Report Identifies Research Needed to Predict Nano-Biointeractions

A set of global research needs for creating computational models that can predict the interactions between engineered nanoparticles and biological systems was released in May by the International Council on Nanotechnology (ICON).

Unlike other reports on research needs for understanding the environmental health and safety and risks associated with engineered nanoparticles, the ICON report is narrowly focused on creating predictive models of nano-biointeractions, included a wide range of stakeholders in development, and is the product of an international team.

Because of those three reasons, said Andrew Maynard, Chief Science Advisor for the Project on Emerging Nanotechnologies, this is a very important document for the public domain and for informing the people making decisions about research priorities.

"Nanotechnology is one of those areas that has tremendous potential," said Maynard, "but I don't think that potential is going to be realized unless we understand how to use the technology safely and wisely."

The report presents the outcome of two workshops which brought together experts in biology, computational modeling, materials science, toxicology, and related fields and representatives from business, governments, academia, industry, non-governmental organizations, and 13 countries.

Participants were charged with developing a framework for predicting the interactions between engineered nanoparticles and organisms at the molecular level. Specifically, they focused on identifying the physicochemical properties of nanomaterials and establishing links between these properties and their biological impacts.

Participants in the first workshop identified research needs for classifying nanomaterials according to their common properties. Key findings include the need for tools that can describe the dynamic nature of nanomaterials, *in vitro* screening tools that correlate the functional properties of biomaterials with their potential for biological interaction, and exposure assessment studies to determine the extent to which a nanomaterial's physicochemical properties affect net dose interactions.

The second workshop focused on the research needs for predicting the outcomes of an interaction between a nanomaterial and an organism. Key findings include the need for models describing how a nanomaterial's physicochemical properties control the biological interactions at its surface, independent validation of dose and dose rates of nanomaterials, and the need for better biomarkers in addressing the variety of nanoparticles and the correlation between *in vitro* and *in vivo* data.

Participants in the two workshops identified a total of 26 research needs for predicting bio-interactions, ranging from establishing validated reference nanomaterials that have been tested *in vitro* and *in vivo* to designing frameworks for data sharing. The 26 needs are categorized within the following areas:

- nanomaterial characterization,
- standard terminology,
- standard reference nanomaterials,
- techniques for detecting nanomaterials in biological media,
- *in vivo* tests and correlation to *in vitro* tests,
- *in vitro* test validation, and
- model development.

In addition, participants identified six research needs for risk management, ranging from validating the effectiveness of personal protective equipment in limiting exposure to understanding the stability and mobility of nanomaterials in common liquid and solid matrices. The research needs are categorized within the following areas:

- metrology for risk management,
- assessment of bioavailability, and
- characterization of potential mobility of embedded nanomaterials.

While the research challenges are great, participants identified an even more fundamental challenge—agreement among researchers on common language and practices for characterizing engineered nanoparticles, in particular with respect to purity, biological endpoint assessment, and data-reporting structures. The need for standard reference materials and assays was a common theme throughout the discussions.

Producing predictive computational models will take time, according to Vicki Colvin, executive director of ICON. "But the systematic approach taken in these workshops, of breaking the big challenge into component areas, will provide a solid foundation for further research, enable risk management, and guide commercial development."

The report lays out the research needs in terms of two-, five-, and 10-year goals. While the timeline for accomplishing some of the research needs may be optimistic, said ICON Director Kristen Kulinowski, many participants recognize the urgency of the problem. There are already a large number of nanomaterials in commerce and in some cases the timeline refers to when participants think things ought to be done, she said.

The workshops-based report, *Towards Predicting Nano-Biointeractions: An International Assessment of Nanotechnology, Health and Safety Research*, is available on the ICON Web site, http://icon.rice.edu.

ICON is an international, multi-stakeholder organization that aims to develop and communicate information on the potential environmental and health risks of nanotechnology. Founded in 2004 at Rice University, it aims to maximize the societal benefit of nanotechnology and minimize the associated risk.

KENDRA RAND

EU Calls for Further Consolidation of European Research Area

Careers and mobility, international cooperation, research infrastructures, joint programming, and knowledge-sharing are main concerns for European research actors, according to a report published by the European Commission. The report draws on over 1000 responses to a public consultation on the Green Paper, "The European Research Area: New Perspectives," published in April 2007. The responses show strong support to further consolidate the European Research Area (ERA) through new and more ambitious actions at all levels in the European Union (EU)—regional, national, and transnational.

"The Seventh Framework Program 2007–2013 with a total budget of €54 billion for European research is now in full swing, but the public consultation shows this is not enough. Structural weaknesses prevent Europe from exploiting the full potential of its overall research capability and require further action either at national or European levels, or both. We must sustain our efforts to realize the European Research Area. At an informal meeting last week, research ministers reaffirmed the fundamental role of the ERA as an engine for driving the competitiveness of Europe. They also acknowledged that Europe now needs to develop a common vision and a better political governance of ERA," said the European Commissioner for Science and Research, Janez Potočnik.

In 2000, the EU called for realizing an ERA, creating a single area across Europe, and overcoming under-capacity, fragmentation, and lack of coordination between national and European research programs. Since then, the European research landscape has changed, with growing socioeconomic challenges and the impact of globalization on science and

technology (S&T) requiring research and development (R&D) policy responses.

The consultation results show that the original ERA objectives remain valid and relevant, but that action remains needed on the issues raised by the ERA Green Paper. Most respondents deem "sharing knowledge" and "developing world-class research infrastructures" most important, the former placed top by universities, research funding organizations, and non-governmental organizations, and the latter by industry and governmental bodies. "Researchers' career and mobility," "international cooperation," and "infrastructures" were identified as the three most important in terms of need for action at the EU level.

Respondents also draw attention to interactions between research, education, and innovation. Member States emphasize the need to consider the role of industry in the ERA and its links to wider innovation and education policy. Industry itself regrets that the Green Paper focused more on challenges to public research systems and not enough on the central roles of private R&D within the ERA and linkages between research and innovation.

Respondents endorse using a variety of instruments to promote ERA-financial incentives, increased EU budget, coordination, and guidelines. While there is little demand for binding legislation, there is support for considering legislative action to improve the careers and mobility of researchers, as well as for a new non-binding legal framework for pan-European research infrastructures.

Concerning publicly funded research, over 70% of respondents call for more open and easy access to scientific data and 84% call for more immediate, accessible, and wider dissemination of scientific publications. More than 80% of respondents support the idea of the EU and Member States collaborating to define common European research priorities to ensure coordinated, efficient, and coherent use of legal and financial instruments and resources.

Most respondents favor Europe adopting a more active approach to define the global S&T agenda internationally. Of the respondents, 75% expressed the wish that Europe should "speak with one voice" and 69% considered that this could be achieved through placing emphasis on a small number of high-priority research themes.

A dominant theme was the need for Member States to commit to a wide and ambitious ERA policy agenda, as a genuine ERA would only be fully realized through Member States, stakeholders, and the Commission working in partnership, with each accepting their responsibility to make it happen.

Five new specific initiatives, following directly from the consultation, will be launched in the coming months. These initiatives will address, in particular:

- the management of intellectual property by public research organizations (recommendation adopted on April 10, 2008),
- the promotion of mobility and careers of Europe's researchers,
- the legal framework for pan-European research infrastructures,
- joint programming and programs, and
- international science and technology cooperation.

India and EU to Strengthen Cooperation in Renewable Energy Research

India and the European Union (EU) have agreed to strengthen cooperation in the area of new and renewable energy on the basis of common interest and mutual benefit under the EU–India Science and Technology Cooperation Agreement. Both sides attach high priority to sustainable development of energy systems to jointly meet the challenges of energy security and climate change. At a workshop held at New Delhi, the two sides identified strategic areas and topics for research and technology development cooperation in solar photovoltaics, solar thermal power generation, wind energy, biomass, and waste-to-energy. Apart from these areas, the Indian side also expressed interest for cooperation in hydrogen, fuel cells, and biofuels.

Science and technology cooperation in the renewable energy sector would include joint studies and research; technology and product development; setting up of pilot demonstration units; capacity building covering testing, standards, best practices, exchange of information; and experts and training. Mechanisms and instruments for cooperation could include participation of India in the EU Framework Program, Technology Platforms for Renewable Energy, European Industrial Initiatives, and Specific International Cooperation Actions.

The Framework Programs are the main instrument of the European Commission for funding research. Energy, including renewable energy, is an important focus area. Under the Seventh Framework Program, which runs from 2007 to 2013, it has been decided to issue an India–EU call for research and technology development proposals in renewable energy in the areas identified at the workshop. Cooperation between research institutions in various EU countries and Indian research institutions would be on the basis of co-investment of resources.

The Indian Ministry of New and Renewable Energy organized the workshop in association with the Directorate General Research of the European Commission and the Department of Science and Technology. Scientists, experts, and delegates from leading institutions who are active in renewable energy research and technology development, apart from officials from both sides, attended the workshop.

Reforms in Research Work for Scientists and PhD Students in India

A task force under the chairship of M.M. Sharma was constituted by India's Central Government to strengthen basic science research at universities. The task force has recommended the creation of 1000 positions of research scientists at various levels, a five-fold increase in the number of PhD graduates from Indian universities within a span of 10 years with proper standards, the promotion of formal linkage between the universities and national level institutions including the CSIR laboratories through joint research projects and training, an inbuilt component of research in post-graduate programs pertaining to science and technology, an upgrade of infrastructural facilities in universities to promote quality scientific research, and the creation of networking centers in basic sciences in leading departments of universities to promote collaborative research. The government has accepted the recommendations, and the task force has been converted into an empowered committee to implement its recommendations. The University Grants Commission has included the proposals under its plan for allocation of funds. □