MÉTODOS MATRICIAIS DE AVALIAÇÃO DE RISCO DE EXPOSIÇÃO A NANOPARTÍCLAS FABRICADAS

MATRIX METHODS FOR ASSESSING THE RISK OF EXPOSURE TO MANUFACTURED NANOPARTICLES

Ana C. Meira Castro, João Santos Baptista e Andréa Pereira

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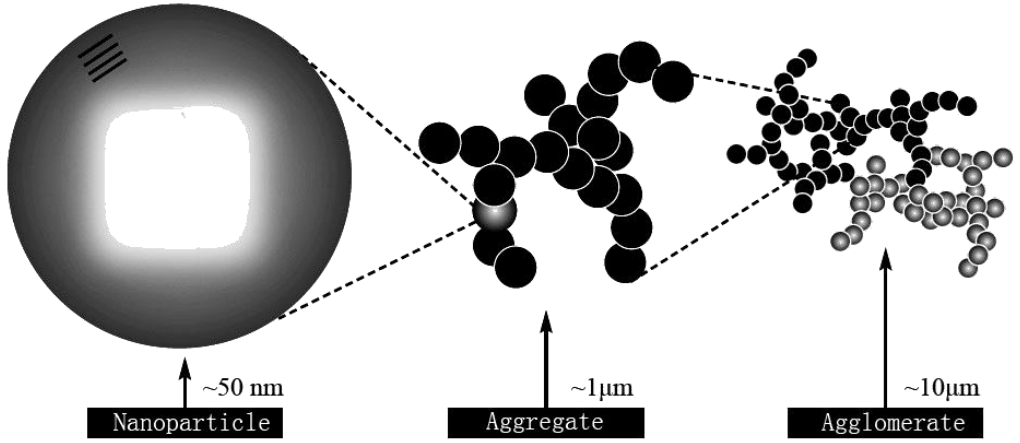
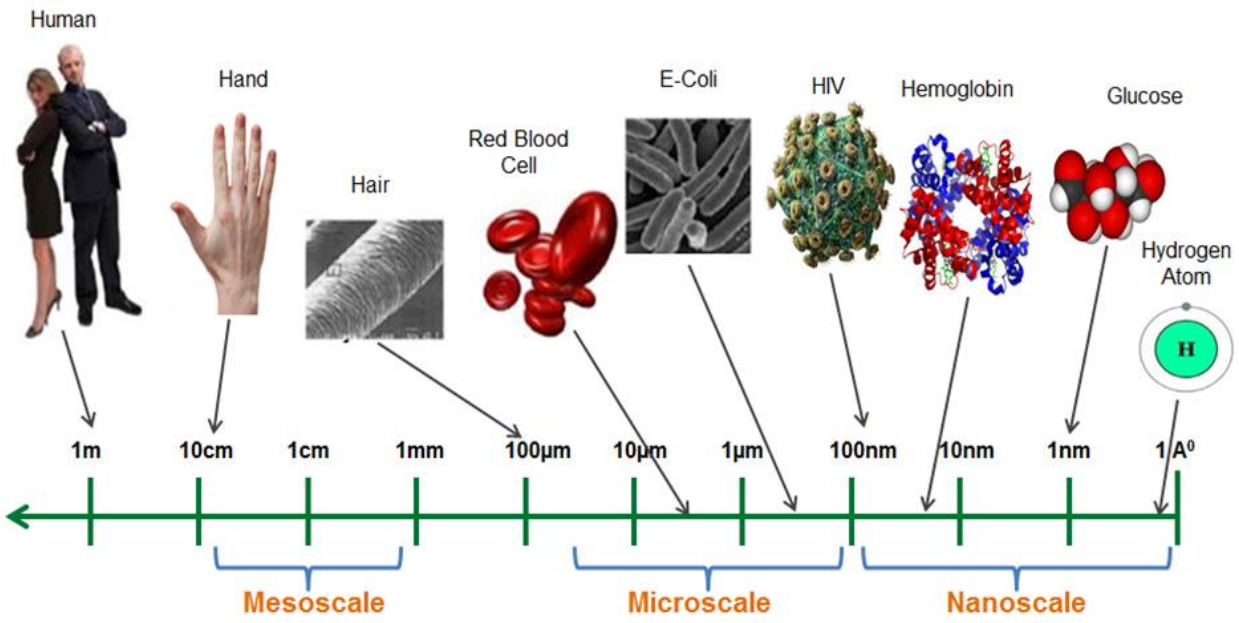
What are manufactured nanoparticles?

So far, there has not yet been published an internationally regulated definition of MNP, it only exists on NM.

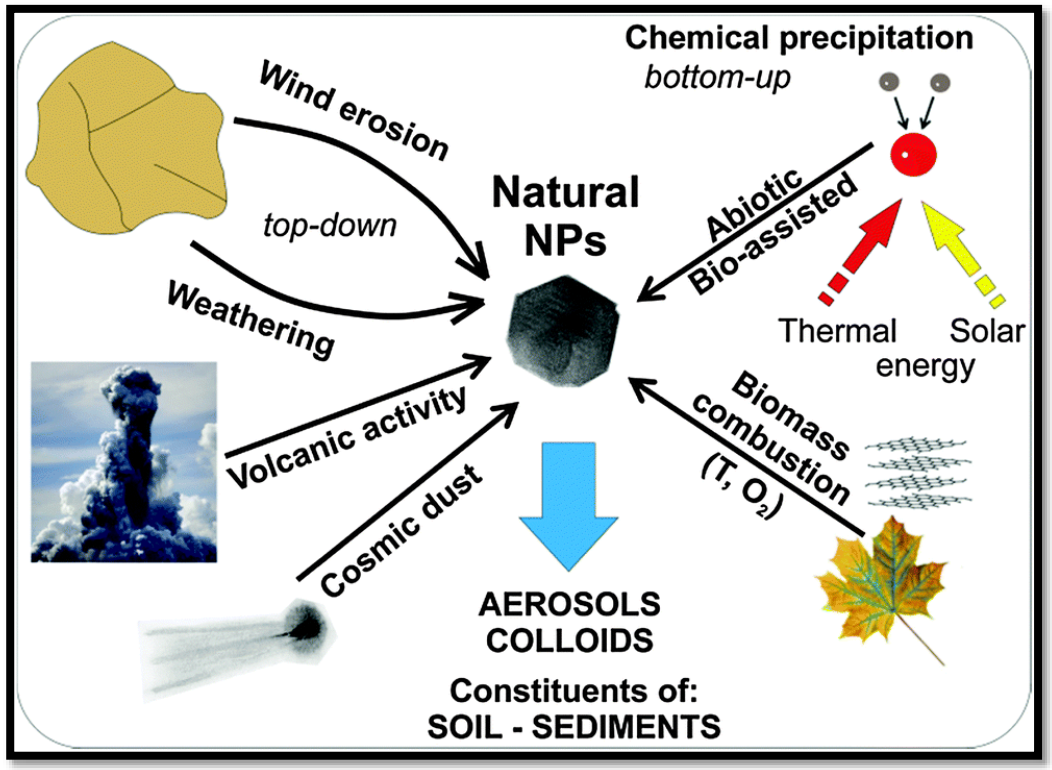
A NM is a natural, incidental or manufactured material (source) containing particles, in an unbound state or as an aggregate or as an agglomerate (state) and where, for 50 % or more of the particles in the number size distribution, one or more external dimensions is in the size range 1 nm - 100 nm (size).

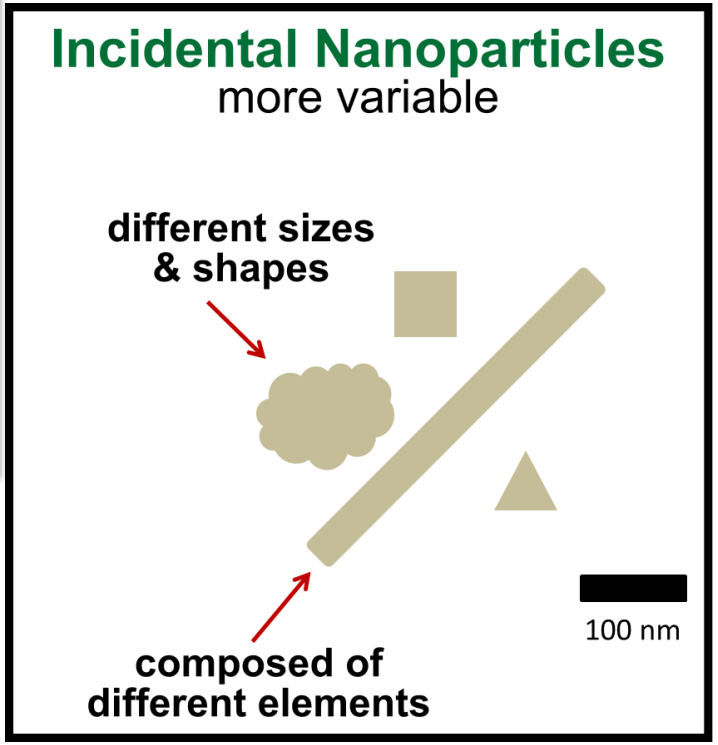


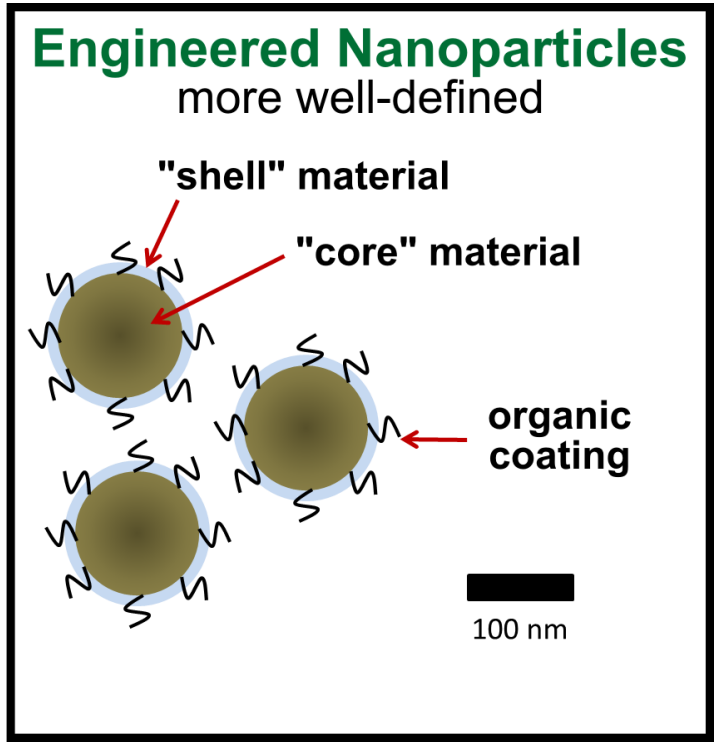


NANOMATERIAL

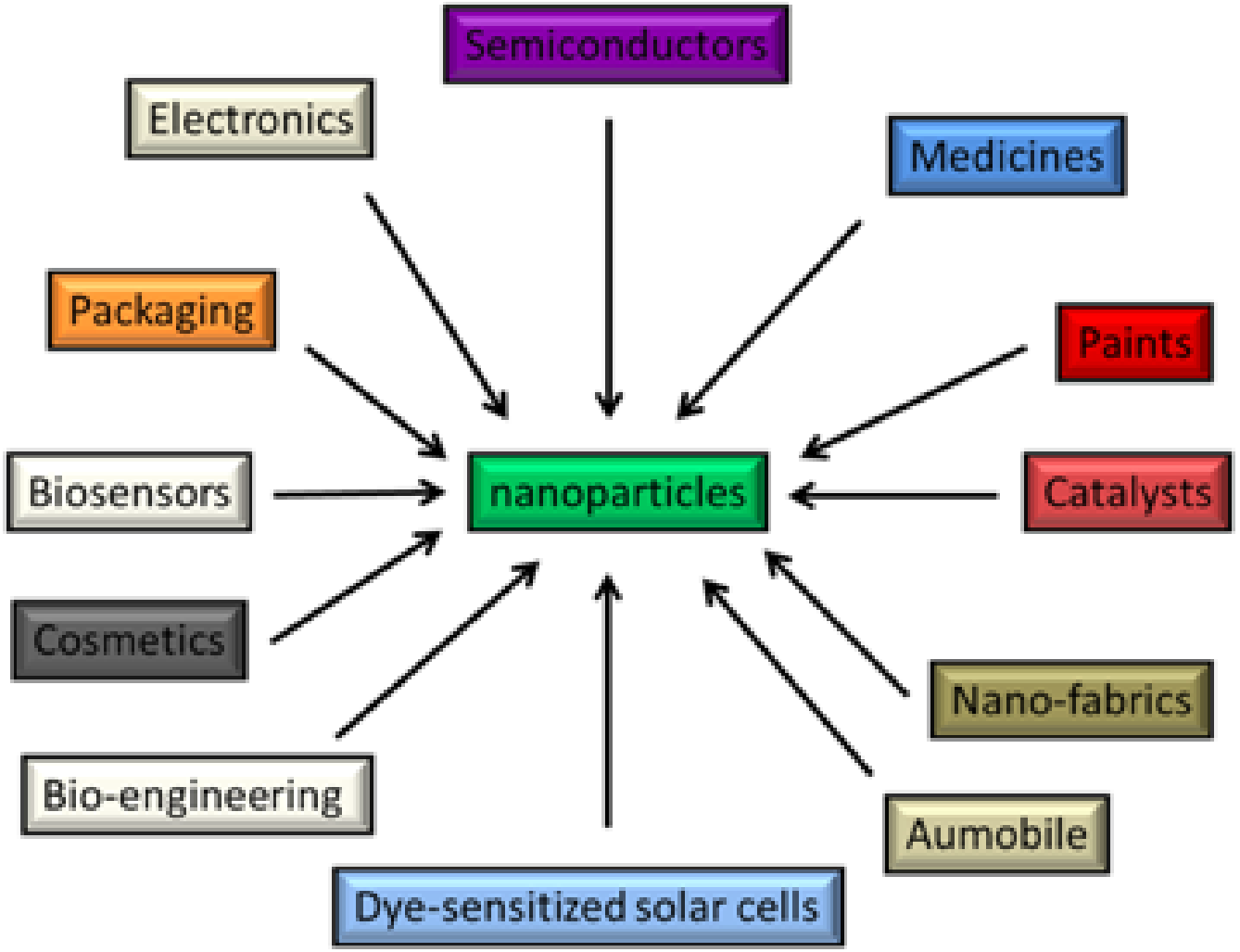
Source







NANOMATERIAL
Applications

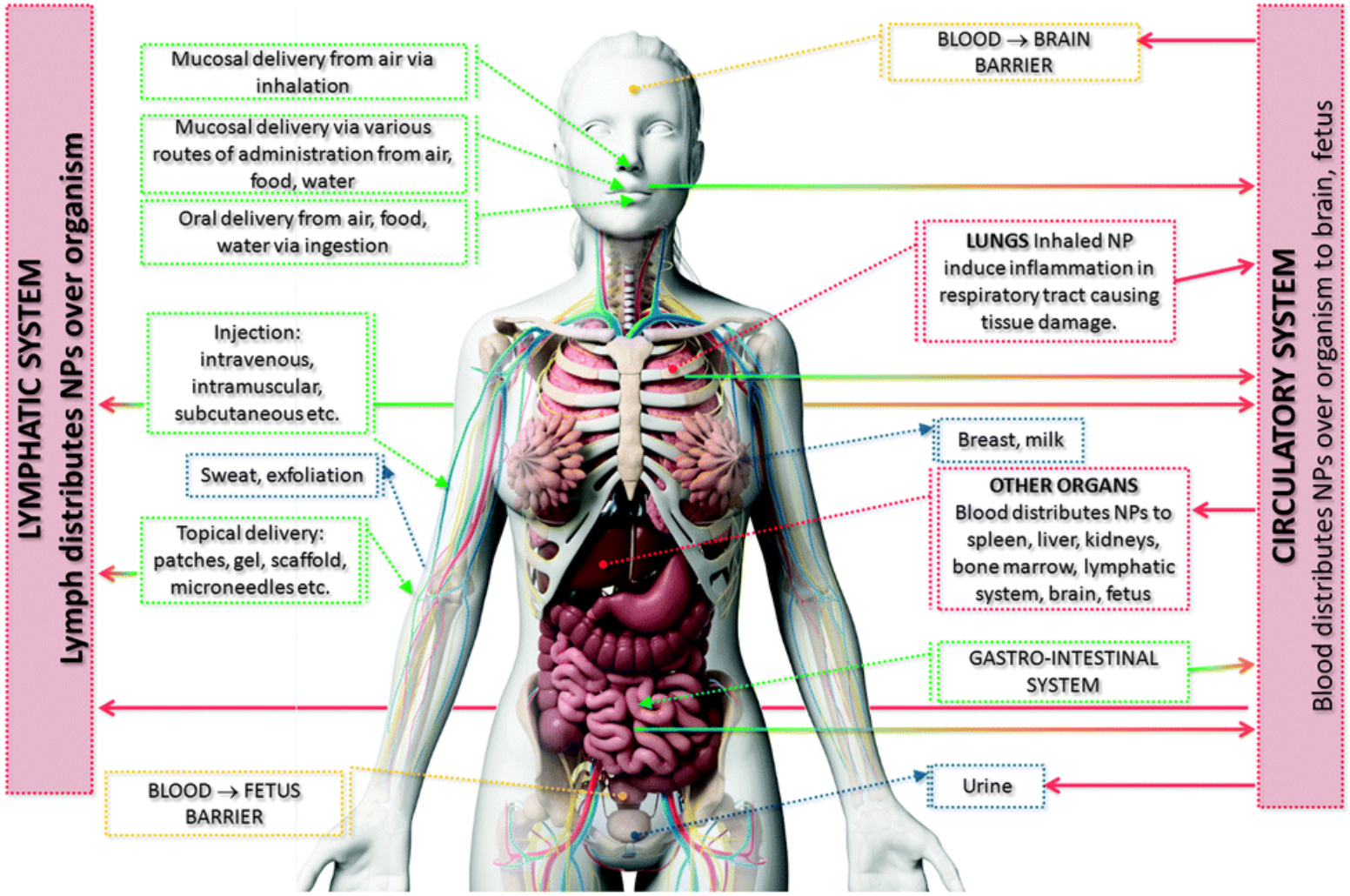


NANOMATERIAL
Impact on human health

Uncertainty

→ **Toxicological characteristics of NM**

→ **Effects on human health**

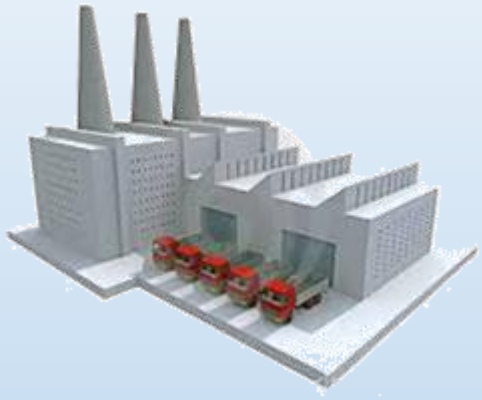


Growth in production of manufactured nanomaterials (MNM)

Exposure of workers

Need to assess and control risks associated to MNM production in the workplaces

Need to use a reliable Risk Assessment Method



ASSESSING THE RISK OF EXPOSURE

- Legislation/ Guides
- Norms
- Methodologies for risk assessment

European Union

- Definition for NM
- Integration of NMs into the REACH regulation (Registration, Evaluation, Authorization and Restriction of Chemicals)
- Information to consumers on food' goods regarding the definition of "**artificial nanomaterial**"

France/ Denmark / Belgic - National registration is mandatory for every NM

USA - Integration of NMs into the legislation on the manufacture, import, processing and distribution of chemical substances.

Brazil - Labelling of nanotechnology products and products using nanotechnology

CONTROL BANDING (CB)

Is a qualitative or semi-quantitative risk assessment and management method used to promote occupational health and safety in workplaces.

It is a process that matches, for example, a **control** measure (e.g., ventilation) to a "**band**" (or range) of hazards (e.g., eye irritation).

The principle of CB was first applied to dangerous chemicals, chemical mixtures and nowadays to nanotechnology due to:

- the significant uncertainty on quantifying exposure and
- the significant difficulty in obtaining reliable data

Control Banding methodology

Set of parameters → **Risk classification (valuation bands)** → **Definition of actuation priorities**

Characteristics of the NM used

- Physical and chemical
- Toxicity

- Measurements in real workplace context
- Characteristics of workplaces / workers exposure factors

- Workplace control actions
- Other factors (health control - medical examinations, individual behaviours, etc.)

Main CB methods available for situations of workplace exposure to engineered nanoparticles (ENP)

Acrónimo	Método de BC
ANSES	Agence nationale de sécurité sanitaire de l'alimentation, de l'environnement et du travail, France
Nanotool	Lawrence Livermore National Laboratory, United States
EPFL	École Polytechnique Fédérale de Lausanne, Switzerland
GWSNN	Guidance Working Safely with Nanomaterials and Nanoproducts, Netherlands
ISPESL	Istituto Superiore per la Prevenzione e la Sicurezza del Lavoro, Italy
OHB	Occupational Hazard Band method, France
NEIRA	Nano-Evaluris Inhalation Risk Assessment method, Heriot-Watt University, Scotland/Europe
NEERA	Nano-Evaluris Explosion Risk Assessment method, Heriot-Watt University, Scotland/Europe
Nanosafer	Nanosafer method, Denmark
Queensland Worksheet	Queensland control banding tool worksheet, Australia
Stoffenmanager	Stoffenmanager method, Netherlands

So far, it is unknown the existence of validated CB methods within the NP.

Advantages and limitations:

- **Application field**
- **Detail of information to insert**
- **Categorization of the risk level**
- **reliability of information**

Advantages and limitations: Application field

- So far, most BC methods can be applied to both research laboratories and industrial workplaces, with the exception of
  - EPFL, Nanotool and Queensland methods, which are designed specifically for **laboratory-scale** applications or in situations involving **small amounts of NM**

- OHB is only applicable in workplaces that involve the use of **solid** materials, powders, solid aerosols in the form of **spherical particles** (excluding fibres) and focus **only on the exposure by inhalation**

Advantages and limitations: Detail of information to insert

- Each method of BC has a specific protocol that involves the introduction of theoretical and field information regarding the physical-chemical and toxicity characteristics of NP, the characteristics of the place of production, the workers' exposure factors and the control measures Involved.
- EPFL - easy-to-use method - in contrast with Nanotool - requires a greater effort.
- ANSES - simple to use but requires professional users qualified in risk prevention to select data on safety data sheets according to the GHS system appropriately
- Stoffenmanager – more complete than ANSES, Nanotool and EPFL but also requires professional users qualified in risk prevention to select data.
- **ISEPSL - the most comprehensive risk assessment method** since it considers both the analysis of NP' physical properties and health related properties. Thus, in comparison with others, it examines more parameters.

Advantages and limitations: Categorization of the risk level

- Some methods are more conservative than others.
- **ANSES - excessively conservative**, since it considers factors that can lead to a rapid assessment of the risk to a higher range (classify a significant part of the workplace at the same level of risk)
- **Nanotool – the less conservative** approach, which tends to reduce the risk of NM with more hazardous properties than its source material. This is due to the fact that this tool provides for the possibility of the method operator not inserting data when they do not have information, choosing to select the **"unknown" response**.

Advantages and limitations: reliability of information

- Frequently the information in NP safety data sheets is **insufficient** and sometimes **differs from supplier to supplier**.
- **lack of reliable and clear toxicological data** for setting exposure limits Occupational risks for each NM

Integrating quantitative measurements into BC methods allows to obtain more reliable results.

- **DustTrak** for measuring NP mass concentrations
- **Condensed Particle Counter** for measuring the NP concentration

However, some uncertainty to the results is also add, since this equipment only measures an average diameter of the NP.

Conclusions

- CB methods are useful tools for risk analysis when facing uncertainties.
- Some are more conservative than others, which may pose some difficulties in prioritizing the risk management task (that usually follows risk assessment).
- The major limitation refers to the user's difficulty in obtaining reliable information about the physical, chemical and /or toxicological properties of NPs
- So far, the reliability and scientific validation of these tools is unknown

Thank you for your attention