CIPAST
citizen participation in science and technology

Newsletter

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Nanotechnology and Society:
Where do we stand in the ladder of citizen participation?

by Nicolas Baya Laffite and Pierre-Benoît Joly, INRA/TSV, EHESS/Centre Alexandre Koyré

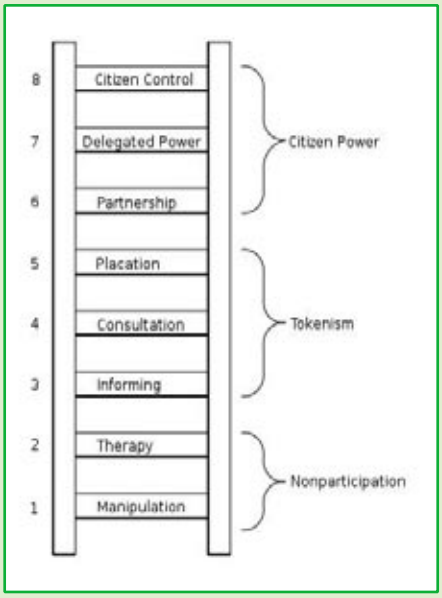
This special issue of the CIPAST newsletter was prepared by Nicolas Baya Laffite at INRA/TSV. It provides a summary of participatory processes in nanotechnology governance in countries where they have developed significantly as a result of political initiatives, namely in the United States, in the UK and in other Member States of the European Union. The newsletter draws on the CIPAST database, the 2007 final report of the Nanotechnology Engagement Group (NEG), and extensive internet research. Our first aim is to give access to data as complete as possible – although not exhaustive – on individual participatory experiences in nanotechnology. The gathering of this information allows to put these individual experiences into perspective and to open a discussion on the roles of public participation, so far in different national and regional political contexts. A table of contents can be found on page 3 of this newsletter.

Yours sincerely,
Norbert Steinhaus, Editor

In the aftermath of the GMO governance failure, the fast development of nanotechnologies has given rise to radically new public policies fostering upstream citizen participation in the debate about the governance of these emerging technologies. Aside from maintaining R&D excellence and industrial competitiveness, the need to organise public debates on risks or uncertainties, as well as on ethical and social aspects has emerged as a priority for nanotechnology governance. For the first time, we are witnessing a shared political will and commitment to develop and carry out a coherent strategy of formal and informal public debates and other kinds of participatory exercises. As a result, different forms of participatory experiences have taken place and a growing variety of publics have engaged in those debates. Built on the criticism of the «deficit model», upstream citizen participation in science and technology has thereby become, along with nanotechnologies, a master narrative of current public policies in many countries[2].

To select the individual experiences, we adopted a broad definition of participation. Following Sherry Arnstein we consider that public participation includes a variety of devices which differentiate on a «Ladder of Citizen Participation[1]»: from manipulation and therapy, through informing and consultation, to partnership, delegated power and citizen control (Cf. Figure below).

In principle, upstream citizen participation in science and technology implies mechanisms and processes to enable two-way exchanges between different publics and different powerholders about technology governance when its development is still in an early stage, with the aspiration of making sure that the goals of the techno-scientific enterprise are aligned with societal values. Nevertheless, in the various cases presented here, different actors foster different notions and expectations of what public engagement in nanotechnology implies. Hence, nanotechnology and citizenship emerge not as natural categories,



CIPAST Project Partners

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but rather as constructed through discourses and practices. In other words, «citizen participation in nanotechnology» cannot be but a specific situated construction.

Consequently, we look at a vast array of initiatives influenced by diverse political cultures, some of which involve a weak degree of engagement whereas others enable greater citizen empowerment when it comes to deciding on the present and future developments of nanotechnologies. As a result, out of the 70 initiatives identified, many of them rate rather low on Arnstein's ladder.

Even for experiences like citizen conferences or citizen juries – which were organised in quite a few countries – a common feature has to be highlighted. None of these experiences has genuinely questioned the legitimacy of the master narrative that goes alongside the development of nanotechnology. This should not be a surprise. As stated in most national initiatives for nanotechnology, the stated goal of participatory governance is to create a propitious environment for the successful development of nanotechnology; and not to give room to discuss the basic rationale of nanotechnology development. Conceived as an essential part of larger national nanoinitiatives, anticipatory nanotechnology governance is framed as «avoiding another GMO controversy». This logic of urgency creates tensions within the overall governance strategy and puts significant constraints on the effectiveness of the participatory processes. In such a context, the question of the impact of upstream citizen participation necessarily arises. How does the outcome of specific micro-level exercises affect, influence, impact or reflect on macro-level decisions? Which is the degree of non-mediated interaction between citizens and powerholders?

Furthermore, as some critics have noted, the idea of upstream public engagement itself is problematic since it supposes a linear conception of the innovation process, and its influence turns to be limited when the goal is the co-construction of innovations. Conversely, what has instead been suggested to be at stake is the degree of irreversibility of socio-technical networks as aligned by powerful actors involved in the development of nanotechnology. To this aim, the Dutch experience of constructive technology assessment on specific domains of application of nanotechnology is quite interesting.

Aside from the question of impact, there is a need to reflect on what is original about the participatory governance of nanotechnology. Certainly, the degree of reflexivity that characterises the whole movement is one of the novel elements that has to be underlined. For instance, the NEG project was establish to document the learning of the groundbreaking participatory experiences in the UK. As this initiative attests, there is an ongoing social learning process based on participatory experimentation that cannot be neglected or overlooked.

In keeping with reflections on societal aspects of nanotechnology, the integration of social sciences through public funding into the governance strategy, has proved both exciting and problematic; especially in view of the fact that social scientists move from a peripheral critical position to the role of policy advisors or experts in social engineering.

Finally, it is no less remarkable that governments have turned not only to consultants but also to diverse institutional players such as universities and academic institutions, R&D agencies, science communication companies, ONGs, and science centres and museums in order to enact, through funding, national participatory initiatives.

In sum, by outlining the activities, CIPAST would like to encourage critical reflection on the ongoing implementation of public participation and to consider where we stand in the ladder of citizen participation. We thus claim that capitalising on individual experiences and fostering the debate on these initiatives is instrumental to achieve genuine citizen empowerment and effective democratic governance of nanotechnology in society.

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[1] http://lithgow-schmidt.dk/sherry-arnstein/ladder-of-citizen-participation.pdf
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CIPAST Newsletter Special Issue Nanotechnologies, March 2008, edited by Norbert Steinhaus, Wissenschaftsladen Bonn e.V., Buschstr. 85 - D-53113 Bonn, Tel + (49) 228 201 61 22, norbert.steinhaus@wilabonn.de. The views expressed in the notes, messages and links are those of the authors and owners of the website and are not necessarily endorsed by the publisher. Whilst every care has been taken, the publisher does not accept any liability for errors that may have occurred. You can subcribe for this newsletter online at www.cipast.org/cipast.php?section=5021. You can find the archive of the newsletter at the CIPAST website at Forum/newsletter/archive.

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United Kingdom

The Nanotechnology and Nanoscience Study: A new Chapter in the Relationship between Science, Technology and Society.

In summer 2003, the UK Government commissioned the Royal Society[1] (RS) and the Royal Academy of Engineering[2] (RAE) to carry out an independent study of N&N developments and whether these raise or are likely to raise new ethical, health and safety or social issues which are not covered by current regulation. At the launch of the Nanotechnology and Nanoscience Study[3] an initial call for views was issued. This has been followed by a number of oral evidence[4] sessions and workshops.

Briefly, two citizens workshops were held in London and Birmingham with around 25 participants. Given the participants' lack of information regarding nanotechnologies, basic information was provided during all discussions. There were two types of reaction towards nanotechnologies: on the one hand, worries about impacts on society and privacy, as well as about efficiency in particular in health; on the other, hopes regarding medical applications, potential impact on humanity, and improvement of life conditions were used by the Working Group to further define the terms of reference, aswel as to shape and inform the study.

As part of the study, the market research company BMRB[5] was commissioned to carry out independent research into public attitudes towards nanotechnology. Their research involved two in-depth workshops with members of the public, which were held in December 2003. The aim of these was to explore participants' ideas about nanotechnology, and to identify and discuss any potential concerns or questions. Three questions, designed to establish public awareness of nanotechnology, were included in an omnibus survey in early January 2004. The survey sought the views of 1000 adults in Great Britain. BMRB's results and analysis of the market research can be found in the report Nanotechnology: Views From the General Public[6]

The study supplied the Government with a final report on nanotechnology and the health, safety, environmental, ethical and social issues that might arise from it. The publication in summer 2004 of the RS and RAE's final report «Nanotechnology and Nanoscience: opportunities and uncertainties[7]» opened a new chapter in the relationship between science, technology and society. The report assesses how this emerging field should be regulated as it develops, calling for public dialogue early in the development of nanotechnologies, thus making nanotechnologies a test case for new ideas about upstream engagement.

The UK government's response to the RS/RAE report endorsed the call for public dialogue as a central element in its goal of building a society that is confident about the governance of science and technology in the interests of securing a future for nanotechnologies. In summer 2005, the government published its Outline Programme for Public Engagement on Nanotechnologies[8] (OPPEN), which presented a series of public engagement projects in order to support the government in achieving a series of goals for public engagement in nanotechnologies. Through the Sciencewise[9] programme and the Copus Grant Schemes[10], the Government funded three public engagement groundbreaking public engagement projects on nanotechnologies: Small Talk[11]; Nanodialogues[12]; and the Nanotechnology Engagement Group[13] (NEG). Other non-government funded projects were listed as relevant to the programme's objectives: NanoJury UK[14]; Global Dialogue for Nanotechnologies and the Poor[15] (GNDP); Nanotechnologies, risk and sustainability; Nanologue[16]; Democs[17]; Institute of Nanotechnology[18]; and Nanoforum[19].

These initiatives that started in 2005 sought to open up discussions about future technological trajectories to public input, at a stage when the big decisions about funding priorities and regulation might be still up for grabs.

NanoJury UK: A Citizens' Jury on Nanotechnologies

NanoJury UK[20] was a citizens' jury on nanotechnologies, organized by the Cambridge University Nanoscience Centre,[21] Greenpeace UK[22], the newspaper The Guardian[23] as the media partner, and the Politics, Ethics and Life Science Research Centre[24] (PEALS) at Newcastle University. It ran for five weeks in June and July, 2005. It was meant as a contribution towards presenting a non-specialist perspective on nanotechnologies' dilemmas, as well as being an opportunity for citizens to have a voice on an issue that they had freely chosen.

The Nano Jury brought together twenty randomly chosen British citizens from different backgrounds, who met during five weeks and heard evidence about a wide range of possible futures and the role that nanotechnologies might play in them. In the fist eight sessions, the Jurors addressed a topic of their choice – «young people and exclusion» – before turning to nanotechnologies, in order accustom them selves to the procedure. In the next ten sessions, they were informed about nanotechnologies by a group of experts from different fields and heard several witnesses selected by an oversight panel and a science advisory panel. In the last sessions, they wrote recommendations[25] for the future development of nanotechologies, which were finally presented at an event in London in September 2005.

The project was funded by Cambridge University Interdisciplinary Research Collaboration[26] (IRC) in Nanotechnology, FRONTIERS[27] Network of Excellence,

Greenpeace UK[28], and PEALS[29]. An analysis of the NanoJury process made by Jasber Singh[30] and by Tom Wakeford et al.[31] at PEALS is available.

For further information contact Tom Wakeford[32] (PEALS)

Demos & Lancaster University : The Nanodialogues & Nanotechnology, Risk and Sustainability projects

The Demos[33] think tank and Lancaster University[34] organised two major projects on upstream public engagement with nanotechnologies: Nanotechnology, Risk and Sustainability and Nanodialogues.

Funded by the Economic and Social Research Council[35] (ESRC), Nanotechnology, Risk and Sustainability was a research and experimentation project focussed on how social and scientific visions influence science policy and research. The project ran from January 2004 to April 2006.

The project had five stages: a study of the biotechnology experience based on research and interviews with stakeholders; a study of the social assumptions embedded in nanotechnology R&D; five focus groups focused on how attitudes towards science and technology are formed, using concept boards that included definitions of nanotechnologies and a three contrasting future scenarios of nanotechnology developed by scientists and policy-makers in early stages of the project; an interactive workshop; and dissemination of the findings which were presented in the final report «Governing at the nanoscale[36]».

For further information on Nanotechnology, Risk and Sustainability contact Matthew Kearnes[37] (Durham University).

Under the Sciencewise[38] grant scheme, the Nanodialogues project consisted of a series of four experiments in new methods of upstream deliberative public dialogue, focusing on nanotechnologies. Between May 2005 and November 2006, the project explored whether the public can meaningfully inform decision-making processes related to emerging technologies in four different contexts.

Experiment one – «A People's inquiry on Nanotechnology and the Environment[39]» – was organised in collaboration with the Environment Agency and consisted of three deliberative focus groups with stakeholders and a group of 13 citizens, which focused on the use of nanoparticles to clean up chemically contaminated land.

Organised in collaboration with the Engineering and Physical Science Research Council[40] and with the Biotechnology and Biological Sciences Research Council[41], experiment two – «Engaging Research Councils[42]» – explored the role of public engagement in research-council decision-making through a deliberative three-day workshop that involved scientists, members of the public, and research-council staff to explore and discuss.

Experiment three – «Nanotechnology and Development[43]» – was organised in collaboration with Practical Action[44] from Zimbabwe and consisted of a three-day workshop, which involved policy-makers, politicians, and representatives from two communities, focussed on whether nanotechnologies can help achieve the millennium development goal of halving the number of people without access to clean water by 2015.

The last experiment – «Corporate Up-stream engagement» – consisted of a series of focus groups, which looked at the use of nanotechnologies in three kinds of consumer products: hair products, oral care, and food. In collaboration with Unilever research staff, Demos drew up several scenarios about these topics that were discussed in four focus groups. The pamphlet «Nanodialogues: Experiments in public engagement with science[45]» presents the findings of these experiments.

For further information on Nanodialogues contact Jack Stilgoe[46] (Demos)

Both projects used a deliberative focus-group approach, where public participants were given the opportunity to discuss and learn about nanotechnologies before meeting scientists and policy-makers. In each case, public participants had time to digest what they had learnt and do their own research. In the Nanotechnology, Risk, and Sustainability, the project organisers summarised in a project report the discussions that had taken place and released a short film from the final session. So as to give participants a degree of ownership of the process, Nanodialogues participants were asked to make recommendations for policy that summarise the views resulting from the discussions.

Small Talk: Supporting science communicators to facilitate dialogue about nanotechnologies

Funded by the Copus Grant Schemes[47] and partner organisations, Small Talk[48] was a programme of public debate activities on nanotechnology managed by ThinkLab[49], in collaboration with The British Association for the Advancement of Science[50], Ecsite-UK[51], the Royal Institution[52], and the Cheltenham Science Festival[53]. It ran between September 2004 and November 2006 with the purpose of supporting science communicators to facilitate dialogue about nanotechnologies between members of the public and scientists.

This collaborative project included 20 different types of participatory events attended by 1200 participants.

Events used a mixture of deliberative methods alongside more traditional science-communications approaches like panel debates with questions and answers in the end. In the end, participants were not asked to produce formal recommendations for policy, but to write on a postcard what they wanted to say to the science minister and a scientist about nanotechnologies. The projects final report[54] presents the findings of the project for both science communicators and policymakers.
For further information contact Melanie Smallman[55] (Think Lab)

DEMOCS (DEliberative Meetings Of CitizenS) & Citizen Science @ Bristol: Enabling people to engage with nanotechnologies

The Wellcome Trust[56] funded two related projects: Democs[57] and Citizen Science @ Bristol[58].

Democs was a three-year tool development project focused on promotion of games on scientific issues led by the New Economics Foundation[59] (NEF) with co-funded by The Wellcome Trust and The EU 6th Framework Programme[60]. The project produced the Democs Card game, conceived to enable small groups of people to engage with complex science policy issues, including nanotechnologies. A version on nanobiotechnologies is being developed as part of the European Nanobio-RAISE[61] project.

Participants are dealt a series of hands of cards to read, and are asked to pick the ones that they feel are most important for the discussion. Then they make clusters to represent key themes of their discussion. At the end of the game, participants state their preferred policy positions on a subject by choosing from four pre-developed policy positions or developing one of their own.

For further information contact Perry Walker[62] (NEF)

The Citizen Science @ Bristol[63] project, led by Bristol Science Centre[64] and the University of Bristol[65], was a three-year programme of activities seeking to engage young people in discussions about the role of science and technology in society, which ended in June 2006.

Two of these one-day events for young students focused on nanotechnologies. Using a mixed participative and science communication approach, Citizen Science @ Bristol included the Democs card game, on-line games and plenary sessions with questions and answers. In the end, students voted on areas of nanotechnology they would like to see funded and the degree of regulation they believed nanotechnologies should have so as to collate participants' views.

For further information on Citizen Science @ Bristol contact Alex Garlick[66] (@ Bristol)

Nanotechnology Engagement Group (NEG): Understanding public engagement with nanotechnologies

The Nanotechnology Engagement Group[67] (NEG) was convened by Involve[68] – a not-for-profit organisation specialising in understanding public engagement in 2005 with the collaboration of the UK Office of Science and Innovation (OSI) and the Universities of Cambridge and Sheffield, to document the learning from six UK public engagement projects on the development and governance of nanotechnologies: NanoJury UK, Small Talk, Nanodialogues, Nanotechnology, Risk and Sustainability, Citizen Science @ Bristol, and Democs.

The objective was, first, to study the stakeholders' expectations of public engagement in these projects, second, to identify the lessons learned from other engagement activities and, third, to analyse how these relate back to the range of new engagement activities undertaken. The learning was communicated to the government, stakeholders, and the wider public.

The NEG conducted a two-year programme of activities that included: desk research, interviews, meetings with group members, and a workshop for scientists, project organisers, public participants, NGOs, and policy-makers held in June, 2006.

The 2007 NEG final report «Democratic Technologies?[69]» presents the findings of this programme of activities and summarises the latest experiences of public engagement on nanotechnologies that have taken place in the UK and in other countries.

Endnotes

[1] http://royalsociety.org/
[2] http://www.raeng.org.uk/
[3] http://www.nanotec.org.uk/index.htm
[4] http://www.nanotec.org.uk/evidence.htm
[5] http://www.bmrb.co.uk/
[6] http://www.nanotec.org.uk/Market Research.pdf
[7] http://www.nanotec.org.uk/finalReport.htm
[8] http://www.berr.gov.uk/files/file27705.pdf
[9] http://www.sciencewise.org.uk/
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[11] http://www.smalltalk.org.uk/
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[13] http://www.involve.org.uk/neg
[14] http://www.nanojury.org.uk
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[31] http://www.nanojury.org.uk/pdfs/nanojury_is_out.pdf
[32] mailto:peals@newcastle.ac.uk
[33] http://www.demos.co.uk/
[34] http://www.lancs.ac.uk/
[35] http://www.esrc.ac.uk/ESRCInfoCentre/index.aspx
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[38] http://www.sciencewise.org.uk/
[39] http://publications.environment-agency.gov.uk/pdf/SCHO0607BMUJ-e-e.pdf
[40] http://www.epsrc.ac.uk/PublicEngagement/Nanotechnology/default.htm
[41] http://www.bbsrc.ac.uk/society/dialogue/index.html
[42] http://www.epsrc.ac.uk/CMSWeb/Downloads/Other/NanodialogueEngagingResearchCouncilsReport.pdf
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[46] mailto:jack@demos.co.uk
[47] http://www.copus.org.uk/
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[55] mailto:melaniesmallman@think-lab.co.uk
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[61] http://nanobio-raise.org/
[62] mailto:perry.walker@neweconomics.org
[63] http://www.at-bristol.org.uk/cz/Default.htm
[64] http://www.at-bristol.org.uk/
[65] http://www.bris.ac.uk/
[66] mailto:alex.garlick@at-bristol.org.uk
[67] http://www.involve.org.uk/neg
[68] http://www.involve.org.uk/
[69] http://83.223.102.125/involvenew/mt/archives/blog_37/Democratic Technologies.pdf

The European Union

The European Strategy for Nanotechnology Governance: Fostering dialogue with society to avoid negative societal impact

As an acknowledged consequence of large-scale technoscience controversies, European Union institutions have become actively receptive to public engagement with science and technology. Anticipated as the possible key for a next industrial revolution, nanotechnologies have been high on the European political agenda, namely since the EuroNanoForum 2003[1], that took place in Trieste, Italy, and during which the concept of an «integrated and responsible» approach to nanotechnology was conceived.

This was followed by the publication of the Communication «Towards a European strategy for nanotechnology[2]» in May 2004, which was adopted by the Commission with the objective to develop an «integrated and responsible» strategy for nanoscience and nanotechnology with the goal to keep Europe at the forefront in this increasingly competitive field. Therefore, societal issues likely to arise, should be urgently anticipated, so as to avoid repeating the failure witnessed in biotechnology governance. The Communication gives particular importance to addressing health, safety and environmental concerns through open dialogue with society, in keeping with the objectives and principles set by European Commission's White Paper on European Governance[3], i.e. those of openness, participation, accountability, effectiveness and coherence. Furthermore, the European strategy for nanotechnologies is strongly aligned with both the development of the European Research Area (ERA)[4] as a key component of the Lisbon objective[5] of making the European Union the world's most competitive and dynamic knowledge-based economy, and the 2001 Science and Society Action Plan[6]. At the same time, with the publication of the Communication «Science and technology, the key to Europe's future - Guidelines for future European Union policy to support research[7]», the debate about the 7th European Research Framework Programme[8] (2007-2010) began.

Following the general principles and standards for consultation of interested parties set by the 2002 Communication «Towards a reinforced culture of consultation and dialogue[9]», the European Commission launched a wide public consultation[10] on the future of nanotechnology in Europe. Stakeholders were invited to provide their opinion on the Commission's proposed strategy for nanotechnology via an extensive open online consultation on the Nanoforum[11] website between August and October 2004. Over 700 responses from researchers, company managers, experts, consultants and journalists were received supporting the elements of the Commission's proposal. The Nanoforum report «Out-

come of the Open Consultation on the European Strategy for Nanotechnology[12]» provides a detailed analysis of community opinion on EU policies with respect to funding, infrastructure, R&D and societal concerns in nanotechnologies.

Taking into account the outcomes of the above-mentioned consultation, the European Commission subsequently adopted in June 2005, the Action Plan «Nanosciences and nanotechnologies: An action plan for Europe 2005-2009[13]», which defines a series of articulated and interconnected actions for the immediate implementation of a «safe, integrated and responsible strategy for nanosciences and nanotechnologies». The plan, like the proposed strategy, encourages to openly acknowledge and investigate the inherent risk that nanotechnology brings alongside progress and benefits for society.

Objectives of the plan included to ensure the integration of ethical concerns, innovation research and social sciences into N&N R&D, as key-means to help build confidence in decision-making related to the governance of nanotechnologies; to support studies and foresight activities into future nanotechnology scenarios so to provide useful information about the possible risks to society; and to create the conditions for and pursue a true dialogue with the stakeholders concerning N&N. In support of this dialogue, special Eurobarometer[14] (EB) surveys were launched to study the awareness of and attitudes towards nanotechnologies across Member States.

The Commission called upon the Member States to further develop a regular dialogue on N&N with the public and to address both real and perceived expectations and concerns «so as to steer developments on a path that avoids negative societal impact».

The European Commission plays an important role in the development of nanosciences and nanotechnologies, not only as policy maker but also as funding body for research and innovation. With particular emphasis on coordination of policies, programmes and projects, the European Commission provided through its 6th Research Framework Programme (FP6, 2002-2006) [15] funding of almost EUR 1.4 billion to more than 550 projects in N&N, thus becoming the largest public funding investor worldwide. Some EUR 28 million from FP5 and FP6 has been dedicated to projects expressly focused on environmental and health aspects of N&N. Such research will significantly increase in FP7, both in size and scope, subject to absorption capacity. Relevant topics, selected after a public consultation in 2006, were included in the first calls.

Among the initiatives in nanotechnologies and Society, the Commission funded a series of major projects on societal issues of nanotechnologies based on different science communication and deliberative participatory approaches, which are detailed below.

Potential ethical issues were examined for all R&D projects considered under FP6, with ethical reviews carried out where appropriate. This practice will continue in FP7. The European Group on Ethics in Science and New Technologies (EGE)[16], an advisory body to the EC President, delivered an opinion on nanomedicine[17] in January 2007, which places emphasis on conducting research both into the safety and the ethical, legal and societal aspects of nanomedicine.

Progress in nearly all areas of the Action Plan, has been the object the Communication «Nanosciences and Nanotechnologies: an action plan for Europe 2005-2009. First Implementation Report 2005-2007[18] «, adopted by the Commission in September 2007. Under the 7th European Research Framework Programme[19] (2007-2010) (FP7), EC funding for N&N will to increase significantly thanks to increases in the «Cooperation» specific programme and the significant reinforcement of «bottom-up» actions. Additional funding may come from the cross-thematic approaches developed in FP7, as nano-, bio- and information technologies have an interdisciplinary character and can

contribute to different industrial sectors and policy objectives. The first calls for proposals under FP7, published in December 2006, included almost 60 calls and topics directly relevant to N&N, in the broad areas of nanosciences, technology development, impact assessment, societal issues, nanomaterials, nanoelectronics, nanomedicine, as well as training and European Research Council[20] (ERC) grants.

For further information, two web sites, the EU Nanotechnology[21] site and the NanoForum[22] are a useful resource.

EuroNanoForum 2003: Examining the state-of-the art to overcome the barriers

EuroNanoForum 2003[23] was organised by the Industrial Technologies Directorate of the European Commission's Research DG in the framework of the Italian Presidency of the European Union, in Trieste, Italy, from 9 to 12 December 2003 to encourage expansion of nanotechnologies in Europe. The Forum focused on examining the present situation of the development of nanosciences and nanotechnologies in Europe. This was done in the context of the international state of the art, and in line with the objectives of the European Research Area[24], and the integrating character of the 6th Research Framework Programme[25].

The Forum's programme was structured to address the main obstacles towards the expansion and reinforcement of nanosciences in general, and to the development and use of nanotechnology-based products and services. A particular emphasis was put to the analysis of their potential applications and the possible risks. Experts and social scientist, including STS scholar Prof. Bryan Wynne from Lancaster University in the UK, examined the barriers to public acceptance of nanotechnologies. The Forum gathered key players and specialists in research, educa-

tion, industry, finance, social sciences, journalism and public administration, with the participation of many top-level scientists and stakeholders. Participants were given the possibility to exchange ideas and opinions, listen to leaders from industry, academia and public administration, build up new research strategies and collaborations in the many research directions offered by nanotechnologies. The outcome of the Forum enabled the Commission to define, at the beginning of 2004, the key elements for a common strategy for the future of nanotechnologies research in an enlarged Europe supported by a strengthened international co-operation.

Nanotech for the Young: Raising awareness about nanotechnology among university and high school students

In parallel with EuroNanoForum 2003 and in the framework of the «NanoTechYoung» scientific exhibition, «Nanotech for the Young[26]» was an open doors session which took place on December 10th 2003, with the objective of raising awareness about nanotechnology among university and high school students. The event was attended by scholars from the last year classes of secondary schools of the Friuli Venezia Giulia Region. In particular, Young PhD students coming from the local universities and experts in nanotechnology who attended and participated in the Forum were available to illustrate to organised groups of young students the science and applications behind nanotechnology.

«NanoTechYoung» was a nanotechnology scientific exhibition and a series of workshops for the youth, held in the city of Trieste between 18th November and 5th December 2003. The exhibition combined visual material (posters, nanomaterials samples, scientific instrumentation, artistic elaborations of scientific pictures and animated videos, films), interactive instruments (microscopes with sample materials, PCs with interactive software) and daily oral presentations by young scientists from the several local Institutions active in the nanotech field.

NanoForum: A comprehensive source of information on nanotechnologies

Nanoforum[27] is a pan-European nanotechnology network funded by the European Union under the Fifth Framework Programme (FP5) to provide information on European nanotechnology efforts and support to the European nanotechnology community. The NanoForum development project ran from July 2002 to July 2007 under the coordination of the Institute of Nanotechnology[28] in the UK and several European project partners. This thematic network provides a comprehensive source of information on all areas of Nanotechnology to the business, the scientific and social communities. The main vehicle for the thematic network is its website[29]. Nanoforum encompasses partners from different disciplines, bring together existing national and regional networks, share best practice on dissemination national, EU-wide and Venture Capital funding to boost SME creation, provide a means for the EU to interface with networks, stimulate nanotechnology initiatives in European underdeveloped countries, stimulate young scientists, publicizes good research and form a network of knowledge and expertise.

EuroNanoForum 2005: Nanotechnology and the health of the EU citizen

Built on the success of EuroNanoForum2003, the EuroNanoForum2005[30] conference was organised by the Institute of Nanotechnology, in Edinburgh from 5th to 9th September 2005. This EU-funded conference promoted developments in nanotechnology that are leading to innovative solutions for health and healthcare in Europe as part of an integrated and responsible approach.

The format was a combination of workshops-on-demand, public debate, forums, and conference showing the state-of-the-art. EuroNanoForum2005 attracted over 1100 participants, with 92 experts from 30 countries speaking over the 5 days. The poster sessions at the conference were performed by the 90 most promising scientists, researchers and students in Europe. These sessions offered attendees a fascinating glimpse of what the future might hold for nanomedicine.

All Scottish schools were invited to send a delegation of 15-16 year old pupils interested in a career in science, together with their teachers. The event was over an afternoon starting with an actor describing life in 2020, talks by invited speakers, and a special tour of the exhibition.

The European Technology Platform NanoMedicine: Nanotechnology for Health [31]was launched during EuroNanoForum2005 by the presentation of the NanoMedicine Vision Paper[32] on 6th September 2005.

Nanologue: An Europe-wide dialogue concerning ethical, legal and social aspects (ELSA) of nanotechnologies

In February 2005, the EU launched the Nanologue[33], a 21-month project in order to establish a common understanding concerning ethical, legal and social aspects (ELSA) of nanotechnology applications, and to facilitate a Europe-wide dialogue among science, business and civil society.

Led by the Wuppertal Institute in Germany, Forum for the Future in the UK, EMPA – the Swiss Federal Laboratories for Materials Testing and Research –, and the pan-European Triple Innova, this research, consultation and dialogue project was developed in three phases. First, a

mapping study[34] identified three specific nanotechnology application areas – energy storage, food packaging, and medical diagnostics – as well as a core set of seven ethical, legal and social aspects as objects for the course of the project: environmental performance, human health, privacy, access, acceptance, liability and regulation.

Second, an opinion study[35] showed two major findings out of the dialogue among business, scientists and project involved civil-society organisations. In first place, even if there is awareness both in science community and in civil society organisations about the need to consider the ethical, social and legal implications of N&N applications, the nature of these are clearer among scientist than among representatives from civil society. Second, representatives of civil society organisations agreed that civil society should influence aspects of N&N affecting human health and the environment, but there was no agreement about whether civil society should seek to influence issues of access, liability, regulation and control.

Finally, a scenario foresight exercise[36] presented three scenarios on how N&N will have developed by 2015: first, a «Disaster Recovery» scenario in which a lack of regulation results in a major accident making public concern about nanotechnology become high and technology development slow and cautious; second, a «Now We're Talking» scenario in which strong regulation and accountability systems are in place resulting in a technology which has been shaped by societal needs and strong health and safety concerns; and finally a «Powering Ahead» scenario in which scientific progress has been faster than expected and nanotechnology is making a real impact, particularly in energy conversion and storage.

In addition to these major results, the project created the NanoMeter[37], an internet-based tool to assess societal implications of nanotechnology.

The pooling, the scenarios, and the on-line tool are the project contributions to facilitate to translate the ongoing discussion into action and thus conduct to a sustainable and successful future of nanotechnology.

NanoDialogue: A framework of basic channels for social debate on nanotechnologies

From February 2005 to March 2007 the EU project NanoDialogue[38] developed, under the coordination of Città della Scienza in Naples, a framework of basic channels for communication and social debate on N&N at the European level. The project aimed to raise awareness on the latest research developments in the N&N field to the general public, while engaging researchers, civil society and citizens in a social dialogue on the societal implications of nanotechnologies and their related sciences. This dialogue helped the project to identify the main ethical, legal and social issues and preoccupations of these groups concerning nanotechnologies. The Consortium included eight science centres around Europe as well as Ecsite[39], the European Network of Science Centres and Museums coordinator of the exhibitions and the Centre for Studies on Democracy at the University of Westminster.

NanoDialogue began with a scenario workshop, held in June 2005, based on the 'exhibition game' methodology, to design the content of the project's communication instruments, namely seven interactive exhibition modules including hands-on exhibits multimedia and educational products on N&N, and a website for disseminating information and for collecting feedback. The exhibition modules were shown in the eight participating countries over the course of at least six months, starting in February 2006.

Simultaneously, a series of locally organised events, science demonstrations and debates were organised to further engage citizens.

Feedback collected at the exhibitions and workshops, and via three focus groups, were analysed and presented as a set of recommendations at the end of the project and at a final conference at the European Parliament in Brussels. The next day, the Commission held a workshop to discuss the findings. At the end project, in February 2007, the exhibition modules were shown in the participating countries, namely Belgium, Estonia, France, Germany, Portugal, Spain and Sweden.

NanoBio-RAISE: Nanobiotechnology - Responsible Action on Issues in Society and Ethics

From November 2005 to November 2007, the EU ran an interdisciplinary ethics research and science communication project called «NanoBio-RAISE[40]». Under the coordination of Delft University of Technology[41] in the Netherlands, jointly with the European project partners[42], this Coordination Action project brought together the key relevant players in the field including committed ethicists, social scientists, nanobiotechnologists, communication specialists, SMEs and major companies using nanobiotechnology, with the overall aim to clarify and anticipate the societal and ethical issues likely to arise as nanobiotechnologies develop and to use the lessons from the European GM debate to respond pro-actively and responsibly to the probable public, media and political concerns.

The project's objectives were to horizon-scan for the developments likely to cause concern; to clarify the ethical issues involved, and recommend and carry out strategies for public communication to address the emerging questions; to take on board the experiences and lessons learned from the European GM debate of the last decade and apply them with this project to the nanobiotechnology discussions. The project incorporated the recommendations of the European Commission's Communication «Towards a European Strategy for

Nanotechnology» and the results of its current Nanoforum public consultation, which surveys European public opinion on these issues.

The project implemented these objectives by means of an expert working group, an on-line forum & bibliographic database, several horizon scanning workshops and public opinion focus group discussions including the Democs card game, ethics & public communication courses for nanobiotechnologists, briefing papers for specific audiences, ethics lecturers, professional public relations and website support to foreseen Nanotechnology Action Plan & FP7 Technology Platform activities

Within this project, the Swedish KTH ran in 2006 a series of public opinion focus groups in four different European locations using a Convergence Seminar model of engagement, which has been developed at the Royal Institute of Technology from Stockholm to facilitate discussion and decision-making about emerging technologies. This was one of the first times that the method was used in practice. During the two and a half hour workshop sessions, 6 to 15 participants discussed, compared and assessed critically three scenarios of the future of nanobiotechnology and applications that represented diverging lines of development in terms of precaution and progress, and contained different ethical themes such as justice and distribution, privacy, health, and enhancement, which went from moderate use to more progressive use.

PATH – Participatory approaches in science and technology

In order to develop robust, transparent and effective policies new participatory structures for involving a wide range of actors and the public are urgently required. Under the coordination of the Socio-economic research programme[43] of the Macaulay Institute (SERG) in the UK, the EU FP6-funded PATH project aimed at forming a network bringing together academics, policy-makers and stakeholders to exchange knowledge and develop future directions for the involvement of society in the deliberation of science-based policy issues. From April 2004 to December 2006, the project focused on two persistent challenges: scale and representation. To date, participatory processes have largely been used at a local scale. However, many policy challenges are relevant to a regional or international scale and hence guidance on how participatory processes can be scaled-up is a pertinent issue. Of key concern in such processes is how best to represent a diverse and diffuse public as well as 'silent voices' (e.g. children, future generations). These two cross-cutting themes of representation and scale will be explored at a generic level, and via three case study areas, namely: genetically modified organisms (GMOs) in agriculture, biodiversity conservation and nanotechnology. An international workshop and an international conference on these themes aimed to integrate elements of best practice in science-based policy deliberation and sketch out future directions with regard to the three case study areas. Project outcomes were disseminated to academic and non-academic audiences through policy briefs, conference proceedings, journal articles, reports and the project website. Project partners were Lancaster University in the UK, The Danish Board of Technology, The Agricultural University Of Norway, Umweltforschungszentrum Leipzig-Halle and the Stuttgart University, Universitat Autonoma de Barcelona and Universita Degli Studi Di Roma.

DEEPEN: «Deepening Ethical Engagement and Participation in Emerging Nanotechnologies»

Launched in October 2006, DEEPEN[44] (Deepening Ethical Engagement and Participation in Emerging Nanotechnologies) is a three-year leading project for integrated understanding of the ethical challenges posed by emerging nanotechnologies in real world circumstances, and their implications for civil society, for governance, and for scientific practice. Led by the Institute for Hazard and Risk Research (IHRR) at Durham University, the project team includes researchers based at Darmstadt University of Technology (Germany), the Centre for Social Studies at the University of Coimbra (Portugal), and the University of Twente (Netherlands). The project purpose is to deepen ethical understanding of issues on emerging nanotechnologies through an interdisciplinary approach that uses insights from philosophy, ethics, and social science, as well as to instigate a programme of cross-European empirical research aimed at unravelling values that a diverse European public use to make sense of emerging nanotechnologies. The project aims to organise a series of deliberative forums in which citizens, stakeholders, experts, and decision-makers can develop convergent and divergent understandings of the social and ethical ramifications of nanotechnology and to develop recommendations for articulation and deliberation of ethical reflection in nanoscience practice and governance processes.

DEEPEN uses an interdisciplinary approach that combines approaches from philosophical and ethical appraisal, qualitative social science, public engagement, and deliberative methods. The project will be delivered through nine integrated work packages over four phases: surveying of ethical and societal issues of concern; integration; experiments in new deliberative processes; and Dissemination DEEPEN will focus on two specific domains of nanotechnology research and exploitation: nanosensors and nanomedicine.

DECIDE: «DEliberative CItizens' Debates» in European science centres and museums

Coordinated by At Bristol[45], the EU-FP6-funded project DECIDE[46] was developed between November 2004 and April 2006 with the overall objective to produce a tool to conduct and facilitate deliberative consultations and monitor the change of attitudes among the European public on contemporary Life Sciences in order to raise awareness and understanding of deliberative democracy methods. Based on the UK Democs activity of the New Economic Foundation, DECIDE produced a kit to facilitate structured debates on various current social and scientific controversial issues in science centres and museums across Europe. The PlayDecide kit - consists of a series of «cards» representing facts, issues, policies and scenarios that help participants to visualize the debate on a discussion board and reach consensus. Participants may add their own arguments as required. There is one specific «Decide on Nanotechnology[47]» kit available on-line. All materials were translated in the languages of the countries where the meetings took place. DECIDE directly engaged a very diverse audience of more than 2000 adult and young citizens in several countries via the European network of science museums and other institutions. All the products developed by DECIDE are available for free on the Internet site[48], together with the results of the meetings, the final report[49], and other valuable information about the project. Project partners included the Cite des Sciences et de l'Industrie[50] in France, Heureka[51] – the Finnish science centre, Ecsite[52] in Belgium, and Fondazione Idis - Citta Della Scienza[53] in Italy. During the whole 18-month project, DECIDE relied on an advisory board that included the New Economics Foundation[54] (NEF) in the UK and Observa - Science in Society[55] in Italy

Nano2Hybrids: A hybrid scientific research and scientific communication project

European scientific research is normally presented to the public after the project is complete. When clear post-hoc descriptions of the science are constructed, it can present a misleading impression of the process of scientific research, the methods and skills used by the researchers, and the levels of uncertainty involved. This makes debate of scientific subjects in the public arena difficult, and blocks the public from actively engaging with the science. Furthermore, the public often never sees many of the most challenging and exciting aspects of scientific research.

The EU-FP6-funded project, Nano2hybrids[56] has a hybrid objective. In principle, this specific targeted scientific research project has the final aim to produce a pocket-sized device that can detect gases in the atmosphere, in particular, benzene. This will be attempt by developing electronic sensors based on nanotechnology. Together with this nanoscience R&D objective, the project faces the challenge to find a new way to involve the public its scientific research, actively engage them in a two-way dialogue on nanoscience R&D and impart a deeper understanding of the scientific process. The objective is to show that scientific research is not about cut-and-dried facts but is a dynamic process of discovery, surprise, occasional failure, and often the unexpected. This hybrid project, launched in October 2007 under the coordination of the Notre Dame de la Paix University of Namur, has as a partner the UK Vega Science Trust, which is specialised in science communication and outreach. Using the latest video and Internet technology, the research team will produce documentary films before and after the project, showing their aims, and eventual outcomes. Throughout the project, the participants will produce video diaries which will be available to view over the Internet, with a forum facilitating discussion between the scientists and the public.

The public will be able to follow the three-year project as it unfolds, its successes and failures. Public feedback may even influence its progression. At the end of the project, the two documentaries and video diary content will be combined into a DVD and made available to educational institutions, etc. This is the first EU scientific research project to ever facilitate genuine two-way dialogue with the public, notably while the project is still underway.

EuroNanoForum 2007: Nanotechnology in industrial applications

The EuroNanoForum 2007 conference and exhibition on 'Nanotechnology in Industrial Applications' was organised in the framework of the German Presidency of the Council of the European Union. The event was established as the foremost European congress for the transfer of nanotechnology from research to industrial processes, products and applications and it was held at Congress Center Düsseldorf from 19 to 21 June 2007. The conference was accompanied by a special industrial exhibition presenting European key players in nanotechnology and has involved also a comprehensive press programme for journalists of the major European media agencies. The Proceedings[57] are available. They provide an overview of the state-of-the-art in nanotechnology for industrial applications, presented by selected international top speakers to open up new perspectives in Europe for coming years.'

European Forum on Nanosciences: Promoting new approaches on nanosciences as driving forces in the knowledge-based society

In October 2006, the COST (European Cooperation in Science and Technology), together with the European Commission, the European Parliament, the ESF (Euro-

pean Science Foundation) and ERA-NET (Consortium on Nanoscience in the European Research Area) organised the European Forum on Nanosciences[58] in order to explore the wide range of new possibilities, underlining the international and interdisciplinary character of Nanoscience. The objective was to promote multidisciplinary and converging approaches on Nanosciences as driving forces in the knowledge-based society; to identify research and training priorities; to contribute to the debate on nanosciences in society and to increase public awareness; to provide a forum to discuss recent scientific results in nanosciences and assess options for future developments; to explore synergies in the involvement of different funding agencies. The Forum gathered a wide audience including researchers and scientists working in Nanosciences, politicians, policy and decision makers in public and private research, representatives of funding agencies for research and technology, representatives of education and training institutions, journalists, stakeholders from industry, and representatives from the civil society. The two days programme of the Forum consisted of three keynote lectures, four thematic sessions and a round table discussion. Participants were invited to complete a questionnaire indicating their suggestions for priority research areas in nanosciences and a limited number of posters were selected for presentation of national and international networking activities.

Nanotechnology: Safety for Success

In keeping with the adoption the action plan[59] defining actions for the «immediate implementation of a safe, integrated and responsible strategy for Nanosciences and Nanotechnologies», a Finnish Presidency conference on nanotechnologies gathered representatives from public administrations, industries, the research community, and consumers' and environmental organisations on 14-15 September 2006 to discuss safety as a prerequisite for the development of a competitive and innovative European nanotechnology sector.

The Nanotechnologies: Safety for Success [60] conference touched upon various sectors currently developing nano-applications, such as food, chemicals, electronics, cosmetics and medicine. However, no matter what the sector, «the development of high technology, such as nanoscience and technology, requires public engagement and trust», summarised the Finnish Minister for Health and Social Affairs, Liisa Hyssälä.

The potential risks of nanotechnology include the risk to health and environment of nanoparticles and materials. The nanoparticles can be inhaled, swallowed, absorbed through skin or injected, but the behaviour of nanoparticles inside the body is not as yet known. As to environmental risks, the effects of free nanoparticles on the air or water are also unknown.

Open consultation on the Strategy for communication outreach in nanotechnology

Integrating the societal dimension and addressing expectations and concerns are an important element of the European strategy for nanotechnology and of the nanotechnology Action Plan[61]. The Working Paper[62] resulting from the workshop on strategy for communication outreach un nanotechnology held by the European Commission it Brussels, February 6th 2007 shapes operative recommendations for future European funding on appropriate communication and innovative approaches to engage the European civil society into a dialogue on nanotechnology. Experts in the field of science communication share success, best practices and challenge stories, to give to different audiences a «voice» in the policy making process. As a result, a set of recommended activities for Europe are outlined, which can be commented by e-mail to Matteo Bonazzi[63].

Recommendations include: surveying targeted publics (especially tough-to-reach and youngsters) to identify their values, concerns and expectations, communication models, cultural specificities and rationalities;

developing new models and tools for communication, dialogue and engagement (especially those «light», unconventional and emotion-based, eg. theatre, art, fairs); developing the role of choice-making process with appropriate new audiences, exchanging visions, scientific cultures and mobility of practitioners in communication; and ensure access to reliable information on ethical, social and legal dimensions of nanotechnology, focusing on ways to mitigate the nanodivide in communication and developing a free data-base on best practices by funnelling all information towards an international body.

Towards a code of conduct for responsible nanosciences and nanotechnology research

The European Commission is planning to adopt in the coming months a «Code of Conduct for Responsible Nanosciences and Nanotechnologies Research». The Community Minimum Standards for Consultation of Interested Parties require that Commission should consult widely before proposing legislation and, wherever appropriate, publish consultation documents. Therefore, prior to drafting and adopting the Recommendation, the Commission submitted through Internet a paper to the attention of interested parties and stakeholders in order to collect a broad sample of inputs emanating from research, industry, civil society organisations, policy and media. More generally, any person feeling concerned by the safe development of N&N in Europe and at global level is welcome to provide inputs. The Public Consultation[64] process, open from 19 July to 21 September 2007, shows the Commission's commitment to developing the potential of nanosciences with appropriate safeguards. A European Code of Conduct for Responsible Nanosciences and Nanotechnologies Research is part

of the European Commission's ambition to promote the balanced dissemination of information on nanotechnology, and to express the fundamental principles on which to base future research developments within this field. This code of conduct would also invite Member States and interested parties to take concrete action for the safe development and use of nanotechnologies. The Code of Conduct would offer those implementing it recognition of a responsible approach towards nanosciences and nanotechnologies research, making their actions more visible at the European level. In this context, the Code of Conduct could highlight three basic principles, which should frame research development in the future: precaution, inclusiveness and integrity.

Endnotes

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The Netherlands

The Rathenau Institute: Nanotechnology in Focus

Since 2003, the Rathenau Institute[1] has been playing a major role in the construction of a public debate on nanotechnologies in the Netherlands and in Europe by encouraging an open dialogue between scientists, government departments, the private sector and the general public. This independent organisation, set up by the Netherlands Ministry of Education, Culture and Science, and managed as a unit of the Royal Netherlands Academy of Arts and Sciences (KNAW[2]) has conducted a series of framework projects including «Nanotechnology» and «Nanotechnology in Focus». These projects included many different participatory activities focusing on the societal and economic impacts that the possible uses of N&N might have in the future.

During of the 2003 and 2004, in the framework of the Nanotechnology project, the Institute organized several expert and stakeholders meetings: «Chances and Risks of Nanoparticles», «Nanotechnology in the Agrofood sector», «Nano-electronics and Ambient Intelligence» and «Biomedical nanotechnology». The result of the project was a major public meeting called «Small Technologies, Big Consequences» about the opportunities and risks presented by nanotechnologies. During the meeting held in late 2004, the different parties – companies, NGOs, scientific organisations and political bodies – emphasised the need for more involvement of social organizations and preferred discussions initiated by third parties on specified applications, rather that one broad public debate organized by the government.

Against this backdrop, the Rathenau Institute developed during 2005 and 2006 the Nanotechnology in Focus[3] project. The project focused on specified nanotechnology applications that are expected to enter the market before 2015. Based on interviews with stakeholders, the focus lied on controversial or desirable applications about which something can be done. The innovation and prioritisation questions were pivotal: Will N&N research indeed lead to innovation before 2015? Was the research agenda realised under the specific heading nanotechnology?

Within this framework, the new department of Science System Assessment (SciSA) conducted in late 2006 a Science System Assessment of N&N: this is, a study of the rise of N&N as a new discipline, how society responds to this and how funding is arranged in the Netherlands. «Nanotechnology: Mapping the Field[4]» mapped the nanotechnology research in the Netherlands and studied the influence of the architecture of the Dutch science system on the scientific organization and knowledge production. The project showed, first, that nano-electronics – developing smaller and faster chips – is of direct importance for several economic sectors in the Netherlands, impacting society as a whole. The study led as well to a refining of the research questions, revealing, that nanotechnology makes more use of incidental than structured funding. Then, funding and research priorities are also influenced by the interaction with society; for example, the promises made by nanotechnology create a societal demand. Two questions arose: What does this demand mean for scientific research into nanotechnology? Does this change the direction of the research or does the research receive more money because it is considered to be more important?

In addition to these projects, the Rathenau Institute focussed on specific topics: Concerning future scenarios, the Rathenau Institute and the Studium Generale of Eindhoven Technical University organised in early 2005 the NanoWorld 2020 Fantasy Competition[5] for doctoral students aiming was to involve young people in discussions on nanotechnology. The target group was asked to sketch the social possibilities and impossibilities of nanotechnology in the year 2020. The competition was part of the Science + Fiction international exposition at Eindhoven Technical University.

Dealing with the possible risks of engineered nanoparticles for health and environment, a workshop that gathered in early 2006, public organisations, Dutch experts from the world of science, the private sector and government representatives with the aim to itemise what responsible policy in this area involves. As a result of the workshop the Rathenau Institute informed the Dutch parliament about the urgency of a clear and responsible strategy in governmental policy. Accordingly to the emerging international debate on synthetic nanoparticles and food, the Rathenau Institute commissioned at the end of 2006 a report[6] on nano-ingredients in food. More recently, a workshop was organized in 2007 in partnership with the Risk Assessment Bureau of the Dutch Food and Non-Food Authority[7] (VWA) aiming to gain a deeper understanding of how risk assessment relates to wider public questions on nanotechnology, food and safety.

Following the European Commission expert group report[8] on converging technologies, the Rathenau Institute has began a series of projects on NBIC convergence, i.e. the question of the coming together of nanotechnology, biotechnology, information technology and cognitive sciences. The notion of NBIC convergence is gaining in profile internationally, both within the government and in industry. The USA's National Science Foundation (NSF) sees the convergence of technologies as a new steering model for the sciences, and argues that to achieve the fastest progress, broad-ranging scientific disciplines must be combined. A number of new interdisciplinary research facilities have been set up around the vision of NBIC convergence, and many of them are found in California's Silicon Valley. One example is the Stanford Bio-X Center, which is conducting advanced research in regenerative medicine. And in Europe, too, more and more research is being stimulated within the public and private sector that requires the combination of knowledge and technology from formerly separate disciplines. The international «Euregion» Eindhoven-Louvain-Aachen is positioning the electronics sector strategically in the health market.

The Rathenau Institute's aim is to demonstrate this development by outlining a number of new scientific areas and innovative regions, the dynamics of which

depend strongly on the synergy between two or more NBIC technologies. This information is important for launching discussions on questions like: does NBIC convergence demand adjustment of educational curricula and a new institutionalization of the sciences? What does NBIC convergence mean for the future of the sciences? What significance does NBIC convergence have for the industrial structure of the Netherlands and innovation policy?

Together with the Netherlands Organization for Applied Scientific Research (TNO[9]) the Rathenau Institute has delivered a literature study[10] for the European Parliament. The paper describes which technological developments fall under the heading NBIC convergence and the emerging political-ethical debate about the consequences for society.

Enabled by the NBIC technological convergence, a new trend in science and technology is emerging: synthetic biology[11]. In contrast to the 'classical approach' in molecular biology, the aim of synthetic biologists is to design new biological systems with artificial genes and cellular structures, new biological parts, devices and systems to contribute to the development of new medicines or cheaper energy. The introduction of such new biology systems can force us to redefine 'life'. Although the development of synthetic biology is in an early stage, the Rathenau Institute recognized its scientific and technological significance as well as its potential impact on society. In 2006, the Rathenau Institut conducted the exploratory study Constructing Life[12] which provides an overview of the developments and dynamics in the field of synthetic biology, as well as an investigation of the social and political agenda. The study served as a starting point for further international research and debate, for example, on the role of government.

In the Netherlands, the discussion on nanotechnology has now entered a new phase with the publication of the «Cabinet Vision on Nanotechnologies» (Kabinetsvisie Nanotechnologieën[13]), which conducted to the establishment of a broad commission to supervise the social embedding of nanotechnology and get the public dialogue on the subject going. In the coming 2007-2008 period[14], the Rathenau Institute will continue to stimulate the discussion in particular from the broad perspective of NBIC convergence focusing on innovation & science policy, ethics & human rights, and on one new convergence area: synthetic biology.

Technology Assessment in the NanoNed Programme: Dedicated methodologies and in-depth studies to improve the interaction between science, technology and society.

NanoNed[15], the Nanotechnology network in the Netherlands, is the nanoinitiative of eight research institutes and Philips. It clusters the nanotechnology Dutch industrial and scientific knowledge infrastructure in a national network and enables a knowledge leap through strong research projects, an infrastructure investment programme and economically relevant dissemination of the knowledge and expertise, resulting in high added value economic growth. Coordinated by the University of Twente's Centre for Studies of Science, Technology and Society, and led by STS scholar Prof. Arie Rip, the Technology Assessment (TA) programme is an essential component of the Nanoned initiative.

Based on the notion of co-evolution (i.e. research activities, scientific fields, funding opportunities and societal visions are interdependent and shape each other mutually) the NanoNed TA programme[16] aims at understanding and improving the interaction between science, technology and society. This requires dedicated methodologies and in-depth studies which result in a mapping of the societal impact of nanotechnology. Namely, the TA programme covers several Ph.D. projects, support for Technology Assessment components in nanotechnology research, interactive workshops and other feedback activities.

The NanoNed's TA projects deal with a broad spectrum of N&N specific issues. For instance, «Social aspects of nanotechnology in the life sciences» focuses on the exploration of societal and ethical questions and a search for meaningful dialogue between researchers and NGOs; «Nanodistricts» deals with the dynamics of regional clusters of research institutes and firms that are emerging with nanotechnology as a key component, like in Grenoble and in Twente; «Paths in micro- and nanotechnologies», tackles the question of how do new technological paths emerge and when do current paths get obsolete; «Nanotechnology and sustainability», focuses on how can broad orientations such as sustainability be taken up in ongoing research and development; «The role of intermediary actors» deals with the question of what happens when funding agencies that intermediate between governments and ongoing research are not able to address the challenges of nanoscience and technology; «Promises and practices» studies the alignment and gaps between the different levels of nanotechnology, i.e. the lab, the programs and the political setting; «Images of nanotechnology» focuses on what images are produced and taken up by various actors, how do these images evolve, and which strategies of actors can be identified; «Risk and responsibility» tackles how governance of nanotechnology will be shaped through concrete issues like risk of nano-particles ; «Methods to map the sociotechnical dynamics of nanotechnology» deals with how to map and assess the co-evolution of nanotechnologies, underlying sciences and societal interest and use.

NanoNed TA programme collaborates with several TA bodies active in this field, like the Dutch Rathenau Institute, and with colleagues and centres in other countries in Europe and elsewhere. NanoNed TA is one of the leading members of the International Nanotechnology & Society Network, together with University of Lancaster (UK) and the two NSF-funded Nanotechnology in Society Centers in the USA. There is also active participation in EU Networks of Excellence, such as Nano2Life[17], Frontiers[18] and PRIME[19].

For further information contact the programme coordinator Prof. Arie Rip[20]

Endnotes

[1] http://www.rathenau.nl/default.asp?steID=2&ID=2351
[2] http://www.knaw.nl/
[3] http://www.rathenau.nl/showpage.asp?steID=2&ID=2108
[4] http://www.rathenau.nl/showpageproject.asp?steID=2&ID=2668
[5] http://nanotechnologie.rathenauinstituut.com/showpage.asp?steID=4&ID=1801
[6] http://www.rathenau.nl/autoparse.asp?steID=1&ID=2950
[7] http://www.vwa.nl/
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[17] http://www.nano2life.com/index.php
[18] http://www.frontiers-eu.org/
[19] http://www.prime-noe.org/
[20] mailto:a.rip@bbt.utwente.nl

Denmark

Citizens' Attitudes Towards Nanotechnology: A survey workshop

On June 7th 2004, the Danish Board of Technology organized a survey workshop on «Citizens' Attitudes towards Nanotechnologies[1]» which involved 29 invited citizens from the Copenhagen area.

The survey was implemented as a series of group interviews on issues previously prepared by a committee of experts, followed by the completion of a questionnaire and a general discussion. This «Interview Meeting[2]» methodology had been previously used within the framework of the DBT, namely in the Citizens' attitudes towards animal cloning survey, carried out in 2003.

The survey showed a group of citizens in general favourably disposed towards nanotechnology. Everybody, however, agreed that in taking the lead within the development of nanotechnology, it is very important that Denmark demonstrate a sound and critical approach to the technology, and initiate research into the risks and ethics involved. The citizens showed serious concern on whether nanotechnology would be applied to «right» purposes, being defined as beneficial to a wider public, and whether people and the environment would be taken adequately into consideration. Special support was recommended to the fight against pollution, the prevention of climatic change, the development of new energy sources, the improvement of the condition of developing countries as well as healthcare and more knowledge about the world in general. In comparison, the objective of a longer life span and of improved consumer durables was met with opposition. Finally, many citizens worried about the private sector being controlled by financial profit instead of what is beneficial to society. In order to prevent damage to human beings and the environment, the citizens recommended careful control and regulation of the development of nanotechnology, nationally as well as internationally.

For further information contact the project manager Ulla Vincentsen[3].

Toxicology and Nanotechnology

In keeping with the recommendations resulting from the «Citizens' Attitudes to Nanotechnology» survey workshop, which identified that knowledge about possible health risks and environmental hazards connected to nanotechnologies is still sparse, the Danish Board of Technology tackled the challenge to investigate if and how development, production and disposal of nanotechnologies is embraced by present rules and regulations. The DBT project Toxicology and Nanotechnology[4], carried out from October 2005 to June 2006, aimed namely

to assess whether nanotechnologies can be handled within the existing framework of regulation and to discuss and give recommendations to how risk assessment of nanotechnologies can be systematized.

For this project, the DBT appointed a working group of experts and relevant professionals with the objective to draw up a draft report which was discussed in a workshop by another group of specialists. The report gave a brief overlook of the present Danish rules and regulations and address the problems of systematizing risk assessment of nanotechnologies and brought forward some recommendations about how to go about the problem.

For further information contact the project manager Ulla Vincentsen[5].

France

Nanotechnologies in Grenoble: Nanodebate in the largest France's nanopole.

The emergence of nanotechnologies has already given rise to numerous formal and informal debates in France, attracting contributions from a variety of stakeholders. A series of important reports[6] tackling ethical, legal, and social issues associated with the development of nanotechnologies have been elaborated and, following the Danish, British and American trend, some important national expertise agencies and politicians have called for the encouragement and the development of public debate processes. Nevertheless, participatory democracy is still considered as a rare phenomenon in France, a country with a state-centred political tradition in which experts and engineers play a major role. One of the most interesting French initiatives for public debate is that of Grenoble.

Nanotechnology projects in Grenoble have roots in scientific activities in the Commissariat à l'Energie Atomique (CEA). CEA started to develop research activities in biotechnology and nano-electronics in the late 90s. CEA and La Metro, the Grenoble metropolitan area council, launched the Minatec project in January 2002, with the objective of creating Europe's top centre for innovation and expertise in micro and nanotechnology by bringing together research activities in nano-electronics and nano-biotechnology. In addition, the Joseph-Fourier University in Grenoble started, with funding from La Metro, the Bi-opolis, a new companies incubator project which opened in fall 2002. CEA and La Metro's Nanobio project, which is part of the European Network Nano2Life, brings together engineers, physicists and biologists and has a broad portfolio of activities. In response to the acknowledged need for «public dialogue», La Metro organized the «Science and Democracy Forum[7]», conceived as an open and participatory event and an opportunity for have a debate. The event was held in June 2005 and it was considered to be the first participatory exercise in science and technology in Grenoble.

The Forum consisted of a two-day event, open to the public, during which scientists, social scientists, local administrators and representatives of environmental associations discussed topics like science and ethics or the response to social demand, and answered questions from the public.

In parallel to the Forum, La Metro commissioned a group of Science and Technology Studies (STS) scholars led by Pierre-Benoit Joly to write a report that includes a comparative review of public participatory mechanisms in technology and recommendations. The «Local Democracy and Social Control of Nanotechnologies[8]» report, released in September 2005, recommended that La Metro organize a citizens' conference to decide about the future of nanotechnology projects in Grenoble and identified the possibility of public intervention, namely in terms of research orientation and funding.

The forum and the commission of the report were followed by another public engagement exercise sponsored by the European Union as part of the Nanodialogue project. Coordinated by the Centre de Culture Scientifique, Technique et Industrielle (CCSTI)[9] – a non-for-profit organisation (association loi 1901) funded by scientists, local and regional authorities and with a seal of the French minister of Research – the exercise consisted of a «citizen dialogue[10]» held in March 2006, with the objective of identifying social concerns and bringing them up to the European Commission. As the forum, the citizen dialogue formulated a demand for information but did not consider the possibility of a deeper public implication.

La Metro has not organized the citizen conference recommended by the report on «Local Democracy»; instead, it sponsored Nanoviv, a series of six public debates organized in Grenoble between September 2006 December 2006 by Vivagora[11], an association devoted to promotion of participative democracy through the organization of public debates on science and technology questions.

The objective of Nanoviv was to identify the actors and stakes, and to formulate recommendations for policy-makers. The method employed sought consensus on needed regulations. Each of the debates that gathered scientists, social scientists, politicians and administrators, focused on a particular issue like «nanomaterials and toxicology» or «nanoscience and application to medicine». PMO, an activist group opposing the development of nanotechnology in Grenoble was invited by the organizers. However, arguing that the debate was a mere communication device, unable to question major decisions, they refused to join. Activists have been continuously blaming these events for trying to regulate «impacts» without contesting nanotechnology projects themselves. For them, these debates do not even consider the possibility of refusing nanotechnology research. The recommendations

written at the end of the debate series have not led to political response.

Enterprises for the Environment: Citizen consultation on health and environment issues related to the development of nanotechnologies

In late 2006, two French organisations engaged with citizen participation in science and technology issues, «Entreprises pour l'Environnement[12]» (EPE) – a coalition of forty leading companies operating in various sectors France which are united by a commitment to the environment and to sustainable development – and the Air Pollution Prevention Association[13] (APPA) – a scientific and technical organisation working to improve the knowledge and prevention of atmospheric pollution phenomena – took the initiative to organise once a year a citizen consultation in order to debate on the health and environmental problems related to specific techno-scientific developments.

The first 2006 exercise dealt with nanotechnologies. The choice responded explicitly to the recommendations made by numerous French agencies to foster up-stream public debate on these complex emerging technologies. With this common aim, EPE and APPA established a multi-stakeholder Steering Committee which set the rules of the game and monitored their observance during the exercise.

The objective consisted in having a group of fifteen citizens formulate recommendations for the development of nanotechnologies. These citizens' recommendations were to be, first, confronted with available contradictory expertise on its related benefits and risks, and then discussed in a action-oriented multi-stakeholder debate.

The participatory exercise was developed in three parts. Firstly, SOFRES[14] – a polling organization – gathered a panel of fifteen citizens with different backgrounds and without any previous knowledge of nanotechnologies. The panel was provided with a document presenting a undisputed information about nanotechnologies, as well as their expected benefits and associated risks. Then, in two half-day sessions, held the 6 and 7 October 2006, the citizen panel listened to ten experts with different backgrounds, who presented nanotechnologies from the health and environment perspective: which benefits are to be expected? Which risks? Which are the precautionary measures that are being, or are to be taken? A questions and answers exchange and a cocktail ended the session.

After the presentation, the group of citizens elaborated a series of recommendations concerning the health and environmental issues related to the development of nanotechnology. In a second session, held two weeks after the first session, on October 21, 2006, these recommendations were discussed in an «action-oriented» round table, that gathered elected politicians, ministers, representatives of environmental protection associations, companies, and scientists. The next day, the citizen panel finalized their «citizen recommendations.»

The citizens' panel recommendations unanimously conclude that the development of nanotechnology must be pursued, in view of their expected benefits in the medical, environmental, and economical development fields. Nevertheless, the citizens' panel recommendations call for information and security measures concerning health and environmental risks which result from the development of these new technologies, namely for workers and researchers. In order to achieve this objective, they recommend the creation of an agency responsible for coordinating research on health and environmental implications of nanoproducts placed on the market. Finally, citizens' recommendations call for objective research and transparent management of nanotechnology. For this they recommend the creation of strict norms and a «good conduct chart» to prevent industrials and politicians from privileging economical profit over citizen health.

In the final report[15], both EPE and APPA express their conclusions and positions in relation to the citizens' panel recommendations. Recognizing the need for better knowledge of the health and environmental risks that might result form the development of nanotechnologies, EPE express their will to profit from this technological development with the necessary precautions, and recall that the Civil Code guarantees the industries responsibility regarding the products they place on the market. APPA concluded that there is a need for more participatory processes oriented to avoiding tensions which result mainly from an information deficit. For APA, the citizens' panel was able to elaborate pertinent recommendations – which do not differ from the ones made by expert agencies – on the basis of quality and contrasted information which takes into account uncertainties.

Nanotechnologies: Potential risks and ethical challenges – A public hearing

The French Parliamentary Office for the Evaluation of Scientific and Technological Choices (OPECST[16]) organized a public session to address the potential risks and ethical stakes of nanotechnologies. The purpose of the meeting, chaired by Mr. Claude Birraux, Deputy, Senior Vice-Chairman of the Office, and Mr. Daniel Raoul, Senator, was to ensure that the Office's reports on this subject were followed up and also to provide information for the many current debates on nanotechnologies. This day session, held on 7 November 2006 in the National Assembly, was attended by chairmen of ethical commissions and committees, directors of research in physics, chemistry and medicine, economists, industrialists and representatives of associations. Focusing on the risks and the ethical questions raised by the use of nanotechnologies and the

responses that all the various persons involved are trying to contribute, the hearing led to a comprehensive review of the specificities of nanotechnologies, the considerable industrial stakes they represent and the progress that could be made with them in the areas of health care, the environment, transport and security. However, the discussions also revealed that no studies have been made higher up the chain about the ethical stakes, the uncertainties of the danger to mankind and his environment, particularly because measuring instruments have not been perfected so far, and the difficulties of applying the principle of precaution with discernment to these technologies. Various opinions were also expressed on the impact of innovations relying on converging NBIC technologies and the control of the speed of scientific progress. A summary[17] report in English is available. For more information see the French National Assembly[18] website.

The «Nanomonde» and «Nanoviv» Citizens' Conferences: The first series of events of its kind in France

In 2006, VivAgora[19] organised two public debates to generate wider public awareness and debate about nanotechnologies, as well as to identify potential problems and solutions related to the development of nanotechnologies.

These events were the first series of events of its kind in France. The Paris-based Nanomonde[20], funded by Île-de-France Regional Counsel, took place from January to June 2006. The Grenoble-based Nanoviv[21], funded by the Rhône Alpes Regional Counsel together with the Isère General Counsel, and de Grenoble Agglomeration Community, ran from September to December 2006.

Both events had the same approach: a six meetings deliberative public debate, all meetings about two and a half hours attended by more than 100 people. Public participants were invited through organisers' networks, and most who attended has an interest, or was involved, in nanotechnology. Every meeting, before the debate, an information sheet was distributed. Then scientists and other experts gave evidence on different aspects of nanotechnology (e.g., technological, social, or economic); a mediator was present to facilitate discussions.

The reports of every debate are available in French in the respective websites, and both projects concluded with a series of policy recommendations based on the debates.

The Île-de-France Citizens' Conference on Nanotechnologies

The Council for the Ile-de-France region organised a Cititzens' conference on nanotechnologies[22] (the French label for the Danish consensus conference) to experiment new ways of involving public opinion in political decisions. The one-day conference took place on January 20, 2007 at the Cité Universitaire in Paris. A panel of sixteen people, selected by the polling organisation IFOP, has been working for one weekend per month since October to grasp the complexities of the subject. The panel of citizens prepared a conference during which they auditioned experts on the issues and questions they considered important. Following the conference, they deliberated together and drew up a series of recommendations[23]. The Council for the Ile-de-France region has undertaken to take these recommendations into account in future decisions concerning nanotechnologies.

La Cité des Sciences et de l'Industrie: Expo Nano & Nanotechnologies: The debate

The Paris science centre Cité des Sciences & de l'Industrie[24], jointly with Cap Sciences[25] and CCSTI Grenoble[26], offered from Mars to September 2007 the exhibition Expo Nano: Technology Takes On A New Dimension[27]. The exhibition was conceived as a journey into the nanoworld in four sections: the foundations[28], techniques[29] and uses[30] of nanotechnologies, together with the ethical issues[31] that they raise. Namely, the debate on the ethical questions that nanotechnologies arise tackle the issue of nanotechnologies and citizen participation by calling for intensive dialogue between the different stakeholders and the general public.

In addition to the January and February 2006, the «Nanotechnology : the challenges[32]» conference cycle, and at the request of the French Ministry for Higher Education and Research and the Ministry for Industry, the Cité des sciences organised, in the framework of the Nano Expo, a stocktaking exercise named Nanotechnologies: The state of the debate, future directions[33] on 19 and 20 March 2007, to provide an overview of the issues raised, and to ask the major groups of stakeholders (scientists, manufacturers, politicians) to define their positions in terms of their expectations, concerns, but above all their recommendations arising from these various debates and projects.

An independent steering committee[34] identified in advance the different groups operating in France which have compiled public documents, containing recommendations, proposals, expectations and questions. These «opinion holders» belong to open debates, involving representatives of civil society, participative and non-participative; associations and unions which have developed recommendations and proposals on the ground for nanotechnologies; groups of experts which have developed opinions of this nature. These groups were asked to set out their recommendations in a stakeholder report[35], which, to ensure that each viewpoint was given the same exposure, had to conform to a set of common guidelines. During the round table discussions[36] these

stakeholder reports were submitted respectively to scientists, manufacturers, and politicians who defined their positions on this overview. The Minister for Industry, François Loos, concluded these discussions by offering the government's position on these points. A verbatim[37] of the debate and the exhibition visit guide[38], containing valuable information are available.

CNAM NanoForum: A permanent open space for dialogue on the health and environmental aspects of nanotechnology

In response to the public call for the creation of instruments for permanent dialogue between the diverse nanotechnologies stakeholders, the Hygiene & Security Chair at the National Conservatory of Arts and Crafts (CNAM[39]) jointly with the Institute of Industrial Hygiene and Environment, the Health General Direction, Vivagora and the Journal de l'Environnement launched in June 2007 the CNAM NanoForum, an open permanent forum to discuss the health, environmental and social aspects related to the industrial development of nanotechnologies. As expressed by the organisers, the initiative claims to be part of a precautionary approach to the development of nanotechnologies, through the institutionalisation of an open forum for tackling societal questions rised bz these new technologies, confronting points of view on their nature, and ways of dealing with them. The Forum was established on the basis of a series of principles, namely those of permanence, or sustained debate; plurality or symmetrical treatment of stakeholders; scientific openness or reflexivity; freedom of speech; and transparency. The CNAM, a Public Scientific, Cultural and Professional Institution among France's top higher education establishments is responsible for the transparency of the debate.

The methodological options were discussed in a preliminary meeting, in which the Forum's approach and thematic agenda for 2007-2008 were defined, so as to establish a consensual objective.

The Forum does not have as an objective the elaboration of a consensual opinion or of policy recommendations. Since the Opening[40] event on June 28, 2007, three meetings have taken place: «Construction Nanomaterials[41]» on November 8, «Nanoprocesses and cosmetic products[42]» on December 6. During the winter and spring 2008, three meetings will take place: «Food and nanotechnologies[43]» on February 7, «Governance of nanotechnology related emerging risks[44]» on April 3, «Nanotechnologies and workers' safety[45]» on June 5,

The Forum takes place at the Arts and Crafts Museum[46] in Paris. In order to participate, free and open inscription[47] is required. For more information, visit the CNAM website or contact Prof. William Dab[48], Head of the Hygiene and Security Chair, CNAM.

The regional government of Flanders, Belgium

The viWTA dossiers on nanotechnology and the Nano Now Technology Festival

The Flemish Institute for Science and Technology Assessment (viWTA[49]) at the Flemish Parliament focuses both on foresight studies and upstream TA, as well as analysis of current technological developments by promoting public debate. This provides a consistent stream of information on the interaction between society and technology, to the benefit of Parliament, interest groups and the general public. VIWTA has been developing a series of studies and participatory activities with the purpose of engaging a larger public on the Nanotechnologies debate. Notably, on the 10th and 11th of November, the VIWTA organised the Nano Nu[50] – Nano Now – Technology Festival, e.i. a public 'festival' of 2 days, including multiple activities, cultural and scientific, artistic and lectures, about the use and the consequences of N&N, aiming at informing while opening the nanotechnology debate to a larger public. In this occasion, VIWTA published a special dossier[51] on Nanotechnologies, which, in addition to the previous 2nd VIWTA dossier «Nanotechnology: the state of the art[52]», exposes in a concise and comprehensible way what N&N means, and gives an overview of the possibilities, the potential disadvantages and challenges of the developments in this field.

Switzerland

Publifocus: Nanotechnology – meaning for health and environment

Nanotechnological developments have the potential to change key areas of life in our society over the coming years and decades. In Switzerland it is only recently that a coordinated approach has been initiated to questions of regulation. Political groups have been paying close attention to the technical developments and studies have been helping to weigh up the opportunities and risks. Any legislation that may be necessary, however, must also take the views of the population into account. How do so-called «laypersons» perceive the nanotech debate? Where do citizens see opportunities for themselves, their health and the environment? And where do the possible risks lie? Does nano-research exceed ethical boundaries? Is there a need for regulation or a standardised declaration? These are questions that TA-SWISS[53] the Centre for Technol-

ogy Assessment at the Swiss Science and Technology Council (SSTC) wanted to discuss with randomly selected citizens' groups in publifocus[54] events. The project run from autumn 2005 to December 2006 with the aim to to demonstrate how the use of nanomaterials and the possible social and economic impact of the new technologies are being assessed by «laypersons» who have some knowledge of the subject. The participants' views were compiled into a report[55], – available in German[56], French[57] and Italian[58] – published in November 2006. The aim of the report was to inform interested members of the public – and members of parliament, as it is they who will have to decide whether there is likely to be any need for legislation as a result of developments in nanoscience and nanotechnology and their applications.

No recommendations are made on the basis of publifocus events; the do, however, give some idea of the views of the publifocus participants, showing where there are areas of conflict.

Nanopublic – Nanotechnologies and society interdisciplinary platform

In April 2006, Science-Society Interface[59] at the University of Lausanne launched Nanopublic[60], a two year project which aims at setting up a platform of exchange and transdisciplinary investigation between the Swiss nanotechnology stakeholders such as researchers in physical sciences, biomedicine and social sciences, firms, policy makers, NGOs and citizens.

Funded by the Anthropos programme[61] and supported by an interdisciplinary research team from the University of Lausanne (UNIL[62]), the Lausanne Federal Institute of Technology (EPFL[63]) and the Institute for Occupational Health Sciences (IST[64]), this interdisciplinary platform has been enabling collaborations with projects following similar objectives in Switzerland and abroad. Nanopublic has organized public conferences and workshops to debate research and innovation policies as well as risk assessment and management or socio-economic and cultural issues. These exchange activities have been supported by fieldwork investigations focused on mapping actors' strategies and identifying the social «imaginaries» shaping the research agenda in N&N.

For further information contact Alain Kaufmann[65], project coordinator

Two Swiss Re Publications on Nanotechnology: Nanotechnology - small size, large impact? & Nanotechnology - Small matter, many unknowns.

Swiss Re[66], the Swiss leading global reinsure, has dedicated teams of experts which track new or emerging risks, and nanotechnology is one of the topics currently in focus. It is vital for the insurance industry to know what losses a new technology can give rise to and what the extent and the frequency of such losses will be. With these basics more or less established, the insurer can better assess the future loss burden, calculate a premium commensurate with the risk and grant adequate insurance cover.

The Swiss Re Centre for Global Dialogue – the expertise and marketing platform of Swiss Re – published a comprehensive report on its first conference of nanotechnology, held in December 2004 in Rüschlikon, Switzerland. Swiss Re's two-day nanotechnology conference at the Centre for Global Dialogue in Rüschlikon offered a broad overview of the topic. Swiss Re is convinced that the successful commercial use of nanotechnology is crucially dependent on such cross-disciplinary dialogue addressing the full scope of potential risks and inherent opportunities. As such, the conference was designed as an open dialogue on risk analysis, risk management and options for acceptable risk transfer. For as many stakeholders as were represented – from science, business, the insurance sector, and regulatory bodies – there were fundamentally different perceptions of nanotechnology as a potential risk and opportunity.

The conference report[67] is a summary publication including papers by the conference's keynote speakers and it provides several «outside in» views on this cutting edge technology. The publication points to how the experts were concerned as much with the concept of «phantom» risk – where no scientifically demonstrable cause-effect relationship can be established as yet – as they were with potential «real» risk. For that reason, they weighed the importance of risk communication heavily. Finally, the conference publication serves as an accessory publication to Nanotechnology: Small matter, many unknowns[68], the title published for a broader readership by Swiss Re in its Risk perception series.

Austria

Austrian Institute of Technology Assessment (ITA): Implementing the internationally established instruments of citizens' participation in technology policy in Austria

In several countries, investigations into aspects of risk, societal and ethical issues of N&N have been conducted, and the European Commission explicitly called for «the incorporation of the societal dimension». So far, Austria has seen few such efforts. The Austrian Institute of Technology Assessment (ITA), an institution focusing on technological trends, on societal consequences and on options for the shaping of technological change, has started a series of projects of inter-disciplinary scientific

research at the interface of technology and society for giving advice to decision-makers on nanotechnologies governance. As a first step, the ITA run from January to May 2006 the «European Research on the Societal and Risk Aspects of Nanotechnology[69]» study with the objective of summarising the European discussion on risk and the societal aspects of nanotechnology. A series of publications[70] in the framework of the project are available on the ITA website.

Almost at the same time, from September 2005 to June 2006 ITA run the «Techpol 2.0. :Awareness – Participation – Legitimacy[71]» project with the aim at implementing the internationally established instruments of citizens' participation in technology policy in Austria. From all the possible participative tools and topics, the project selected those that are best suited for the specific situation of the commissioning consortium and adapted them for Austria. Following an analysis of strengths and weaknesses of both participative interaction formats and the Austrian research and technology policy, the project identified topics that are apt for a participatory process, recommended the appropriate tool, and prepared the subsequent practical implementation. A series of project related publications are available on the project website[72].

Nano Trust: An information desk and promoter of discussion

The ITA «Nano Trust[73]» project started in September 2007 with the objective of developing an integrative analysis of the state of knowledge regarding health and environment. As documented by the two previous projects on the state of risk and accompanying research, there is massive need for research and communication. This three year project aims at meeting these needs. The heart of the research project is to continually survey, analyse and summarise the state of knowledge regarding potential health and environmental risks of nanotechnology. For the first time in Austria, these important aspects of technology development will be under systematic scrutiny and beyond single R&D projects, that is investigated on a meta level. At the same time, research lacunae will be identified and diverse assessments made transparent. NanoTrust is thus an information desk and promoter of discussion: Both for the general public, the administration and the nano research community a sort of service point will be established for questions regarding the assessment of security issues. The project will be funded for at first three years by the Austrian Ministry of Transport, Innovation and Technology (BMVIT). A series of project related publications[74] are available on the project website.

Germany

The Consumer Conference on Nanotechnology

The Consumer Conference on Nanotechnology was launched as a pilot project by the Federal Institute for Risk Assessment[75] (BfR) and was jointly staged with the Independent Institute for Environmental Concerns (UfU) and the Institute for Ecological Economic Research (IÖW). It draws on the model of the Danish consensus conference and is being tested by BfR as one possible tool of extended risk communication. The backdrop to BfR's risk communication activities is the dialogue between risk assessors, risk managers and various interest groups from science, politics, industry, associations, public agencies and the public at large. The staging of a consumer conference puts BfR's statutory remit on risk communication into practice by directly involving groups of consumers in the discussions about the risks and benefits prior to the introduction of a broadly based consumer application of this technology. This is the first time that a public agency in Germany has used this tool.

16 people of various ages and occupations were extracted from a cohort of 6,000 randomly selected individuals on the basis of sociodemographic criteria for the Consumer Conference on Nanotechnology. This group took a comprehensive look at this subject at two preparatory weekends, prepared questions on various consumer aspects of this technology and selected experts from science, associations, public agencies and industry to answer them.

The closing event of the «BfR Consumer Conference on Nanotechnology» was held in Berlin from 18 to 20. November 2006. At a public hearing the invited experts responded to the consumer group's questions on the use of nanotechnology in foods, cosmetics and textiles. An, at times, heated debate was conducted on the question of the labelling of nanoproducts. The participants called for clear labelling in order to be able to decide for themselves whether they wanted to purchase products manufactured using nanotechnology or not. Other important discussion items were the development of suitable measurement methods to detect nanoparticles, disposal of nanoproducts and the provision of funds to research possible risks.

In private deliberations the group then prepared its vote on nanotechnology. It was presented to the public on 20 November 2006 and handed over to representatives of public agencies, politics and associations. It names foods as the most sensitive area for the use of nanomaterials. Consumers felt that the promised advantages to be derived from using nanotechnology like changes to the flow properties of ketchup or the trickling properties of products were non-essential given the potential risks. Regarding the use of nanotechnology in cosmetics and textiles the consumers felt that the

already foreseeable benefits clearly outweighed potential risks. For instance, nanoparticles in sunscreen could provide better UV protection and help to counter the increase in skin cancer. The consumers were also of the opinion that nanotechnology could be expected to offer more quality of life in work, sports and daily clothing.

Nanotechnology is of importance for the Federal Institute for Risk Assessment in conjunction with consumer health protection as new materials manufactured on this basis are increasingly being used in consumer products like cosmetics, clothing textiles, household products as well as in foods and food supplements in future, too. The recording of a fact-based opinion aims to identify the requirements consumers expect nanotechnology to meet. The consumer vote is, therefore, an important source of information for both producers and decision-makers from politics and consumer health protection authorities when dealing with nanotechnology and its products. The final report[76] is available.

NanoTruck: An exhibit vehicle presenting the fascinating world of nanotechnology to the general public

With the objective to promote the dialogue between the world of science and the general public, the Federal Ministry of Education and Research (BMBF) sent in January 2004 the «nanoTruck[77]» on a journey through Germany. The «nanoTruck: a journey to the nanocosmos – a world of minute proportions» is a common project organized by the Federal Ministry of Education and Research (BMBF) and the initiative entitled Science in Dialogue (WiD). This exhibit vehicle presents the complex, fascinating world of nanotechnology to the general public. The campaign was designed to provide information on the current state of research and development potential in nanotechnology. The «nanoTruck» plays the major role in this project: The road show vehicle with its integrated exhibit will be found at events at shools, universities or research facilities. It will be present at information events as well as at trade shows and conferences. Once arrived at the location, the truck is being transformed into a mobile experience, offering first-hand scientific information on approximately 60 m² of display space. Among other things, the programme includes a laser show, multimedia presentations, guided tours through the exhibit, open-house events, lectures and panel discussions. A wide range of exhibits, including measuring instruments that make atoms visible, and materials with astounding characteristics, communicate the fascinating world of nanotechnology with a very hands-on approach. Experienced scientists will also staff the truck on its tour to readily answer any questions visitors might have.

NanoReisen: Adventures beyond the decimal

NanoReisen[78] (NanoJourneys) whisk the visitor away to micro- and nano-cosmos. On various routes the visitor can gradually «shrink itself» into worlds invisible to us and penetrate into the smallest known dimensions of our universe. A suitcase in which one can carry helpful utensils for the trip are a constant companion during the journey. Among other things, it contains a virtual travel guide with brief background information on the respective travelling size. To show how small the worlds are, an info bar provides the visitor with an overview of the corresponding sizes.

Norway

Under its NANOMAT programme, the Research Council of Norway, jointly with the National Research Ethics Committee for Science and Technology (NENT) and the Norwegian Board of Technology (Teknologirådet[79]) appointed in 2004 a working group to study national research and competency needs with a view to ethical, social and health, safety and the environment related aspects of nanotechnology. The report Nanotechnology and new materials[80] attaches importance to a general «better safe than sorry» approach, in tandem with any comparative research advantages Norway may have in the international arena. The study was conducted as a preliminary project and has constituted a background material for new projects.

In 2005, the Norwegian Board of Technology started its Nanotechnology project[81] with the purpose to stimulate an informed debate about the promises and consequences of nanotechnology, for both the individual and society. The project aims to provide information to the authorities and the general public on nanotechnology's present and possible future uses and challenges concerning growth, societal consequences, risk and ethics. The programme plans to carry out workshops, open hearings and meetings, and case-studies.

Spain

The «Dialogue on Nanoscience and Nanotechnologies» Project

In 2003 the Catalan Special Research Centre on Theories and Practices to Overcome Inequalities (CREA[82]), in collaboration with the Communication and Scientific Dissemination Department within the Barcelona Science Park, started a project to open the Science Park to the Neighbourhood. This project was a

framework within which many activities and different groups of participants related to science and technology in science & society were included. The «Dialogue on Nanoscience and Nanotechnology» Project had three stages of activity:

1. Survey on public knowledge of nanotechnology;
2. Working groups and
3. a seminar called «Dialogue on Nanoscience and Nanotechnology», which was held at the end of November 2005.

The project opened up a public debate on N&N on different levels of society, and it involved students as well as laymen. The results of the public debate basically arose from the analysis of the two previous stages. Besides, in all of the fieldwork from this scientific discipline, participants shared their thoughts, questions and concerns, which were summarized by a researcher from CREA. Everything was presented in the seminar «Dialogue on Nanoscience and Nanotechnology». The seminar was a meeting point for researchers from the area of N&N. The inclusion of the publics' opinions, especially people who have not traditionally been involved in scientific research, were seen as an innovate element. The use and development of new methods based on the inclusion of social groups' opinions in the analysis and dissemination of the project contributed towards enabling the project to have a social impact and help to ensure that policy recommendations result from the dialogue between scientists and other stakeholders. There is a need for such projects. Furthermore, these initiatives demonstrate that the public has a real interest in science, which disproves the stereotypes. This type of initiative also helps to raise awareness for the need for research projects, on any topic, to include the participation of the end-users in order to improve the quality of the research process and to increase its social impact.

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Endnotes

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[2] http://tekno.dk/subpage.php3?article=1234&toppic=kategori12&language=uk
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[83] mailto:crea@pcb.ub.es

The United States of America

The Loka Institute: Advocating for the integration of science and technology studies research with N&N

With the launch of the National Nanotechnology Initiative[1] (NNI) – the US federal R&D programme established to coordinate the multi-agency efforts in nanoscale science, engineering, and technology– in 2000, and the adoption of the «21st Century Nanotechnology Research and Development Act[2]» in 2003, the US government embarked on an ambitious and long term R&D programme in nanotechnology with the objective of ensuring United States global leadership in the development and application of nanotechnology.

Regarding ethical, legal, environmental, and societal concerns related to nanotechnology, the 21st Century Nanotechnology Act notably endorses ensuring that these are considered during the development of nanotechnology by establishing a research programme to identify these concerns, and by providing for «public input and outreach to be integrated into the National Nanotechnology Initiative by the convening of regular and ongoing public discussions, through mechanisms such as citizens' panels, consensus conferences, and educational events, as appropriate».

This new official public policy has been considered to be a major achievement for Science, Technology and Studies (STS) scholars, who have strongly advocated for public «upstream engagement» in science and technology, specially since the recognition that the failure of the biotechnology is linked to the «deficit model».

For instance, before the U.S. Congress passed the Act in 2003, STS scholars Langdon Winner and Davis Baird of The Loka Institute[3], a non-profit research and advocacy organization working to expand public involvement in science and technology, testified before the Congress House Science Committee[4] during the legislative process, about the integration of science and technology studies research with N&N and the need for open deliberations about technological choices. Both the NNI and the 21st Century Nanotechnology Act recognize that input from citizens is helpful in effective decision-making.

Additionally, Loka mobilized a broad-based group of community activists, academics, and philanthropic leaders to sign a letter[5] to elected officials and science policy advisors to include specific participatory provisions in the pending legislation. Shortly after the legislation was signed into law, Loka organized a workshop[6] at Howard University in 2004 for community activists from around the country to make recommendations about how to implement the participation provision after it became law.

Loka Board Chair Rick Worthington has presented his analysis of the political economy of participation[7] in

nanotechnology policy to an international conference of community researchers and science policy activists. In 2007, Loka submitted comments on a nano risk framework[8] proposed by DuPont and Environmental Defense, and several Loka participants have been active in a coalition of public interest, popular education and labour groups that brings participatory, environmental, and social concerns into global policy discourse over nanotech. This group developed Joint Principles for Oversight of Nanomaterials and Nanotechnologies[9] released July 31, 2007. More than 40 organizations worldwide – ranging from small organizations such as Accion Ecologica in Ecuador and the International Center for Technology Assessment in Washington, to the AFL-CIO and Friends of the Earth – signed the principles. A Loka Alert[10] addressing our take on the politics of nanotechnology – including the case for a pause in commercialization – was issued in August 2007.

The NSE Nanotechnology in Society Network

As part of the US National Nanotechnology Initiative[11] (NNI), the National Science Foundation[12] (NSE) has funded two Centres for Nanotechnology in Society: one at the University of at Arizona State University (CNS-ASU[13]) and another one at the University of California, Santa Barbara (CNS-UCSB[14]). The CNS-ASU provides an operational model for a new way to organize research through improved reflexiveness and social learning which can signal emerging problems, enable anticipatory governance, and, through improved contextual awareness, guide trajectories of N&N knowledge and innovation toward socially desirable outcomes, and away from undesirable ones. In pursuit of this broadest impact, CNS-ASU trains a cadre of interdisciplinary researchers to engage the complex societal implications of N&N; catalyzes more diverse, comprehensive, and adventurous interactions among a wide variety of publics potentially interested in and affected by NSE; and creates new levels of awareness about N&N-in-society among decision makers ranging from consumers to scientists to high level policy makers. CNS-ASU joins Arizona State University with the University of Wisconsin – Madison, the Georgia Institute of Technology, North Carolina State University, Rutgers, The State University of New Jersey, the University of Colorado – Boulder, and other universities, individuals, and groups in the academic and private sector, as well as the developing International Nanotechnology and Society Network (INSN[15]) at ASU. The CNS-UCSB, on the other hand, focuses on the historical context of nanotechnology, on the innovation process and global diffusion of ideas in the field; and on risk perception and social response to nanotechnology. The centre also explores methods for public participation in setting the agenda for nanotechnology's future. The Co-sponsored by the California NanoSystems Institute at UC Santa Barbara, CNS-UCSB hosts free, quarterly NanoMeeter (formerly NanoCafe) events, created to engage the general public on growing nanotechnologies issues. In addition, NSF also funded additional nano-in-society projects at the Nano Science & Technology Studies Group at the University of South Carolina[16] (nSTS-USC)– to examine the role of images in communicating about nanotechnology – and at Harvard University –to develop «NanoConnection to Society,» including a NanoEthicsBank and a NanoEnvironBank.

The Meridian Institute: Global Dialogue on Nanotechnology and the Poor (GDNP)

The Global Dialogue on Nanotechnology and the Poor (GDNP) is conducted by the Meridian Institute[17], a non-profit organization working at the local, national and international levels to help people make informed decisions about complex and controversial societal issues through facilitation, mediation, and consultation services. Since 2003, Meridian has been working on issues related to nanotechnology and society. Lunched in may 2004, with the support of the Rockefeller Foundation (US), the Department for International Development (UK) and the Canadian International Development Research Centre, this two year project aims at raising awareness about the impact of nanotechnologies for the poor and to identify ways in which nanoscience and nanotechnology can have a positive role in international development. During the first phase of the GDNP (May 2004 - August 2005), Meridian's strategies focused on raising awareness about the implications of nanotechnology for the poor through a series of tools and strategies, which included participating in meetings and conferences[18]; publishing an important report[19] about the implications of nanotechnology for developing countries; organizing together with Dialogue by Design (UK) an online consultation[20] for people to share their own views and questions; and conducting one-on-one consultations with numerous individuals. To define the focus of GDNP's second phase, Meridian convened a Steering Group (SG) in June 2005 in London. Twenty people living and working in both developed and developing countries participated in the meeting. During the SG meeting, Meridian sought input on the strategic direction for the GDNP, especially the precise focus of the multi-stakeholder dialogue processes that will be the primary focus during the second phase of the GDNP. The meeting summary[21] is available.

The project's current phase activities has included setting up a Nanotechnology and Development news[22] service available by email and online; convening a multi-stakeholder global-level group, the Critical Connections Group (CCG), to provide a mechanism for leaders to look across and discuss the activities being undertaken by the GDNP and other organizations, focusing in particular on linkages and synergy among activities, lessons learned, and identification of gaps in research and dialogue; pub-

lishing a paper entitled «Nanotechnology, Water, and Development[23]» which explores the scale and significance of water and sanitation problems in developing countries, the broad array of challenges associated with improving access to water, and the possible opportunities and risks of using nanotechnology to address these challenges; a and convening two important international multi-stakeholder workshops on Nanotechnology, Water, and Development[24] and on Nanotechnology, Commodities, and Development[25].

Informed Public Perceptions of Nanotechnologies and Trust in Government

Supported by the National Science Foundation[26], the Woodrow Wilson International Center for Scholars and the Pew Charitable Trusts established in April 2005 their «Project on Emerging Nanotechnologies[27]» with the objective of helping ensure that, as nanotechnologies advance, possible risks are minimized, public and consumer engagement remains strong, and the potential benefits of these new technologies are realized. In response to a 2004 study of US citizens, which identified low levels of trust in their government's ability to manage risk associated with nanotechnologies, the 2005 study «Informed Public Perceptions of Nanotechnology and Trust in Government[28]» aimed at understanding why levels of trust are so low, and to look in-depth into what US citizens know and do not know about nanotechnologies. Twelve groups of citizens gathered in three locations around the USA. The 177 citizens which participated were divided in demographically representative groups. Participants were given background material, which presented a balanced view of known and projected applications of nanotechnologies, as well as information on the roles of six regulatory agencies, Congress, and the White House in nanotechnologies oversight. Scientists and regulators reviewed the material for accuracy and ease of comprehension by lay people. The material focused on conveying of known facts and reasoning, rather than just statements of opposing positions. Public perceptions were obtained through questionnaires that were completed before receiving background material. After reading the material, individual responses to concerns and anticipated benefits of nanotechnologies were gathered, and participants took part in group discussions about concerns, benefits, and perceptions of regulatory agencies. Finally, participants completed a post-study questionnaire. Participants had low general awareness of nanotechnologies, but generally a positive attitude towards it, feeling that benefits will exceed risks. They showed little support for a nanotechnologies ban and their concerns centred on unknowns, potential health risks, the danger of 'playing God', long-term effects, and the risks of nanotechnologies in food and military applications. Participants called for effective regulation, product labelling, and more safety testing and information. The level of trust in US government agencies was initially low, but increased when their responsibilities were understood better. However, trust in some bodies decreased after more information.

NISE Network's Forums for Dialog and Deliberation

The US National Science Foundation[29] has committed 20 million dollars over five years (2005 – 2010) to science museums under the auspices of the Nanoscale Informal Science Education Network[30]. The NISE network brings together museum professionals, researchers, and informal science educators to inform and engage the public about N&N its related societal and environmental impacts through a series of exhibitions and public forums such as the Forums for Dialog and Deliberation[31]. Five collaborating science museums support the network: the Museum of Science (Boston, MA), the Science Museum of Minnesota (St. Paul, MN), the Oregon Museum of Science and Industry (Portland, OR), the North Carolina Museum of Life and Science (Durham, NC) and Exploratorium (San Francisco, CA). This consortium organises at least three forum-events per year, which last two to three hours and are attended by 30–50 participants per event. Aiming at enabling participants to articulate their own perspective on N&N and to hear the perspectives of others, forums have included speaker presentations and small group discussions that have so far focused on the regulation of nanotechnology. Formats have varied, including weighing up of alternative scenarios or asking of multiple questions for groups to consider. Forums have brought scientists and non-scientists together not only through expert presentations and interactions with the audience, but through representation of a variety of expertise among participants. Most survey respondents have acknowledged learning about the values of others during the course of the Forums. A challenge of the project is to engage a more diverse audience beyond that of existing museum visitors, to include those traditionally under-represented in discussions about societal and environmental impacts of science and technology. An integral part of the project plan is to create affordable, sustainable Forum models that can be adopted easily by smaller museums and community centres with modest resources.

NanoMeeter: Public Nano Café series at the University of California – Santa Barbara

The California NanoSystems Institute (CNSI-UCSB[32]) and the Center for Nanotechnology in Society (CNS-UCSB[33]) of the University of California - Santa Barbara (UCSB[34]) launched in April 2007 a collaborative quarterly series of events called NanoMeeter (originally known as Public Nano Café) in order to promote and foster discus-

sion about emerging nanotechnologies and their implications. During the first NanoCafé, which was held in the lobby of the California Nano Systems Institute, CNSI Director Evelyn Hu and CNS Co-Director Patrick McCray offered an overview of nanotechnologies, how they could change our lives, their benefits, and their potential risks. The CNS hosts now the formerly Public Nano-Café[35] events. Each NanoMeeter explores a different topic within nanotechnology, such as nanomedicine or global competition. Professors from UC Santa Barbara present an overview of each topic, and participants are invited to listen and participate in an informal question-and-answer session. While significant nanotechnology research is performed at UC Santa Barbara's CNSI and CNS, these events offer an opportunity for members of the greater Santa Barbara community to learn more about the nanotechnology field and earn a greater understanding of this emerging technology. Contact: events@cnsi-ucsb-edu.

STS Civic Forum on the Societal Implication of Nanotechnology at the University of Texas - Austin

The Science, Technology and Society[39] (STS) interdisciplinary programme in the College of Liberal Arts[40] at the University of Texas at Austin[41], aims at giving students, faculty, and others in the community the opportunity to explore the wide ranges of social impacts of emerging technologies and new scientific discoveries, using the diverse approaches of the liberal arts, social sciences, and humanities. Societal Impacts of Nanotechnology is one of the key UT-Austin STS programme areas. In October 2005, UT Austin STS programme organised the STS Civic Forum on the Societal Implications of Nanotechnology[42], a day long event attended by over 300 participants, mixed in terms of gender, ethnicity, age, occupation, and nanotechnology knowledge level which created an environment rich in dialog and information sharing from many perspectives. The event brought together stakeholders from several different societal groups including members of the general public, private sector, government and academia. The STS Civic Forum on Nanotechnology was designed to engage the attendees in a variety of ways including general education about nanotechnology, through the viewing of two informative films and a question/answer session with a diverse panel of nanotechnology experts. In addition, participants were exposed to the real-life applied applications of nanotechnology through the nanotechnology fair in which various organizations showcased products and research developed through the use of nanotechnology. By creating a «Nano Scenario», the 300 participating stakeholders all came together in an experiential activity. The forum model deepens the stakeholders' understanding of different perspectives and creates the conditions for the emergence of new forms of enlightened civic engagement and decision-making for communities, counties, states, and the national government. More information can be found at the STS programme webpage, Nano Future[43], which offers a clear introduction to the societal implications of nanotechnology.

Nano Science & Technology Studies at the University of South Carolina: The South Carolina Citizens' School of Nanotechnology

Funded by the University of South Carolina (USC) and the National Science Foundation, and coordinated by the Nano Science & Technology Studies (nSTS[36]) group at the University of South Carolina NanoCenter[37], the South Carolina Citizens' School of Nanotechnology[38] has been offering a means to improve non-scientists' knowledge of nanotechnologies, and nurture their confidence for having active and constructive voices and roles in discussions of nanotechnology policy. The citizens' school takes place in spring and autumn of every year. Every round consists of six to eight weekly meetings, featuring a series of background readings, presentations, visits to nanotechnology laboratories, and discussions. Around 30–40 participants attend every school. There is an ethos of dialogue: the participants question the experts and have many opportunities to express their values and concerns. The success of the first SCCSN, which was slightly oversubscribed, has lead to the programme being offered regularly. Feedback from participants has been very positive. In response to suggestions and requests from participants, several features have been added: more material on societal and ethical issues; a tour of scientific laboratories to see Scanning Tunneling Microscopes (STMs), electron microscopes, and other instruments that make nanotechnology possible; and a concluding session in the form of a round-table discussion that brings together all speakers and that gives participants additional opportunities to ask questions and express concerns.

The University of Wisconsin - Madison Citizens' Consensus Conference on Nanotechnology

Supported by the University of Wisconsin – Madison Rural Sociology Department,[44] the UW Madison Nanoscale Center and Engineering[45], and the UW Madison Integrated Liberal Studies[46] as part of their joint Initiative on Nanotechnologies, The Madison Area Citizens' Consensus Conference on Nanotechnology[47] was held in April 2005 with the objective to raise the profiles of both nanotechnologies and citizen participation through the media and to gain the attention of elected officials as well as an understanding of if, and how, participation in a consensus conference affects citizens' understanding of a subject and their sense of political empowerment. Modelled on the Danish deliberative process, Madison's first consensus

conference aimed to allow area citizens to consider the promises and perils of the many possible future nanotechnologies before they reach the market. The project was based on the twin premises that citizens have the right to have a say on all matters that affect their lives and that lay people are able to understand complex information and may have insights that specialists do not consider.

During two months thirteen demographically diverse Madison area citizens were recruited through press coverage in local newspapers, television, radio, and press releases to major newspapers, on the basis of the organiser's belief that they could best contribute to a well-rounded citizen panel. The conference took place over three Sunday meetings, before which participants read background material on nanotechnologies. At the first meeting, participants discussed their reading and developed a list of questions about nanotechnologies. At the second meeting, seven specialists from a range of fields, including engineering, toxicology, policy analysis, communications, and bioethics sought to address participants' questions in a public forum. This meeting was open to the public and 30 people attended. At the third meeting, the citizen panellists drafted recommendations for the government, on the basis of their reading and two discussion sessions. The recommendations were launched in a report[48] at a press conference for elected officials and the media on April 28, 2005. The panellists' recommendations covered greater health and safety testing of nanotechnologies materials, product labelling, provision of mechanisms for citizen involvement in the direction of research, greater media coverage, and increased funding for exploration of the societal and ethical impacts of nanotechnologies. Copies were also sent to all Wisconsin legislators. Six state-elected officials attended the conference's press event, but whether they have taken any action on the recommendations is unclear.

The University of Wisconsin - Madison's Nano Cafés

Sponsored by members of the Citizens' Coalition on Nanotechnology, in cooperation with faculty in the UW—Madison Nanoscale Science and Engineering Center[49] and the Nelson Institute for Environmental Studies[50], the Madison's Nano Cafés[51] have been giving citizens access to the normally somewhat mysterious realm of nanotechnology research. After the Madison Area Citizens' Consensus Conference on Nanotechnology[52] organized at the University of Wisconsin - Madison in the spring of 2005, several members of the citizen panel wishing to continue engaging with scientists and educating the public about nanotechnology, formed the Citizens' Coalition on Nanotechnology (CCoN). In order to achieve this objective, a professor involved in the conference suggested the Science Café idea, having attended one in Europe, where the concept originated around 1997, namely in France in England. Launched in July 2006, the Nano Café series provide a casual atmosphere in which people who want to know more about nanotechnology can listen to experts, ask questions and share ideas. Thus, the Madison-area residents have a unique forum to exercise debate on specific topics going from potentially hazardous nano-sunscreens and cosmetics to privacy concerns raised by biosensors, from environmental and medical to military uses of nanotechnology. In order to reach diverse audiences, the Nano Cafés are held in different parts of the community -coffee shops, libraries, or community centres. UW-Madison experts explain their work, answer questions and address concerns from members of the public as part of a lively conversation about the impact of recent research. The focus of the event is definitely on the questions of those in attendance, most of whom are non-scientists. In order for Nano Cafés to be as democratic and participative as possible, a growing number of citizens are actively involved in organizing Nano Cafés—helping to select topics, scientists, readings, and even presenting information about nanotechnology at the events. In the end, attendees are also asked to point out the themes they want to hear more about during the next Nano Cafés. Detailed information on the upcoming[53] and past[54] Nano Cafés can be found online.

Public Participation in Nanotechnology Workshop: An Initial Dialogue

Approximately 175 people, from a broad spectrum of organizations, government, industry, media, and academia attended a workshop on Public Participation in Nanotechnology on May 30-31, 2006 in Arlington, Virginia. In an initial dialogue on the subject, participants learned about and discussed possible subjects for and approaches to engaging the public on nanotechnology-related issues.

The workshop was sponsored by the Nanoscale Science, Engineering and Technology Subcommittee, and organized by the National Nanotechnology Coordination Office (NNCO) with support from the U.S. Environmental Protection Agency (EPA), the International Association for Public Participation (IAP2) and the National Coalition for Dialogue and Deliberation (NCDD).

The workshop agenda[55] included presentations dealing with questions and topics such as: Why Participation? What Outcomes Should We Seek? How Should We Approach Public Participation for Nanotechnology? How Should We Conduct Public Participation for Nanotechnology? Abstracts[56] of the presentations are available on line. Participants[57] heard from experts speakers[58] in the areas of public participation models and best practices, issue frames, risk and science communications, and public participation in other high-tech areas. Break-

out group dialogues focused on key issues and identified areas of consensus and recommendations for report back to the larger group and integration into a final report. The workshop's proceedings are being synthesized into a report that will be made available publicly

For further information contact Cate Alexander[59], Communications Director National Nanotechnology Coordination Office.

NIOSH public consultation on guidance document regarding medical screening of workers exposed to nanoparticles

The National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention (NIOSH, CDC[60]) has recently conducted a public review of the NIOSH document entitled Current Intelligence Bulletin (CIB): Interim Guidance on Medical Screening of Workers Potentially Exposed to Engineered Nanoparticles[61]. This document has been determined by NIOSH to be a Significant Guidance document, which does not have the force and effect of law. The overall goal of the review was to enhance the quality and credibility of Agency recommendations by ensuring that the scientific and technical work underlying these recommendations receives appropriate review by independent scientific and technical experts. The draft CIB was developed to address concerns about whether workers exposed to engineered nanoparticles will be at increased risk of adverse health effects and whether medical screening or some other type of occupational health surveillance is appropriate for these workers. Although increasing evidence indicates that exposure to some engineered nanoparticles can cause adverse health effects in laboratory animals, insufficient medical evidence exists at this time to recommend the specific medical screening of workers potentially exposed to engineered nanoparticles.

The peer review charge, consistent with NIOSH peer review practice, is meant to ensure that credible and appropriate science is used in the development of its recommendations on the medical screening for workers exposed to nanoparticles. The objectives of this document are to describe the scientific evidence relevant to exposure to engineered nanoparticles, the elements of an occupational medical screening programme, and the overall aspects of a good health surveillance programme in identifying and preventing exposure to potential hazards. The charge to the Peer Reviewers is to review the document to determine whether the hazard identification is a reasonable reflection of the available scientific studies, the discussion of occupational health surveillance including medical screening is consistent with sound occupational health practice, and the conclusions that form the basis of the recommendations are appropriate.

To facilitate review of this Current Intelligence Bulletin, the five questions below should be considered:

1. Do the data cited support the conclusions of the document?
2. Are the conclusions appropriate in light of the current understanding of the toxicological data?
3. Is medical surveillance appropriate at this time for workers with potential exposure to engineered nanoparticles; if so, what form(s) of medical surveillance are specific for such workers?
4. What are the potential benefits, adverse impacts, and limitations of medical screening of workers potentially exposed to engineered nanoparticles?
5. What are the potential benefits, adverse impacts, and limitations of establishing an exposure registry for workers exposed to engineered nanoparticles?

The Peer Reviewers will be provided all substantive public comments received in NIOSH by February 15, 2008.

A public meeting has been held on January 30, 2008, at the Robert A. Taft Laboratory in Cincinnati, Ohio, as a forum for scientists and representatives of government agencies, industry, labor, and other stakeholders to discuss the document. The meeting was open to the public. Priority for attendance was given to those providing oral comments. Written comments on the document are accepted by email[62] or using the online form[63] from December 14, 2007 through February 15, 2008.

Endnotes

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Australia & New Zealand

The CSIRO minerals' nanotechnology and Society project: Two public workshops

The Commonwealth Scientific and Research Organisation (CSIRO[1]), Australia's national science agency, works to provide new ways to enhance the economic and social performance of a broad range of industry sectors, many of which are involved in N&N R&D. Focusing on social implications and governance of N&N, a social science research group working in the Sustainable Development research area[2] of the CSIRO minerals[3] division has initiated in 2003 a series of public dialogue activities as part of the «Nanotechnology and Society» project. Two public workshops and a set of interviews with key informants were conducted in 2004: one in Bendigo and one in Melbourne.

Held in March 2004, the Bendigo Workshop on Nanotechnologies, brought together nanotechnology specialists, academics, CSIRO staff, government representatives and community members to learn about and discuss some of the applications and possible social and environmental implications of N&N. The objective was to through listen to and analyse the public participants' views so as to inform the shaping of an ethical and ecological framework for CSIRO's research decisions.

The methodology consisted of a one-day regional workshop with community members, nanotechnology specialists, CSIRO staff, and government representatives, brought together to learn about and discuss some applications and possible implications of nanotechnologies. Participants were divided into small working groups that were allocated a hypothetical scenario kit to stimulate discussions about the social, economic, and environmental implications of nanotechnology.

Participants displayed a similar mix of optimism and concern that has emerged in other public engagement activities on nanotechnologies, i.e. participants supported nanotechnology initiatives that could demonstrate socioeconomic wellbeing and environmental sustainability, particularly concerned with issues of regional economic development. Participants called for CSIRO to be more pro-active in engaging the public on decision-making in science and technology, and to demonstrate that it takes the views of the public seriously by ongoing consultations and giving of feedback. While the response of the public has been positive, the work has not met the original goal of influencing CSIRO's N&N research agenda.

Workshop organisers have used the data collected to draft a 'community issues checklist', reflecting the issues raised by the Bendigo participants. The list is intended to help scientists and research planners reflect on the social, environmental, and economic implications of their work. For a full account of the findings

and a copy of the checklist, see Cameron et al (2004). Nanotechnology: the Bendigo Workshop[4].

The Melbourne Citizens' Panel on Nanotechnologies aimed at exploring different perspectives on the implications of nanotechnology research and development in five areas: commercialisation; ethics; regulation; environment; and social impacts. The topics were chosen on the basis of the data collected from the Bendigo workshop. The methodology consisted of a one-day Citizens' Panel focusing these five issue-areas in the context of nanotechnology. These issues were looked at in the context of three different perspectives: industry; government; and community. The self-selected participants heard presentations by expert witnesses and took part in group-discussions. At the end of the day, they divided into groups according to the three categories listed above, and every group formulated an answer to the hypothetical question: 'What statement will Australia make to the United Nations Forum on Nanotechnology in 2006?' Additional research was done through a literature review and stakeholder interviews.

The Citizens' Panel confirmed the findings of the Bendigo workshop—ie, that engagement with the public by scientific institutions such as CSIRO may assist their decision-making and reflective processes. Both projects found that discussions were less polarised and participants more willing to engage with different perspective than the organisers had anticipated. Asking participants to look at every issue from the three perspectives of industry, government, and community helped people take into account the many different considerations involved in research and development. This contributed to providing slightly more nuanced responses than those that have emerged from similar processes elsewhere. For a full analysis of the findings of the workshop, see Katz et al (2005). Citizens Panel on Nanotechnology: Report to Participants.[5] For a global analysis of the CSIRO experience of public dialogue, see Solomon et al (2005) Talking about Nanotechnologies: Experiences of public dialogue at CSIRO[6].

The New Zealand Focus Groups on Nanotechnologies: Developing an understanding public attitudes towards nanotechnologies

The Agribusiness and Economics Research Unit (AERU) from Lincoln University has for some time been involved in researching public reactions to biotechnology through national focus groups and surveys. With funding provided by the MacDiarmid Institute for Advanced materials and Nanotechnology[7], AERU organised launched in June 2005 the first New Zealand research on public reactions to nanotechnology. The overall purpose of this project was to inform the development of nanotechnologies and their applications through developing an understanding of public reactions and attitudes. Specific objectives included identifying and comparing reactions to nanotechnologies and some nanotechnology applications and providing guidance for interactions between scientists, policy-makers, and the public.

The method consisted of a series of focus groups which met three times during the months of June to November, 2005. Overall, there were a total of 40 participants with ages ranging from 25 to 72, of which nine were male. The groups were facilitated with a general plan involving the introduction of topics and use of educational material. Apart from these forms of standardisation, the method encouraged the facilitation of discussion of emergent themes. An introductory session involved consideration of examples of topical issues involving science and technology. The second session used an educational video to familiarise participants with nanotechnology followed by discussion of everyday actual commercial products that incorporated nanotechnology. The third session used six examples of nanotechnology developments that may occur in the next 25 years to prompt discussion.

Participants' views reflected the attitudes and concerns expressed at similar events elsewhere: People were generally supportive of nanotechnology developments with apparent social, economic, and environmental benefits, but were concerned about uncertainties in health and safety and environmental sustainability. There were concerns about the 'hyped' and biased nature of much of the information available about nanotechnologies, and calls for more reliable information to be made available to the general public. For a full analysis of the findings, see the final report «Nanotechnology—Ethical and Social Issues[8]».

Latin America & Brazil

Latin American Nanotechnology and Society Network (ReLANS)

Coordinated by Development Studies Department at the Autonomous University of Zacatecas (UAED-UAZ[9]) and by the Centre for Interdisciplinary Research in Sciences and Humanities at the Autonomous National University of Mexico (CEIICH[10]) in Mexico, the Latin American Nanotechnology and Society Network (ReLANS[11]) was set to discuss the role of N&N in development, notably in Latin American.

Many Latin American countries have started publicly funded national initiatives to investigate on N&N. In this emerging context, ReLANS aims at creating a forum for dialogue and information exchange on the development of N&N in Latin America. To accomplish this objective, ReLANS has been setting up agreements

and collaboration programs with academic institutions, governments and society in general, both domestic and foreign, with the purpose of examining the impact that such emerging technology will have in Latin American societies. A core objective for ReLANS is to evaluate the effects that nanotechnology has on politics, the economy, society, the environment, the legal sphere and the ethical issues surrounding the use of this technology which includes imported goods that incorporate some form of nanocomponents.

What is the current situation in regard of the advancement of nanotechnology worldwide and what is the role of Latin America? What are the benefits and the implications for Latin America in relation to the development of nanotechnology? What are the main uncertainties associated with nanotechnologies that are of concern for the society and the environment? What are the implications of the use of nanotechnology for civil society and the military, and how can this be evaluated within the Latin American reality? To what degree are N&N of interest to the public in Latin America? What is the level of knowledge that people has regarding the issues surrounding nanotechnology? What can be done to stimulate and to promote a dialogue related to the benefits and risks of nanotechnology, among experts, the public and between social organizations? How and what instruments can be used in order to regulate both nanotechnology research and the commercialization of «nanoproducts» in Latin America? These questions reflect some of the main concerns for ReLANS, that in a way could serve as guiding principles for the scientific and public discussion regarding nanotechnology:

NanoAventura: A Brazilian exhibition on nanoscience and nanotechnology

The NanoAventura[12] (NanoAdventure) was developed in 2005 and represents the first travelling exhibition of the UNICAMP Science Museum, a cultural and leisure centre that is being developed in the city of Campinas, in the state of São Paulo (Brazil). This informal educational experience aims to motivate scientific interest and curiosity on this emerging field, presenting basic notions on nanoscience and potential uses of nanotechnology.

One guide and four facilitators lead an hour-long visit for a group with a maximum of 48 participants. After a video and a performance that give some basic ideas of size, scale, and about the constituents of matter, visitors participate in interactive and collaborative computer games. Each one of the four game stations, especially designed for this exhibition, simulates experiments at the nanoscale, and can be played by up to 12 people simultaneously. It is worth noticing that the design of the games was intended to avoid as much as possible any kind of science fiction, and the design team tried to simulate experimental procedures that in principle could be carried out in real laboratories. These games were developed pretending to be instruments used to clean surfaces atom by atom with atomic force microscopes, to introduce specific drugs into a cell, to assemble nanocircuits with scanning microscopes, and to perform a virtual tour into scientific laboratories. After the games, a facilitator makes a summary of what the participants have seen, and data obtained from the actual performance of the teams is used to stimulate the participants. Finally, to close the session, a 3D video visually recovers some of the previously presented ideas, extending the experience to further questioning.

Evaluations, based on written questionnaires and interviews, were conducted since the first steps of the exhibition and showed some of the difficulties and challenges in communicating a scientific area that is still new to the target public (Cf. Murriello, S.E, Contier,D., Knobel,M. «Challanges of an exhibition on nanoscience and nanotechnology[13]». Journal of Science Communication (JCOM), v.5, n.4. Dec.2006). It appeared from this evaluations that the general attitude regarding this emergent field is rather positive and confident, based on optimistic views of technology. But it also emerged an appeal related to questions of biology and health.

Endnotes

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