



ELIMINATING WORK-RELATED CANCER

Exposome and Safe by Design

TNO innovation
for life

Wouter Fransman

WORK-RELATED CANCER

Numbers and figures about work-related cancer caused by carcinogenic substances in the EU



Mortality



7~12 deaths



Incidence

every hour...

10~12 new cases



90% ♂ male
10% ♀ female



75% Lung, prostate, colorectum, bladder



Costs



Direct

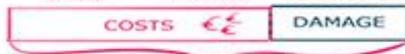


Indirect



Intangible

329



IMPACT

IN € BILLION PER YEAR

ROADMAP ON CARCINOGENS

OUR JOURNEY TOWARDS TACKLING CARCINOGENS

TO HELP BUSINESSES WE STARTED THE ROADMAP ON CARCINOGENS AN ACTION SCHEME TO RAISE AWARENESS AND EXCHANGE BEST PRACTICES

KEY FACTS

- Exposure to cancer-causing agents in the workplace is the main contributing factor to non-communicable diseases.
- Every year in Europe, over 100,000 people die as a result of these agents.
- 457 companies are participating in the Roadmap.
- 13 countries are involved.
- 23 companies have implemented measures to reduce exposure.
- 4 companies have implemented measures to reduce exposure.
- 100+ companies have implemented measures to reduce exposure.
- 100+ companies have implemented measures to reduce exposure.

OUR JOURNEY TOWARDS TACKLING CARCINOGENS

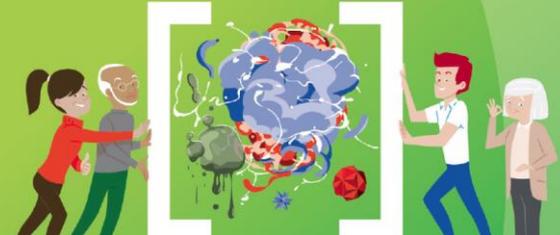
1. The European Commission proposes a new 2-year action plan to tackle Carcinogens and Mutagen Substances.
2. The Roadmap on Carcinogens is launched.
3. The Roadmap on Carcinogens is launched.
4. The Roadmap on Carcinogens is launched.
5. The Roadmap on Carcinogens is launched.
6. The Roadmap on Carcinogens is launched.
7. The Roadmap on Carcinogens is launched.

JOIN IN AND HELP INCREASE KNOWLEDGE AND AWARENESS!

WWW.ROADMAPONCARCINOGENS.EU



Workplaces
**MANAGE
DANGEROUS
SUBSTANCES**



HUMAN BEHAVIOR



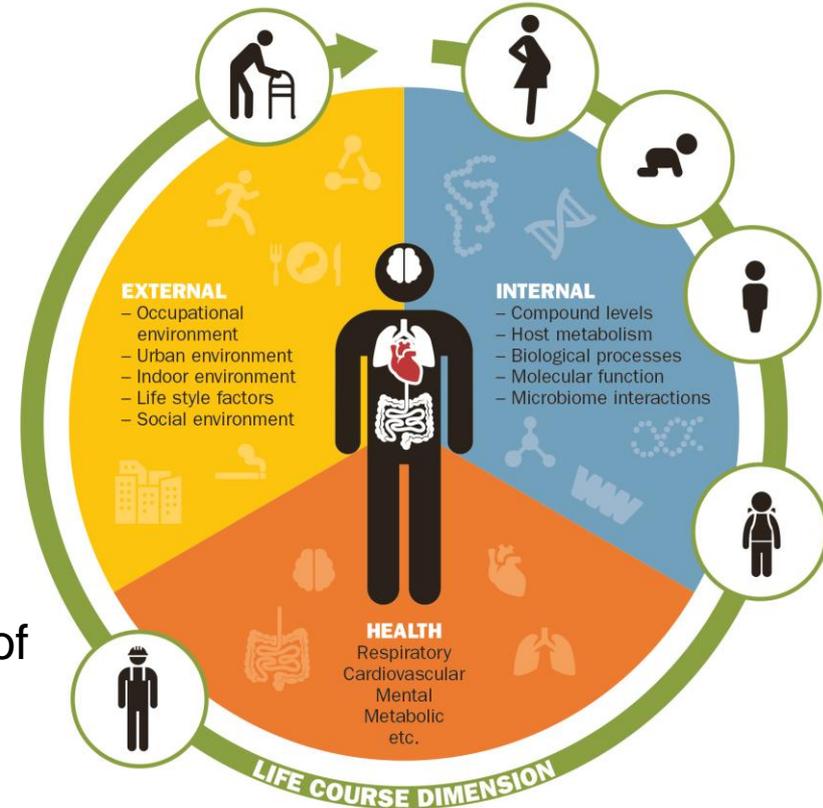
Real Time Risk Management (Exposome)



Safe by Design (material or process)

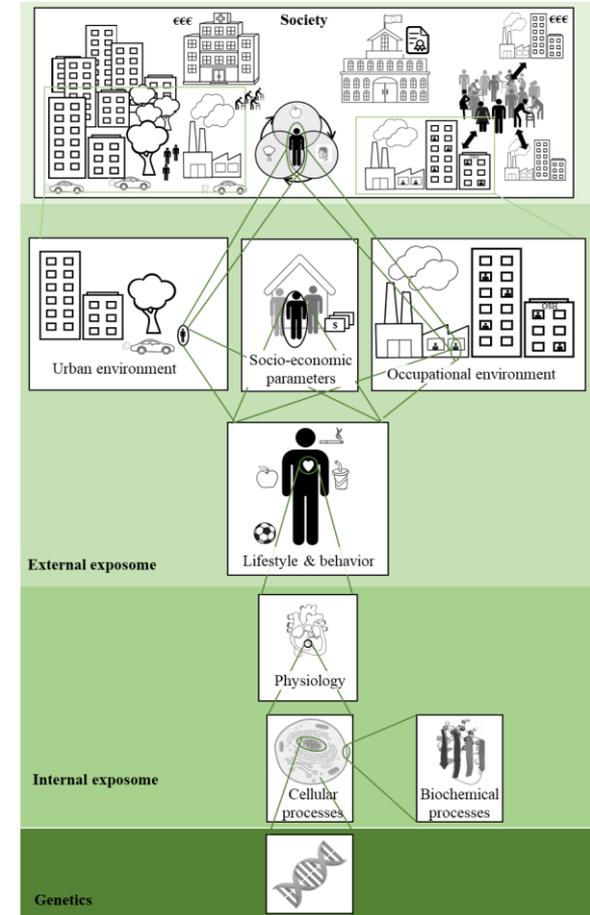
THE EXPOSOME

- › Totality of all exposures
 - › From conception until death
- › Counterpart of genome:
 - › Believed to explain 70-80% of disease
- › Links external exposures to internal markers of exposure and disease
- › A more holistic approach to exposure and health



THE EXPOSOME

- › Understand how the **economic and societal environment** influence health and vice versa
- › Map the **totality** of an individual's exposure in relation to health
- › Assess the extent to which these **combined exposures** affect inherent biological functions in their relation to health
- › Assess how genetics affect **individual susceptibility** & how genetics are affected by the exposome



EXPOSOME TECHNOLOGIES AND APPLICATIONS

TNO innovation
for life

Combinations of new technologies....



Smart data,
IoT



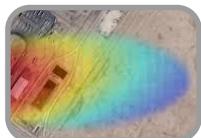
Sensor
technology



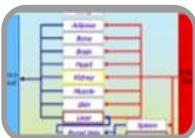
Big data



Omics



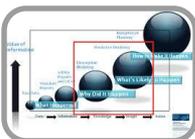
External
modelling



Internal
modelling



Pattern
recognition



Advanced
analytics

...enable new opportunities...

Data

- Faster, cheaper, longer duration
- Reliable, accurate & specific
- Multiple sources & stressors
- Personalized
- Real time update and integration



Models / inference

- Combining multiple routes/sources
- Constructing exposure profiles
- 3D Exposure / hazard mapping
- Predictions



Prevention/management

- Data driven, health relevant
- Personalized or group based
- Real-time, automated

...for effective prevention and promotion of health



Data & health driven group based risk assessment and management: policy, guidelines & procedures



Real-time monitoring & management of the exposome

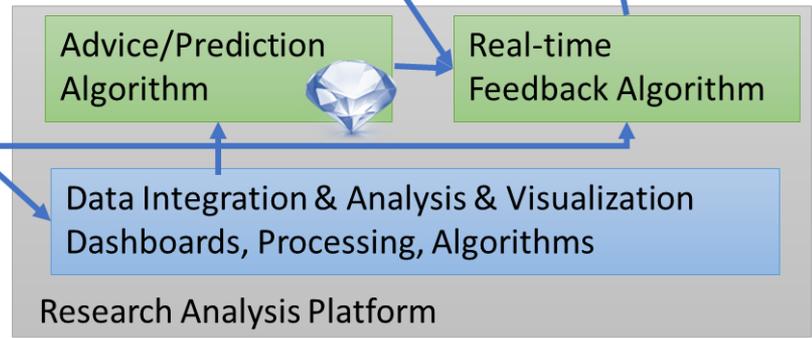
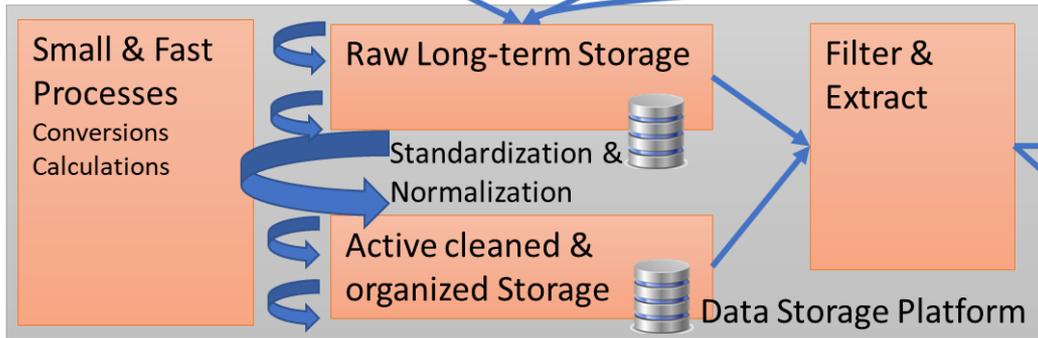
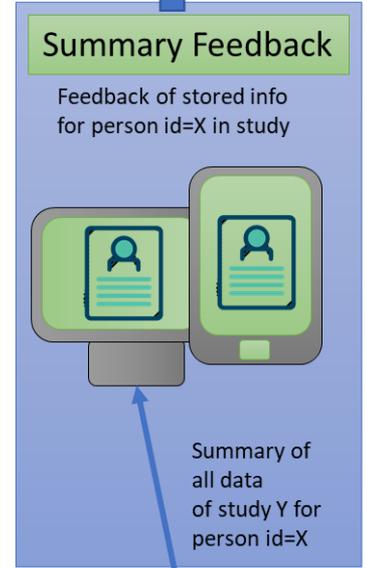
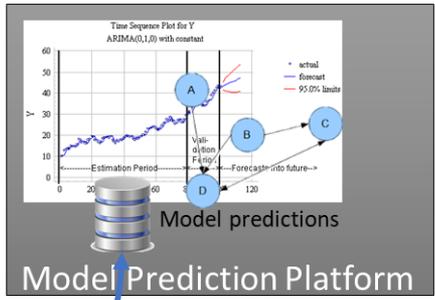
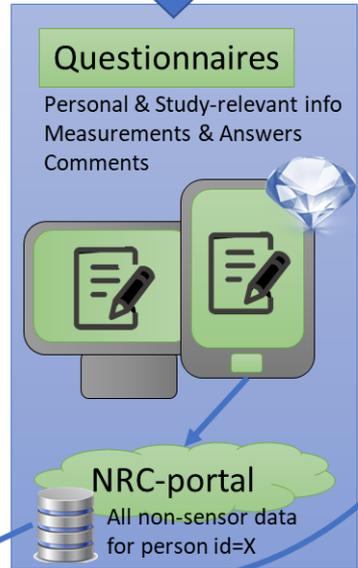
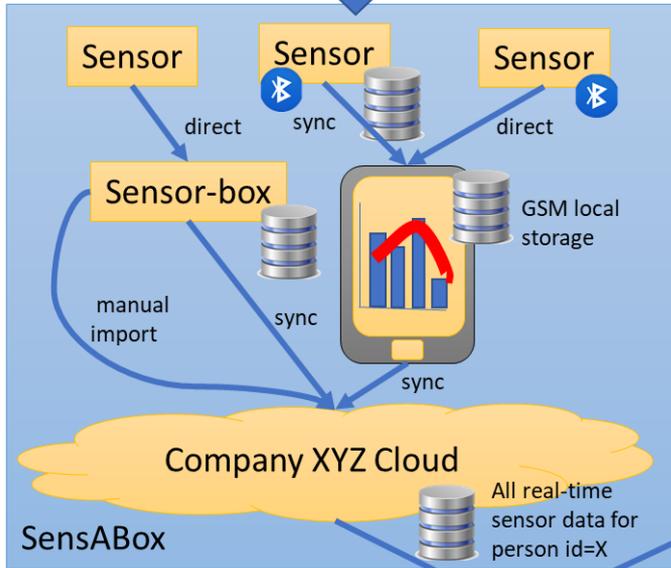


Individualised monitoring and decision support



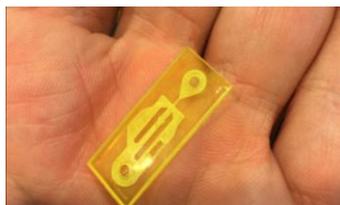
Individuals
Citizens
Person X

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for life

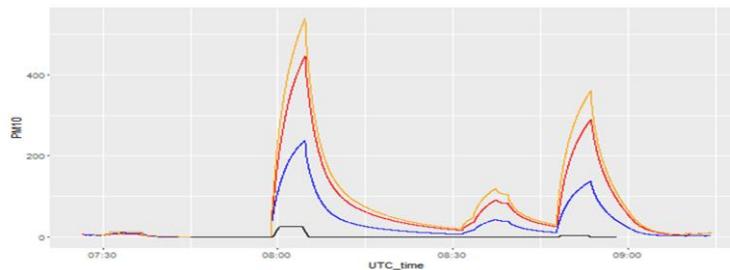


SENSORING

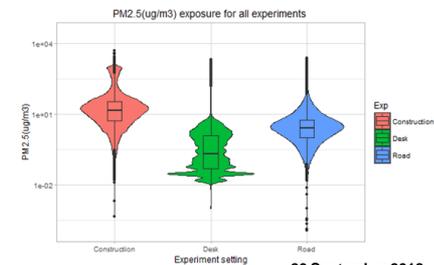
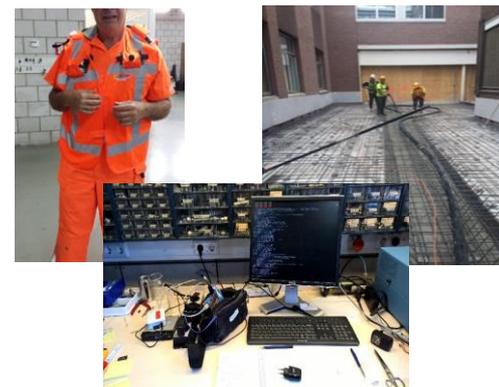
Sensor development



Sensor validation



Sensor application (2017)



OUR CAPABILITIES WILL DRIVE HEALTH & SAFETY IMPROVEMENT AND BUSINESS IMPACT

Capabilities

Deliverables

Infrastructure



Sensors

Sensors & Alarm

Connectivity

Security



Infrastructure



Analytics

Data Management

Analytics

Security

Change Management



Behavioural Change

Decision support

Advice

Behavioural Change

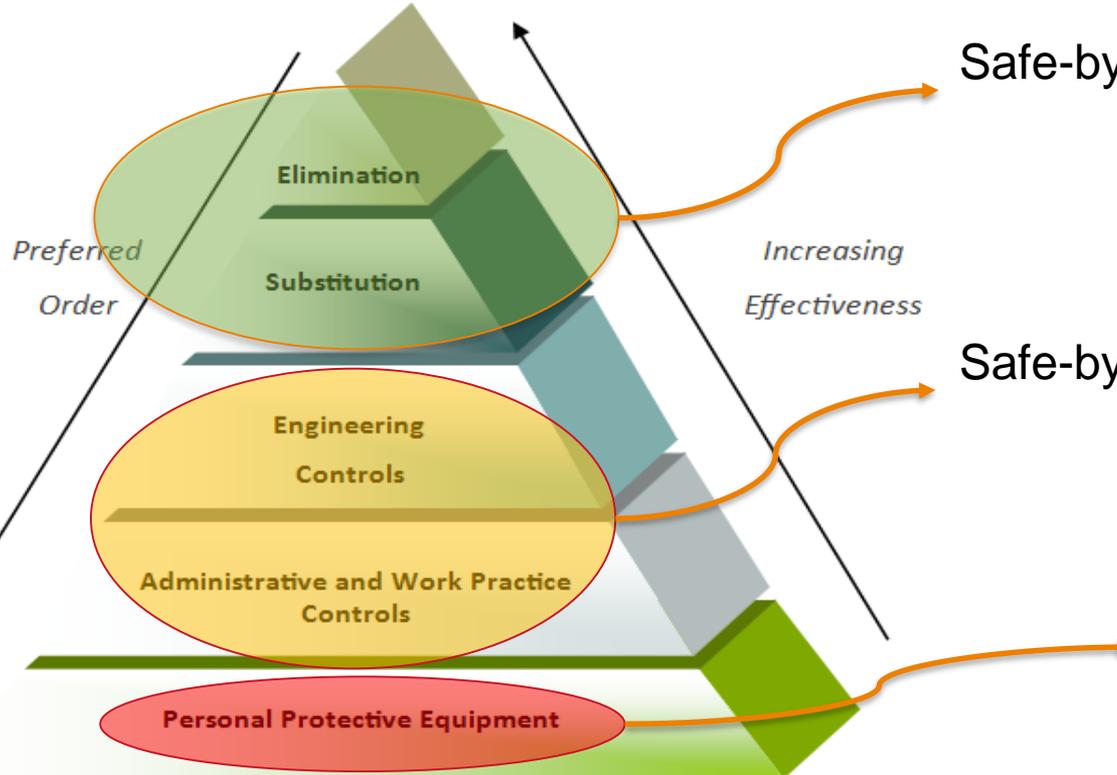
SAFE BY DESIGN



- Level 1: direct replacement of the substance of concern by a significantly different substance with comparable functionality, rather than drop-in replacement with a similar chemical. We refer to this as the **'molecular level'**.
- Level 2: replacement of the material that the substance of high concern is used in, or redesigning processes, products, services and/or product chains, including non-chemical solutions. We refer to this as the **'material', 'product/service' or 'process' level**.

MANAGING THE RISKS OF CHEMICAL EXPOSURE

STOP



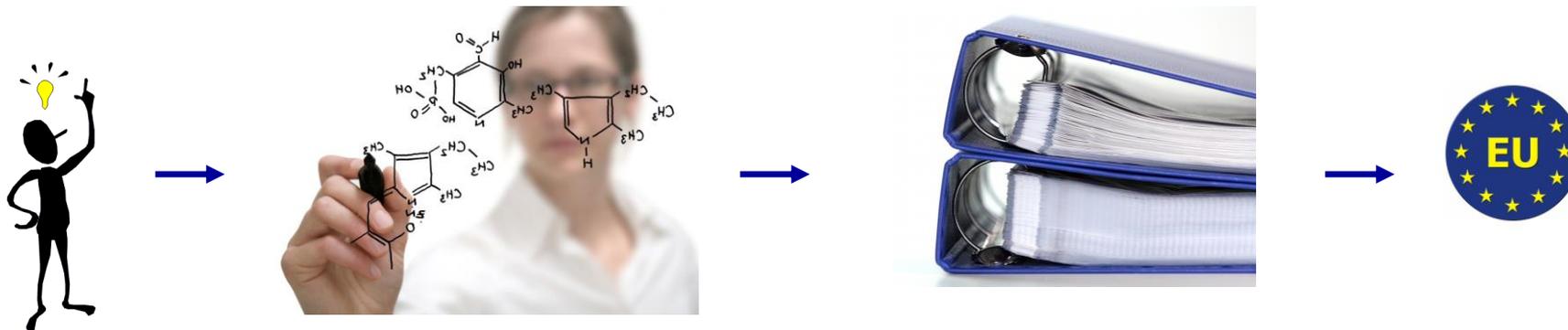
Safe-by-"material"-design
Level 1



Safe-by-"process"-design
Level 2



SAFE BY DESIGN LEVEL 1



Research & Development

Early safety screening in design and selection of chemicals has many advantages.

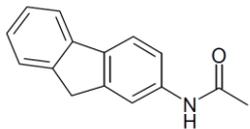
Dossier preparation & Registration

Information Requirements have to be fulfilled in order to realize Registration and marketing of the chemical.

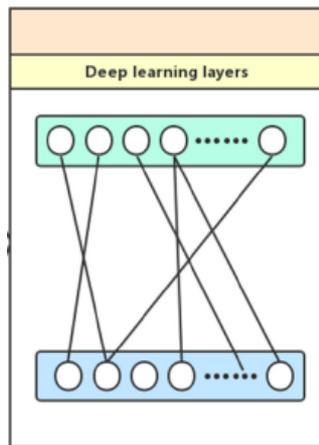
SAFE BY DESIGN LEVEL 1 TNO'S VISION TO SAFETY SCREENING

Apply Deep Learning & AI approaches

chemical
structure query
&
Biological data



Integration of all data

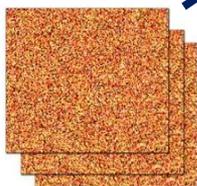


machine learning

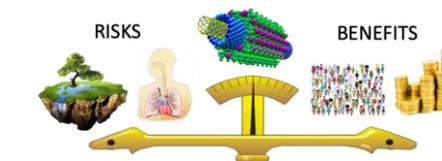
chem/bio/tox
databases



biological data
(gene expression,
in vitro assays)
GEO, CMap, CTD...)



Prediction safety
profile query



Experimental data

+

In silico tools

+

Read-across data

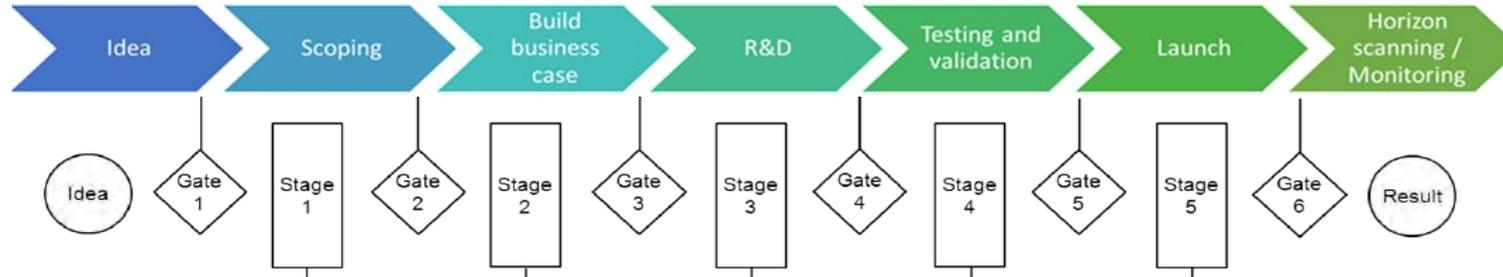
&

Expert judgement

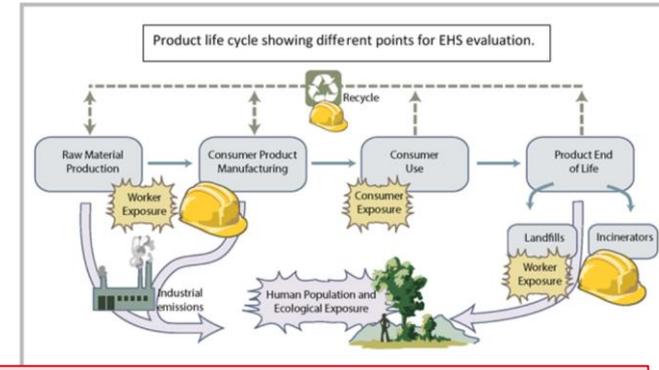
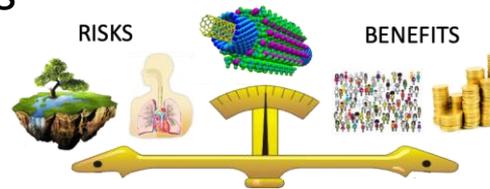
In silico prediction
Safety Profile



SAFE BY DESIGN LEVEL 1



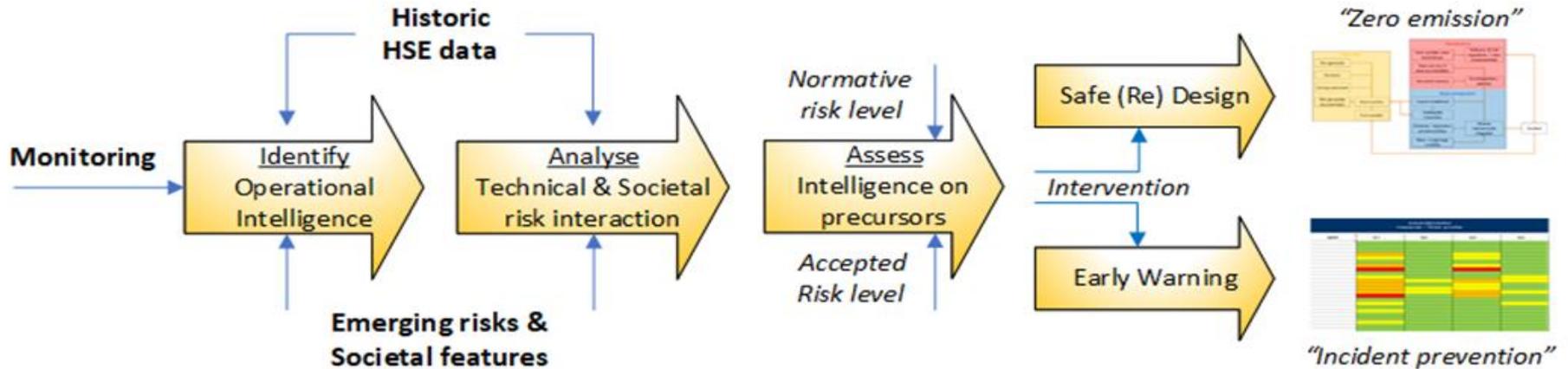
- Change in development is most cost efficient in early stages



OECD WPMN project

Moving Towards a 'Safe Innovation Approach' for Sustainable NMs and Nano-enabled Products:
Overview of existing risk assessment tools and frameworks, and their applicability in industrial innovations

SAFE BY DESIGN LEVEL 2



STAKEHOLDER COMMUNICATION



RISK GOVERNANCE



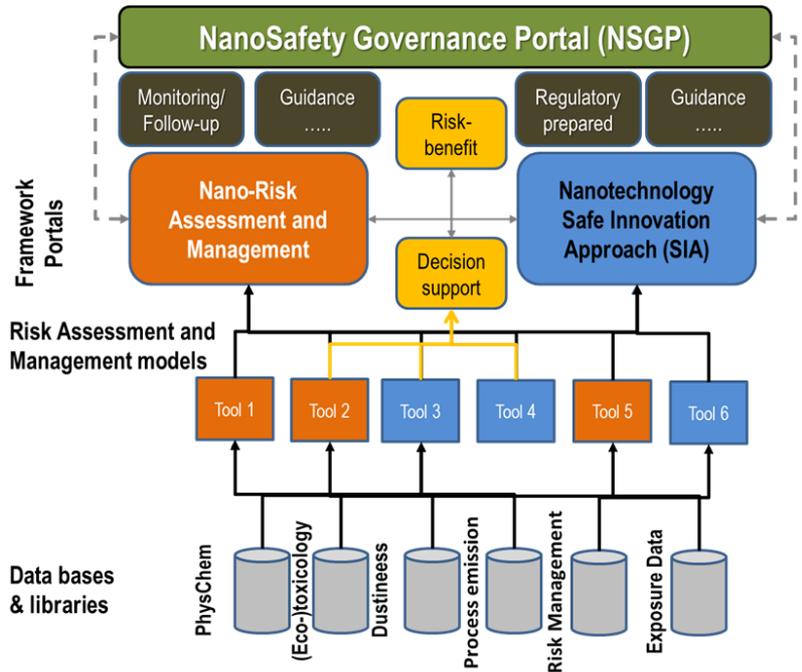
New Tool ?

Nanospecific?
 Complying with user needs?
 Suitable application stage?

- Pre-regulatory
- Regulatory
- Post-regulatory

Application domain?
 Scenarios covered?
 Data requirements?
 User requirements?
 Scientific sound of results?
 Acceptability in domain?

- Science
- Regulation
- Industry



Users: NRCG, industry, service providers, regulators, NGO's etc.

› **THANK YOU FOR YOUR ATTENTION**

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Take a look:

TNO.NL/TNO-INSIGHTS

TNO innovation
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