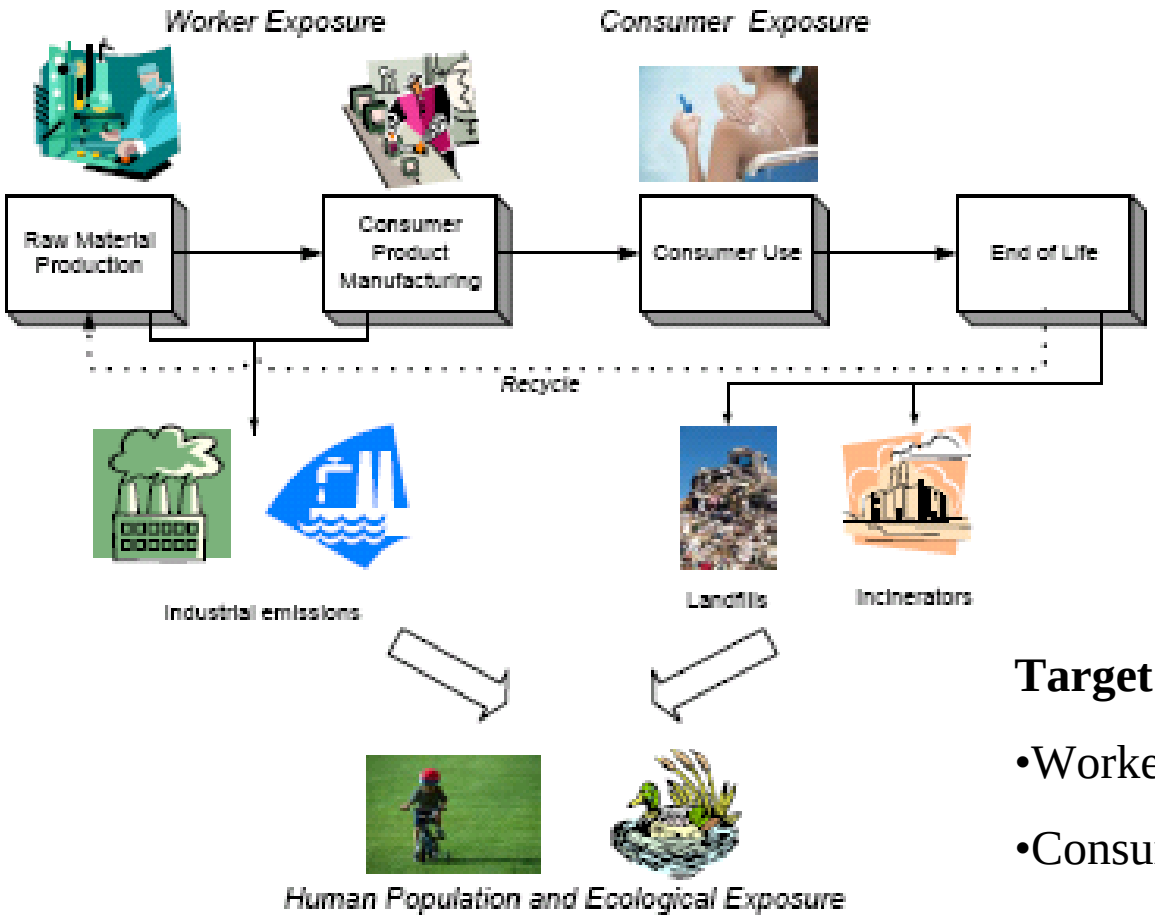
Environmental Risks Aspects

J. Bouillard

Ineris

Life Cycle and Risk Analysis



Fate

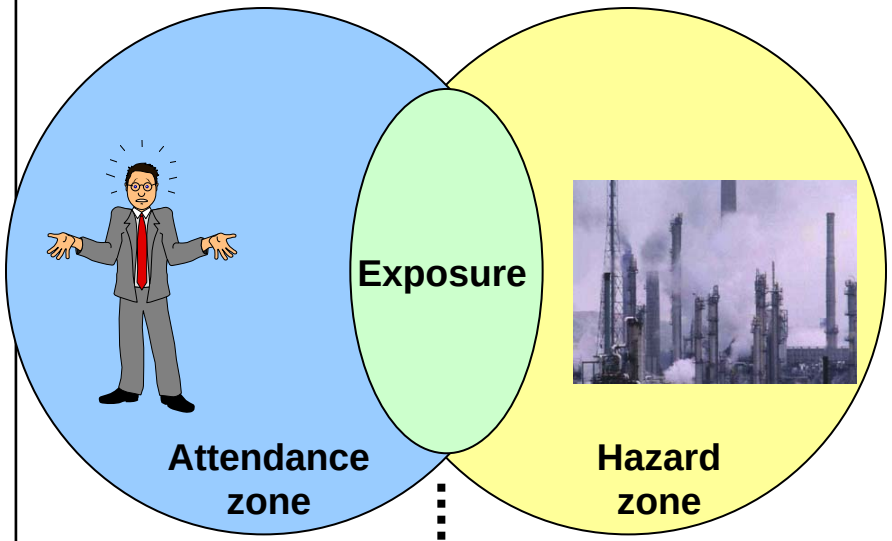
- Air
- Water
- Soil

Target vulnerabililty

- Worker exposure
- Consumer exposure
- Population & Environment Exposure

Principles of risk analysis methodologies (1)

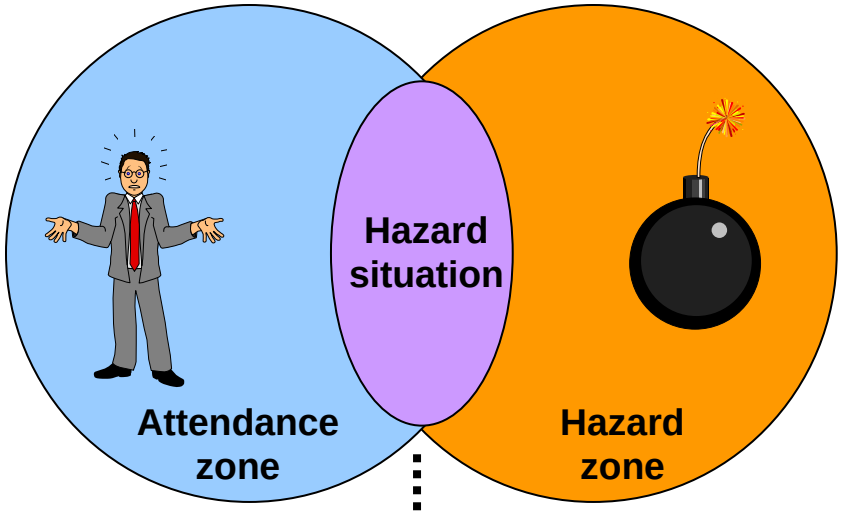
Chronic or continuous (usually) human exposure



Time

Personal damage = a disease

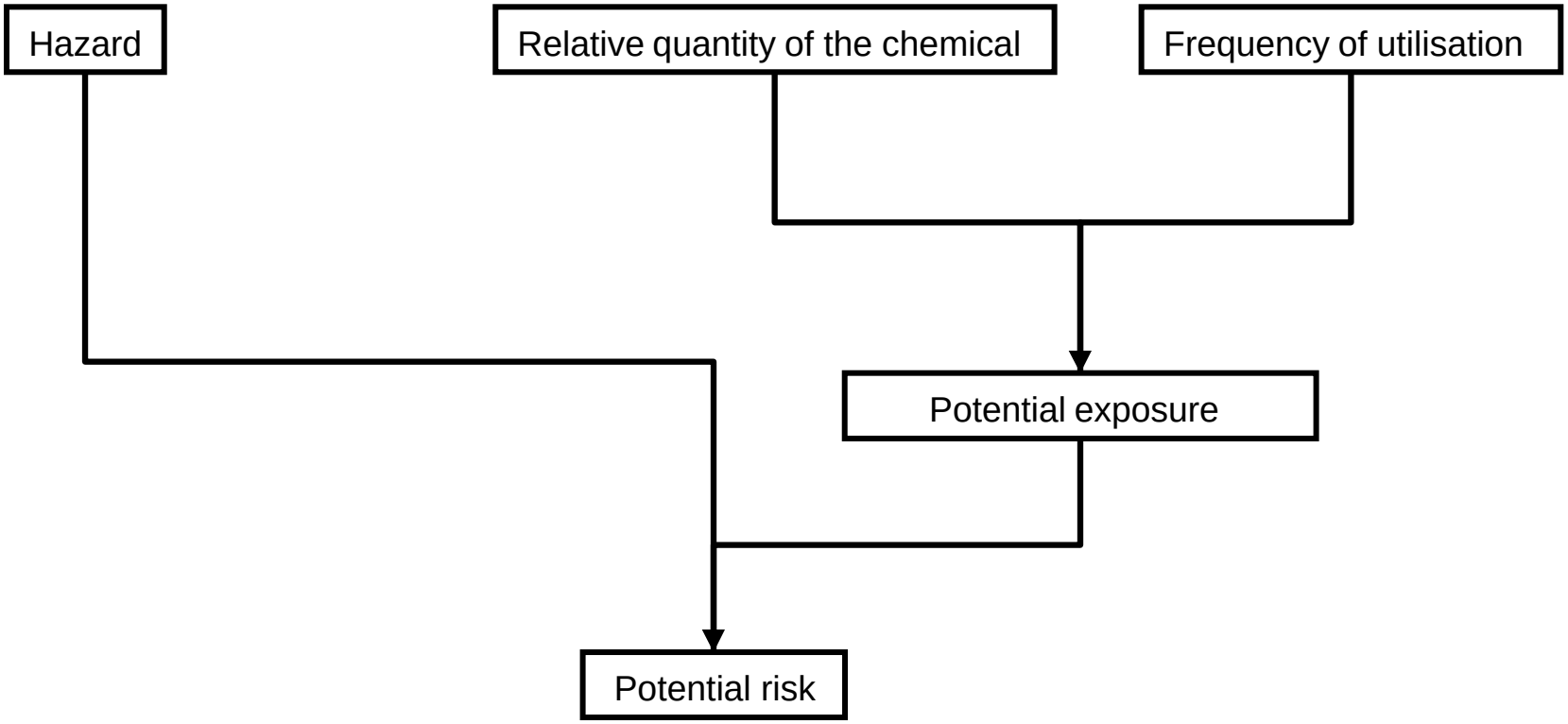
Acute (short-term) exposure, and/or incidents



Hazard event

Personal damage = a lesion

Proposition of the hierarchisation risks for toxic chemicals (1)



ICON data base- CBEN Rice Unversity

Human Exposure Measurement and Control

Exposure of Nanomaterials from industrial sources (main products and waste streams)

- Gas phase (aerosols, smokes…)
- Liquid phase (colloidal suspensions)

Exposure from Consumer products

Nanotechnology is rapidly advancing, with more than 300 nanoproducts already on the market.

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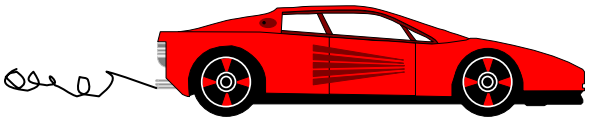
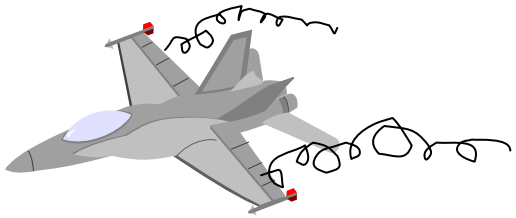




Examples of Exposure from Consumer products

▪ Sunscreen (Cosmetics)	Dermal, Ingestion, inhalation
▪ Metal catalyst in gasoline	Inhalation
▪ Paints , coatings	Dermal, ingestion, inhalation
▪ Clothings	Dermal

Challenging Research Areas (Critical Enabling Technologies)

- Selective Chemical Identification, Detection and Characterisation of nanomaterials (Bulk-Surface).
- Environmental Fate of Nanomaterials (air,water,soil)
- Biodegradation, Bioavailability, bio accumulation-bio persistence in particular media.
- Transformation of nanomaterials in environment.

Challenges for Exposure monitoring Tools

Biological Markers

Personal sampling and Monitoring

- work place, interior space

Ambiant Monitoring and Modeling

Challenges for Human Health Effects of nanoparticles

What Metrics to use (number, surface, mass)?

- Surface charge effects
- Differential deposition patterns in lungs depending of specific metrics
- Effects of agglomeration of nanoparticles

Accidental Risks- Fundamental Unknowns

Explosion and Fire

- Is it conduction driven or radiation driven ?
- Toxic releases?
- Transition to Detonation?

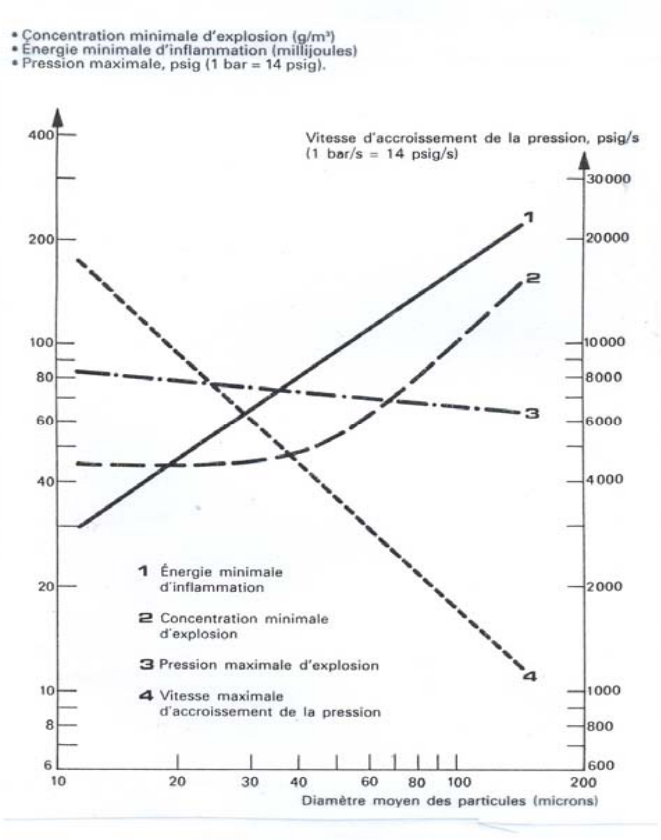
Toxic Dispersion

- Role of agglomeration or desagglomeration
- Kinetic theory of granular dispersion, Molecular Dynamics Approach
- What Metrics to use?

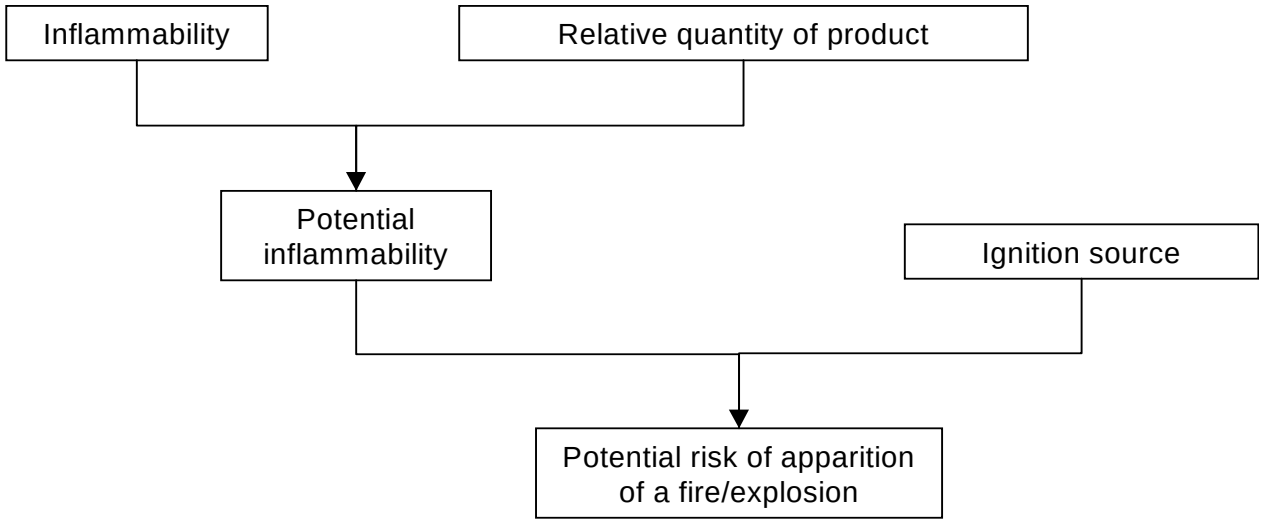
Miniaturisation of current tools

Explosion of Aluminum Powder (HSL)

Particle size effects on various safety parameters



Hierachisation of Explosion Risks



Explosion Risk Asssessment

$$R = P \times I \times V$$

R = Risk

P = Hazard Probability

I = Intensity of the phenomenon

V = Target vulnerability(workers in our case)

Proposed methodology for fire/explosion risk

The proposed methodology will take into account of the following equation:

Risk score =
severity of the risk score ×
frequency of the hazard score ×
worker exposure frequency score ×
existing measures of risk reduction management

- Severity of the risk = sensibility index (MIE) × Violence index (Kst) × Quantity of the nanoparticles used (or surface area ?)

- Frequency of the hazard = Occurence of the formation of an explosive atmosphere × Frequency of the presence of an ignition source

- Worker Exposure = Exposure frequency × number of persons exposed

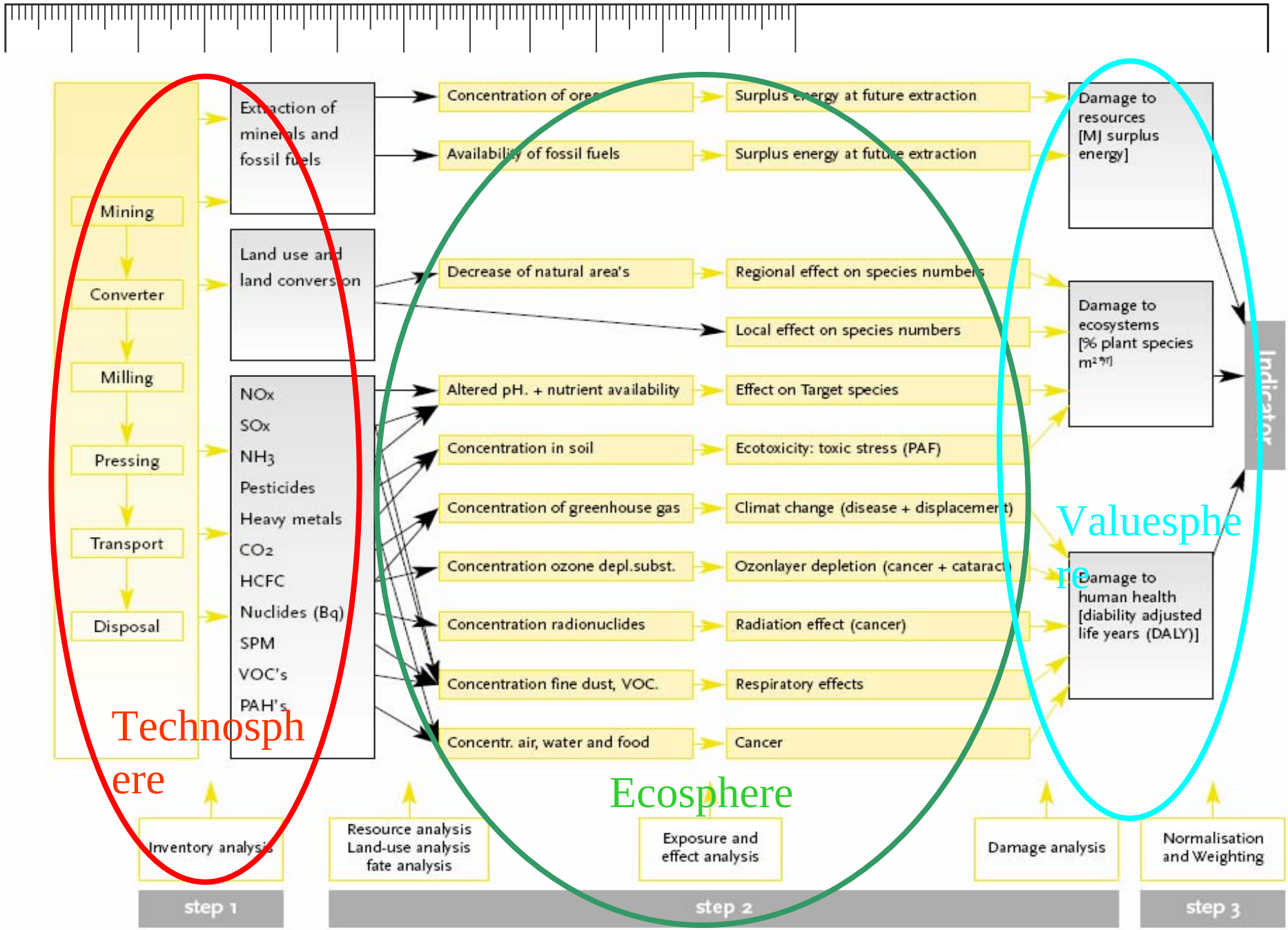
Nanosafe2 -Workscope (CEA)

Life cycle analysis- UCL (T. Harker)

- Eco-indicators for environmental impacts
  - damage to resources
  - damage to quality of ecosystems -loss of species diversity
  - damage of human health-DALY measure
  - Application to Carbon nanotubes uses as fillers in elastomers

Risk Assessment - INERIS (J. Bouillard)

- What metrics to be used- New characterisation tools need to be developed (exposure, explosion…)
- Work oriented towards worker protection


Mining
Converter
Milling
Pressing
Transport
Disposal
Extraction of minerals and fossil fuels
Land use and land conversion
NOx
SOx
NH3
Pesticides
Heavy metals
CO2
HCFC
Nuclides (Bq)
SPM
VOC's
PAH's
Concentration of ores
Availability of fossil fuels
Decrease of natural area's
Altered pH. + nutrient availability
Concentration in soil
Concentration of greenhouse gas
Concentration ozone depl.subst.
Concentration radionuclides
Concentration fine dust, VOC.
Concentr. air, water and food
Surplus energy at future extraction
Surplus energy at future extraction
Regional effect on species numbers
Local effect on species numbers
Effect on Target species
Ecotoxicity: toxic stress (PAF)
Climat change (disease + displacement)
Ozonlayer depletion (cancer + cataract)
Radiation effect (cancer)
Respiratory effects
Cancer
Damage to resources [MJ surplus energy]
Damage to ecosystems [% plant species m²?yr]
Damage to human health [diability adjusted life years (DALY)]
Indicator
Technosphere
Ecosphere
Valuesphere
Inventory analysis
Resource analysis
Land-use analysis
fate analysis
Exposure and effect analysis
Damage analysis
Normalisation and Weighting
step 1
step 2
step 3

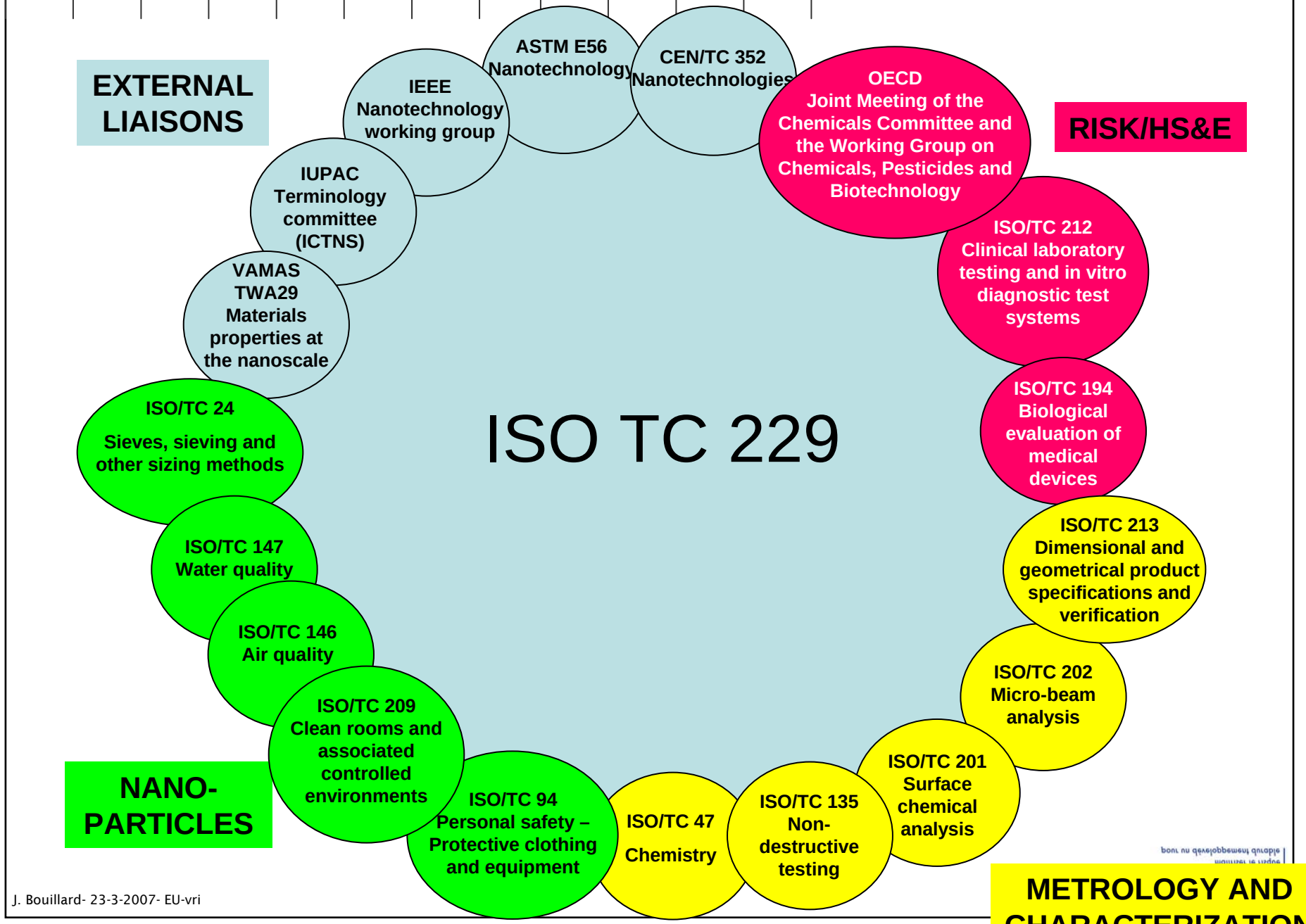
Nanosafe2 -Workscope (next)

Regulation-Standards (HSL, D. Mark)

- Four Main Areas:
  - Measurement and characterisation
  - Exposure control
  - Toxicity
  - Fire and Explosions

Linkages with Project Nano-Strand (Standardization related to R&D of nanotechnology), LNE, J. M. Aublanc

POSSIBLE PRIMARY LIAISONS



J. Bouillard- 23-3-2007- EU-vri

SAPHIR - Workscope (Cilas)

WP5.1 Industrial safety (Coordinated by M Merad, INERIS)

- define a methodology to assess risks in terms of safety and environmental damages on the new technologies developed within Saphir project ;
- define safety procedures for nanomaterials processing ;
- define a technical thresholds of risk acceptability for nanomaterials processing ;
- define good practices in risk communication for " factory for nano's" ;

WP5.2 Cost efficiency

- Good practices in cost-benefits studies in risk analysis and risk management process.
- Good practices in the assessment of environmental impacts: a list of impact scenarios, inform about impact mechanism

List of contacts

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