EU US Roadmap Nanoinformatics 2030

The Policy
What it does

Provides a framework that will allow scientists to effectively research the environmental and health safety of nanomaterials.

Synopsis

On November 15, 2018, the European Nanosafety Cluster published the EU-US Nanoinformatics 2030 Roadmap [12]. The document is a joint effort of European and American scientists from multiple fields that comprise nanoinformatics. It lays out the challenges the scientific community needs to address in order to be able to efficiently research the environmental and health safety of nanotechnology [13].

To better understand the properties of nanomaterials (NM), it is essential to collect, store and analyze enormous amounts of data. Nanoinformatics [14], a relatively new research field, seeks to develop the tools and structures needed to solve the many inherent challenges of this process. First among the challenges is a lack of comprehensive databases and various restrictions to access them. Second, and perhaps more problematic, is the lack of regulatory requirements for data collection, standards, and definitions. To address these challenges, the scientific community needs a set of harmonized and interconnected databases that are built according to an accepted framework, the development of corresponding modeling and assessment techniques, and the creation of global collaboration channels.

The document introduces guidelines that help address some of the challenges described above. It offers a model for creating a set of structured databases for coordinated data collection. Those databases could then be used to model, predict and validate the properties of new materials and their possible hazards. These predictions and assessments would then be available to inform policy and support the development of appropriate regulatory action for the safety of the public and the protection of the environment.

Towards the safe use of nanotechnology, policymakers and researchers in related fields may consider how the guidelines described in this document apply to them and take part in the discussion this document raises.

Core Challenges

The roadmap describes several core design challenges that the nanoinformatics community should address towards better research of environment and health safety (EHS) of nanomaterials:

1. Data Collection and Curation. The research community requires a unified system for representation of materials and their properties. This system should consist of a federated and connected database, that is managed according to common curation processes. Files should be created according to unified templates and formats and through shared work procedures. Metadata should also be unified through common requirements and specifications. When describing materials, a unified ontology should be used. Lastly, sustainability measures should be enacted to allow access to data years after it was collected.

2. Statistical Modelling. Modern chemoinformatic [15] methods and materials modelling techniques should be adopted by groups involved in the nanoEHS research community in order to solve nanotechnology-related questions and assess the effects of exposure to these materials.

3. Properties, interactions and fate of NMs. A systematic evaluation of the NM descriptors could improve the
predictive models for nano EHS. The major challenge for such evaluations is the need for multiscale models, these models are an enormous task given current research resources. In addition, for some interactions the research community is still lacking the predictive models themselves.

**Solutions and Pilot Projects**

Over the last decade, most US-based nanoEHS research concentrated in centers at Duke University [16], UCLA [17], and Harvard [18]. EU-based research, on the other hand, was done through a collaboration of 30-70 different institutions, depending on the project. Examples of projects addressing the above challenges include OpenRiskNet [19], an online infrastructure to support risk analysis and NanoCommons [20], which is an online platform for the nanosafety research community.

In addition, the report lists of nano-specific databases, such as eNanoMapper [21], NanoHub [22] and DaNa [23]. Other projects, such as NanoPUZZLES [24], ModENPTox [25] and PreNanoTox [26], are examples of recent modelling projects at the EU. MARINA [27], NanoMILE [28] and NanoSolutions [29], among others, are examples of nanoEHS projects generating large-scale datasets. Following the perspectives and milestones described in the roadmap will allow the nanoEHS community to advance from the current stage of the research and address the challenges described earlier.

**Context**

A curated and aggregated database of information relevant to nanoEHS research would have important impacts on all the relevant stakeholders – academia, industry and regulatory agencies – along with the benefits of safer use of nanomaterials for the public and the environment.

Academic researchers working on nanoEHS related research will be the direct benefactors from the existence of high-quality data. With access to data, resources and funds directed to these research projects will be used in a more efficient way, and the speed in which researchers can react and respond to developments will be faster. More efficient research will then translate into more efficient support and relevancy to regulatory agencies.

As a result, it is in the interest of regulatory agencies to support these goals. These agencies should be the main consumers of the research output produced by the community. Given that regulation is usually a slow and painful process that requires coordination between many different agencies, having accurate and on-time research at hand would surely improve the regulatory outcomes.

The industry will also benefit from improved research. Better regulation and research output would help firms avoid using hazardous materials in their products and will direct them on the required safety measures for the protection of workers, consumers and the environment.
The Science

Science Synopsis

Nanotechnology [30] will have a major role in the next technological revolution. As our ability to modify and design structures at the nanoscale will improve, the potential applications of such technology will most likely transform many industries and economic sectors [31]. Yet, along with great potential, will come great risks. The widespread application of nanotechnology will have to be conducted responsibly. The study of the environmental and health safety of nanomaterials aims to address these issues exactly. Research in this area attempts to understand the toxicology and the possible outcomes of exposure to these new nanomaterials.

Concern about the safety of unknown materials and chemicals always existed along with the development of new technologies. In the past, the phase of progress generally allowed in many cases enough time to test the safety of those materials before approving their commercial use and delivery. Exceptions included cases like Asbestos [32], a mineral promoted for use in the construction industry and later discovered to be carcinogenic. In many other cases, researchers were able to protect the public safety and the environment from introduction of other hazardous materials.

Today, the development of nanomaterials is advancing rapidly. The phase of new structures being developed and suggested for various uses is much faster than the speed in which past discoveries and development were made. Adding to the challenge, even materials we already know might act differently at the nanoscale. Since the technology is advancing so fast, it is much more difficult to assess the safety of these new inventions. To address this, the scientific community needs to respond and adapt, and develop the infrastructure that will allow this type of research.

Scientific Assumptions

- Nanoscale materials might be harmful [33] to the environment and/or living beings.
- Nanoscale can be harmful even if the same material at the non-nano scale is not harmful. For example, recent studies show that silver nanoparticles behave very differently [34] compared to macroscale silver.
- Better information and modelling techniques are the best ways for researchers to assess the risk of nanomaterials. Methods for risk assessment are constantly evolving [35] to keep up with our understanding of the possible risks and concerns.
- With enough investment and planning, we could regulate the safe use of nanoscale materials. Along the years, some voices expressed the opposite – that nanotechnology and similar advancements should be put to a halt [36] to prevent a catastrophe.

The Debate

Scientific Controversies / Uncertainties
Two main scientific uncertainties dominate the discussion. On the one hand, nanotechnology and new materials have the potential to improve the lives of people and help society deal with a wide range of challenges in many different fields. On the other hand, it is not clear that using these new materials does not create new risks and challenges that would need to be addressed. The way forward is a balance between the optimists who believe in the opportunities NMs offer, and others who highlight our need to progress carefully.

Second, as much as acknowledging the risks is important, it is much more difficult to come up with solutions that would address these safety issues in a timely and sufficient manner. Measures and techniques to assess risk are evolving and changing along the development of the field, and decisions on resource allocation should be made carefully. Through collaboration and discussion, scientists believe they will be able to direct the limited resources that exist to the most promising efforts to protect the planet and society.

Status

At the time of preparation of this brief, the recommendations were not endorsed by the US or any of the EU governments. Several independent pilot projects are presented in the document.

Related Policies

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Recommended Citation


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