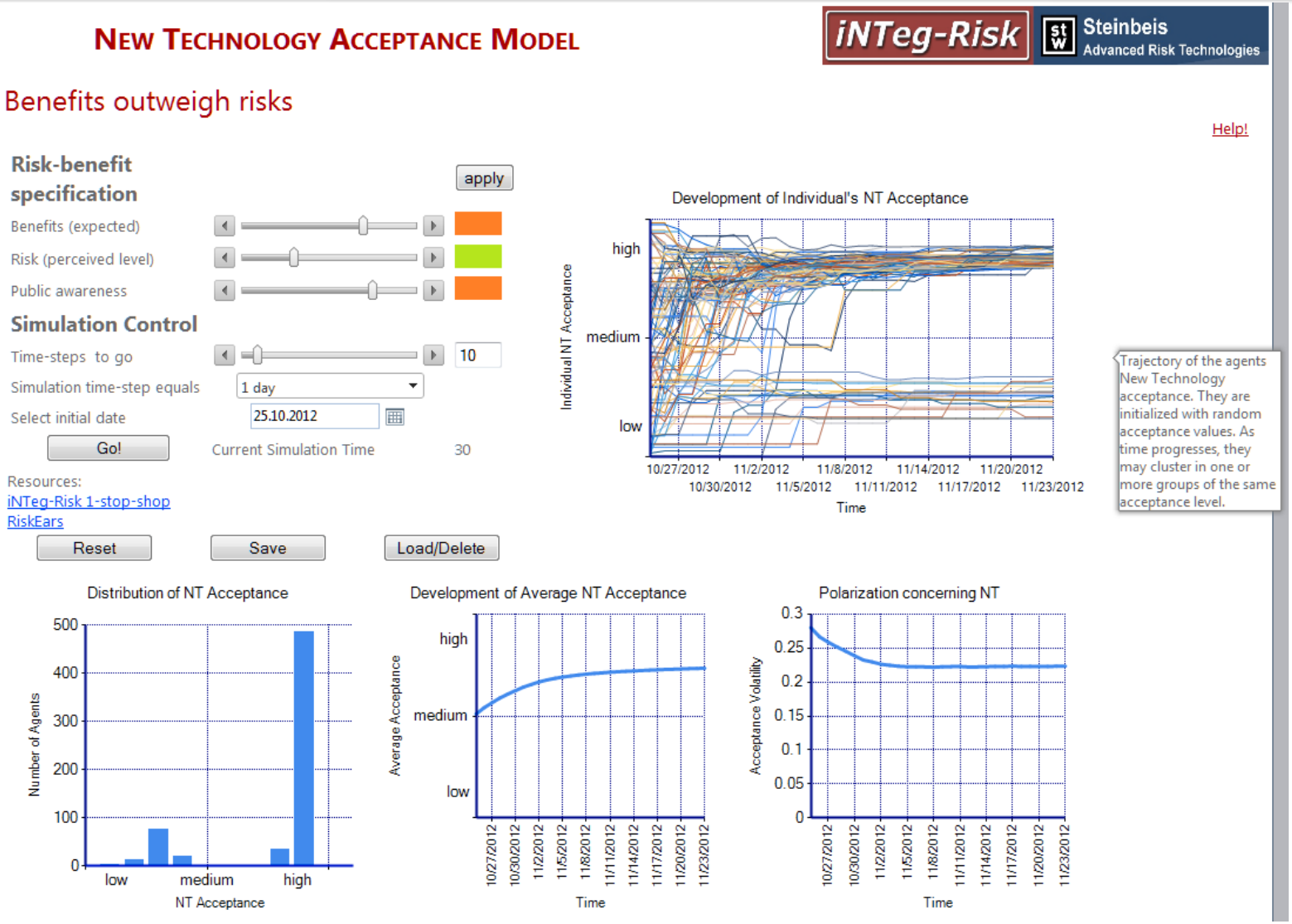








Conclusions – for nano, it's much about (public) acceptance; Will perceived benefits outweigh?



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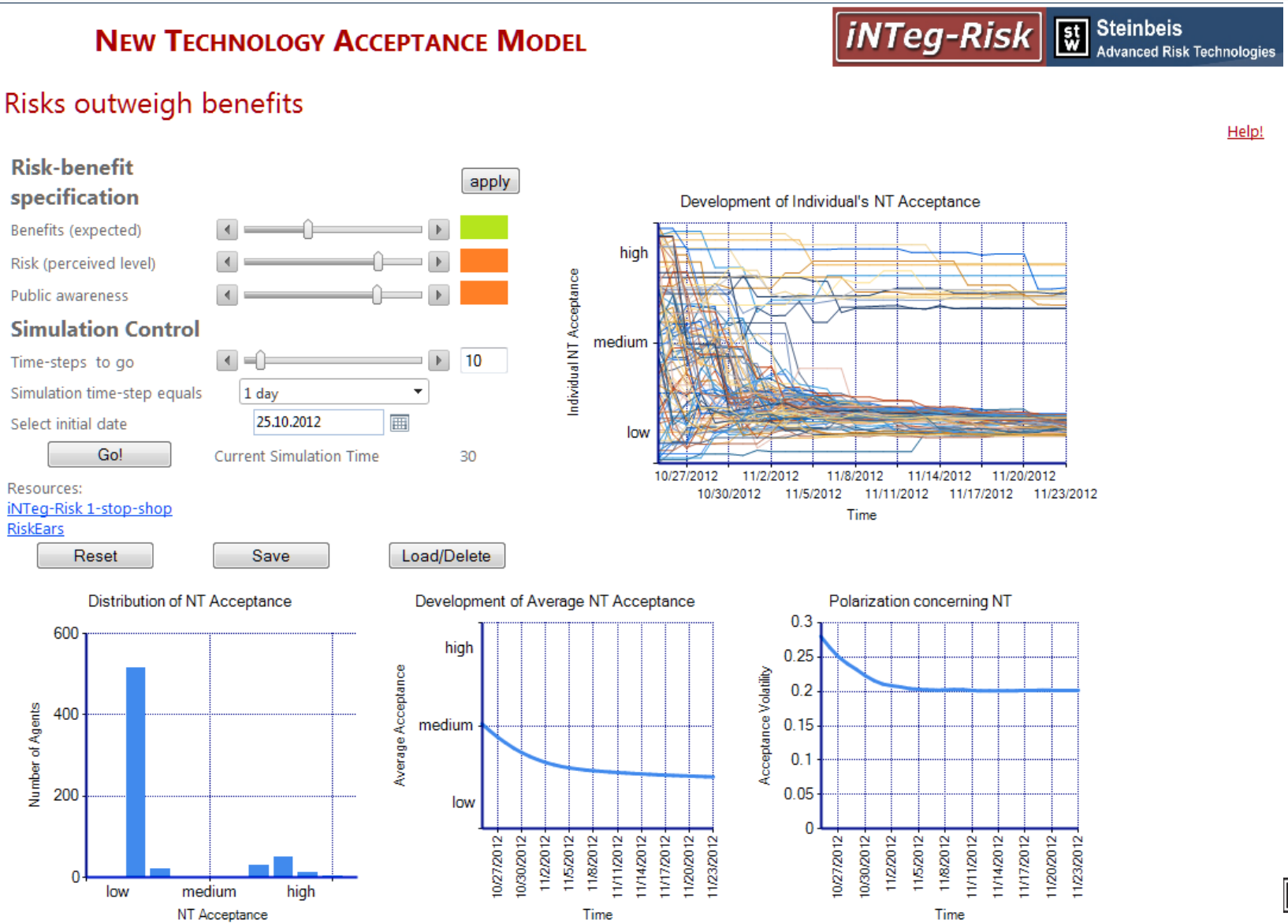
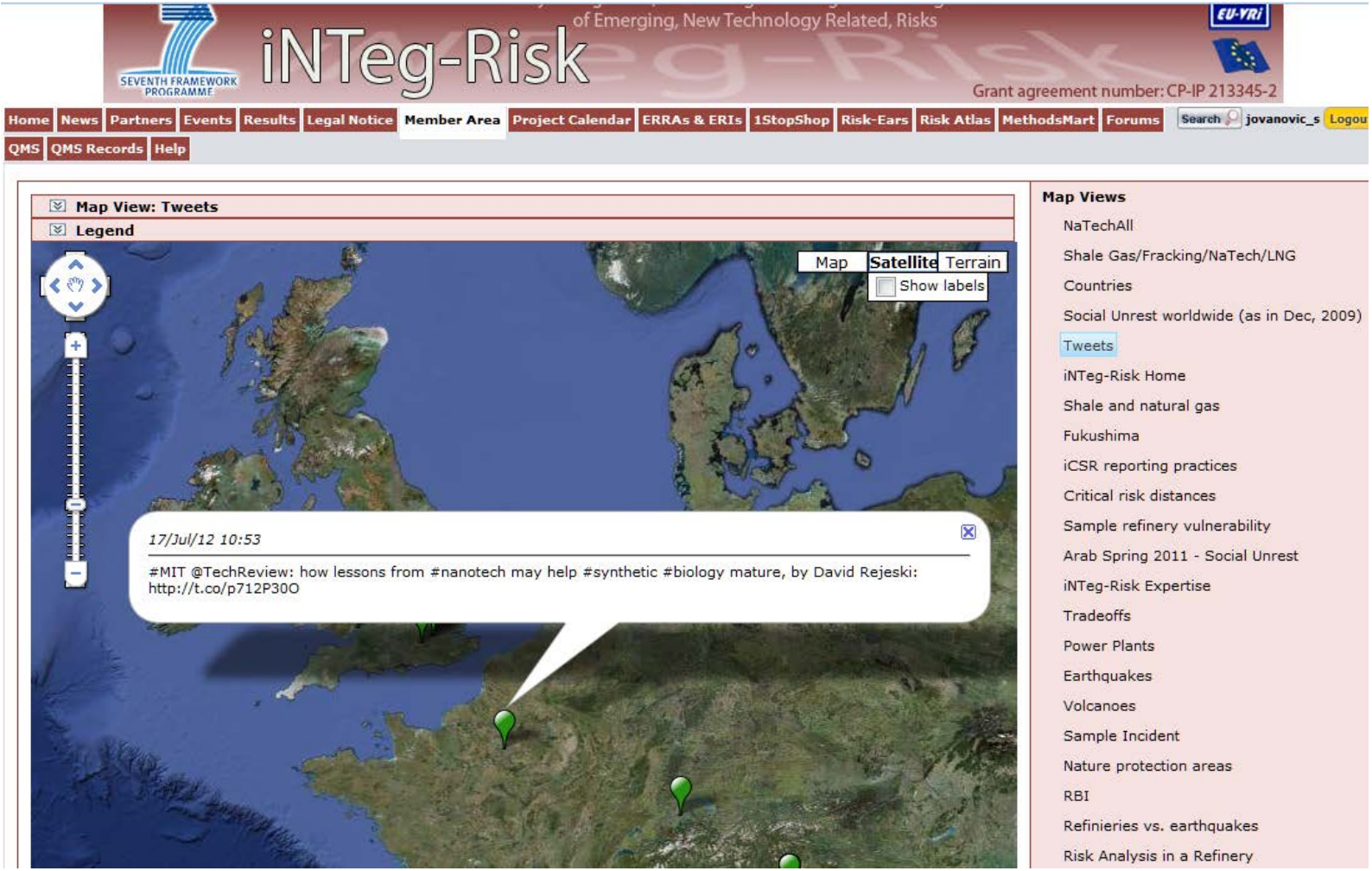


Data from: experts, articles, feed, tweets, …



Conclusion

- Analyzing life cycle behavior and potential risks of nanotechnologies and products is an ever increasing factor of sustainable success of nanotechnologies and products. This analysis should be comparable among different projects.
- Nanosafety issues for nanotoxicology, nanorisk governance (including regulation), nanorisk assessment and for industrial safety are different, but compatible. Sustainability of the nanotechnology will be ensured only within an integrated approach.
- Ensure that the research related interests of RTD projects match those of industry

Conclusion – “Expertology” of “extended nanosafety”?