

# 10 Years of Nanosafety Training: from Basic Science to Risk Governance

Leveraging Interprofessional Education to the Study of Nanosafety: From Basic Science through Safe-by-Design and Nanomedicine to Risk Governance



**Fostering dialogue about risk assessment and management and safe-by-design of nano-(bio)materials through cross-cutting insights from nanosafety, nanomedicine and risk governance fields was the mission of the 10th Anniversary of the Venice NanoSafety Training School held online on 21-25 June 2021**

Jointly organized between seven EU funded H2020 research projects (BIORIMA, Gov4Nano, GRACIOUS, NanoInformaTIX, NANORIGO, PATROLS and RiskGONE) and following more than a decade of tradition, this year's Nanosafety Training School took place in an online setting. Unfortunately, because of the pandemic situation and the restriction of physical events, the nanosafety community couldn't meet as usual in beautiful Venice. Nevertheless, the 10th edition of this Nanosafety Training School was held successfully with more than 170 registrants from across the Globe. The programme included different sessions on each afternoon, with contributions from many experts with different scientific backgrounds presenting the latest results of EU's nanosafety research arena. The training started with two key note lectures on the Monday afternoon: **Georgios Katalagarianakis (former EU Commission)** talked about "Let's celebrate: Eleven years of the Venice Training School, sixteen years of European Nanosafety research. History, lessons learned and perspectives", while **Steffi Friedrichs (AcumenIST)** introduced "Concepts of sustainable Nanofabrication". After this inspiring start, several sessions were held during the week, combining lectures with interactive sessions.

## From Nanosafety to Nanomedicine: a 10-year Perspective

This session provided a perspective on nanosafety research conducted in the past decade and a view to the application of nanomaterials in medicine. **Bengt Fadeel (Karolinska Institutet)** has been involved in several EU-funded and national projects focused on nanosafety including MARINA and BIORIMA as well as the EU-funded Graphene Flagship. Special focus was put on lessons learned from these projects with emphasis on the synthetic and biological "identities" of nanomaterials and interactions of nanomaterials with biological systems.

## Hazard to Human Health & Environment

In this training, **Hedwig Braakhuis (RIVM)**, **Sabina Halappanavar (Health Canada)**, **Fiona Murphy (Heriot-Watt University)** and **Samantha Llewellyn (Swansea University)** presented the latest progress in nanomaterial hazard testing. This included the use of the Adverse Outcome Pathway (AOP) concept to unravel the mechanisms behind nanomaterial toxicity. In addition, the use of alternative methods was discussed.

## Fate & Exposure Assessment

This session focused on recent developments in the assessment of fate of exposure of nanomaterials. **Teresa Fernandes (Heriot-Watt University), Socorro Vazquez (LEITAT), Sam Harrison (UK Centre for Ecology & Hydrology)** and **Joris Quik (RIVM)** discussed how to use the basic information on nanomaterial exposure scenarios description to determine the likelihood & route of exposure, and how this information can be used in the assessment and management of exposure to nanomaterials. Next to that, information was provided on how to use models to perform nanomaterial environmental exposure assessment, explaining what these models are, what they include, why they are useful and the different levels of complexity, to make them more realistic and reflecting environmental reality. Participants were able to try some of the models, input some real data, and also analyze the results.

### RRI Roleplay Workshop: Safe-by-Design Sustainability Forum

**Sean Hardy** and **Raquel Bertoldo (Symlog)** held the First Annual Safe-by-Design Sustainability Forum. Since it's now common knowledge that nano-enabled products are important to realizing UN Sustainable Development Goals, the implementation of Safe-by-Design processes have been proposed as a method to achieve these goals. But what does Safe-by-Design mean in the field of nanotechnology? Is it already in practice or are we far away from it? What are its challenges? What does it imply for each stakeholder group? These questions and more served as basis of the session's interactive role-play workshop, which allowed participants to discuss and debate with their peers the various meanings of "Safe/r/ty-by-Design" from their own as well as stakeholders' perspectives.

### Similarity, grouping and read-across approaches

In this session, **Vicki Stone (Heriot-Watt University), Agnes Oomen (RIVM), Nina Jeliaskova (IdeaConsult)** and **Richard Cross (UK Centre for Ecology and Hydrology)** focused on:

- Grouping hypotheses, IATAs and the GRACIOUS Framework
- A quick introduction to Read Across in a regulatory setting
- How similar do nanoforms need to be to allow grouping and read-across
- Environmental case studies for similarity, grouping and read-across

### Risk Assessment & Management

**Alex Zabeo (Greendecision)** provided training in using the BIORIMA Decision Support System. This system employs advanced models to support the occupational, consumer and environmental risk assessment of nanomaterials and biomaterials along the lifecycle of nano-enabled consumer products and medical applications. In situations where the risks are not controlled, the system proposes suitable Risk Management Measures and provides information about the efficacy of these measures.

### Risk Governance

**Martin Himly, Sabine Hofer** and **Nobert Hofstaetter (University of Salzburg)**, as well as **Dmitri Ciornii (BAM)** and **Daan Schuurbijs (DPF)** built this session on the question "Risk assessment with social dimension: how does risk governance differ from risk assessment or management?"

The webinar started with a short *introduction to the program*, linking nanosafety data and knowledge readiness with the social dimension of risk governance, given by [Martin Himly](#), Chair of the [WG-A "Education, Training and Communication" of the NSC](#).

Next, [Sabine Hofer](#) introduced the process of risk governance, walking the attendees through the six individual steps for managing the life cycle of risk:

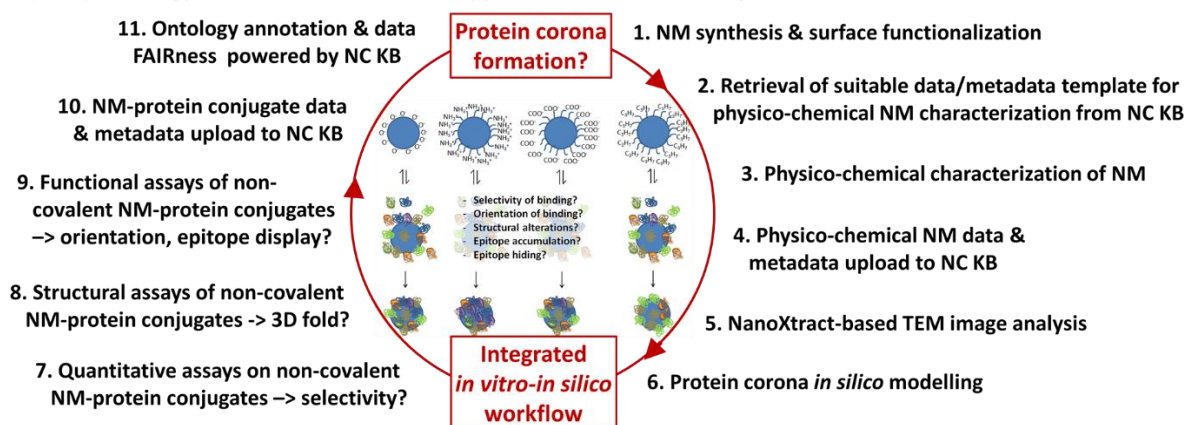
- i. pre-assessment, **to set the stage** for the risk governance process
- ii. scientific (technical) assessment, the **knowledge base synthesis** for subsequent steps
- iii. opinion, concern & risk perception assessment for **capturing public perception and concerns**

- iv. evaluation, a step where the **significance and acceptability of the risk is determined**
- v. risk management for the **treatment and regulation** of the risk
- vi. monitoring and feedback, which aims at the **adoption of measures until the end** of risk life cycle

This session was concluded by [Norbert Hofstaetter](#) with an interactive element raising awareness of the different angles that different stakeholder may approach a specific case in their individual risk perception. Guided by questions participants had the chance to identify in what sense risk governance differs from risk assessment and management.

The data block of the scientific/technical assessment (see above step ii) was introduced by [Martin Himly](#) covering topics such as FAIRness (*i.e.*, Findability, Accessibility, Interoperability, Reusability) of data, metadata completeness, and data shepherding, thereby highlighting the integration of experimental *in vitro* data with *in silico* modelling tools, facilitating enrichment and gap-filling of the still fragmented data landscape in nanosafety assessment. This workflow was depicted on a specific case of studying protein corona formation and its impact on human hazard assessment, displaying the features of the [NanoCommons Knowledge Base](#).

*The NanoCommons Knowledge Base (NC KB) integrates reliable experimental in vitro data on nanomaterials (NMs), ontology-annotated & metadata-supplemented, with in silico prediction tools*



Within this same thematic block [Dmitri Ciomii](#) further eluded on quality assurance of data, defined by the Knowledge Readiness Level (KaRL), which, in analogy to NASA's Technology Readiness Levels (TRLs), defines a categorization system of data, information, and knowledge which enables transformation of data and information into functional knowledge for nanorisk governance. In this sense it goes beyond the technical curation of data and metadata, as it further involves quality and completeness filters, regulatory compliance requirements, nanorisk-related tools, and most importantly, human input (inclusion of all stakeholder groups).

Next to that, different stakeholder views and how socioeconomic aspects can be incorporated into the risk governance process to warrant inclusiveness for different values into the risk/benefit estimation were discussed by [Daan Schuurbijs](#). After his input talk the session became more interactive by role playing through the case of E171 in food asking:

- shall we ban TiO<sub>2</sub> in food?
- if you were a policy maker how would you respond to NGOs / industry?

- how could we improve the governance process?

The webinar presentation slides and the recording (recorded for educational purposes) are available in the [NSC NanoHub](#), the [NanoCommons Infrastructure](#), at [Zenodo](#), the [NSC YouTube channel](#), and in the [NanoCommons' Elixir TeSS channel](#).

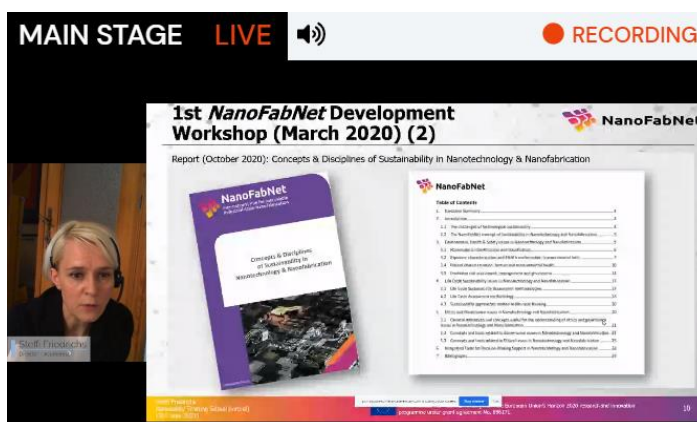
### Modelling

On the last training day, **Giulia Mancardi (Politecnico di Torino)**, **Vio Buchete (UCD)** and **Agur Sevink (Leiden University)** talked about upscale from classical Molecular Dynamics to Brownian Dynamic for nanoparticle clustering and aggregation, nanoparticle-protein docking as well as nanoparticle-membrane interactions.

Although we had to adapt to a fully online event, the Training School was a great success, huge thanks to all speakers and organizers that made it happen. The School's Organizing Team is already looking forward to the next edition of the Nanosafety Training School, hopefully as real physical event in Venice, Italy, in 2022.



→ Key Note 1



→ Key Note 2

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 **Nanosafety Training School**  
From Basic Science to Risk Governance of present & future Nanomaterials  
Interprofessional Education Training School



**Risk Governance – Risk assessment with social dimension** ★  
3:30pm – 5:00pm

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 **Nanosafety Training School**  
From Basic Science to Risk Governance of present & future Nanomaterials  
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**Risk Assessment & Management** ★  
1:00pm – 2:30pm

**MAIN STAGE**

**Similarity Assessment, Grouping & Read Across Approaches** ☆  
4:30pm - 6:00pm  
LIVE NOW

MAIN STAGE LIVE RECORDING

chromacam

**Danail Hristozov**  
Head Of Research - Greendecision S.r.l.

**Welcome & Keynote Session** ☆  
1:00pm - 2:30pm  
LIVE NOW 44

**Stella Stoycheva**  
Yordas Group

**Georgios Katalagarianakis**  
Expert - Independent

Audio/Video Issues? Raise Hand

**RRI Roleplay Workshop: Safe-by-Design Sustainability Forum** ☆  
2:00pm - 3:30pm  
LIVE NOW 20

MAIN STAGE LIVE RECORDING

**Sean Hardy**  
Research Assistant - Institut SynBio

**Raquel Bertolde**  
Research Fellow - Institut SynBio

**Jose Arturo Jimenez Chavez**  
Student

**RRI Roleplay Workshop: Safe-by-Design Sustainability Forum** ☆  
2:00pm - 3:30pm  
LIVE NOW 26

MAIN STAGE LIVE RECORDING

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Research Assistant - Institut SynBio

**Raquel Bertolde**  
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