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Building expert consensus on problems of uncertainty and complexity in nanomaterial safety

ABSTRACT. A modified Delphi Method was used to determine the opinions of a range of experts from academia, industry and government in the field of nanotechnology, mainly those working in the areas of safety, occupational and environmental health, and nanotoxicology. The focus was on uncertainty and complexity. A questionnaire was prepared and the responses were collated and arranged by theme in a draft text. This text was then used in a second iteration for further comments both in a live plenary discussion at a nano-safety conference in Prague (November 2010) and subsequently electronically. A draft was prepared for final comments from a small panel before completion of the report. The participants identified the following ten priorities in the development of nano-safety: the need for realistic exposure scenarios, better established dose–response relationships, improved extrapolation from *in vitro* to *in vivo*, identification of the most relevant assessment parameters, understanding the dynamic biological interfaces, long term studies, information about stability and reactivity, understanding the behaviour of the protein corona, having test guidelines adapted to manufactured nanomaterials, and the development of more advanced statistical and computational methods. The discussions also investigated the basic nature of the uncertainties and how to distinguish between mere lack of data and intrinsic uncertainties that are a consequence of the complexity of living systems. The results of the consensual process are presented here, together with the identified priorities and some implications for strategy in nano-safety research and development.

Keywords: complexity, nanomaterial safety, scientific adequacy, uncertainty

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