



ELIMINATING WORK-RELATED CANCER

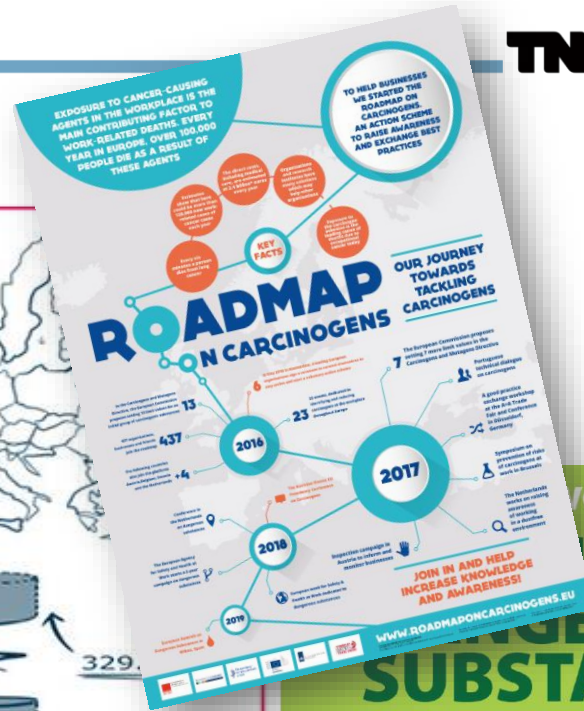
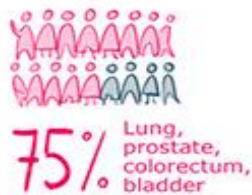
Exposome and Safe by Design

TNO innovation
for life

Wouter Fransman

WORK-RELATED CANCER

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

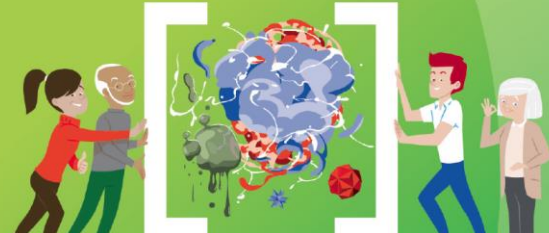


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workplaces

**AGE
DANGEROUS
SUBSTANCES**



HUMAN BEHAVIOR



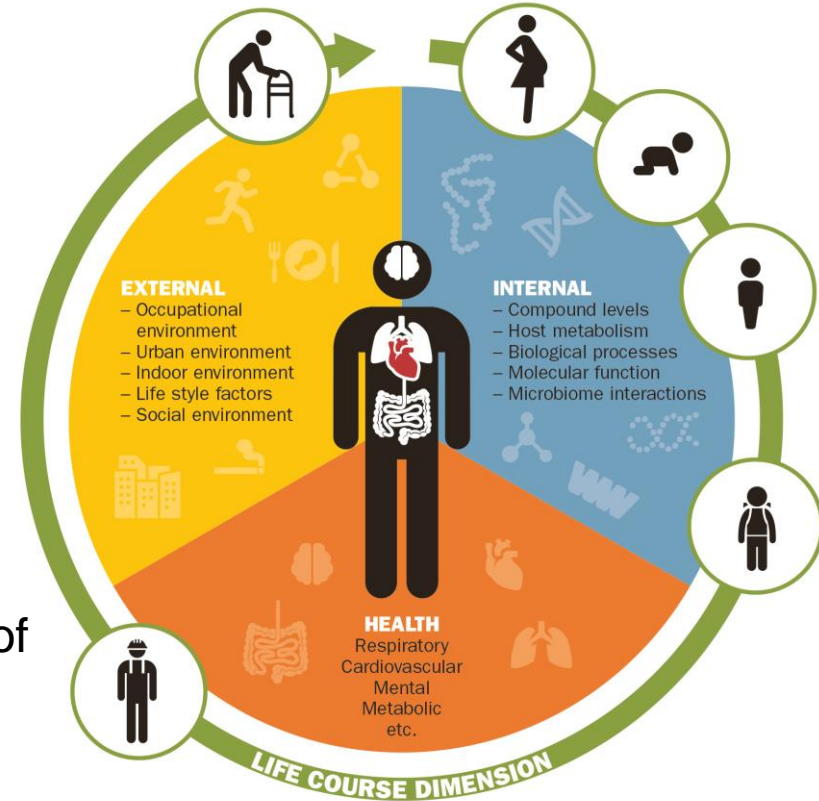
Real Time Risk Management (Exposome)



Safe by Design (material or process)

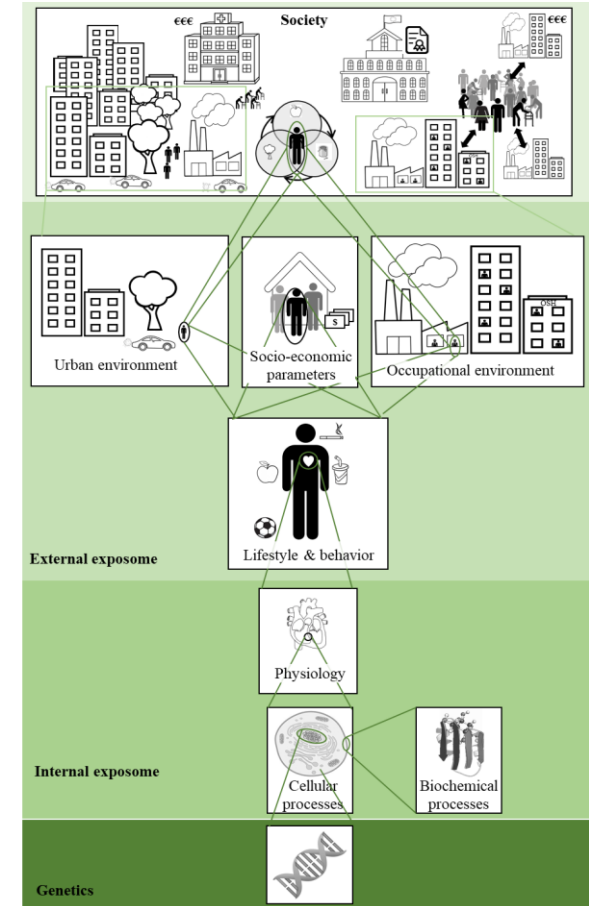
THE EXPOSOME

- › 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

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Combinations of new technologies....



Smart data,
IoT



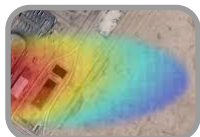
Sensor
technology



Big data



Omics



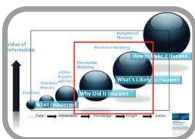
External
modelling



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



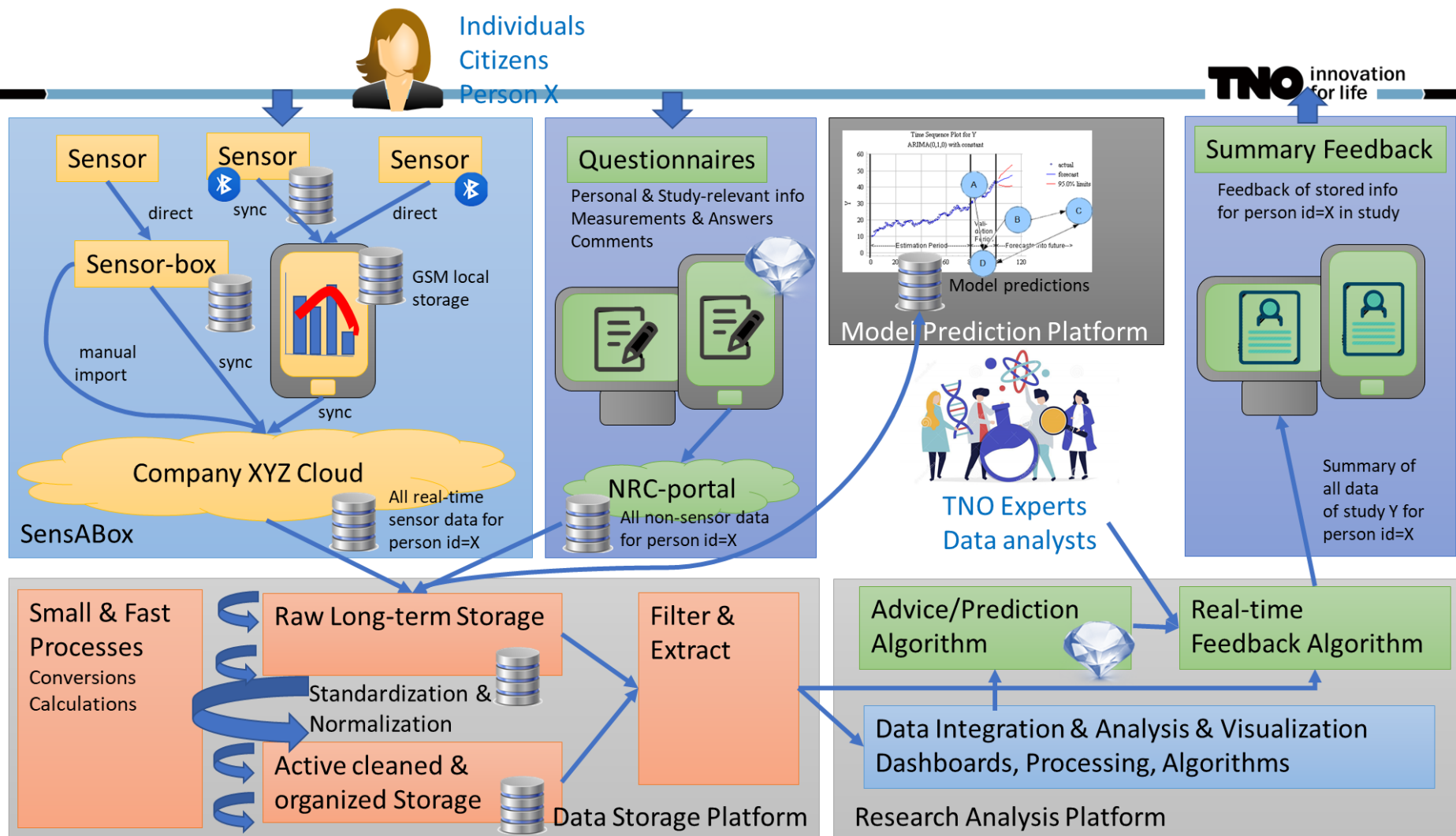
Data & health driven group based risk
assessment and management: policy,
guidelines & procedures



Real-time monitoring &
management of the exposome

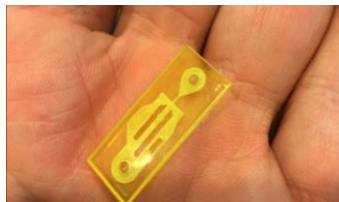


Individualised monitoring and
decision support

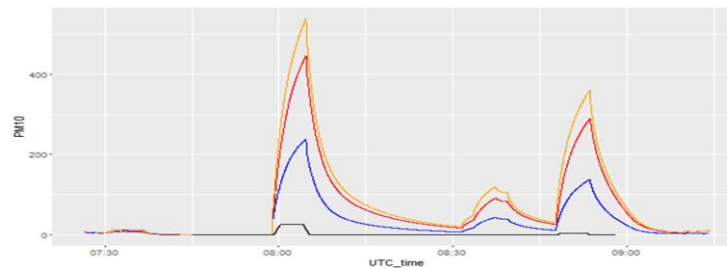


SENSORING

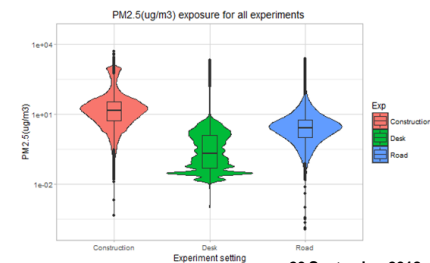
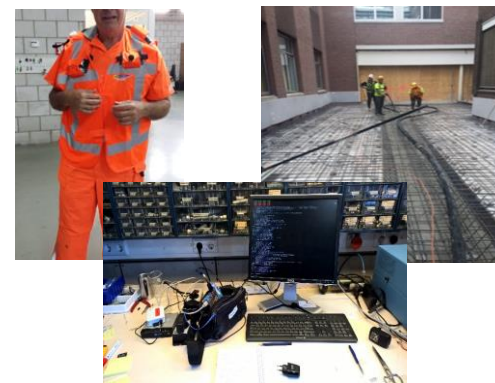
Sensor development



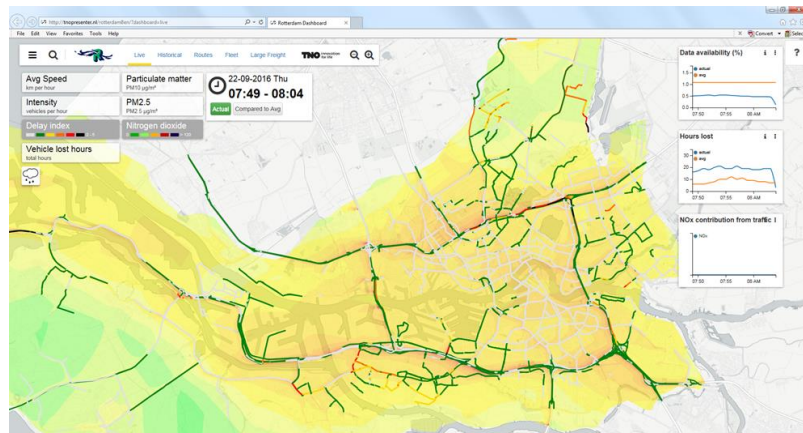
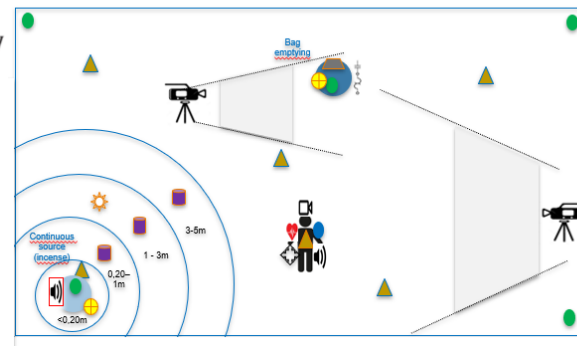
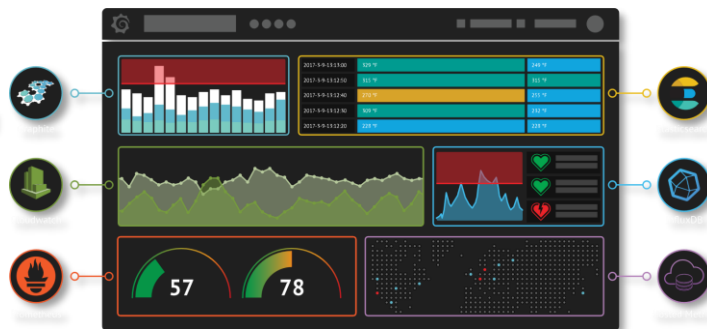
Sensor validation



Sensor application (2017)



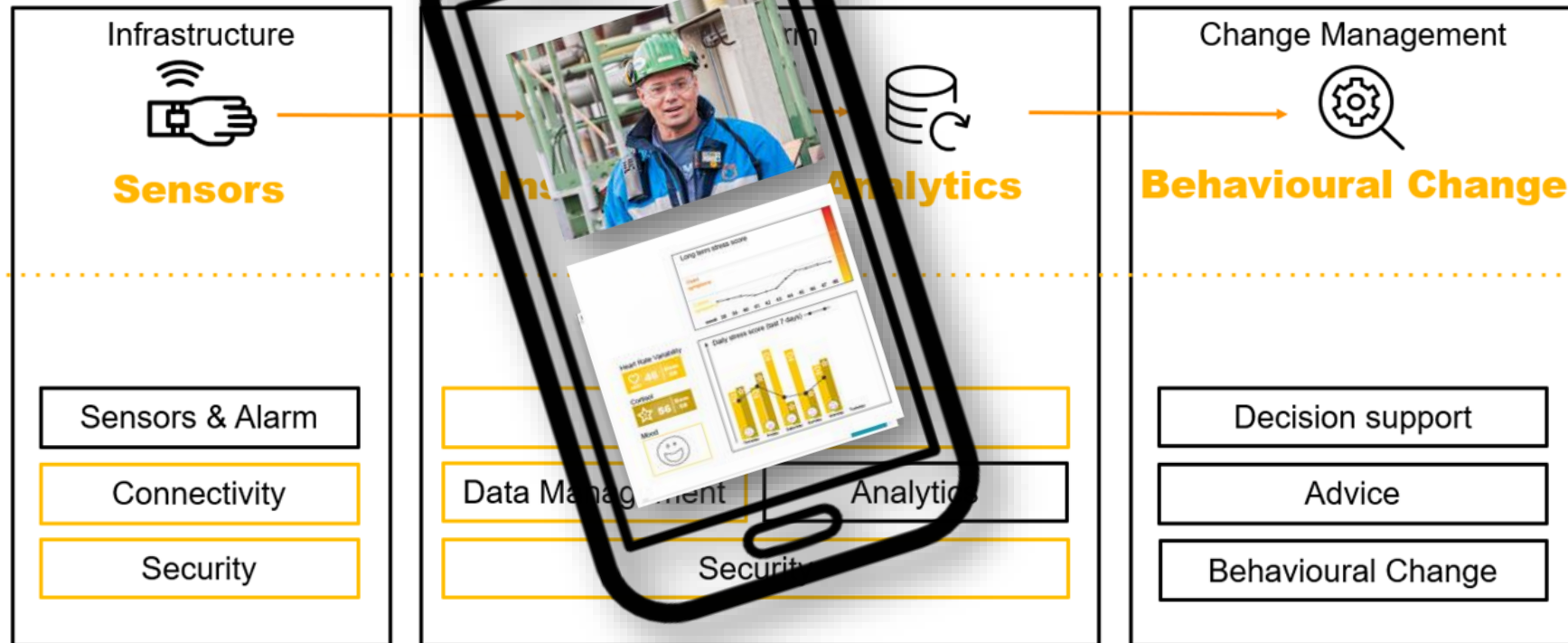
FIELD STUDY



OUR CAPABILITIES WILL DRIVE HEALTH & SAFETY IMPROVEMENT AND BUSINESS IMPACT

Capabilities

Deliverables



SAFE BY DESIGN



Ministerie van Infrastructuur
en Waterstaat



Centre for
Strategy & Evaluation
Services

wood.

The Netherlands, Ministry of Infrastructure and Water Management

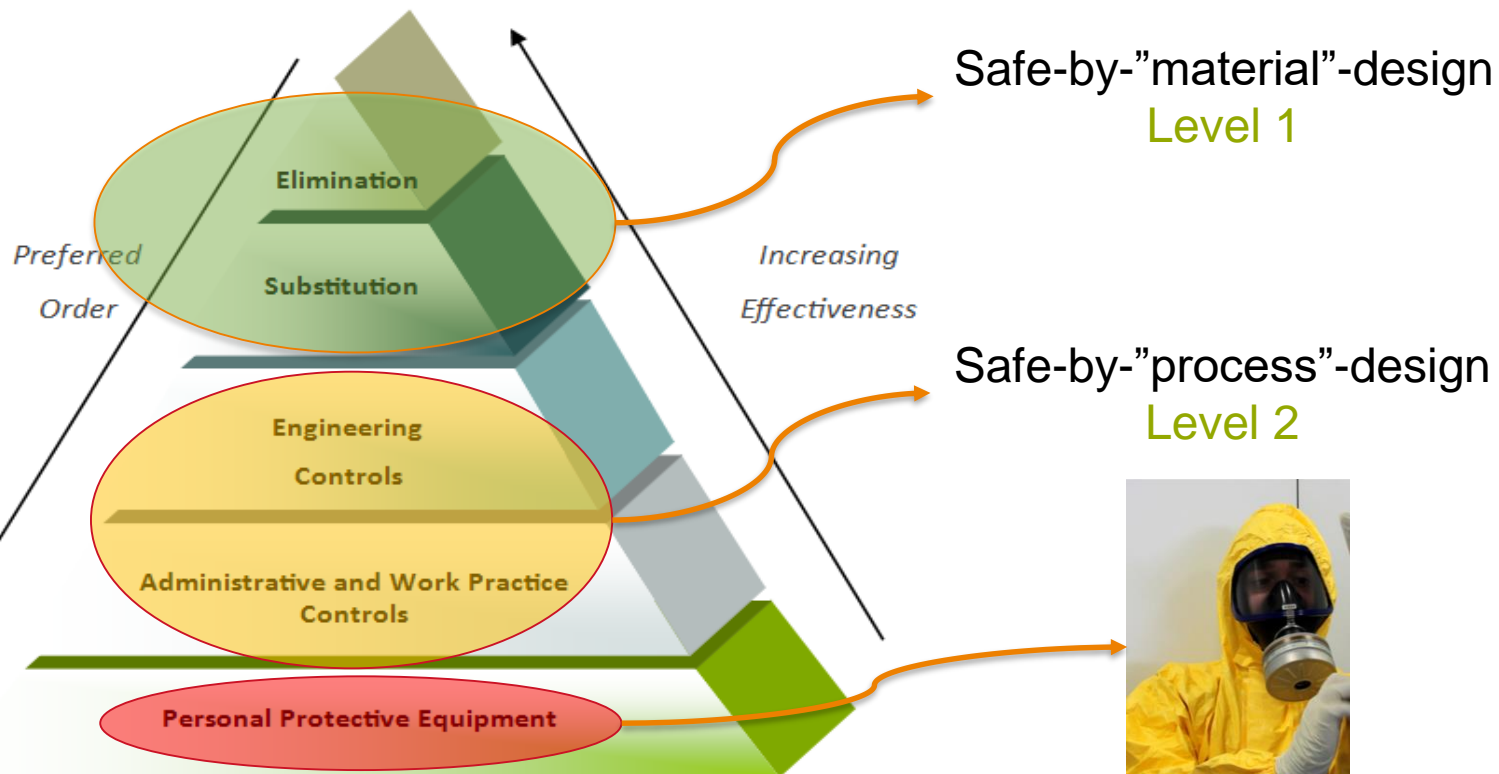
Safe Chemicals Innovation Agenda

Towards a Research Agenda for Safe Chemicals, Materials and Products

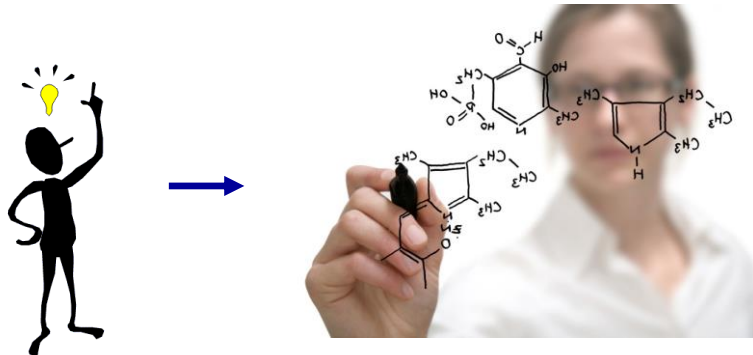
- Level 1: direct replacement of the substance of concern by a significantly different substance with comparable functionality, rather than drop-in replacement with a similar chemical. We refer to this as the **'molecular level'**.
- Level 2: replacement of the material that the substance of high concern 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 DESIGN LEVEL 1



Research & Development

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



Dossier preparation & Registration

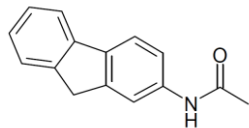
Information Requirements have to be fulfilled in order to realize Registration and marketing of the chemical.

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

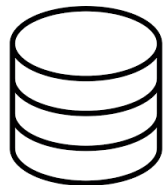
Apply Deep Learning & AI approaches

Integration of all data

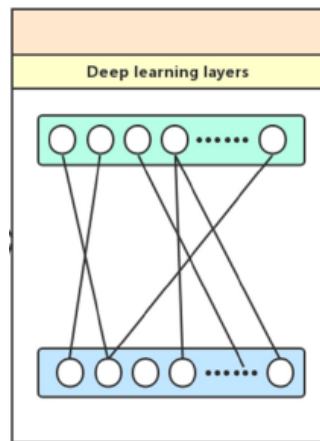
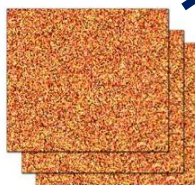
chemical
structure query
&
Biological data



chem/bio/tox
databases



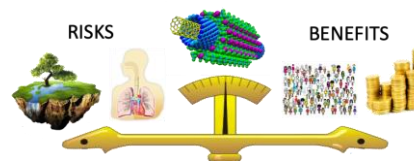
biological data
(gene expression,
in vitro assays)
GEO, CMap, CTD...)



machine learning

EUTOXRISK

Prediction safety
profile query



Experimental data

+

In silico tools

+

Read-across data

&

Expert judgement



In silico prediction
Safety Profile

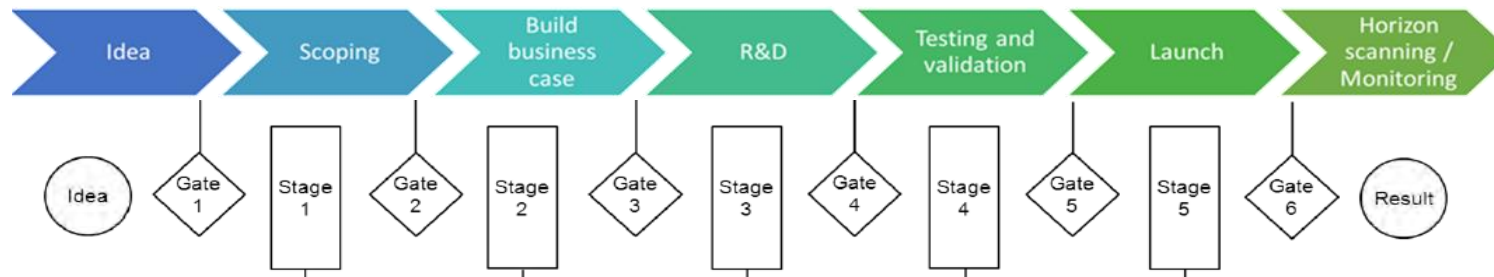


SAFE BY DESIGN LEVEL 1

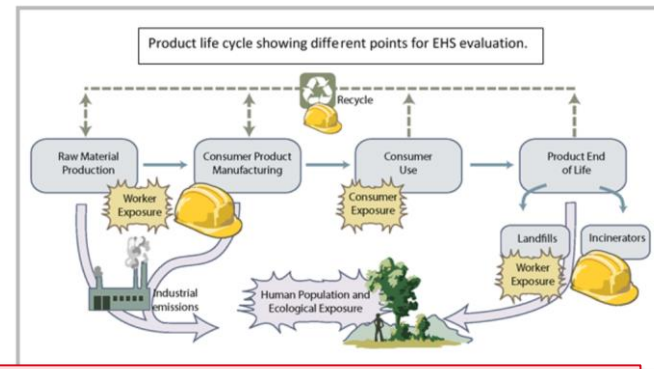
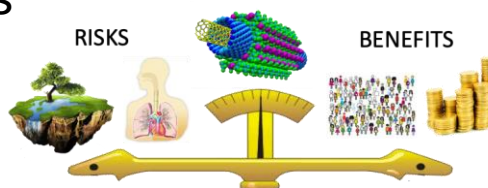
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NanoReg²

caLIBRAte
nano risk governance



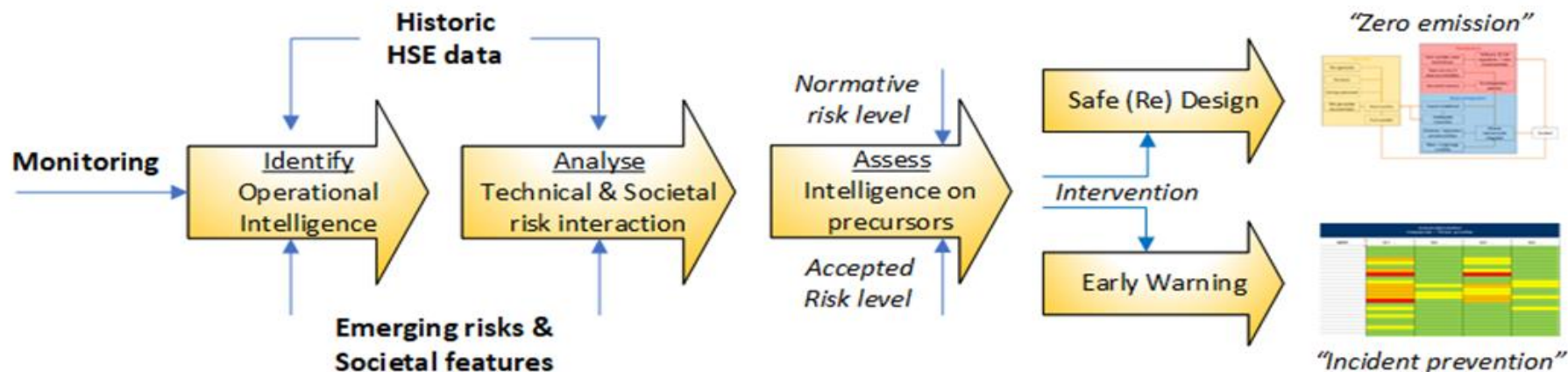
- Change in development is most cost efficient in early stages



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

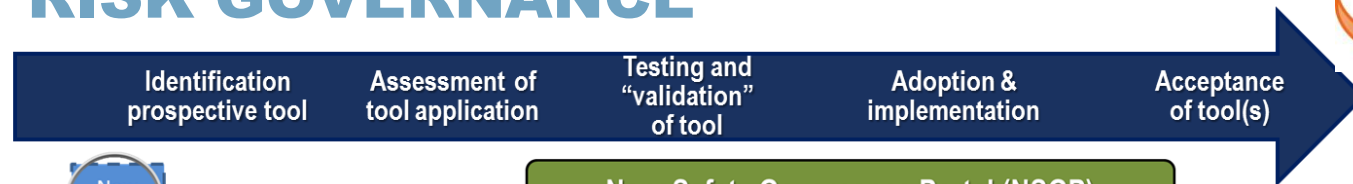
SAFE BY DESIGN LEVEL 2



STAKEHOLDER COMMUNICATION



RISK GOVERNANCE



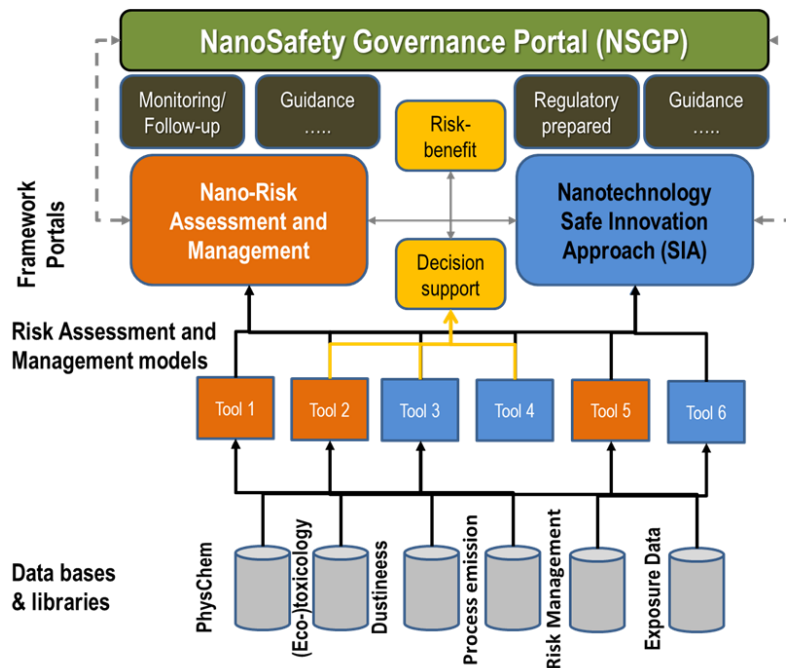
New Tool ?

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: NRG, industry, service providers, regulators, NGO's etc.



A long-exposure photograph of a city street at night. On the left is a multi-story brick building with many lit windows. On the right is a modern building with a curved facade and large glass windows, also lit up. In the foreground, a curved pedestrian bridge or walkway with a metal railing runs across the frame. Bright green light trails from a moving light source, possibly a bicycle or a small plane, arc across the upper right portion of the image. The overall scene is illuminated by city lights, creating a vibrant urban atmosphere.

› **THANK YOU FOR YOUR ATTENTION**

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Take a look:

TNO.NL/TNO-INSIGHTS

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