

Swiss Re



# Nanotechnology

## Small matter, many unknowns

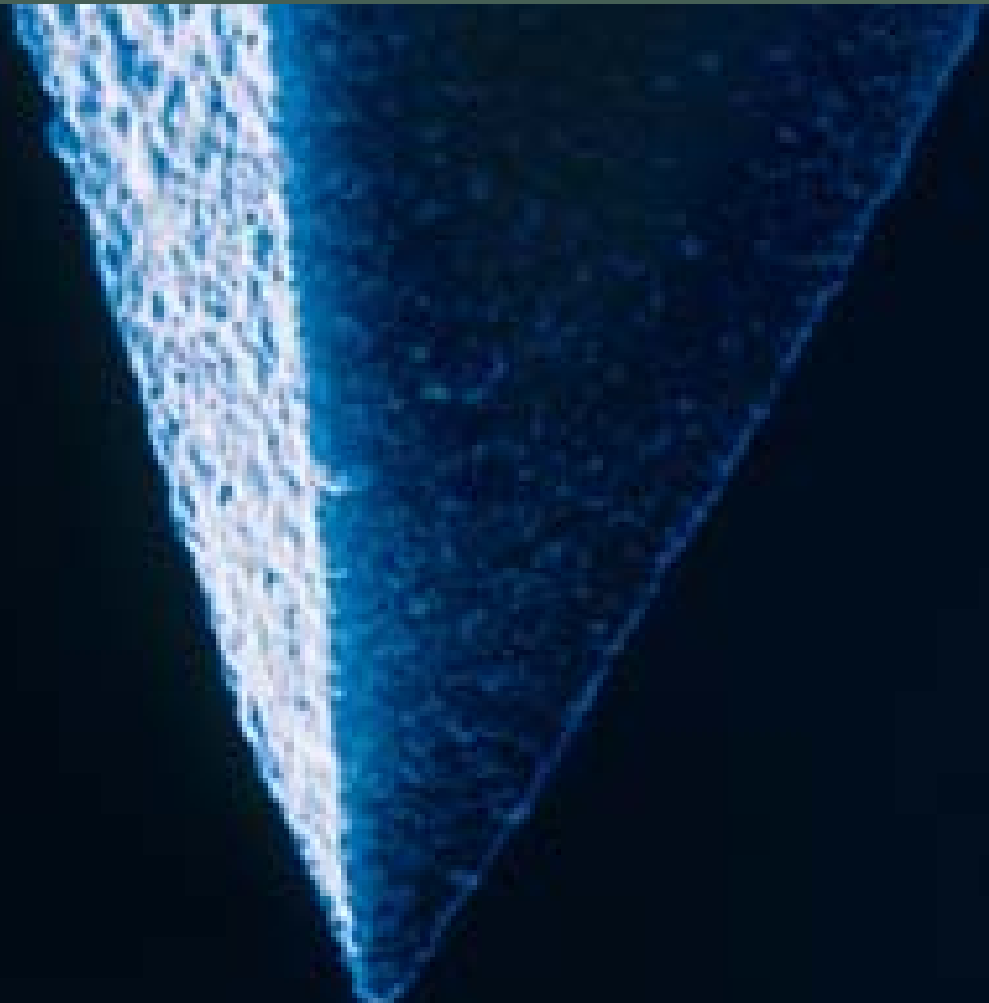
Robinson Economic  
Forecasting Conf.

Atlanta, GA

August 2006

Kurt Karl, Swiss Re

Head Economic  
Research &  
Consulting, NY





# Agenda

- What is nanotechnology?
- Uses of nanotechnology
- Risks of nanotechnology
- Insurability issues
- Conclusions



Question: What do these new products have in common?

**Joint and muscle pain cream**

**Foot warmer**

**Washable bed mattress**

**Customized hand, face and body creams**

**Golf ball and club**

**Windshield cleaner**

**Wound dressing for burn victims**

**Military-grade disinfectant**

**Dental adhesive**

**Water-repellent house coating**

Technological  
progress and  
emerging risks



# Answer

Technological  
progress and  
emerging risks

These items were recently named to the *Forbes* list of  
“Top 10 Nanoproducts” of the year

# Nanoparticles Ubiquitous in industrial production

Materials



Pharmaceuticals



Sustainability



Electronics



Chemicals



Tools

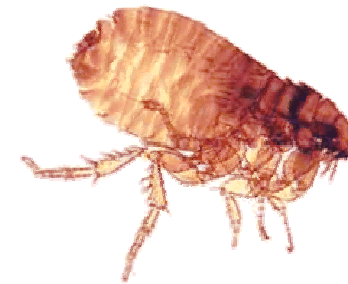




## Introduction

- *nanos*: Greek term for *dwarf*
- Nanometer is one millionth of a millimeter
- Nanotechnology visualizes, characterizes, produces and manipulates matter of the size of 1 – 100 nm.
- Small size
  - High surface to volume ratio
  - Unique properties (material strength and weight reduction, conductivity, new optical properties, reactivity)
  - New entry ways (high mobility in human body and environment)

flea =  
1000 000 nm



<100 nm





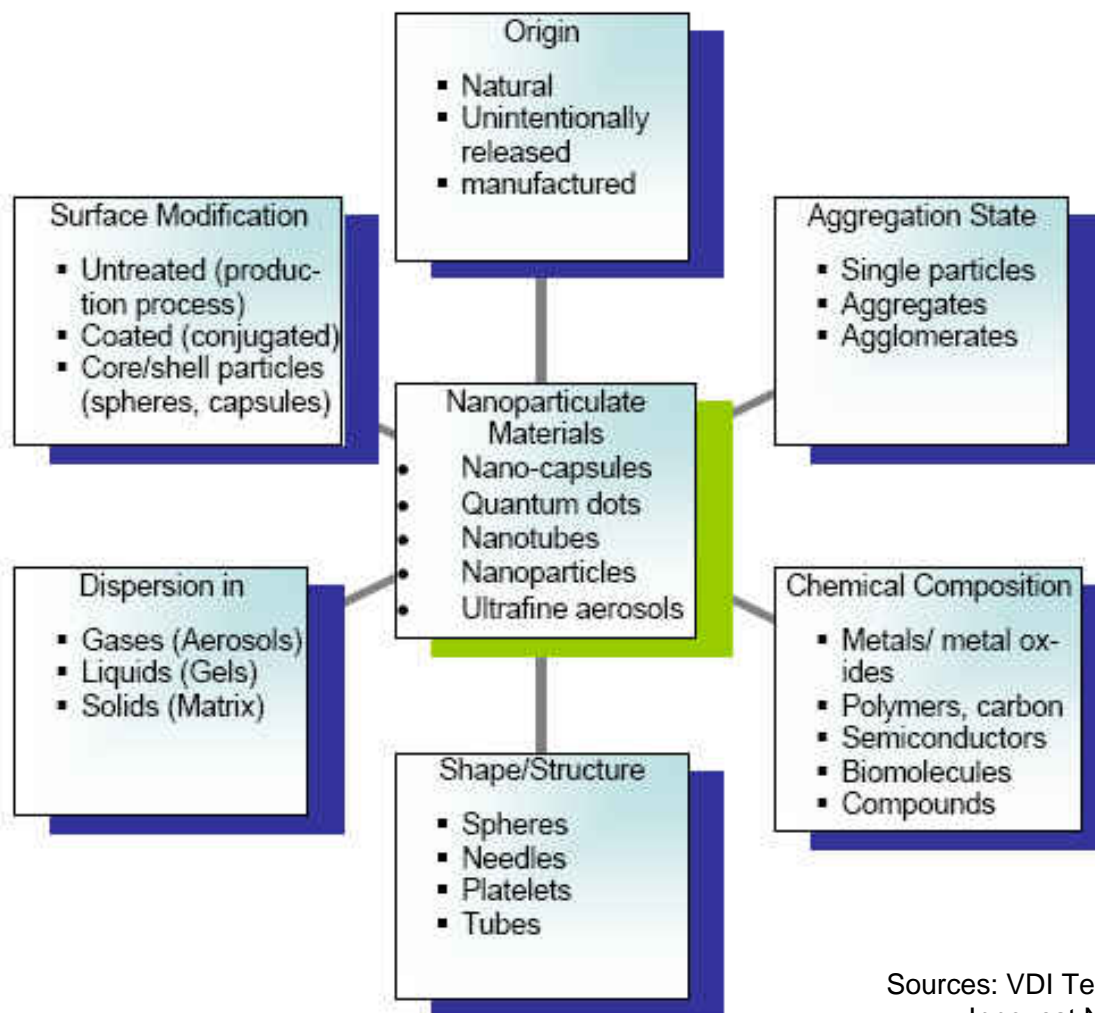
What is  
nanotechnology?

*The dimension “nanometer“*

V'eee'eee'eee'ry small

- The ratio between a nanometer and a meter is equal to the ratio between a walnut's and earth's diameter
- 1 meter = 1 billion nanometers
- = Mind-bogglingly small
  - Red blood cell is 7,000 nm
  - Bacteria usually is 1,000 nm
  - Ball-shaped virus is 60 – 100 nm

# Characterization of nanoparticles







## Is the risk perceived?

### ■ Ads: „World’s 1<sup>st</sup> Silver Nano-Enabled Washing Machine” (October 2005)

- Samsung Electronics has launched a **health-friendly and environment-friendly** washing machine designed to promote healthy living among users by keeping clothes bacteria and fungus-free for 30 days.
- Samsung’s silver nano technology, combining the disinfectant and antibiotic properties of **electrolytic silver nanoparticles (Ag<sup>+</sup>)**, removes 99.9% of harmful germs without having to wash clothes in hot water.
- When the machine is set on ‘Silver Sterilization’ mode, the **laundry load is covered with Silver Nano particles during the rinse cycle**. After the washing is complete, the clothes are found to be **totally devoid of bacteria** and unpleasant odor for 30 days. Furthermore, this process results in allergy-proof clothes as they become coated with silver nano ions, **protecting them from allergens**.

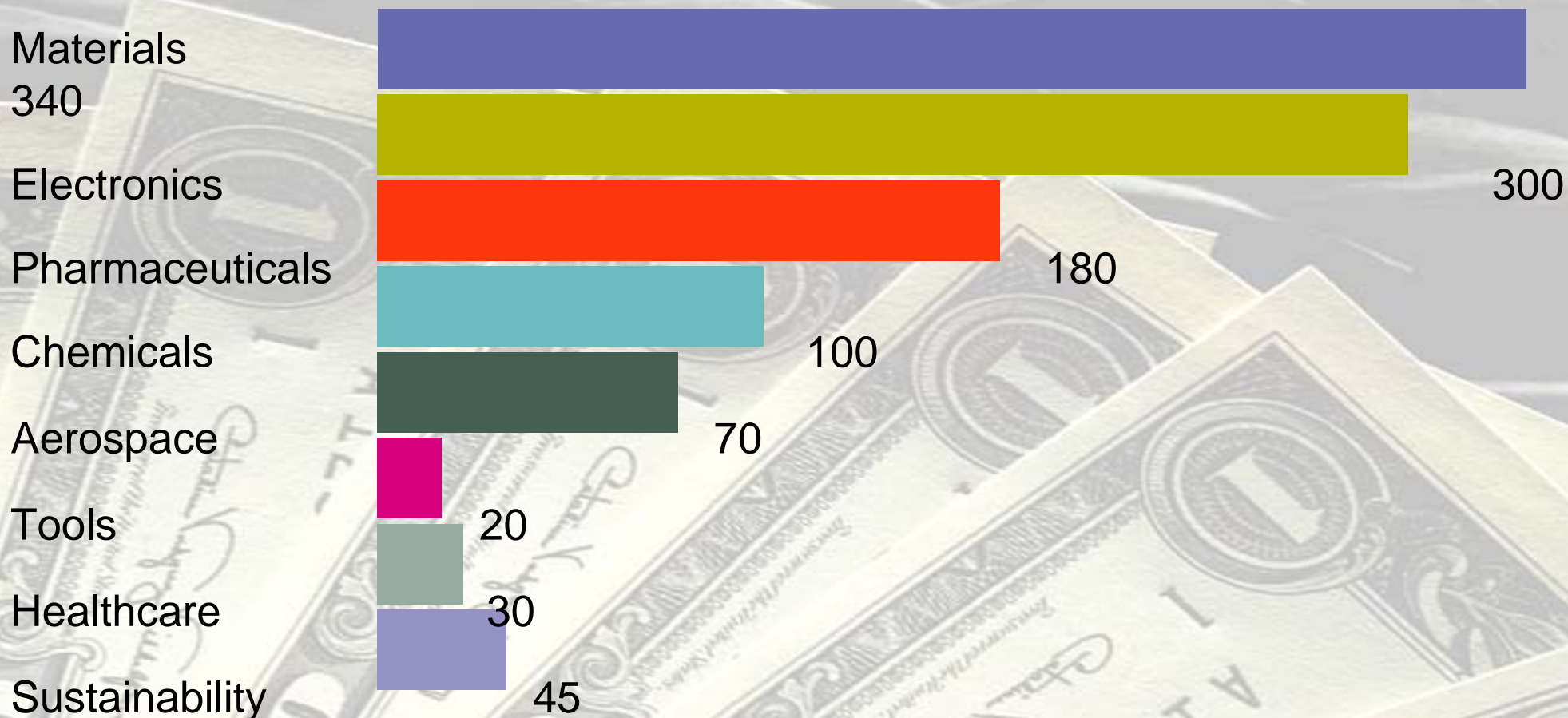


- **Unknown impact on non-target bacteria required for ecosystem balance!** Dr Vicky Stone, Toxicologist, Napier University Edinburgh, UK

# Estimated worldwide revenues expected to exceed USD 1 trillion by 2015



## Nanotechnology revenues worldwide by 2015 (USD bn)



Source: National Science Foundation



## Some specific applications

- Titanium dioxide in suntan lotion
- Ferrous oxide used in imaging techniques (X-rays)
- Special type of nanoparticle, a “buckyball“, can partially inhibit the AIDS pathogen
- Organic light emitting diodes have a nano-covering that lights up when electrified, are inexpensive to manufacture and more efficient than conventional light bulbs
- Silicon dioxide mixed with a nanodisperse fluid is used in water purification
- Scratch-proof paint
- IBM’s Millipede: 100GB on a surface the size of a stamp

## “Real risks” vs “phantom risks”

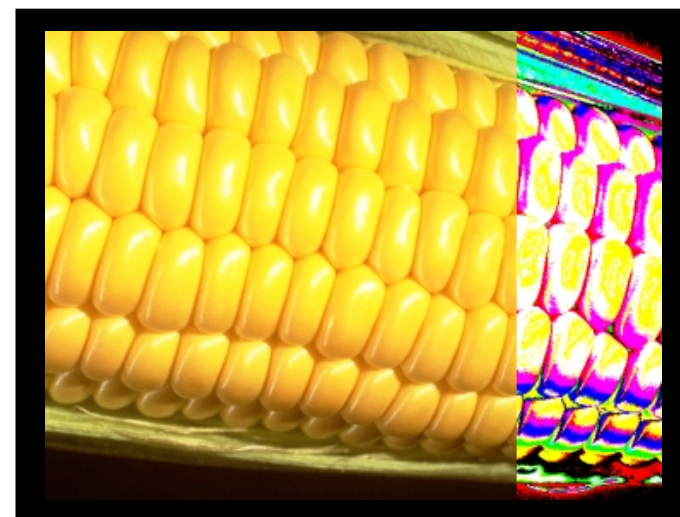
### “Real risks”

Scientifically proven  
cause/effect relationship



### “Phantom risks”

Risk perceived to be a  
threat:  
e.g. genetically modified corn





## Risks and benefits – are they balanced?

### **Precaution and liability**

- Precaution and novel technologies: Zero tolerance for system failures (*assumed or apparent*)
- Asserting safety: Constant extension of tort law rules

### **Public demand vs. individual behavior**

- Claim for absolute safety – while demanding the benefits

- **Insurance** enables risk taking – participates in the downside and thus focuses on anticipating the loss potential

- **Insurability** requires societal acceptability of risks and

# Hazards to living organisms

**Entry into blood stream**  
via nose, digestive system, lung, skin?

↓  
**Body distribution**  
incl. brain?

**Biodegradable**

Elimination



**Acute toxicity?**

**Non-biodegradable**

Accumulation?



**Chronic toxicity?**



## Hazards to the environment

- Particles treated to avoid agglomeration
- Passage through soil, transport of contaminants (heavy metals) → reaction with other substances?
- Ground water: drinking water quality/pesticide problem
- Absorption by plants (entry into food chain)?

Removal difficult, filters insufficient



## Insurability and its limits

Actuarial  
criteria

	Criterion of insurability	Requirement
1	Measurability	loss experience
2	Loss occurrence	Independent, spread
3	Maximum possible loss (insured)	manageable
4	Average loss	moderate
5	Loss frequency	suff. high
6	Mutuality (against moral hazard, adverse selection)	fortuitous, random undeliberate

### The insurance industry's role:

- Risk financing with premiums
- Enables risk taking
- Cuts capital costs and protect the balance sheet





## Insurability and its limits

market-  
determined

societal 

7	Net premium	adequate, affordable
8	Profitability, preference	insurance cover limits
9	Insurance industry capacity	sufficient
10	Public values, policy	consistent with cover
11	Legitimacy	legally and morally acceptable agreement

**sigma 4/2005**  
**Innovating to insure**  
**the uninsurable**

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Cover must be consistent with societal attitudes towards risk.



## Regulatory environment

- FDA: “Substantially equivalent”
  - EU (Scientific Committee for Cosmetic Products and Non-Food Products intended for Consumers): “TiO<sub>2</sub> is safe” (regardless of size)
  - MSDS: Recommendations according to bulk material
  - No disclosure obligation – exposure in products difficult to assess
  - No standardization/norms available
- Basis for:
- Comparison of scientific data
  - Regulatory environment
  - Labelling issues
  - Legal setup



*Nanotechnology is not (yet) a public issue:*

## “The revolution in your hands”

- Hardly known
- Insufficient information
- Rather indifferent attitude
- However, positive connotation for ‘revolutionary’ materials can be lost! e.g. asbestos
  - demonstrate the benefits
  - but, invest in risk research
  - examine for toxicity, reactivity and dispersion qualities
  - know the risks to address any concerns in order to gain credibility and trust



## Conclusions

- Defining nomenclature and standardization is a foremost priority
- More toxicological studies and exposure assessments are needed
- Transparent risk dialogue among industry, regulators, scientists and the public is essential
- It does not pay off to ignore potential risks – anticipating and managing risks is the only way to ensure nanotechnology's sustainable development and insurability



**Based on: Annabelle Hett, "Nanotechnology - Small matter, many unknowns," presentation and publication (available from Swiss Re, upon request)**

**and on, Thomas Epprecht: "UBS Nanotechnology Seminar," presentation, London, 14 Nov. '05**