



Communicating Nanoethics

Annual Report 4 on Ethical and Societal Aspects, ObservatoryNano WP4

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Abstract

This 4th annual ObservatoryNano report on Ethical and Societal Aspects of Nanotechnology report focuses on Communicating Nanoethics. The report aims to contribute to current EU policy making on Responsible Research and Innovation. A key aspect of this is two-way communication between citizens and EU institutions. As a resource for policy makers, this report offers insights and policy options resulting from analysis of different national public dialogue and engagement activities and their impact on public opinion and policy making. Policy makers interested in reflecting on the choices they make can gain deeper understanding from a review of risk and science communication literature included in this report. As a case study of a dialogue instrument, the present report includes results of the testing of the ObservatoryNano Ethics Toolkit. This is an instrument for scientists engaging with the public about ethical and societal aspects of their research. This toolkit and other instruments could contribute to responsible (nano) research and innovation.

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Executive Summary

Currently, how to interpret and implement “Responsible Research and Innovation” is high on the EU and international policy making agenda. Two-way communication with European citizens about emerging technologies with major potential societal consequences is a prominent aspect. In 2010, the European Commission published a roadmap for communication about nanotechnology with European citizens (Bonazzi, 2010). The present report aims to contribute to policy making by analysing national dialogue and engagement activities. These have been held in several EU member and associate states in the last decade. Could past experience with different dialogue instruments be useful to European policy makers? The ObservatoryNano has developed such an instrument: the Ethics Toolkit. Its usefulness for specific types of dialogues is discussed in this report.

What does the Commission propose to do? The European roadmap on nanocommunication introduces “a new communication model that relates to citizens’ concerns and needs”. In subsequent dialogue and engagement “the communication model’s efficacy to deliver its messages to millions of citizens” will be tested. Aims include “increasing the consensus between stakeholders, society and policy makers on EC decision making about nanotechnology; and strengthening the image of the EC as an impartial, transparent and trustworthy communicator on nanotechnology”. The activities planned in the roadmap should culminate in an electronic platform NODE for interactive communication with millions of EU citizens about nanotechnology. (Bonazzi, 2010)

Nationals of EU Member States are EU citizens since the Treaty of Maastricht of 1992; therefore they have political rights at EU level. The lack of adequate two-way communication between citizens and EU institutions hampers the exercise of these rights. Setting up such a platform could be a valuable solution, if the audience involved is addressed as citizens rather than mere laity, consumers or stakeholders.

However, the choice to focus on nanotechnology could complicate matters. National dialogues demonstrate that nanotechnology may be too abstract to engage masses of lay persons. Experts advise focusing on particular sensitive aspects or applications of nanotechnology. Consequences for citizens are easier to grasp of e.g. nanotechnology in food, cosmetics and other consumer products. More limited stakeholder groups are interested in occupational safety and life cycle and environmental aspects. Currently, policy makers prefer specific stakeholder dialogue in closed working groups. The results should be reported to the public transparently. New broad public dialogue processes focus on policy dilemmas close to citizens’ concerns and interests, such as energy policies and healthcare. Key enabling technologies may be addressed in these broader dialogues.

Activities aimed at contributions to government and governance and awareness raising have apparently been more effective than attempts at developing new forms of direct democracy. In policy making on priorities in research and innovation, the triple helix of research, industry and government remains

dominant. Government bodies making policies on regulation and risk governance are institutionalising the involvement of stakeholders. Experiments with direct democracy had more limited success and may depend on the political climate.

What instruments can be used in such dialogue activities? As a case study, experiences with the ObservatoryNano Ethics Toolkit are highlighted. This is an attempt to inspire and provide a language for non-ethicists working with new ethically sensitive technology. Relevant concepts are offered to facilitate reflection. This toolkit is primarily intended for a scientific audience and has been tested on such groups. The toolkit could also be adapted for communicating nanoethics to different audiences and in education. It is not the sole solution to all issues related to responsible research and innovation.

Lessons can be learned from academic studies on risk and science communication. Policy makers aiming to influence public understanding should first understand this public understanding of science. Communication should address distinct audiences differently. E.g. men/women, religious/non-religious are predisposed in different positive or negative ways towards science and technology. Communicating nanotechnology should take into account the risk society concept of Ulrich Beck. In communication about science and technology, four conceptual models of the public are distinguished. In two models, the main focus is delivery of information to the public. A "deficit model", assumes that the public needs to be educated to appreciate the benefits of science and technology. A contextual model differentiates between audiences and assumes a more active role of the audience. The Ethics Toolkit could play a role in this second type of awareness raising activities. Two other models focus mainly on engaging the public. The lay expertise model emphasises non-traditional expertise found among groups in the public. This model appears to be dominant in stakeholder dialogues for nanorisk governance. It is also inherent in the ObservatoryNano Nanometer, a self-assessment tool for evaluating ethical and societal aspects of nano-enabled products. Finally, public engagement exercises aim to involve the general public in policy making. Academics have different views on "the public": laity, consumers, stakeholders or citizens. Views also differ on the appropriate timing of public engagement. The European Commission could consider these aspects in developing its communication strategy.

Currently, nanotechnology is maturing and the bulk of investment is shifting from public to private funders. At the same time, the political debate at EU and national levels focuses increasingly on risk governance and regulation of nanomaterials and nanotechnologies at the work floor, in products and in the environment. This suggests that nanocommunication initiatives taken by the European Commission could be focused on regulation. The European Commission could encourage industry and research organisations to engage in dialogue on nanotechnology in sensitive products. ObservatoryNano tools including the Ethics Toolkit and Nanometer are especially suitable for such localised dialogues.

In general, EU policy on responsible research and innovation could benefit from one or more public information and communication platforms or observatories. These should bring together relevant information from different sources, extract policy options and bring them to the attention of relevant bodies such as the European Commission, the European Parliament STOA office, European Group on Ethics and international cooperation platforms.

1 General introduction

This 4th annual report on Ethical and Societal Aspects of Nanotechnology report focuses on Communicating Nanoethics. The aim of this report is to contribute to current EU policy making on Responsible Research and Innovation. A key aspect of this is two-way communication between citizens and EU institutions.

In the last decade, the European Commission has concentrated its efforts in Responsible Research and Innovation on issues like risk management and governance, precaution and the role of scientific expertise. The European Commission has proposed the new HORIZON 2020 research and innovation programme in 2011, including: excellent science, industrial leadership and societal challenges. Societal engagement and responsible research and innovation are horizontal activities. How to implement this is a key question on the policy agenda. (see also Sutcliffe, 2012, Sutcliffe & Kinf, 2012)

In 2010, the European Commission published a roadmap for communication about nanotechnology with European citizens (Bonazzi, 2010). This roadmap proposes a comprehensive communication strategy including awareness raising and public engagement activities at EU and Member States levels. Likewise, the OECD has developed and tested practical guidelines for communication and outreach about nanotechnology in cooperation with member states. (OECD, 2012) The present report places these initiatives in context by analysing experiences with national dialogue and engagement activities that have been held in several EU member and associate states in the last decade. How could these plans benefit from past experience with different kinds of dialogue instruments? In particular, the report presents experiences with the ObservatoryNano Ethics Toolkit developed for communication between scientists and the public about ethical aspects of nanotechnology.

What does the Commission propose to do? The European roadmap on nanocommunication introduces “a new communication model that relates to citizens’ concerns and needs”. In subsequent dialogue and engagement “the communication model’s efficacy to deliver its messages to millions of citizens” will be tested. Aims include “increasing the consensus between stakeholders, society and policy makers on EC decision making about nanotechnology; and strengthening the image of the EC as an impartial, transparent and trustworthy communicator on nanotechnology”. Building on experience in earlier projects funded under the 6th and 7th Framework Programmes (FPs) for RTD (FP6 and FP7), the roadmap outlines a strategy for nanocommunication in EU funded projects in 2009-2011. This should culminate in an electronic platform NODE for interactive communication with hundreds of millions EU citizens about nanotechnology. (Bonazzi, 2010) This NODE has not yet started, but the projects have been ongoing for some years.

Why should the European Commission want to communicate with citizens about nanotechnology? The Treaty of Maastricht in 1992 grants all 495 million nationals of EU member states citizenship of the European Union. This gives them a number of rights, including political rights such as voting for, being elected into

and petitioning the European Parliament.¹ Formally having a right is one thing, but being able to exercise the right is a different matter. Citizens lacking awareness of important debates and policies at European level are not in a position to speak out and influence decision making. The current consultations² about Green Papers and other policy proposals by the European Commission usually attract far less than the millions of citizens envisaged in the nanocommunication roadmap. E.g. the open consultation "Towards a Strategic Nanotechnology Action Plan (SNAP) 2010-2015" in 2009-2010 only received 716 online responses and several written ones.³ The frequent Eurobarometer opinion polls may cover all EU Member and Associate States, but do not reach many more than 25,000 individuals in each survey.⁴ Political journalists tend to focus on debates in the national parliaments that in many cases merely call for or discuss implementation of European directives and regulations. An example is the series of discussions about risk governance of nanomaterials in the Dutch Second Chamber of Parliament between 2004 and 2011, where the government eventually promised to lobby for common European regulations rather than proposing its own legislation.⁵ In this respect, the European Commission's attempt at developing a communication model reaching out to millions of its citizens appears laudable.

Questions can be raised whether nanotechnology is the right subject for a pilot study testing such a communication model. The present report examines experiences in national dialogues and expert opinions on what could be useful future nanodialogue activities. Aims and effectiveness of different types of activities are analysed. In addition, ethics and ELSA literature on risk communication and science communication is reviewed.

As a case study, experiences with the ObservatoryNano Ethics Toolkit are highlighted. This toolkit has been developed to raise awareness and develop responsible, informed communication practices ensuring peaceful and mutually beneficial progress both for society and for the scientific and technological actors involved. Parts of the toolkit are: "How to think about ethical problems?" "How to communicate in a fair way?" "Who is responsible for what?" After a short explanation of the contents of the ObservatoryNano Ethics Toolkit, this report starts with an overview of how the Ethics Toolkit has been used and discussed in events during the ObservatoryNano project. From this experience, some conclusions are drawn on the aims for which the Ethics Toolkit can be used, and on the scope of its usefulness.

Subsequently, a variety of public dialogue and engagement activities are analysed that have been held in the last decade. Because the European nanocommunication roadmap (Bonazzi, 2010) already analyses EU funded activities, only activities by national, local or other international institutions are included in the present report. For this analysis, available information has been collected related to the following questions (in annex 1):

- a) What were the aims of these exercises?
- b) Which groups were involved?

¹ http://ec.europa.eu/justice/citizen/index_en.htm

² http://ec.europa.eu/yourvoice/consultations/index_en.htm

³ http://ec.europa.eu/research/industrial_technologies/policy_en.html

⁴ http://ec.europa.eu/public_opinion/index_en.htm

⁵ www.tweedekamer.nl

- c) In which country / countries?
- d) Which issues were discussed?
- e) What were the main concerns?
- f) How and by whom have the results of the exercises been taken up? What - if any - impact have the exercises had?

The observed impact of activities on public opinions and policy making has been analysed on the level of the region of Flanders (Belgium), and at country level in France, Germany, The Netherlands, Switzerland, the UK and the USA. These countries were selected because there has been relatively much activity in nanocommunication in these countries compared to other countries. In addition, the impact of different types of activities on different aims has also been analysed:

- Contributions to government and governance
- Direct democracy
- Awareness raising
- Academic studies

The results of some academic studies relevant to risk and science communication of nanotechnology have been reviewed in chapter 4. This review gives an overview of the state of the art on risk and science communication in ethics and ELSA literature. It subsequently zooms into particular findings of issues related to nanorisk or nanoscience communication. In preparation for the present report, a workshop on responsible research and innovation has been organised with experts and European policy makers. The results are included as well. Finally, conclusions and policy options are presented that discuss the role the ObservatoryNano Ethics Toolkit could play in public dialogue and engagement on nanotechnology. In addition, lessons are drawn from the experience in national dialogues, expert opinions and literature review that could be taken into account in the European Commission's roadmap on communicating nanotechnology.

2 The Ethics Toolkit

The toolkit for ethical reflection and communication on nanotechnology for nanoscientists has been developed and tested by CEA-LARSIM in the framework of the ObservatoryNano project. The contents of the toolkit are summarised in the figure below. The full text can be downloaded from the ObservatoryNano website.⁶ In the following section, the experience with testing the toolkit is evaluated by Alexei Grinbaum and Vincent Bontems of CEA.

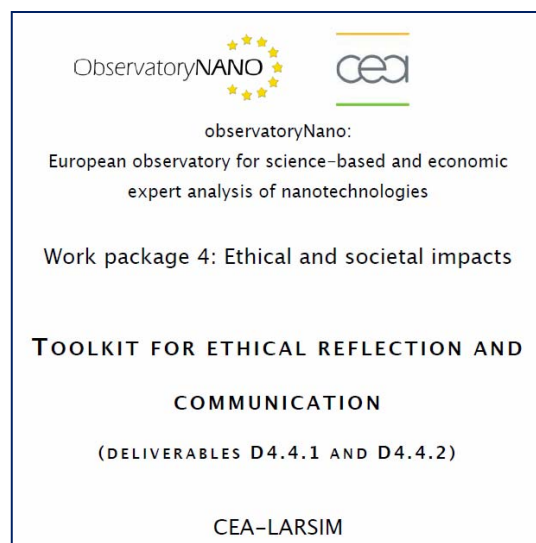
Ethics toolkit

Chapters

- Part I Introduction
- Part II Classifying ethical and societal issues
- Part III Thinking with the help of ethical concepts
- Part IV Responsible communication
- Part V Narratives of nanotech
- Part VI Glossary

Issues

- Nanobiotechnology
- Nanomedicine
- Food and cosmetics nanotechnology
- Information and communication technology
- Nanotechnology in the military: questions of dual use
- Questions relative to risk and uncertainty
- Questions relative to public communication on nanotechnology
- Questions relative to visions and fictions
- Questions of social justice
- Questions of responsibility
- Questions of epistemology



Narratives

- Prometheus
- The Golem of Jeremiah
- Frankenstein
- A positive Prometheus?
- Pandora's box
- Daedalus
- The Matrix

75 pages, can be downloaded from www.observatorynano.eu



⁶ <http://www.observatorynano.eu/project/catalogue/4ET/>

Results of toolkit test

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Reviewed by Vincent Bontems (CEA-Saclay/LARSIM)

21 February 2012

General remarks

Since 2010 the Toolkit for ethical reflection and communication (ObservatoryNano deliverables 4.4.1 and 4.4.2) has been tested at several dozen meetings and workshops in scientific audiences of various types (see annex 1). These included:

- Presentations in large groups (45 people and more) followed by a discussion.
- Presentations in medium-sized groups (15-45 people) followed by a discussion.
- Workshops in small groups (7-15 people) with detailed feedback and suggestions.

The Toolkit has proven successful on its main goal: to encourage scientists to develop a reflective approach on ethical and societal impacts of their research. Despite finding this topic generally difficult because of lack of relevant training and philosophical education, scientists were better able to identify ethical questions after having worked with the Toolkit. As the Toolkit was tested mainly on groups of scientists without prior experience of ethical discussions, after the workshops they have shown accrued interest and clearly visible curiosity in pursuing this type of reflection.

It has been recorded that the targeted approach of the Toolkit and the choice of language that is directly suited for debate in a scientific audience were instrumental in communicating the message in an easier and directly comprehensible way.

Recurrent general suggestions include:

- A need to develop methodological materials for applying the Toolkit in different groups (by target audience, size and time span)
- A need to translate the Toolkit into national languages to facilitate understanding and to increase its impact on the scientist's thinking

Remarks to Part I

This Part is usually skipped in oral presentations and even upon reading the written version. It's too short for being able to present a detailed argument, and the positions aren't convincing because they obviously call for a deeper reflection. It has been suggested that Part I be merged with Part III for a thorough presentation of philosophical ethics and a detailed analysis of the questions asked in Part I.

Remarks to Part II

This Part is usually acclaimed as being the most directly operational part of the Toolkit. Most scientists begin to read the document here. They react with interest to the structured form of the catalogue of ethical questions. They also treat with curiosity the subsections that present ethical questions that aren't normally discussed in ethics committees: questions of epistemology and ethics, questions related to visions and fictions, and so forth. This Part could evolve in a small brochure 'Ethical Questions of Modern Technology' to be used by research organizations and the European Commission for raising awareness of all stakeholders (without limitation to scientists only).

It has also been noted that many of the ethical questions presented in Part II are not new (the Toolkit makes this clear, too). However, the Toolkit does not contain a historic review of science-society discussions of past years, where such questions had been raised with regard to previous generations of emerging technologies. Scientists are keen to learn from experience, and a historic overview with some concrete examples may become a useful addition.

Remarks to Part III

This Part is a short introduction to philosophical ethics. Some workshop participants found it useful but too short, while those willing to remain at a purely 'operational' level reacted to it without pronounced interest. Globally, each kind of feedback presents approximately one half of collected responses.

It seems that the connections made between ethical concepts and particular technological cases (called "case studies", like the question of toxicology, etc.) aren't particularly useful in this Part. It has been suggested that it could be rewritten as a 'thesaurus' of philosophical terms or a separate introductory essay on philosophical ethics, by removing the links with technology that were sometimes characterized as artificial. It seems that the best solution would be for the Toolkit to include a review of ethical concepts, while the audience (consisting of researchers) should be asked to contribute concrete examples from their experience.

It has also been suggested that modern ethical theories, in particular ethics of *care*, should be included and explained.

One recurrent critique received from scientists concerns the level of simplification in this part of the Toolkit. At several occasions it was claimed by particularly enthusiastic and philosophically minded workshop participants that the scientist, even if s/he has no prior knowledge of ethical theory, would be willing to learn more than basic concepts. As an example, it has been suggested to add to the presentation of Kant's categorical imperative a deeper discussion of action rules, including Socrates' and other alternative principles.

Generally speaking, this part of the Toolkit could evolve into a standalone tutorial on philosophical ethics, and the short presentation attempted in the existing version of the Toolkit was sometimes found excessively simplified.

It has been found, too, that the concepts introduced in Part III were often used by the researcher in his future scientific work, when dealing independently with the new ethical questions raised in the course of their research.

Remarks to Part IV

This Part has produced numerous but mixed reactions. Most participants appreciated analysis in the narrative subsections, sometimes finding it too short. It was often argued that the subsection on “halo of nanotechnology” should be separated from the questions of communication and moved to a more substantial philosophical analysis.

Many participants have expressed their concern that the suggestion to refer to ‘virtues’ (e.g., lucidity, modesty, openness) in communication was a shortcut with uncertain consequences. It has even been said that brandishing these virtues openly may be perceived as a marketing campaign. This was mostly due to novelty of the proposed approach, based on a philosophical motivation for ‘virtues’ rather than a simplistic PR point of view. As a result, it has been suggested that a full-fledged section on ‘virtue ethics’ be inserted here in replacement of the existing text. It seems necessary to give a complete presentation of the notion of virtue ethics in philosophy, then prove its relevance for scientific communication and science-society relations and explore the opportunities that it presents for communicators as well as working scientists.

Concerning the subsection on narratives, it has been suggested to move it to Part V, where it naturally belongs by subject area.

Remarks to Part V

This Part was mostly used as a tool to open up the debate and let the scientist express his or her thoughts without having to deal with unfamiliar concepts of philosophical ethics. Since narratives belong to common culture, they have proven instrumental in igniting the discussion and involving in it even those participants whose own thinking had been paralyzed by the unusual character of topics under consideration. The emotional character of narratives was helpful in overcoming purely rationalistic accounts of science-society relations and appealing to the scientists’ own affective reaction in order to get them involved in the debate.

At most workshops a common understanding has been achieved that contemporary research is perceived by society through narratives that circulate in it, rather than the specialized knowledge only accessible to experts. However, two observations are due here. First, some philosophers coming from the analytic tradition find it hard or undesirable to use narratives when presenting ethical questions in a scientific audience, for their purported lack of rationality. Second, the scientists themselves sometimes criticized the use of narratives, because their connection with their everyday work was generally observed as far from being self-explanatory. As a recurrent remark, it has been argued that narratives should not be used without interpretation and suitable commentary, or otherwise scientific community would expose itself to the risks of uncontrolled judgement on the basis of narratives that have little or nothing to do with the reality of contemporary science. The question was asked, particularly by active communicators, as to what form of presentation of these narratives would be best suited to the purposes of discussing ethical questions of modern technology. It has been noted that many scientists aren’t spontaneously capable of interpreting complex myths, such as Daedalus or Golem, and finding a connection between these stories and their own work. Younger students are often more active here than midcareer researchers. Some participants indicated that they would need guidance in order to avoid that their interpretation be limited to simplified “yes-no” association (“this is me” or “this isn’t me”).

However, some scientists have suggested that such associations should also be kept as a part of legitimate interpretation of narratives.

Among the narratives presented in the Toolkit, those of Prometheus and Pandora were most widely used during the workshops. Modern myths, e.g. The Matrix, had less appeal for the scientific community, although the problem of science-fiction has been deemed important for communicating science to teenagers in order to raise a new generation of researchers.

During the tests of the Toolkit in Asia, notably Japan and South Korea, it has been noted that the set of narratives is culture-dependent and should be modified for the application of the Toolkit in non-European cultures. Colleagues in South Korea and India have expressed interest in developing 'localized' versions of the Toolkit. Colleagues in Quebec have expressed the need to balance what they perceived as European myths by a different evaluation of these narratives that one finds in Northern America. It is clear that this part of the Toolkit needs to be adapted to the particular cultural background of the audience, whether Californian techno-enthusiasts or Japanese engineers without any experience of working with the narratives common in Western culture.

3 Public dialogue and engagement

Whereas in the last chapter, the case of the Ethics Toolkit as an instrument in communicating nanoethics was explored, this chapter broadens the scope to experiences in national dialogues. The European Commission, governments and stakeholders in several European and other countries have initiated a wide range of projects and activities aimed at informing, engaging and debating with distinct groups in society about nanotechnology. The report “Communicating Nanotechnology” published by the European Commission (Bonazzi, 2010) gives a recent roadmap of past, current and planned activities funded by the European Commission.

The present report complements the EC roadmap by reviewing national activities held in the last decade and analyzing results. The analysis will be on aggregate national efforts and impacts, and by aim of activity and targeted audience. The national analysis will include the following countries in alphabetic order: Belgium, France, Germany, the Netherlands, Switzerland, UK and the USA. Countries are selected because several activities have been organised in them on a national and/or regional scale. Activities in other countries are also included in the analysis by aims and audience.

3.1 Analysis of national impact of public dialogue and public engagement exercises

In this section, public dialogue and engagement exercises in a number of European countries and the USA are put in context. An analysis of visible impact is made as far as the available evidence allows.

Europe in general

The European Commission and several other organisations in European countries have funded a wide range of projects and engagement exercises in the last decade. Whether and how these exercises have influenced public opinion is hard to say. One of the most comprehensive studies has been published by Eurobarometer. This organisation has polled opinions of European citizens on nanotechnology as part of periodic special Eurobarometer studies on Biotechnology in 2002, 2005 and 2010. Compared to other new technologies, Europeans were less certain about what nanotechnology could mean for society (40% did not know, 41% was positive, 9% neutral and 10% negative). Whereas between 2002 and 2005 public opinion became more optimistic, between 2005 and 2010, the number of people expecting nanotechnology to ‘make things worse’ increased. Awareness of nanotechnology remained low. In 2010, only 45% said they had heard about nanotechnology. However, 60% supported nanotechnology. (Gaskell et al. 2010)

The Eurobarometer study allows for comparing public opinions in different EU Member and Associated States. It gives some indication of what effects public dialogue and engagement exercises held prior to the opinion poll may have had on public opinion in a particular country, as discussed below.

Belgium

Between 2006 and 2010, the Flemish Agency for Innovation by Science and Technology IWT funded the NanoSoc project, organising a public and stakeholder dialogue on societal aspects of nanotechnology. The project resulted in a roadmap for responsible development of nanotechnology. This included proposals for a different approach to anticipatory governance of new technologies with uncertain consequences. The roadmap inspired a resolution adopted by the Flemish Parliament in 2009 – shortly before elections - calling for a Flemish Action Plan Nanotechnology including proposals for nanogovernance and health and environmental risk assessment. In Flanders, Parliamentary resolutions are non-binding, and have to be re-introduced again after an election. To date, nobody has taken such a new initiative. The coordinators of the NanoSoc project have made proposals for valorisation of the project outcomes, but it is up to the responsible policy makers to implement it. (see also Malsch, 2011a)

The NanoSoc project may have temporarily influenced the opinion of a majority of the Flemish parliament, its impact on public awareness in Belgium as a whole (Dutch-speaking Flanders and French speaking Wallonia) is not visible in the Eurobarometer study held around the end of the project. By February 2010, 1012 Belgian respondents to the Eurobarometer survey of Biotechnology answered some questions on nanotechnology. 41% of Belgian respondents had ever heard of nanotechnology before, less than the 46% of all EU27 respondents. Despite this lower awareness, considerably more Belgians were certain about their opinions on the effects of nanotechnology on our way of life in 20 years than the average EU27 citizen (25% don't know versus 40% don't know). Belgian respondents were more divided on whether nanotechnology should be encouraged than the average EU27 citizen. (European Commission, 2010)

	Effect on way of life in 20 years				Nanotechnology should be encouraged		
	Positive	No effect	Negative	Don't know	Agree	Disagree	Don't Know
Belgium	45%	16%	14%	25%	44%	34%	22%
EU 27	41%	9%	10%	40%	40%	25%	35%

In parallel to the sociological NanoSoc project, other bodies in Flanders have developed a strategy for nano-innovation involving some stakeholder groups. In 2008, the Flemish Scientific Council for Science and Innovation published an advice on innovation policy recommending a focus on 6 clusters including one on NANOTECH. These clusters were discussed with 200 representatives of industry and research and resulted in recommended priorities. (VRWI, 2008) More recent government proposals have included nanotechnology in a more general strategy for an "Innovation Centre Flanders", targeting challenge driven innovation in 6 focal points including eco-innovation, green energy etc. IMEC remains one of four strategic research organisations. It specialises in a.o. nanoelectronics and nanotechnology, and will receive funding of €48.235.000 in 2012-2016. There is no reference to the NanoSoc roadmap or action plan nanotechnology but there is reference to the VRWI clusters. (Vlaams Parlement, 2011)

France

Since around 2005, several rather limited dialogue projects have been organised by different organisations in France, including the independent dialogue platform Vivagora and the regional government of Ile de France. In addition, the political and policy debate is continuing in France, and the Office for Evaluations of Scientific and Technological Matters (OPECST) of the two French chambers of parliament and other parliamentary committees have examined nanotechnology and related aspects since 2003. In 2006 they organised a public hearing. The national bioethics committee CCNE has published an opinion on nanosciences, nanotechnologies and health in 2007, in the same period as the European Group on Ethics. This committee has an advisory role to political bodies.

From 15 October 2009 until 24 February 2010, the National Committee on Public Debate (CNDP) organised a national nanodebate through an internet site and 17 local events throughout France on a broad range of issues. This debate was increasingly disrupted by opponents of any debate and considered to have been a failure by French commentators.

However, the Eurobarometer poll held at the end of the French National Debate on Nanotechnology does not indicate a very negative impact on public opinions in France. The fact that this debate was nearing its end at the time of the poll may explain the higher than average awareness of nanotechnology.

By February 2010, 1018 French respondents to the Eurobarometer survey of Biotechnology answered some questions on nanotechnology. 54% of French respondents had ever heard of nanotechnology before, more than the 46% of all EU27 respondents. French respondents were somewhat more positive about nanotechnology on our way of life in 20 years than the average EU27 citizen and had more or less the same opinion on whether nanotechnology should be encouraged as the average EU27 citizen. (European Commission, 2010)

	Effect on way of life in 20 years				Nanotechnology should be encouraged		
	Positive	No effect	Negative	Don't know	Agree	Disagree	Don't Know
France	45%	8%	8%	39%	41%	27%	32%
EU 27	41%	9%	10%	40%	40%	25%	35%

The government published its response to the outcomes of the public debate in February 2012, considerably later than originally promised (by Summer 2010). In the response, the government recalled that of the €80 million dedicated to nanotechnology under the relaunch plan ("plan de relans"), 10% is for societal and health dimensions. There is currently insufficient knowledge about EHS risks and ethical and societal questions are raised. In October 2007, Grenelle de 'l'Environnement started planning the public debate that was held in 2009 and 2010. This debate gave evidence of public concerns on information, transparency and dialogue, the need for risk research and impacts on civil liberties and ethics. The government response includes three main lines:

I: Better appreciation of the issues and foreseeable risks associated to nanomaterials and nanotechnologies.

This is translated in actions related to research, development and socio-ethical issues. Research issues: the government will invest more in (eco) toxicology research and metrology, new characterisation equipment, education and training

and risk-benefit analysis. At EU and international level a risk assessment methodology should be implemented.

Development issues: at EU level, France pleads for increasingly taking into account specific properties of nanomaterials in directives and regulations (e.g. REACH revision 2012, labelling biocides and novel foods regulations). France favours European labelling of consumer products with nanoparticles. Occupational health risks should be prevented. Certification is needed to eliminate nano-waste. International standardisation efforts should develop norms for classification of nanomaterials.

Socio-ethical issues: Regarding convergence of nano, bio, info and cogno, social and human sciences should help to clarify them and their methodologies should be improved and systematised. Nanoscientists should receive training in social and human sciences. Research organisations are encouraged to set up ethics committees and CNIL is encouraged to reinforce its monitoring and alerting action on societal impacts of nanotechnology.

II: Respond to public need for continuous and actualised information on nanotechnology, its applications and corresponding public actions.

This is done by creating an interministerial government portal www.nano.gouv.fr. Already since article 185 of the law of 12 July 2010⁷, the government has made declaration of nanoparticles in products obligatory. Information that is not revealing industrial and trade secrets should be included in a public database. France, Belgium, Italy and the Netherlands are pleading for a European harmonised declaration of nanoparticulate substances. Feasibility of labelling and public information should be studied by EU institutions, CEN or states. Public awareness and education of youth should be encouraged by relevant organisations.

III: Link the different actors for responsible governance of nanotechnology development.

The government supports dialogue and exchange initiatives open to the public. An interministerial task force coordinated by the Commissariat General of Sustainable Development has to organise actions for responsible governance of nanotechnology. This includes preparatory work on possible forms of appropriate governance, and setting up a working group including stakeholders. Open questions should be covered through permanent mobilisation of relevant national organisations and through participation in EU and international working groups.

Germany

In Germany, a wide variety of dialogue and communication activities aimed at policy makers and politicians, stakeholders and the general public and youth have been undertaken since the late 1990s by several public organizations. Even though no direct relationship can be demonstrated, it appears reasonable to expect that these activities have contributed to a relatively high public awareness of nanotechnology compared to other European countries.

By February 2010, 1531 German respondents to the Eurobarometer survey of Biotechnology answered some questions on nanotechnology. 65% of German respondents had ever heard of nanotechnology before, much more than the 46%

⁷ Grenelle 2 Environment Law no 2010-788 of 12 July 2010. This includes several measures to fight pollution including the obligation of 'firms who manufacture, import or distribute substances in a nano-particulate state to declare what these substances are and what they are used for'. (Grenelle 2, 2010)

of all EU27 respondents. German respondents were about as positive about nanotechnology on our way of life in 20 years as the average EU27 citizen and had more or less the same opinion on whether nanotechnology should be encouraged as the average EU27 citizen. (European Commission, 2010)

	Effect on way of life in 20 years				Nanotechnology should be encouraged		
	Positive	No effect	Negative	Don't know	Agree	Disagree	Don't Know
Germany	43%	7%	13%	37%	46%	29%	25%
EU 27	41%	9%	10%	40%	40%	25%	35%

On a political level, discussions in the Parliament since 2004 have contributed to the development of government action plans for nanotechnology incorporating promotion of innovation as well as risk assessment, regulation and dialogue. Until now, dialogue activities have been mainly limited to stakeholder dialogues, in particular those organized by the NanoKommission. In the Nanotechnology Action Plan 2015 (BMBF, 2011), a citizens dialogue on nanotechnology was announced. However, the two first citizens dialogues initiated by BMBF in 2011 are not explicitly targeting nanotechnology but rather Energy Technology for the Future (as a response to the renewed discussion on Nuclear Energy sparked by the Fukushima accident in Japan), and Research for Our Health. These topics are closer to daily life and may attract more interest than an abstract theme such as nanotechnology. Nanomedicine and convergence of nano-bio-info-cogno technologies are addressed in the dialogue on healthcare. (c.f. Malsch, 2011b)

The Netherlands

In the Netherlands, policy and stakeholder dialogue about nanotechnology started in 2003, at the initiative of the Rathenau Institute. Nanoscientists and industrialists had been discussing potential implications and planning of a research programme for nanotechnology since 1996. In the research programme NanoNed, technology assessment and social science research into ethical, legal and social aspects was an integral part from the beginning (2005). Government policy concerns included socio-economic opportunities as well as risk governance. These were articulated in a vision document (2006) and an action plan (2008). As part of this action plan, the government installed a Committee Societal Dialogue Nanotechnology who organised the national dialogue in 2009 and 2010.

By February 2010, 1018 Dutch respondents to the Eurobarometer survey of Biotechnology answered some questions on nanotechnology. 61% of Dutch respondents had ever heard of nanotechnology before, more than the 46% of all EU27 respondents. Dutch respondents were more positive about nanotechnology on our way of life in 20 years than the average EU27 citizen but on the contrary, significantly more respondents did not think that nanotechnology should be encouraged than the average EU27 citizen (35% compared to 25%). (European Commission, 2010)

	Effect on way of life in 20 years				Nanotechnology should be encouraged		
	Positive	No effect	Negative	Don't know	Agree	Disagree	Don't Know

Netherlands	52%	9%	9%	30%	41%	35%	24%
EU 27	41%	9%	10%	40%	40%	25%	35%

This Eurobarometer poll was held at the public start of the Dutch Societal Dialogue Nanotechnology. The Committee Societal Dialogue Nanotechnology also held opinion polls on nanotechnology. This included a zero measurement at the beginning of the dialogue (August 2009) among 2545 respondents (18+) and a one measurement at the end of the dialogue (November 2010) among 3031 respondents (18+). According to these polls, awareness of nanotechnology (respondents saying that they had heard about nanotechnology) increased from 54% in 2009 to 64% end of 2010.

The government did not interfere in the national dialogue, but welcomed the conclusions of the committee. In general, all interested stakeholders are welcome to participate in governance of nanotechnology, and key players like employers associations and trade unions, environmental and consumer associations have participated in dialogue activities. For the general public, nanotechnology remains a rather abstract concept. Those who participated in the dialogue tend to welcome potential benefits as long as government, industry and research organisations take their responsibility for risk assessment and regulation. The government welcomes further public dialogue on nanotechnology but does not intend to take the initiative again. (c.f. Malsch, 2011)

Switzerland

Switzerland is a world leader in dialogue about nanotechnology risk governance. In 2003, the Parliamentary Technology Assessment organisation TA Swiss was among the first to publish a study on ethical, legal and social aspects of nanomedicine (In Germany, TAB published a more comprehensive report on nanotechnology in the same year, c.f. Malsch, 2011b). Several organisations including Innovation Society and Risk Dialogue have been organising projects and dialogues on risk governance of nanotechnology since then. The parliament has also discussed promoting and regulating nanotechnology from 2006.

This investment in public and stakeholder dialogue seems to have paid off in public awareness. By February 2010, 1026 Swiss respondents to the Eurobarometer survey of Biotechnology answered some questions on nanotechnology. 76% of Swiss respondents had ever heard of nanotechnology before, much more than the 46% of all EU27 respondents. Swiss respondents were somewhat more positive about nanotechnology on our way of life in 20 years than the average EU27 citizen and were a bit more in favour of encouraging nanotechnology than average. (European Commission, 2010)

	Effect on way of life in 20 years				Nanotechnology should be encouraged		
	Positive	No effect	Negative	Don't know	Agree	Disagree	Don't Know
Switzerland	47%	13%	10%	30%	44%	26%	30%
EU 27	41%	9%	10%	40%	40%	25%	35%

UK

The UK initiated international debate on societal aspects of nanotechnology after Prince Charles drew attention to a report of the Canadian NGO ETC group calling for a moratorium on nanomaterials. (E.g. The Daily Telegraph, 2003) The Royal Society / Royal Academy of Engineering study on Nanotechnology (RS/RAE, 2004) set the agenda for responsible governance of nanotechnology in the UK and in other countries and the European Union.

After the publication of the report by the Royal Society and Royal Academy of Engineering, a number of projects and platforms were initiated for public and stakeholder dialogue on nanotechnology. Some of these ran until 2007, including two projects funded by DTI: DEMOS - The Nanodialogues and Nanotechnology Engagement Group. Other projects were also running for some time, but it is not clear who funded them (Small Talk, Nanojury, DEMOCS Card Game and Nano and Me).

The RS/RAE study dominated nano-governance in the UK until 2007, when the Council for Science and Technology published its planned progress report criticising the UK governance lack of investment in EHS research. The government announced measures to address this issue. (CST, 2007) In 2008, the Royal Commission on Environmental Pollution published a report on nanomaterials in the environment, criticising UK government risk assessment and governance strategies. In addition to government policy and funding initiatives, the government funded several dialogue platforms until 2010, including NIDG (Nanotechnology Issues Dialogue Group) and NSF (Nanotechnology Stakeholder Forum).

All this activity does not seem to have contributed a lot to public awareness about nanotechnology. By February 2010, 1311 UK respondents to the Eurobarometer survey of Biotechnology answered some questions on nanotechnology. 48% of UK respondents had ever heard of nanotechnology before, comparable to the 46% of all EU27 respondents. UK respondents were somewhat less certain about the effect of nanotechnology on our way of life in 20 years and on whether nanotechnology should be encouraged than the average EU27 citizen. (European Commission, 2010)

	Effect on way of life in 20 years				Nanotechnology should be encouraged		
	Positive	No effect	Negative	Don't know	Agree	Disagree	Don't Know
UK	40%	8%	5%	47%	38%	22%	40%
EU 27	41%	9%	10%	40%	40%	25%	35%

The government did not publish its foreseen 5 year progress report on the implementation of the RS/RAE study by 2010. Instead it published a new strategy for nanotechnology after wide consultation (HM Government, 2010). In this report, the government announced its intentions to integrate the different discussion groups into one NCG (Nanotechnology Collaboration Group). However, this strategy was published just before the elections. Since the installation of the new government, nanotechnology seems to have disappeared from the political agenda in the UK. Stakeholder dialogue appears to have been stopped. A report on research council support for nanoscience criticised the lack of coordination between a variety of national 'nano' committees, continuity in funding and

communication with the scientific and industrial community. (Smith et al, 2010). Several opinion leaders on nanotechnology in the UK started to raise questions about this apparent discontinuation of the dialogue in the middle of 2011. Donald Bruce considered that the dialogue about nanotechnology in general had run its course, but called for a trusted authority to regulate products incorporating nanotechnology where the need arose. He did see a need for more focused continuing dialogue about specific applications of nanotechnology. (Malsch 2011c)

In November 2011, in response to questions in the House of Commons, Mr Willets commented that the government considered the nano-strategy of 2010 “a useful source of views and input” in its thinking about nanotechnology, and that he had recently organised a roundtable about it. The government was committed to “successful and responsible commercialisation of nano-scale technologies”. (Parliament, 2011)

UK - Nanofood

In 2010, the House of Lords investigated the use of nanotechnology in food and concluded that there were opportunities for applications of nanotechnology in food, but that uncertainty remained about potential risks of nanomaterials in food. The Lords were particularly concerned about the lack of openness in the food industry and its hesitation to engage in open public dialogue about nano in food. They called upon the government to encourage openness in the sector and proposed to organise targeted stakeholder dialogue between government, industry, academia and consumer groups. They also recommended that the Food Standards Agency (FSA) should publish a list of products containing nanomaterials on the market. (Lords, 2010) In response, the FSA set up the required discussion group in January 2011 and has discussed proposed policies with the participants.

In 2012, Research Councils UK (RCUK) commissioned Involve to conduct a review of RCUK dialogue and engagement exercises including in nanotechnology.⁸

USA

In the USA, the National Science Foundation has stimulated consideration of ethical, legal and societal issues of nanotechnology from the beginning of the National Nanotechnology. A first attempt at reviewing possible issues was made at the conference on Societal Implications in Arlington, VA in 2001. Furthermore, the US Congress included consideration of and social science research on such issues in the “21st Century Nanotechnology Research and Development Act” it passed in 2003. This has been articulated in the establishment and funding of two Centres for Nanotechnology in Society, at Arizona State University and at University of California at Santa Barbara in 2005. Following an evaluation after 5 years, funding for both centres will continue until 2015. David Guston (2010) considered that societal research on nanotechnology has made significant progress under NNI sponsorship in the period 2005-2010. However, the societal research portfolio was too small compared to general progress in natural science and engineering. Furthermore societal research should be better integrated in

⁸ <http://www.involve.org.uk/review-of-research-councils-uk-dialogues/>

natural science and engineering research activities. Finally public engagement with nanotechnology should be better focused on dialogue rather than education. Roco et al. (2010) witness a change of vision on nanogovernance between 2001 and 2010. The viability and societal implications of nanotechnology have been confirmed, while extreme positive and negative predictions have receded. An international community of nanotechnology research, education, production and societal assessment has been established. The emphasis on science-driven governance in 2001 has been transformed into governance driven by economic and societal outcomes. There is an increasing focus on anticipatory governance. International cooperation and competition has become a reality. "Nanotechnology is becoming a model for addressing the societal implications and governance issues of emerging technologies generally" (Guston 2010). Roco et al (2010) foresee increasing emphasis on innovation and commercialisation for societal 'returns on investment' including economic development and job creation and measures to ensure safety and public participation. Nanotechnology will become a general purpose enabling technology. The imperative will be to focus on how nanotechnology can create cognitive, social and environmental value (moral progress). Nanotechnology governance will become institutionalised. Global coordination will be needed for international standards and nomenclature, nanoEHS and ELSI. An international cofunding mechanism is envisioned. (Roco et al, 2010)

3.2 Aims of the exercises

The reviewed exercises can be categorised according to their aims. These aims fall into four general categories:

- Contributions to government and governance
- Direct democracy
- Awareness raising
- Academic studies

Government

Projects generating contributions to government policies and governance of nanotechnology were often organised by public institutions, but also by industry and civil society actors. Among these activities, two broad types can be distinguished: those involving the traditional triple helix of science, industry and government and those experimenting with non-traditional governance of nanotechnology where civil society experts were involved.

Activities involving the triple helix tend to be well integrated into decision making on investment in science, technology and innovation. For example, in Flanders, the VRWI advice on innovation policy (2006) is referred to in subsequent government strategies including investment in nano-innovation. In Germany, studies of technological trends and socio-economic impacts of nanotechnology by the Engineers Society VDI-TZ have influenced government policy making. In France, the first parliamentary study related to nano focused on socio-economic potential of micro-nanotechnology (Saunier, 2003). In the Netherlands, the government action plan on nanotechnology (2008) refers to the strategic research agenda of the National Nanotechnology Initiative for its part on

research and innovation. This agenda was developed by researchers and industrialists in consultation with the government.

Nano-governance activities involving other types of stakeholders have started as broad horizon scanning projects such as the US NSF conference on nanotechnology and society of 2001 followed by a similar conference co-organised by NSF and the European Commission (2002)⁹. This was followed by general studies of ethical, legal and societal aspects of nanotechnology by several national Parliamentary Technology Assessment organisations. These include the German TAB study on nanotechnology (2003), the Swiss TA-Swiss study on nanomedicine, the UK Royal Society / Royal Academy of Engineering Study on nanotechnology (2004) and the Dutch Rathenau Institute activities in 2004.

Later nano-governance activities focused increasingly on risk governance of engineered nanomaterials. These were organised by Parliamentary Technology Assessment organisations, but also government (and EU and OECD) departments and agencies responsible for Environment, Health and Safety and protection of consumers and employees. In addition, large chemical companies and industrial associations also experimented with stakeholder engagement. Civil society organisations including some environmental groups (ETC group, FOE, EEB), trade unions and consumer associations started campaigns or participated in nano-governance activities organised by public bodies. After an experimental phase of around 5 years, such risk governance of nanotechnology is institutionalised and integrated in public policy making on regulating nanomaterials. Stakeholder involvement tends to be on invitation based on expertise and representativity.

In Germany the Federal Ministry for the Environment (2006-2012) organised its BMU Nanodialog and installed a NanoKommission involving a variety of stakeholders, the government also funded the NanoCare citizens dialogue (2007-2009) and the Federal Institute of Risk Assessment BfR organised a dialogue and opinion survey (2006-2010). The Chemical industry BASF organised its own dialogue forum nano (2009-2010). In the Netherlands, the Rathenau Institute organised several stakeholder workshops on risks of nanoparticles and nanofood. The National Institute for Health and Environment RIVM established a knowledge and information resource on nanotechnology involving invited stakeholder representatives. The Socio-Economic Council (Employers and Employees associations) organised its own consultation on occupational safety of nanomaterials, etc.

In Switzerland, TA Swiss and several other organisations organised stakeholder dialogue on nanorisks. In France, parliament put risks of nanomaterials on the political agenda (Birraux, Raoul & Saunier, 2007). In Austria, the Nanotrust project acts as a clearing house for information about nanosafety and societal aspects and stimulates discussions. The Norwegian Technology Council project on nanosafety has resulted in a national nanoproduct register.

Even though risk governance of engineered nanomaterials including regulation is the main focus of stakeholder dialogues, other issues have also been discussed in the last decade. On the side of consumer products, there is most discussion on nano-ingredients in food, cosmetics and other household products. Labelling and transparency are core issues next to safety. Examples of such projects are the

⁹ http://cordis.europa.eu/nanotechnology/src/events_archive.htm

US Woodrow Wilson Nanotech project, the UK House of Lords study on Nanofood, the German BfR dialogue with consumers and several projects in the Dutch nanodialogue.

In addition, ethical, societal and religious aspects of nanomedicine, privacy and security issues related to ICT and other applications of nanotechnology, and the nanogap between haves and have-nots are among the issues most discussed. Examples include the Meridian Institute project on Nano and the Poor, the German Youth forum on nanomedicine, several projects in the Dutch nanodialogue, TA Swiss projects on nanomedicine and nanofood and projects organised by STOA, Rathenau Institute, ITAS/TAB and Danish Council of Ethics on human enhancement, synthetic biology and converging technologies. Several (bio)ethics committees have also given opinions to government on nanoethics, including the French and Portuguese National Bioethics Committees and UNESCO COMEST working group on ethics of nanotechnology. However, many of these issues are not specific to nanotechnology and any ongoing discussion tends to be under different headings. E.g. the Danish Board of Technology has had projects on more general issues like ICT and privacy, responsible innovation and chemical safety.

Direct democracy

In addition to the government problem oriented activities, a variety of projects have attempted to develop new forms of direct democracy in decision making on science and technology. In France, the civil society organisation Vivagora has been aiming for capacity building for participatory democracy since 2005. Ile de France Nanocitoyens aimed to involve public opinion in political decisions and C'NanoIDF's transversal action bureau on nanoscience and society aimed to create and develop relations between nanoscience actors and society. No information could be found on the impacts on decision making of these projects. In Belgium (Flanders), the NanoSoc project developed a roadmap for responsible development of nanotechnology integrating public dialogue in priority setting in S&T. The project had temporary success by the adoption of a resolution on a nano-action plan in the Flemish Parliament, but this has so far not led to noticeable change in ST&I policy in Flanders.

In the UK, after the Royal Society / Royal Academy of Engineering (RS/RAE) study on nanotechnology, several projects were undertaken aiming at so-called upstream or midstream public engagement. These include the Nanojury in 2005, the Small Talk project in 2004-2006, the DEMOS nanodialogues in 2007, the DEMOCS card games on nanotechnology and related topics and the web-portal Nano and Me. Several of these projects were mentioned by the government in its report on the implementation of the RS/RAE recommendations in 2007. The funding council EPSRC also experimented with public engagement in priority setting on funding nanomedicine projects. This is widely regarded as a successful case (c.f. Malsch, 2009, 2011c, 2012). However, the impact on policy making appears to depend on the political climate. Government interest in nanotechnology in general and in public engagement with nanotechnology has faded since the elections of 2010.

The Dutch and French national dialogues on nanotechnology also included the aim to discuss nanotechnology and communicate public views and concerns back to government. Even though the Dutch dialogue received positive reactions and the French negative, in both cases the impact on government policies appears to

be limited. Both governments in their reactions highlighted strategies they had already developed before the public dialogues and did not announce remarkable changes in policies or funding strategies in response to the outcomes of the dialogues. (French government, 2012, Dutch government, 2011)

Awareness raising

Other projects aimed to raise public awareness of nanotechnology and to educate different audiences. Some projects specifically targeted young people.

Projects aiming to educate young people and adults include the Nanotruck mobile exhibition of nanotechnology and its applications that visited schools and events throughout Germany. This nanotruck attracted interest of policy makers in other European countries as well. In the Dutch national dialogue a similar mobile “nanosupermarket” included artist impressions of possible future nanoproducts.

Other projects in the Dutch nanodialogue developed and tested secondary school education materials and raised awareness of nanotechnology among young people in their leisure time at a pop festival, through an internet contest and other media. The project Nanosociety is continuing after the end of the dialogue and educates secondary school children about opportunities, risks, potential and concerns of nanotechnology. The Swiss Nanocube project also offers nanoeducation through internet about similar topics.

Some projects targeting the general public aimed to raise awareness for nanotechnology in general. These included the website Nano and Me (UK), several projects in the Dutch nanodialogue, again the Swiss Nanocube project and NanoUNAM in Mexico. Some awareness raising projects targeted risk assessment and regulation, including the Information platform Nanosafety in Hessen, Germany.

The impact on public awareness of each individual exercise is hard to measure directly. The Eurobarometer results of awareness in different individual countries suggest that public awareness in countries with more activities tends to be higher than in other countries.

Academic studies

Finally, ethical and societal aspects of nanotechnology have been the focus of academic studies since about 2005. Some are large studies integrated in national nanotechnology research programmes, such as the TA NanoNed flagship (2005-2010) and follow-up Theme 1 on Risks Analysis and Technology Assessment (RATA) in the NanoNextNL programme (2011-2015). Other large programmes are more on a distance such as the two Centres for Nano in Society in the USA that are nevertheless an integral part of the US National Nanotechnology Initiative. In addition, there are smaller studies by research groups and centres. These include the NanoOffice at TU Darmstadt, Germany, some projects at the 3TU Centre for Ethics of new technology in the Netherlands, the Nanoethics, Nanotrust and Nanoethos projects in Norway, the Centre for bioethics and nanoethics in Denmark and the I2TA project in Japan. The NanoSoc project in Flanders mentioned before also fits in this category. Some of these studies aim to develop understanding of science dynamics and other social studies of science

and technology. Other studies on ethical and philosophical aspects aim for reflection on ethical dilemmas and philosophy of science. Nanotechnology is here a case study of more general theories or topic for developing new dialogue and research methodologies, including the fields of risk and science communication explored in the next section. A key indicator of success of these studies could be the number of publications in scientific journals and books. Such publication data have not been identified in literature or reports. The start of the journal *Nanoethics* in 2007 and its continuation up to date is a qualitative indicator of the interest in studying ethical and societal aspects of nanotechnology among social scientists and philosophers, but relevant articles continue to be published in other journals and books as well.

In the next chapter, relevant insights of two relevant academic areas of research are presented: risk and science communication.

4 Communication and the public: Review of scholarly discussions of nanotechnology and nanoethics

The following are abstracts from peer reviewed articles and collections of articles about science communication and communication to the public with a particular focus on themes relevant for nanoscience and nanotechnology. The articles cover a wide range of topics that may be of interest for anyone wanting to learn more about the scholarly discussions related to the communication of nanotechnology. In particular, it could be relevant to the planning of the European Commission roadmap for communicating nanotechnology. (Bonazzi, 2010)

4.1 Understanding the public understanding

In order to develop communication about concepts and application of nanotechnology between scientists and the public an appropriate starting point is needed. One method of defining the starting point is to test public knowledge by questionnaires. However, there is general disagreement as to whether a better informed public as such is a more positive public when it comes to nanotechnology. It turns out that nanotechnology is hard to grasp and conceptualize for people. (p. 185, Castellini et al, 2006) Researchers should actively engage their audience in discussion, making sure the benefits and risks involved. Facilitating a discussion will help the audience have a better technical understanding of nanotechnology as well as ease their fears and concerns. (p. 187, Castellini et al, 2006)

Little knowledge exists about where the public seek information about nanotechnology. However, as with all other types of information, there is a shift towards online information. Investigations are attempted into *who* uses online sources, *what* the general public searches for and *what* they find. The study in question uses both survey data and behavioral tracking data to learn more about the use of online sources and information about nanotechnology. (p. 1083, Anderson et al, 2010) Differences appear in types of science media users: Television and newspapers attracts older users, science on the internet attracts a range of ages: 26,4% of the 18-34 years old, 28,6 of the 44-54 years old, and 25,3% of the above 55 years old being likely to utilize internet sources. (p. 1087,

Anderson et al, 2010) Gender differences were slight. Males were a little more likely than women to pay attention to science on the internet. Science internet users are more educated than users of other mediums. (p. 1087, Anderson et al, 2010) Not surprisingly, nanotechnology was searched much less than other (often older) science-related issues. (p. 1089, Anderson et al, 2010) Specific themes range from: *nanobots to health, definition, application, research and science. Future, government and regulation, information and biology* were searched, but much less. (p. 1089, Anderson et al, 2010) Consensus conferences or discussion forums are recent models of public engagement. They emphasize the importance of alternative ways for the public to seek out information about emerging technologies. These models have not yet addressed the importance of online sources. (p. 1093, Anderson et al, 2010)

When reading statistics about what the public thinks of different technologies, hereunder nanotechnology, risks and benefits, it is vital for researchers to learn more about the background for such statistics of opinions. There is little data about what is actually associated with a positive attitude which public support for funding nanotechnology depends on. However, many assumptions are made. A study has focused on how value predispositions, communications variables and different perceptions are associated with the support for public funding of nanotechnology. Nanotechnology needs public support in order to become the defining technology for the 21st century as forecasted because it needs public funding. As such it is important to try to get an idea of what influences public opinion. The deficit model of attitude formation asserts that public support for nanotechnology will grow as awareness or knowledge of it expands. Studies have shown that familiarity with nanotechnology is correlated with positive attitudes towards it. The predisposition argument asserts that personal values and heuristics could play a bigger part in shaping public attitudes towards nanotechnologies. For example, individuals who hold a pro-science and technology orientation are more likely to seek put scientific information from the mass media, to discuss science with others, which in turn, produces positive attitudes towards the technology. (p.2704, Ho, S. et al 2009)

The hypotheses connected with value predisposition, cognitive processing and mass media are based on several commonly known assumptions: The religiously grounded idea that technologies cross boundaries and researches tend to be 'playing God', makes religious belief negatively associated with public support for federal funding of nanotechnology. However, deference to scientific authority will be positively associated for public support for funding. (p.2705, Ho, S. et al 2009) The mass media have a dual function: they provide information and the media frame such as a positive tone of coverage offers heuristic cues. Another assumption is therefore that media use will be positively associated with public support for funding. (p.2706, Ho, S. et al 2009) Individuals process information by different cognitive processes, by for example talking about it with others and connecting it with pre-existing knowledge. This is news elaboration and interpersonal discussion. It is assumed that both elaborative processing and interpersonal discussion is positively associated with public support for funding. (p.2706, Ho, S. et al 2009) Risk perception is defined as the judgments people make when they are asked to characterize and evaluate hazardous activities and technologies. Perceived risk will e negatively associated with public funding, perceived benefits will be positively associated with public funding, it is assumed. (p.2707, Ho, S. et al 2009)

By a random-digit-dial in the US a survey was conducted to test the listed commonly accepted assumptions. The study examined the associations of mass

media use, reflective integration, factual scientific knowledge, trust in scientists, and risks and benefits perception with public support for federal funding. Overall, findings provide support for the hypothesis that mass media use had a positive association with public support for federal funding of nanotechnology. Notably, the results support the hypothesis that elaborative processing was positively associated with public attitudes towards nanotechnology. Heuristics in the form of value predispositions, trust and risk and benefits perception were also shown to have a bearing on public support for funding. Taken together, these findings underscore the important role of cognitive and heuristic cues when it comes to understanding how the public form attitude towards emerging technologies. The findings can be used in designing effective science communication and public outreach efforts. (p.2709, Ho, S. et al 2009) From all the assumptions, only the assumptions about scientific discussion linked with a positive attitude was not supported directly. (p.2710, Ho, S. et al 2009)

Interpersonal discussion has been the aim of other researchers, more specifically the interpersonal discussion following citizen engagement about nanotechnology: What, If anything, Do they say? Participants in a program for citizen engagement about nanotechnology are asked about their post-engagement discursive behavior. It is important to know what the impact on discursive behavior is beyond the direct participation in order to know more about what is the extended gain from public engagement activities which are time-consuming and expensive. (p. 209, Besley, J.C et al, 2008)

The focus of recent years of the importance of deliberative democracy has had a parallel in the proliferation of public engagement methods meant to involve citizens in an active dialogue about important issues. Those interested in science and environmental policy making appear particularly interested in deliberative forms of engagement. The study in question has the goal of assessing whether interpersonal discussion has the potential to extend the impact of engagement beyond those who participate directly. The method of the study is to by ask participants whether they have spoken to their family, friends, coworkers or others about their experience. Also, it addresses how the attitude towards the nanotechnology and the experts presenting the science were perceived. (p. 210, Besley, J.C et al, 2008)

The novelty of studying interpersonal communication as a consequence of deliberative democratic events is seen in the light of the general focus in political communication on media coverage as the key mediator for civic dialogue. In some cases, deliberative events are broadcasted. However, the obvious goal of extending the dialogue to others than the participants might be achieved otherwise also. Political communication research acknowledges the importance of interpersonal discussion. (p. 211, Besley, J.C et al, 2008)

The study investigates the following questions: How much will public engagements participants talk to others about their experience? It is addressed both whether they talk and what they say. Also, the participants framing of the technology they talk about and the framing of the experts who presented at the event they attended, is addressed. (p. 214, Besley, J.C et al, 2008) The participants came from the Citizens School of Nanotechnology hosted by the University of South Carolina every semester since 2004: 8 Weeks series of 90-minutes sessions. The participants of the school are not formally expected to be policy advisors but an opens discussion of the research and development and future perspectives are expected. (p. 215, Besley, J.C et al, 2008)

The participants indicated themselves that they felt they had a middling amount of knowledge about nanotechnology. Respondents were positive about the

relative benefits, compared to the risks of technology, while also seeing relatively few health and environmental hazards. They expressed very little opposition to the use of nanotechnology in commercial application and substantial support for nanotechnology and federal funding for nanotechnology. The survey indicates that people talk most to their friends and coworkers, followed by their family members. (p. 219, Besley, J.C et al, 2008) Respondents framed their feed back overwhelmingly in terms of scientific progress, which includes an emphasis on nanotechnology in terms of research and new advances. Those who framed their talk of nanotechnology in terms of scientific progress had a higher level of reported discussion with friends and both immediate and extended family. A majority reported saying positive things about the experts. (p. 222, Besley, J.C et al, 2008)

The main conclusion is that communication through citizen engagement does result in interpersonal discussion. The science communication literature provides useable classifications of the discussions: frame works for categorizing the discussions, justice as fairness, trust and confidence. The degree to which the engagement of citizens beyond those participating directly in public engagement via their personal network is of great significance and should be further developed. (p. 228, Besley, J.C et al, 2008)

4.2 Communication

Theories of communication in the academic literature have changed over the past decade, also science communication. The idea that 'facts speak for themselves' when science is presented by scientist directly or mediated by journalists is left behind. Therefore, it is not acceptable to blame it on the inadequacies of journalists and the irrationality of the public when there is an apparent failure in the communication of facts to the public and when facts are not received as expected. In order to communicate properly and to maximize the potential of science communication to the public is necessary to 'frame' the message communicated. 'Frames' can be defined as 'schemata of interpretation'. Communication is always integrated with a frame and a scheme, which is part of understanding what is communicated. These schemes allow individuals to locate, perceive, identify and label issues, events and topics. (p. 42-44 Nisbeth *in* Kahlor, L et al, 2010)

The conclusion that framing the message is absolutely necessary comes from several case studies of very different scenarios of science communication: the use of embryonic stem cells, nuclear energy, evolution and climate debate: the American Vice president Al Gore offers an example of climate debating with his 2008 book "An Inconvenient Truth". In all these cases and many others, framing as strategic messaging has been used to trigger favorable interpretations among key stakeholder and audiences. (p. 49 Nisbeth, M. *in* Kahlor, L et al, 2010)

However, understanding exactly how a message will be received by an audience is a complicated matter. Foreseeing it precisely is even more difficult. Several studies and theoretical modeling within social psychology make attempts to understand how the general public makes sense of scientific information. Sinclair and Miller have focused on *advertising* and *public relations*. These are tools organizations may use to communicate with audiences via mass media. *Advertising* involves purchasing space or time in a media vehicle and offers the greatest control over the message sent. *Public relations* provide the organization with less control of the message they wish to send. On the other hand, public

relations appear more credible and objective to audiences because the message is not clearly sponsored by the organization itself. It is important to study these types of communication because they may constitute a sizeable proportion of the relatively limited amount of scientific communication received and consumed by members of the general public. (p. 89 Sinclair, J. and Miller, B. *in* Kahlor, L et al, 2010)

The concept of technology advocacy is defined as 'efforts to support an organization's interest on issues related to science and technology'. Technology advocacy messages typically address a) the positive effects of the sponsor's activities b) the association between those activities and commonly held societal values. A case story is General Electric and their attempt to communicate about their Series of Locomotives: *Ecomagination* from 2007. Their strategy involved advertising photos of the locomotive along with a sun flower. Instead of showing a dirty, heavy diesel machine, they moved the focus to diesel efficiency and the necessity of transport. Companies engage in technology advocacy to protect their position in the market by building public support for the sponsor itself and their own products. Campaigns are often launched in response to current or anticipated controversy, and are designed to build trust while deflecting criticism of the organization, its products, or services. (p. 90+93 Sinclair, J. et al *in* Kahlor, L et al, 2010)

Science communication cannot consist of technical knowledge alone if the non-scientist is to understand it and – for times matter more importantly – if the nonscientist's attitudes are to be predicted. Therefore, research tries to investigate what types of beliefs people use to interpret messages about science – and about technology advocacy messages. One of the models to understand communication to the public is *The persuasion-knowledge Model (PKM)*. It provides guidance for indentifying a variety of beliefs that an audience accesses in response to a persuasive situation, and focuses on audience member's knowledge of a persuasive agent's goals and tactics. According to PKM three types of consumer knowledge affects the outcome of a persuasion attempt: 1) topic knowledge, 2) agent knowledge, and 3) persuasion knowledge. *Topic knowledge* encompasses beliefs about the merit of the information presented in the persuasive message. People use topic knowledge to evaluate the supporting arguments in a message as strong or weak. *Agent knowledge* encompasses beliefs about the goals and characteristics of the persuasive agent. *Persuasion knowledge* consists of beliefs about the purpose of a particular type of persuasive tactic, an audience member's own goals related to the persuasion attempt, and the actions one can take to manage the persuasion attempt. Both the target and the agent encompass all three types of knowledge. The persuasion attempt of the agent and the persuasion coping behavior of the target meet in a persuasion episode. If this episode is understood properly by understanding the audience motives, it will be possible to seek strategies for the impact of the advocacy message and the outcome. Trust and accountability play a very important part in this process. (p. 95 Sinclair, J. et al *in* Kahlor, L et al, 2010)

The research knowledge already gained from studies of science communication can be used in the communication of nanotechnology. However, the scholars agree that in the case of nanotechnology and related technologies there is a need for more serious attention to science communication education. It is very different what types of science communication programs universities and other institutions offer. Typically, the courses are dominated by *either* teachers and students from journalism studies *or* by teachers and students from disciplines within natural science. In order to change this tendency to division between

faculties, The University of Johns Hopkins made an effort to change their science communication courses over a period of several years from 2005. In 2006 they offered the science communication courses as workshops and integrated other media, such as the campus radio show. Johns Hopkins succeeded in their goal of achieving a more truly interdisciplinary course on science communication. Other Universities have had similar success with their processes. (p. 238 Pearce, A. et al *in* Kahlor, L et al, 2010)

The following advice is an abstract from "Recommendations and Considerations for Offering an Interdisciplinary Science and Communication Course". (Table 10.1, p. 247 Pearce, A. et al *in* Kahlor, L et al, 2010) The recommendations are as follows: Examine what others are doing and what the needs of the institution are, both the need of the personnel and of the departments; consult the literature on the subject; involve people from multiple disciplines in both planning and execution stages; decide early on what the course goals and products are to be; negotiate content, teaching styles and schedule with the participating faculty; determine what resources are available; know your target audience; involve media, direct students to a wide range of resources; embrace different perspectives; evaluate course effectiveness, student perception, understanding and appreciation of general public; inform the administration of the efforts made. (p. 247 (p. 238-243 Pearce, A., Romero, A. et al *in* Kahlor, L et al, 2010)

4.3 Reporting science

There is a tendency for scientists to assume that science will always inevitably 'get bad press'. The reason for this in the eyes of journalists is that routine science is not newsworthy. It lacks the stuff of drama and sensation and is really rather boring! This attitude digs a trench between scientists and journalists. Descriptions, narrations and illustration of science are often lofty and with a mystique surrounding it. This attitude distances science from the public, misrepresents it and obscures the impression of science being important for everyday lives and its critical effect on daily life. (p. 13, Anderson, A. et al 2009) To make science newsworthy one of the facts to be considered is the science writing itself. Science writing is a discipline encompassing both science and writing. The discipline has already evolved from a strange subculture of journalism to a profession in its own right. With this evolution as a discipline, an evolution of the role as science writer has followed. He or she is not merely a translator of facts and is not understood as a scout on a mission to bring messages from one side of a bridge or world to the other. The science writer is the master of a deeply satisfying discipline, and one of those most difficult to master. He or she is among other things understood as a 'gatekeeper' in the news room deciding which developments in the real world will make it into the news. The science reporter must be able to identify the good science story. To identify the good science story, Rensberger lists the following criteria to be considered for the science case in question: Fascination value, size of natural audience, importance, reliability of the results, timeliness. (p. 20-21 Anderson, A. et al 2009)

The inherent differences in ideals and goals for the disciplines of science and journalism are further investigated and described in the literature. Journalism has truth-telling as a professional ideal and has as a guide for the discipline. The guide is the '5 W's and an H'. They constitute the founding questions: Who, What, When, Where, Why and How. Unfortunately, too often journalism settles

with the first 4 W's and leaves out the Why, since this particularly letter raises more questions than it answers. Journalism has an unfortunate tendency to wanting to satisfy people curiosity as opposed to stimulating it. (p. 23-24 Anderson, A. et al 2009) The differences become apparent when the scientist is the basic source for the scientist. The scientist is unlikely to contact the news office at a journalistically appropriate time, since he or she does not operate at the same places or even in the same time zone: A period of 6 days and 6 months can be very differently felt and experienced. There may even be a fear from the scientist to look like a show-off, and to be misunderstood. The journalist is concerned with the framing of the news story: the scientist as source, trustworthiness, credibility, legitimacy, the news value, whether the story is potentially controversial, whether there are disagreeing sources and how to weigh these. At the same time, the journalist is concerned with what interests the public. The scientist, however, has his or her concerns with the question of why this particular journalist wants the interview, with whether or not the journalist can be trusted, whether the interview will benefit the ongoing research and whether it will be possible to communicate the scientific uncertainty involved. (p.36 Anderson, A. et al 2009)

Examples of the different perspectives are listed below. (p. 30 Anderson, A. et al 2009)

Scientist	Journalist
Long time	Short time
Details	Big picture
Disputation	Drama=conflict
Peer review	Review before publication unacceptable
Technical term=precision	Technical terms = obfuscates science and makes it incomprehensible to the general reader

The Royal society commissioned a working group who produced a report in 2006. The report investigates the difficult relation between scientist and the media. However, it concludes that interactions with the media have become an imperative, a duty of citizenship! While recognizing complicating factors such as intellectual property rights, commercial considerations and security issues, the report states:

“In this context the research community has two main responsibilities. The first is to attempt an accurate assessment of the potential implications for the public. The second is to ensure the timely and appropriate communication to the public of results if such communication is in the public interest. These twin responsibilities should be embedded within the culture of the research community as a whole, and all practices should take them into account and respect them”. (2006 The Royal Society cited p. 113 in Anderson, A. et al 2009)

4.4 Communication issues of particular relevance for nanotechnology

Nanotechnology is the type of science and technology that made Ulrich Bech label the modern world 'A Risk Society'. Nanotechnology is parallel to other emerging technologies. It is the responsibility of the media to help scientists define the 'risk' of these technologies. (p. 46 Anderson, A. et al 2009) It is a hard job to do so, because it has to do with factors that are far away from traditional journalism, such as: long term risks and scientific uncertainty. However, It is part of the obligation of navigating in the world of technology that has changed from calculable risk to non-calculable risk. The challenges are created with the speed of technology itself. Risk in risk society is defined by its consequences being unpredictable, uncontrollable, and incommunicable. (p. 54 Anderson, A. et al 2009)

Several factors influence this assignment and decide what reached the audience of the media. An attempt to explain why particular risk events, defined by experts as non-threatening, attract significant socio-political attention (amplification), while other risk events, judged to pose a larger objective threat, gain little prominence (attenuation). Kaspersen and colleagues have created a framework or a model intended for analyzing risk events. Their model is called the SARF- model which stands for: The Social Amplification of Risk Framework. It aims to examine broadly, and in social and historical context, how risk and risk events interact with psychological, social, institutional and cultural processes in ways that amplify or attenuate risk perceptions and concerns, and thereby shape risk behavior, influence institutional processes, and effect risk consequences. (p. 59 Anderson, A. et al 2009) The original model identified four pathways or mechanisms in which risk amplification takes place: Signal value, heuristics, social group relations and stigmatization. Signal value refers to what a risk event signals or warns. Heuristics are short-hand mechanisms that people use every day in order to evaluate complex risk information. Social relations within social and political groups (e.g. advocacy groups, industry, government agencies) affect how risk 'mutates' and how publics respond. So does the specific character of these relations. Finally, stigmatization, a concept originally applied to marginalized individuals and groups, designates a situation where a technology becomes 'tainted' or 'blemished' by discourses of risk, and is extremely hard to overcome once it takes root. (p. 60 Anderson, A. et al 2009)

SARF and other models, however, have been criticized of being too media centric and to have a linear understanding of communication that is outdated. Ulrich Bech's conception of risk, however, is too abstract to be empirically tested. Knowledge and risk perceptions are influenced by other factors than the media themselves. For example influenced by family and friends, colleagues and health professionals and are mediated by factors such as age, gender, ethnicity and social class. It is suggested that scientists play a more active role in the news production than their own representation would suggest. They could actively take advantage of this situation. (p. 64-65, Anderson, A. et al 2009)

Nanotechnologies representation in the media has intensified over the past decades. In a US study from 1986-2004 it increased from a few articles in the late 1990 to over 150 in 2003. (p. 68, Anderson, A. et al 2009) The same study showed that it expanded from being restricted to the prestige press to other media which suggests that there is a growing public interest. The US coverage tended to be very positive towards the developments. Few studies have compared the news coverage internationally. Those that have suggest that the coverage in the US is more positive, whilst risks are slightly more evident in the UK reporting. (p. 69, Anderson, A. et al 2009) A UK study was conducted from 2003-2004 which was a formative period for nanoscience and nanotechnology. In

this 15-month period a number of nanorelated articles arise in the press, including high-profile comments made by HRH Prince Charles, the commission of the joint RS/RAE study focusing on nanotechnology and the release of a number of fictional books and films in the area. The study included newspapers from different categories: red-top, mid-market and opinion leading publications. (p. 74-75 Anderson, A. et al 2009) The attempt to analyze the type of coverage of nanorelated stories in the UK concludes that apart from the interest focusing on the Prince Charles intervention, the science-related frame dominated the coverage in the period, indicating a strong news interest in the scientific implications of nanoscience, medical applications were the main focus. Comparably dominating was the 'science fiction and popular culture' frame. There seems to be an unclear boundary between fictional and factual aspects of nanotechnology. Celebratory articles indicate an interest in the economic implications of nanotechnology. These stories focus on awards along with 'business story and funding articles'. The framing varied from news paper to news paper. Very different factors, psychological and sociological, influenced the journalists writing the articles. (p.75 Anderson, A. et al 2009)

4.5 The Concept of 'the public'

Amongst the scholarly literature there is a general agreement that the concept of the public - when the issues is communication about science to the public - is changing and has changed over the past 20 years. (p.11, Kahlor, L et al, 2010) Complex scientific issues are an inherent part of a modern society and these issues are inherently debated. However, instead of the traditional channels of linear dissemination of popularization and models of the public knowledge of science as a 'deficit', public understanding of science is now perceived with models stressing lay knowledge, public engagement and public participation in science policy making.

The deficit model conceives the public as having a deficit in knowledge of scientific matters. This deficit is conceived as a gap or hole that can be filled with knowledge. Only about 5% of the American public is to be counted as scientific literate, only 20% interested and informed and the rest are 'residual'. The model strives to raise this number, because then 'everything will be better'. However, there are several problems connected to this model. An inherent problem is the goal of the model: The model has an inbuilt understanding of the result of more public knowledge. More knowledge and understanding will naturally lead to a public appreciation of the benefits provided by science to society. (p. 12-13 Kahlor, L et al, 2010)

An alternative model, called 'the contextual model of understanding of public knowledge of science' takes its point of reference in an understanding of the individual, not as creatures responding to information as empty containers but as individuals processing information according to social and psychological schemas shaped by previous experiences, cultural context, and personal circumstances. The contextual model also recognizes the ability of social systems of media representations to either dampen or amplify public concern about specific issues. However, the contextual model has been criticized to also have the agenda that more understanding will lead to appreciation of scientific endeavors. (p. 14 Kahlor, L et al, 2010)

Another model appreciates other knowledge than scientific knowledge and criticizes scientists of being unreasonably certain and even arrogant about their

knowledge. This attitude leads to a failure to recognize the contingencies or additional information needed to make real-world personal or policy decisions. It also fails to acknowledge local knowledge and expertise in specific fields. The model is called 'The lay expertise model' or 'model of lay knowledge'. (p.15, Kahlor, L et al, 2012) This model suggests that activities designed to enhance trust among participants in a policy dispute are more important than educational or informational approaches. However, this model that is driven towards empowerment of local communities is criticized of being anti-science and to lack guidance for practical activities that can enhance public understanding of particular issues.

The public engagement model focuses on a series of activities intended at enhancing public participation in science policy, such as: Consensus conferences, citizen juries, deliberative technology assessment, science shops, deliberative polling. (p.16, Kahlor, L et al, 2010)

The difference between the models can be illustrated with the following model. (p. 17, Kahlor, L et al, 2010) Overlapping between the different models is possible.

Main Focus: Information delivery	Main Focus: Engaging the Public
<p>Contextual model</p> <ul style="list-style-type: none"> • Tied to particular audiences • Pays attention to needs and situations that may be time, location, disease, language dependent • Highlights ability of audiences to quickly become knowledgeable about relevant topics 	<p>Lay expertise model</p> <ul style="list-style-type: none"> • Acknowledges limitations of scientific information • Acknowledges potential knowledge of particular audiences • Highlights interactive nature of scientific process • Accepts expertise away from scientists
<p>Deficit model</p> <ul style="list-style-type: none"> • Linear transmission of information from experts to the public • Belief that good transmission of information leads to reduced 'deficit' in knowledge • Belief that reduced deficit leads to better decisions, and often better support for science 	<p>Public engagement model</p> <ul style="list-style-type: none"> • Focuses on policy issues involving scientific and technical knowledge • Tied to democratic ideal of wide public participation in policy process • Builds mechanisms for engaging citizens in active policy making • Real public authority over policy resources

A case story about the emerging paradigm shift in the views on public engagement of the scientific community, is a booklet from the National Academy of science and the Institute of Medicine in 2008. Earlier assumptions about how 'informing the public of scientific facts' will lead to alterations in perception of policy makers or citizens are left behind. The process of making the booklet is an example of a growing recognition that communications is not simply a 'translation of facts' – it is a negotiation of meaning. In preparing the booklet, an audience-based approach was used to find the most appropriate frame for

engaging people in the debate. The *intended* focus of the information material about science and evolution was not received as expected by a focus groups commissioned by the National Academy. The focus groups consisted of representatives from the target groups: teachers, school board members, journalists, activist parents and clergy. The material was tested on them to see how they reacted to different frames or interpretative storylines that served as explanations for why alternatives to evolution were inappropriate for science classes. The reactions of the focus groups were incorporated in the further work. The committee had expected to find the most convincing storyline to be the authority of past legal decisions and the constitutional separation of Church and State. Instead, the committee discovered that emphasizing evolutionary science as the modern building block for advances in medicine was the most effective frame for translating the importance of teaching evolution. (p. 40-41 Nisbeth *in* Kahlor, L., 2010)

The public conception of nanotechnology is a subject of concern. Scientists' concerns are that if the public has a hostile perception of nanotechnology, it will also be against valuable innovation. The challenge is that there is no agreed language, no repertoire of metaphors and only few established non-expert communities of interest in the field who could be key players in generating support, shared values, narratives and strategies – the things necessary for common understanding. The ambition is to have up-stream public engagement or to have discussions of technologies *before* they are established. (p. 126-127 Anderson, A. et al, 2009) There is an alarming contrast between the perception of the public and the perception of the scientists and the science policy makers of nanotechnology. A study consisting of both online questionnaires and in-depth interviews shows that there is an overall optimism. This fact in itself leads to the suggestion that the optimism leads to neglect and underplay of dangers and uncertainty. (p. 135, Anderson, A. et al, 2009) The differences need to be understood. Besides, the scientists tendency to treat the media as a 'black box', overlook their own role as key expert sources. (p. 154 Anderson, A. et al, 2009) As demonstrated in the reviews, heterogeneity exists as to how the public as a whole can be represented. In discussions of nanotechnology, the collective public has been referred to in three dominant ways: as laity; as consumers; and as stakeholders. In the case of the *public as laity*, engagement is primarily presented as important because there is a need for members of the public to be educated and informed about nanotechnology — mostly to establish a relationship of trust between members of the public, scientists and decision-makers. In this approach, nanotechnology is presented as a new, complex and promising field of scientific research. In the case of the *public as consumers*, nanotechnology appears as a range of (actual or potential) commodities, and hence, engagement is typically promoted to either achieve acceptance of existing products and/or enable the development of acceptable future products. In *the public as stakeholders*, nanotechnology is portrayed as a development with socially transformative potential and involving risks that need to be managed to minimize harm. The aim of engagement here is typically to ensure that development proceeds through careful consideration of the range of potential impacts and interests involved. A fourth rationale for engagement can be mentioned: the (democratic) 'normative': *The public as citizens*. This rationale promotes public engagement because it is the most appropriate and legitimate approach to scientific and technological development in a democratic society (and not because of a desire to achieve a particular goal or to seek a better decision/outcome). Wickson et al. argue that this frame is needed to support this

rationale. Framing the public as citizens allows people to express concerns that fall beyond externally imposed and/or narrow categories such as consumer, laity and stakeholder. This opens a possibility to go beyond the question "what is the public?" (that is, static ready-made entities) and ask, "who are the public?" (that is, dynamic self defining actors). (p.757 Wickson et al, 2010)

Two factors are central when framing the public as citizens: individuals are empowered, and act as members of communities. This means that when framed as citizens, individuals not only have a right to be (passively) informed, they also have a duty to (actively) inform others (for example, share their knowledge, visions and values with researchers and decision makers). (p.758, Wickson et al, 2010)

The same research group has made an effort to develop what they consider to be a conceptual map of the areas of tension in the scholarly debates. They identify five top topics of tension. In a general sense, these are: 1. Why should public participation or public engagement be done? 2. Who should be involved? 3. How should it be initiated? 4. When is the right time to do it? 5. Where should it be grounded? While there is a general consensus on the importance of public participation or public engagement in Science and Technology Studies discourse, tension arises through the existence of competing answers to these questions. While different views coexist in theory, tension between them becomes acute during the shift into practice when choices must be made in concrete terms. When these choices are not well justified or lack transparency, confusion and debate can arise around the appropriateness or success of particular public participation or public engagement endeavors. (p.828, Delgado et al, Sage Publications 2011)

After reviewing a vast amount of literature from Science and Technology Studies they develop the five questions further and expand on them. Here following the chapter headlines of the main body of their article: 1. The rationale: Why should public participation or public engagement be done? 2. Expertise and publics: Who should be included in public participation or public engagement? 3. Invited or uninvited: How should public participation or public engagement be initiated? 4. Upstream, midstream or downstream: When is the right time for public participation or public engagement? 5. Universal or context specific: Where should public participation or public engagement be grounded?

"Upstream" public participation or public engagement is seen as an opportunity for social values to be disclosed, debated and consciously incorporated into technological development before particular trajectories and attitudes become set. Early public participation or public engagement is therefore thought to enable a more reflexive and socially robust techno-scientific development. Despite a general theoretical agreement in the Science and Technology Studies community in favor of upstream public participation or public engagement, tension remains between diverging answers to the question of how far "upstream" it makes sense to go. The question is related to whether it is possible to make a clear distinction between stages of basic research and applied technological development. Some have suggested a type of "midstream" engagement in laboratories and research activities while others have suggested public participation or public engagement move all the way up to research funding decisions. In performing their mapping exercise Delgado et al. have used a double strategy: first making explicit the general topics of tension that exist in

Science and Technology Studies discourse on public participation or public engagement; and second, focusing on how the tensions are entangled in the case of nanotechnology. Exploring how the five topics of tension interact and where they create competing demands on Science and Technology Studies scholars in moving public participation or public engagement from theory into practice is, Delgado et al. believe, a valuable step in trying to negotiate a way forward in the age of engagement. Disentangling different tensions provides an opportunity to make an overall consideration of the various aspects of public participation or public engagement and the fitness for purpose for any particular case and situation in question. In the age of engagement, Science and Technology Studies scholars are being pushed into an agonistic situation: divided between the aim of maintaining a critical and reflexive approach based on theoretical ideals and a social commitment to engaging in action, which inevitably involves making tough choices and compromises across a range of ideals. (p. 840 Delgado et al. in Sage Publications 2011)

5 Responsible Research and Innovation

In the last chapter, relevant insights from academic studies on communicating about science and its societal aspects were presented. In this chapter, the focus returns to the policy making agenda. What could such insights and selected tools contribute to responsible research and innovation?

Since the formal end of the first European Action Plan for Nanotechnology (2005-2009), European policy makers have increasingly shifted their attention from responsible development of nanotechnologies in particular to responsible research and innovation in general. In order to contribute to this changing policy agenda, ObservatoryNano has organised a workshop presenting the Ethics Toolkit and another instrument for ethical reflection and communication, the ObservatoryNano Nanometer. During this workshop, their potential relevance to the emerging policy agenda for “Responsible Innovation” was discussed with representatives of the European Commission and experts in nanoethics and ELSA.¹⁰

The ObservatoryNano Ethics Toolkit¹¹ is an attempt to inspire and provide a language for non-ethicists working with technology that may cause ethical concern or ethical dilemmas at any level: research, technology development or in practice. The toolkit points to relevant concepts in order to facilitate a reflection of the practitioner with new insight, new language and new inspiration. It is an example of the approach of ongoing normative assessment developed by Alexei Grinbaum and Jean-Pierre Dupuy. Norms and values change in society. A process is needed to revisit those discussions regularly. Temporary solutions should be found and the discussion should be revisited after a while.

The ObservatoryNano Ethics Toolkit is primarily intended for a scientific audience and has been tested on such groups. With the help of philosophical concepts translated and applied and inspiration from literature and story-telling, people who have tried the ethics toolkit are assisted in their reflection, development and application of ethical behaviour and virtues. The Ethics Toolkit can be used in discussions to find arguments for one’s position. A methodology on how to use the Toolkit in groups of ten up to one hundred people should still be developed. Whereas Responsible Research and Innovation is located at the system level, the Ethics Toolkit only addresses one type of actors: scientists. Other tools for decision makers and civil society should also be developed. E.g. narratives could be attractive for decision makers. The Ethics Toolkit should include a checklist. In the NanoDiaRa project, it is difficult to attract attention of natural scientists to discussions on ethics. The Toolkit could be “one stone to build a bridge” between natural scientists and ethicists.

In order to make scientists and companies realise that ethics might also be relevant for them, another tool has been developed within the ObservatoryNano, the Nanometer. This tool is a self-assessment tool that guides the user through questions on whether or not the research assessed has aspects in its application

¹⁰ See annex 4 for the agenda and participants list of this workshop.

¹¹ See also discussion in chapter 2 above.

that are ethically, societally or environmentally relevant. The questionnaire forces the user to reflect upon how sure he or she actually is when it comes to the knowledgebase analysing the risks of the research in question. Is there a solid base of knowledge, or has the application not yet been tested? The Nanometer is a business tool for implementing Life Cycle thinking including societal and ethical aspects in R&D institutions and business. A less specific "Innovation Meter" could be attractive for future supporters. It has potential use in standardisation together with other tools. The common denominator is Corporate Social Responsibility. Companies have to communicate about possible risks and benefits to their shareholders. The tools can be useful to check compliance in an organisation at a less detailed level than ISO 26000. Companies can use it to demonstrate dynamic progress towards risk governance. The Nanometer package makes ObservatoryNano a methodology for evaluating the dynamic state of the art with an assessment that could be useful to Constructive Technology Assessment and address many different stakeholders in multicriteria evaluation. It gives an idea of opportunities to change.

With the help of these tools responsible research for Europe was discussed and the role of an Observatory to follow the activities from an interdisciplinary point of view necessary for non-specialists following the development of nanoresearch and technology in Europe. In the last decade, the European Commission has concentrated its efforts in Responsible Research and Innovation on issues like risk management and governance, precaution and the role of scientific expertise. The proposed HORIZON 2020 programme has been announced by the European Commission in 2011. This includes three priorities: excellent science (€27818 M), industrial leadership (€20280 M) and societal challenges (€35888 M). Societal engagement and responsible research and innovation are horizontal activities. How to implement this is the question. This may be clarified in the European Research Area (ERA) framework and Recommendation on Responsible Research and Innovation to be published by the EC in 2012 and 2013, respectively. Though not explicitly included, the notion of responsibility was connected to the ERA. Prior to the publication of the EC recommendation on Responsible Research and Innovation, a public consultation will be organised probably in the first semester of 2012. Other related activities are an expert group preparing an impact assessment, a steering group and hearings with representatives of Member States and other experts. The proposal for a recommendation will represent the state of the art of reflection on the topic.

Workshop participants mentioned the following issues that should be taken into account by the European Commission:

- How to balance responsibility of scientists and industrialists for new impacts of their work and freedom of research and innovation with compliance with established rules and security of researchers acting within the law?
- The right balance between the need to be responsible and the human desire to be unbounded should be found.
- Collective responsibility at the level of innovation systems should somehow be translated to individual responsibilities of all the actors involved (scientists, industrialists, policy makers etc).
- Responsible innovation requires cradle to cradle thinking. This is inherent in the Nanometer tool developed in ObservatoryNano.

- The organisation model of the Dutch NanoNextNL research programme could be a useful model for implementing responsible research and innovation for the European Commission: theme 1 on Risk Assessment and Technology Assessment is a cross cutting theme across the whole programme.¹²
- At international level, stakeholders are interested in global and non-global compliance to international agreements. The responsible research and innovation concept should specify how Member States organise themselves in cooperation with the EU and how the EU enters international agreements and participates in discussions on the international agenda. At the last meeting of the Transatlantic Economic Council in November 2011, a list was agreed on of actions to be implemented for responsible development of technology.
- Responsibility also applies to the economy; this has not completely been taken into account. The FramingNano project has proposed a governance framework, taking into account concerns of companies and NGO's. Responsibility should govern the supply and demand side. Education goes beyond research. The costs of non-compliance should be assessed, and socio-economic assessment should be included. Go beyond nano-aspects and strengthen and assure deliberative processes including research, innovation and other actors.
- The proposed HORIZON 2020 budget of €80 billion should include a declaration of intentions or finality, not just objectives of research. Evaluators should take stock of intentions without evaluating proposals to certain criteria.
- Whereas all agree that expert advice should be independent, excellent and transparent, there is a problem with English semantics and common definitions that may not translate equally well in all languages. In this regard, identifying instances of manipulation processes is very important. The "Babel syndrome" should be reduced through work on translation and safe descriptions of terminology. Taxonomies of new knowledge should be high on the agenda. The Transatlantic Council report published last November calls for open archive, open access and translation if necessary.
- Public communication about research and innovation incorporates risks of indoctrination of the non-expert audience. While there is a need to empower consumers to make informed choices, capturing of the debate by organisations with a hidden agenda should be avoided.
- On the other hand, public concerns that are expressed in dialogues about research can present opportunities for innovation.
- Methods should be developed to get the message of responsible research and innovation across to different types of stakeholders in mixed audiences.
- Risk governance is currently inconsistent. Cars kill thousands of people each year and continue to be used, and chemicals such as phtalates are banned without any relevant evidence of harm to humans, if one goes beyond laboratory findings.
- Philosophical debates on responsible research and innovation are currently focused on extreme cases such as synthetic biology. According to one participant, these debates should flip back to mainstream (bio)technology.

¹² www.nanonextnl.nl

According to comments sent by Alfred Nordmann, some tacit assumptions underlying the work of the ObservatoryNano must be made explicit now:

- Is the Observatory about S&T or about industrial sectors fed by S&T&I? What is the right object of interest of responsible research and innovation? The end or the first half of the knowledge chain?
- Is the Observatory free of recommendations and judgements or should it be an evaluating observatory? In the latter case roadmapping and planning for the future should be included.
- Is the observatory a support action to technology development or a permanent independent institution in the European Research and Innovation Landscape?
- Should a future observatory limit itself to mere expert based predictions of the future or include an overview of broad stakeholder visions?

The workshop participants made the following suggestions for a future Observatory:

- Good governance should be the leading principle rather than establishing a fixed structure of the observatory.
- In addition to observation, results should be translated in policy options. In the Netherlands, policy makers asked for such interpretation in the RIVM newsletters signalling new issues in risk and regulation of nanotechnology.
- A future Observatory could be useful to the European Parliament STOA office that needs a robust long term observatory to base their recommendations on. They must express their own needs for such an open source archive.
- The Observatory should not be a platform for negotiations, but give an overview of information from different identified sources. Stakeholders must have trust in the quality of expertise, its excellence and transparency. In the long term, an observatory should be able to see weak signals of what is happening or indeed failings in such a system.
- There should be more dialogue between Observatory and European Group on Ethics.
- Responsible research and innovation has to be implemented at three levels: individual, collective and international coordination. At the level of international coordination, stakeholders require (non)global compliance to international agreements. There is a need for joint research on multicriteria / multidomain assessment methodologies of possible changes induced by research and innovation. ObservatoryNano and ICPC-NanoNet offer tools for handling complexity and uncertainty. International dialogues on research and innovation should be qualified and input given into them.
- The Observatory could offer an opportunity to do technological and societal foresight exercises. Multi criteria and multi domain approaches are needed. Economic aspects should be included for SMEs. They are the source of many innovations. They generally don't have time or money to find relevant information. Giving them the information helps to strengthen capacity to give positive feedback. European Institutions should identify gaps and create a level playing field at EU level.
- One or more Internet portals referencing projects where ethical aspects of research are discussed could be useful.
- The ObservatoryNano should be promoted more actively, because it has done valuable work.

To conclude, the Ethics Toolkit and Nanometer were well-received and especially the Nanometer integrated into the ObservatoryNano makes it an interesting instrument for responsible research and innovation at individual, collective and international coordination levels. The European Commission policy on responsible research and innovation is still under development and several issues should be resolved. A future Observatory could have an important role if it is promoted and connected to relevant policy making, advisory and negotiation bodies such as the European Parliament STOA office, European Group on Ethics and international cooperation platforms.

6 Conclusions and policy options

The analysis in this report gives rise to some policy options for EU policy making on Responsible Research and Innovation, especially regarding two-way communication between citizens and EU institutions. These policy options range from a concrete case study of a single instrument (the ObservatoryNano Ethics Toolkit) to strategic considerations of communication with citizens at EU and national levels. The ObservatoryNano Ethics Toolkit turns out to be particularly useful as an instrument for scientists engaging with the public about ethical and societal aspects of their research. Analysis of different public dialogue and engagement activities and their impact on public opinion and policy making, demonstrates that different aims have been pursued with varying success. The experience in these former dialogues could be useful in planning future initiatives. A review of risk and science communication literature places these practical experiences in a theoretical context that stimulates reflection on what are or should be the goals pursued through the communication exercises.

6.1 The role of the ObservatoryNano Ethics Toolkit in public dialogue and engagement on nanotechnology

It is obvious that the ObservatoryNano Ethics Toolkit is not the sole solution to all issues related to responsible research and innovation. As participants in the workshop organised by ObservatoryNano noted, the toolkit only focuses on one actor while responsible research and innovation is situated at the system level. As discussed in chapter 4, four kinds of aims of public dialogue and engagement activities can be distinguished:

- Contributions to government and governance
- Direct democracy
- Awareness raising
- Academic studies

The ethics toolkit can mainly contribute to the last two aims: awareness raising and academic studies. For interested natural scientists and engineers it offers arguments in discussions with the general public or stakeholders about ethical issues related to their work. This may help improve the quality of the dialogue and perhaps enable the discussants to get out of deadlocks. The toolkit could also be adapted to the needs of other audiences. Especially the narratives appear to appeal to policy makers. The toolkit is designed for use in local discussions in groups of 10-100 participants, not at the level of national dialogue or governance

processes. Parts of it could be developed into stand alone brochures for communicating nanoethics to different audiences and in education.

6.2 New issues for the public dialogue on nanotechnology

In the European roadmap on nanocommunication, the ground is prepared by introducing “a new communication model that relates to citizens’ concerns and needs”. This is followed by dialogue and engagement to test “the communication model’s efficacy to deliver its messages to millions of citizens.” “This communication exercise is expected to have two major, desirable effects: increasing the consensus between stakeholders, society and policy makers on EC decision making about nanotechnology; and strengthening the image of the EC as an impartial, transparent and trustworthy communicator on nanotechnology”. (Bonazzi, 2010)

The European Union is gradually developing into something more like a federal state than a trans-national association of states. In this process, policy making by the European institutions (council, parliament and commission) is taking over national policy making by national governments and parliaments. These European policies influence the daily lives of citizens in all EU member states, but there is a deficit in communication about the policy making process in both ways. European politics gets reported less in national media than national politics. On the other hand, awareness among European citizens of consultations and other opportunities to be heard by the European policy makers is low. In this light, the European roadmap on nanocommunication could be a necessary and worthwhile attempt at improving two-way communication between citizens and European policy makers on research and innovation. After all, responsible research and innovation is deemed to be of crucial importance to the future socio-economic development of Europe and its citizens. Such a shift towards framing the audience as citizens rather than laity, consumers or stakeholders is also a current trend in academic literature, as discussed in section 4.5.

Is nanotechnology the proper subject for a pilot study testing this communication model? There are some arguments in favour. Firstly, the European Commission has invested billions of euros in nanotechnology research under the 6th and 7th Framework Programmes (FPs) for RTD. In FP6, €1.4 billion was invested and in 2007-2008 in FP7, €1.1 billion with increasing budgets in subsequent years.¹³ Even though adoption of the proposed SNAP action plan is not foreseen before 2013, nanotechnology remains one of the Key Enabling Technologies at the core of the EU Innovation Union and HORIZON 2020 programme.¹⁴ Informing European citizens about how their taxes have been and will be spent represents good governance. Secondly, several experts including Prof Dr Armin Grunwald (Germany) and Dr Donald Bruce (UK) still see a need for dialogue about risk governance and regulation of nanomaterials in consumer products, occupational safety and life cycle aspects. (Malsch, 2011b, 2011c)

However, focusing on nanotechnology also has a downside. Firstly, nanotechnology is a rather abstract concept far from people’s daily lives.

¹³ <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2009:0607:FIN:EN:PDF>

¹⁴ http://ec.europa.eu/research/innovation-union/index_en.cfm

Experience in national dialogues and engagement exercises in several countries has taught that it is difficult to attract a wide audience for discussions about nanotechnology and that participants find it hard to grasp the issues. In Germany, where the government announced a citizens' dialogue on nanotechnology beginning of 2011, this has not been initiated yet. Instead, citizens' dialogues have been organised on energy and healthcare policies including nanotechnology among the key enabling technologies. (c.f. Malsch et al, 2012) The problem of abstractness can be overcome by focusing discussions on sensitive applications like nanotechnology in food, cosmetics and other consumer products. Secondly, initiating a new or intensified communication programme on nanotechnology now could be too late. At EU level and in several Member States, political decision making on investment in nanotechnology arguably peaked between 2004 and 2010. This is reflected in several policy documents and projects investigating ethical, legal and societal aspects.¹⁵ Currently, parliamentary interest in nanotechnology tends to focus on regulating market access of products incorporating nanomaterials and on chemicals (REACH).

Whereas the first decade of the 21st century was dedicated to building up capacity for nanoscience and nanotechnology R&D, the current priorities are stimulating nano-innovation and technology transfer to industry, and risk governance and regulation. This implies that the authority to decide on priorities in nanotechnology is gradually shifting from public to private decision makers. This makes it less obvious for the European Commission to take the initiative for communicating with the public about nanotechnology. An alternative could be to encourage nano-innovating research organisations and companies to engage in public dialogue with their stakeholders, in line with the EC Communication on Corporate Social Responsibility (EC, 2011). This would solve the problem of abstractness, because such discussions would automatically focus on particular products incorporating nanomaterials and nanotechnologies. In such localised discussions, dialogue instruments like the ObservatoryNano Ethics Toolkit and Nanometer could be valuable. The Ethics Toolkit is a rich source of arguments to improve the quality of the discussion and get out of deadlocks. The Nanometer is an interactive tool for organising discussion and making sure all relevant aspects are taken into account.

Weighing pros and cons, there are strong arguments in favour of improving EU communication strategies with its citizens. However, if a pilot study of such a communication model targets nanotechnologies, this should be planned carefully. It is advisable to take into account experiences in earlier national dialogue and engagement exercises.

What can be learned from these earlier nanodialogues? The experience with different types of nanodialogue and engagement activities in the past decade discussed in section 3.2 appears to indicate that activities aimed at contributions to government and governance and awareness raising have been more effective than attempts at developing new forms of direct democracy. In policy making on priorities in research and innovation, the triple helix of research, industry and government remains dominant. But interestingly, in policy making on regulation and risk governance, involvement of stakeholders appears to become

¹⁵ http://ec.europa.eu/nanotechnology/index_en.html

institutionalised. The initiative for such successful broader stakeholder engagement is taken by government departments or public institutions with a task in regulation, risk governance or risk assessment. Experiments with direct democracy initiated by academics or NGO's/consultants (e.g. in the UK and Flanders) tend to have more limited success and appear to be dependent on the political climate.

Activities in the framework of academic studies may indirectly contribute to government and governance, if brought to the attention of policy makers through reports or workshops targeting them. In the present report, relevant results from studies on risk and science communication are analysed in chapter 5. Before planning communication exercises aimed at influencing public understanding, it is important to understand this public understanding of science. As has been noted, nanotechnology is hard to grasp. Studies indicate that researchers should actively engage their audience in discussion to stimulate understanding. Relevant methods in science communication include TV, newspapers, consensus conferences, discussion forums and internet sources.

In the literature it is argued that nanotechnology needs public support because it depends on public funding. It is therefore important to investigate what influences public opinion. This also depends on the predisposition of different audiences towards science and technology. Communication issues that are of particular relevance to nanotechnology include the relationship between nanotechnology and the risk society conceptualised by Ulrich Beck. Journalists and scientists should cooperate in communicating about and assessing uncertain risks of nanotechnology. There is room for this, given the fact that representation of nanotechnology in the media has intensified over the last decades.

In communication about science and technology, four conceptual models of the public are distinguished. In two models, the main focus is delivery of information to the public. Traditionally, such awareness raising activities are dominated by a "deficit model", assuming that the public needs to be educated to appreciate the benefits of science and technology. More sophisticated awareness raising activities assume a contextual model that differentiates between audiences and assumes a more active role of the audience. The Ethics Toolkit could play a role in this type of awareness raising activities. Two other models focus mainly on engaging the public. The lay expertise model emphasises non-traditional expertise that can be found among groups in the public. This model appears to be dominant in stakeholder dialogues organised in nanorisk governance. It is also arguably inherent in the ObservatoryNano Nanometer discussed briefly in chapter 5. This is a self-assessment tool for evaluating ethical and societal aspects of nano-enabled products where input from different relevant experts can be collected. Finally, public engagement exercises focus on involving the public at large in policy making. This is a form of direct democracy and as noted has been less successful in influencing policy making of nanotechnology in the last decade. Furthermore, academic experts in the field of Science and Technology Studies are discussing the theoretical and practical value of different types of public engagement. The planning of the European Commission roadmap on nanocommunication could benefit from this analytical framework and these considerations for science communication by calling for requirements that are adequate to the aims selected projects should contribute to.

The European Commission roadmap on nanocommunication is part of a broader policy on responsible research and innovation. This policy is still under development and several issues should be resolved (see chapter 5). Communication and public dialogue are key aspects of this. There could be a need for one or more public information and communication platforms or observatories that bring together relevant information from different sources, extracts policy options and brings it to the attention of relevant policy making, advisory and negotiation bodies including the European Commission, the European Parliament STOA office, European Group on Ethics and international cooperation platforms.

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Annexes

Annex 1: List of Toolkit testing activities

Teaching

ENSTA, INSTN, Ecole Centrale, Sciences Po Paris, Ecole Polytechnique

Workshop and conference presentations

1. International Nanomaterials Ethics Workshop (Seoul, March 2012)
2. Conference "Nanotechnologies", Académie de Versailles (Paris, February 2012)
3. « Les enjeux éthiques des nanotechnologies » (Grenoble, December 2011)
4. SNet 2011 – 3rd Annual Meeting of the Society for the study of Nanoscience and Emerging Technologies (Tempe, Arizona, November 2011)
5. Journée « Nanotechnologies », Institut pour la maîtrise des risques (Paris, October 2011)
6. Entretiens Jacques Cartier (Montréal, October 2011)
7. « Les enjeux éthiques des nanotechnologies » (Saclay, October 2011)
8. Summer school "Changement climatique, science et société" (Paris, August 2011)
9. Forum « Biologie synthétique: recréer la vie » (Paris, Collège de France, June 2011)

10. Franco-British workshop on responsible innovation (French Embassy, London, May 2011)
11. Conference and parliamentary hearing "Synthetic biology for learning and doing" (Paris, Assemblée Nationale, May 2011)
12. Colloque « Originalités de la vie » (Paris, Ecole Normale Supérieure, April 2011)
13. « Nanotechnologie et éthique : quel dialogue ? » (Ambert, France, April 2011)
14. « Nanotechnology and Ethics: Why, what and for Whom ? » (Fribourg, Switzerland, February 2011)
15. Workshop « Nano-objets synthétiques et bio-inspirés » (Orsay, January 2011)
16. « Les nanotechnologies : il n'y a pas de bénéfice sans risque » (Ecole Polytechnique, Palaiseau, January 2011)
17. Comité d'éthique de l'Université de Provence (Marseille, January 2011)
18. CEA-SPEC meeting (Saclay, December 2010)
19. Ethics of Nanotechnology (lecture tour in Russia, Vladivostok, Irkutsk and Moscow, December 2010)
20. Journées nationales nanosciences et nanotechnologies de l'ANR-P3N-Cnano (Lille, November 2010)
21. "Les halos des images des nanotechnologies" (Cité des Sciences, November 2010)
22. AFC Cytométrie 2010 : Le Golem Nanotechnologique (Marseille, October 2010)
23. « Nanoimages : Scientific or Manifest ? » (Darmstadt, October 2010)
24. Nanotechnologies : quel bilan ? Quelles perspectives? (Auvergne, October 2010)
25. ESONN European School of Nanosciences and Nanotechnologies (Grenoble, September 2010)
26. IEEE Nano 2010 (Seoul, August 2010)
27. Minatec Crossroads conference (Grenoble, June 2010)
28. Maîtrise des risques liés aux nanomatériaux (Toulouse, June 2010)
29. Conference "From word civilization to image civilization" (Lisbon, May 2010)
30. Minatec general meeting and Minatec expert group on nanoelectronics and ICT (Grenoble, March 2010)
31. « Nanotechnologies : nouvel espoir ou boîte de Pandore ? » (Tours, February 2010)
32. IoN European meeting on nanomedicine (Glasgow, February 2010)
33. Role of narrative in the normative assessment of emerging technologies (Paris, December 2009)
34. OMNT expert meeting on biomimetic technological applications (Grenoble, December 2009)
35. KIST-CEA Nanoscience Workshop (Seoul, October 2009)
36. Workshop "Imag(in)ing the Nanoscale" (Paris, October 2009)
37. Les risques créés par les nanotechnologies (ENS Cachan, September 2009)
38. Colloque franco-canadien LIA-LABN2 (Lyon, July 2009)

Annex 2: nanodialogue activities per country

Belgium: Flanders

Exercise	Scope	Aims	Groups	Issues	Concerns	Uptake & impact
VRWI 2006	Flanders	Policy	Government, politicians	Innovation policy, socio-economic development	Identify 6 priority clusters including materials-nano-processing industry	Referred to in government strategies
NanoSoc 2006-10	Flanders	dialogue	Public, stakeholders	Roadmap for responsible development of nanotechnology	Uncertainty, anticipatory governance	Resolution Flemish Parliament 2009, valorisation pending
Resolution Flemish Parliament 25-03-2009	Flanders	governance	Politicians, government	Flemish Action Plan Nanotechnology	Nanogovernance, risk assessment (health, environment)	Waiting for initiative new parliament

France

Exercise	Scope	Aims	Groups	Issues	Concerns	Uptake & Impact
CNDP, National Debate on Nanotechnology	Large, national 2009-10	dialogue	public	Broad sweep of issues: Regional innovation activities, risks, ethics, social aspects, regulation, governance	debate disrupted by opponents of any dialogue	Considered a failure by key stakeholders. Government responded 2 yrs later, with plans for responsible governance, transparency and networking relevant actors
Vivagora different projects since 2005	Unclear	Capacity building for participatory democracy	Public, stakeholders	Risks, precaution, sustainability, governance, equity	Consumer products, therapy / enhancement, synthetic biology	?
Ile de France Nanocitoyens:	Local / Ile de France region, 2006-7	Involve public opinion in political decisions	public	Risk assessment, ethics, information and communication, legislation and regulations	Favour nanotechnology, but conditions must be set up by Ile de France government. Set up monitoring body	The Nanosciences Action of Ile de France includes an interdisciplinary "Bureau Action Transverse Nanoscience et Societe".
C'NanoIDF "Bureau Action Transverse Nanoscience et Societe".	Local / Ile de France region, 2006-present	Create and develop relations between nanoscience actors and society	Public, stakeholders	Valorisation, tox/ecotox and Social and Human Sciences	Public dialogue	?
OPECST (Parliamentary office for evaluation of scientific and technological matters) 2003-2008	National	Political debate, government	Politicians, policy makers	Micro- and nanotechnologies, technology policy, societal and economic aspects, ELSA, medical applications	Socio-economic benefits, risks and ethical aspects	Carried out by Representatives and Senators, high political visibility and relevance.

Parliament (Assemblée Nationale) 2011	National	Political debate, government	Politicians, policy makers	Precaution	Assessing the relevance of current regulations for a.o. nanotechnologies	Carried out by Representatives, high political visibility and relevance.
CCNE (National Bioethics Committee)	National	Political debate, scientific community	Politicians, policy makers, scientists	Risks, biomedical ethics, privacy, dual use	Responsible development of nanosciences and nanotechnologies with health implications	Official advisory role to government and parliament. Uptake is not clear.

Germany

Exercise	Scope	Aims	Groups	Issues	Concerns	Uptake
BMU NanoDialog / NanoKommission 2006-12	National	governance	stakeholders	Risk governance, green nano, integrated risk-benefit assessment of nanomaterials and products	Evaluation of implementation of 5 principles for responsible nanotechnology development: good governance, transparency, dialogue, risk management, value chain	Taken up by BMU (Federal Government) Recommendations of 1 st phase 2006-8 were not taken up by industry. Some initiatives to improve this were taken in 2 nd phase 2008-10.
Information platform Nanosafety	Regional (Hessen)	Awareness raising	General public	Regulation, risk assessment, risk management, public perception, communication	one-way communication	?
TAB projects related to nanotechnology, 2003-11 / VDI TZ reports on nanotechnology, innovation and economic potential 1998-2011	National	Government policy, regulation	Bundestag	Opportunities, risks, governance, ethical and societal aspects	Governing nanotechnology	Bundestag Resolution 15/3051 adopted 16-12-2004: Breaking into the nanocosmos: taking opportunities, assessing risks; Resolution 16/12695 adopted 30-06-2009: Nanotechnology: targeted research support for future oriented innovation and growth areas Reflected in Government Action plans Nano 2010, Nano 2015
Nano Office (Technical University Darmstadt) project on nano regulation 2006-7)	National	Government policy	BMBF	Regulation	Institutional Model Raster-Sonden-Agentur (Scanning Probe Agency)	?
NanoCare citizens dialogue 2007-9	National	Risk governance	Citizens, stakeholders	Responsible nanotechnology, safety, production,	Benefits welcome, pre-market testing needed	?

				health		
Deutschen Evangelischen Kirchentag 2007	National	dialogue	Church members, citizens	Dialogue scientists-citizens	?	?
BfR (Federal Risk Assessment) 2006-10	Berlin, Brandenburg, National	Dialogue, opinion survey	Consumers	Food, Cosmetics, Textiles, consumer goods, consumer protection	Responsible development, need for definition, labelling, measurement, LCA, occupational safety (in developing countries), invest in risk assessment, information, consumer safety Benefits deemed more important than risks	BfR
Deutschen Hygiene Museum Dresden Citizens Dialogue 2004	Local (Dresden)	Dialogue	Citizens	Opportunities and risks	More opportunities than risks, public information, jobs	?
NanoTruck	National	Information	Citizens, youth	Information	Exhibits	?
BASF Dialogueforum Nano 2009-10		Dialogue	Stakeholders	Risk governance	Transparency along life cycle	?
Jugendforen Nanomedizin 2007-2008	Munchen	Dialogue	Youth	Opportunities, risk, ethical and social aspects of nanomedicine	More dialogue, justice, biomedical ethics, enhancement, military uses, patenting, risk and regulation	?

The Netherlands

Exercise	Scope	Aims	Groups	Issues	Concerns	Uptake & impact
CieMDN, Nanopodium	Large, national 35 projects	Information, dialogue	General public, stakeholders, experts, youth	Opportunities, risks, potential, concerns	Responsibly onwards with nanotechnology	Report presented to government, discussed in parliament Increasing awareness (10%). Government responded positively in September 2011.
TA NanoNed	Small, local,	Reflection, CTA	scientists, stakeholders	Innovation, stakeholder dialogue, media analysis, CTA methodology	Waiting games hampering innovation	Discussed by policy makers Pilot projects to overcome waiting games
Rathenau Instituut	Medium, national,	dialogue	parliament, stakeholders	Risk governance, converging	Regulation and governance, preparing	Discussed in parliament Influence on

				technologies, human enhancement, stakeholder dialogue	society for technological progress	policy
Government nanotechnology pages	Small, internet	information	General public	Information on government policies	Public awareness	?
Nanosociety	Small, medium	information	2 nd school children	Education, awareness	Opportunities, risks, potential, concerns	?
projects 3TUCfE	Small, CTA,	reflection	stakeholders, scientists	Ethics, bioethics, ICT and privacy, security	Responsible innovation	NWO programme Responsible Innovation, valorisation to policy makers
Nanoplaza 2011	Small, internet	dialogue	stakeholders	Actual issues	Stakeholder dialogue, awareness	One article was cited in a Parliamentary question

Switzerland

Exercise	Scope	Aims	Groups	Issues	Concerns	Uptake & Impact
TA-Swiss nanotechnology projects 2003-12	Medium, national	Reflection, CTA	parliament	Nanomedicine, nanofood, risk governance	Ethical aspects, risk governance	?
Risiko Dialog, nanotechnology activities	National, EU / Germany	EHS, risk governance	stakeholders	Risk governance	Risk governance, transparency	?
Swiss Nano Cube	Internet	information	Youth, general public	Awareness, education	Opportunities, risks, benefits, concerns	?
Innovationsgesellschaft, nanosafety projects	local	EHS, risk governance	Industry, stakeholders	Risk governance	Managing risks	?
Parliament postulate Micro and nanotechnology as strategic project of national interest 2006	National	Research and innovation	Government	Nanotechnology programme	Strategic national interest	Adopted 16-10-2006
Parliament motion legal regulation nanotechnologies 2007	National	Regulation	Government	Risk government; regulation per sector; public dialogue	Protection health workers & consumers, environment; agrifood, textile, household, cosmetics, medicine	Adopted 22-03-2007
Parliament postulate need for regulating nanotechnologies 2010	National	Regulation	Government	Review of need for nanoregulation	Regulatory gaps	Adopted 9-03-2010

UK

Exercise	Scope	Aims	Groups	Issues	Concerns	Uptake & Impact
Royal Society / Royal Academy of Engineering study on nanoscience and nanotechnology (2004)	Large, national / international	Dialogue, governance	Stakeholders, parliament, government	Broad analysis of technological trends, socio-economic potential, ethical, social, health, environment,	Governing nanotechnology / EHS research agenda	By government: formal response / progress report 2007 / not in 2010 after 5 years International: by

				safety, regulatory aspects		EU and other governments Major, agenda setting worldwide. UK: 2007: lack of funding EHS research
DEMOS, the Nanodialogues	DTI funded Until 2007	dialogue	Stakeholders, policy makers, scientists, industry	Public engagement, nano-remediation, water purification, research policy, food	Upstream / midstream public engagement	Mentioned by government in response to review 2007
Nanotechnology Engagement Group (NEG) 2005-2007	DTI funded Until 2007	dialogue		Science and public engagement policy	Funding targeted to societal goals, risk governance, transparency	
Small Talk project 2004-2006	SCOPUS grant	dialogue	Scientists, public, policy makers	Understanding public and policy makers concerns and aspirations regarding nano	Gap between public perception and political reality	Reported to NEG and NIDG. Mentioned by government in response to review 2007
Nanojury 2005	medium	dialogue	public	Upstream public engagement with nanotechnology policy	Governance, research priorities, transparency, risk, regulation	Reported to government, received interest among social scientists and in media
DEMOCS card games	Small	dialogue	Public, youth	Nanotechnology, Nanobiotechnology, Human Enhancement, Synthetic Biology etc	Democratising decision making on science	?
Nano and Me	BIS funded website	Dialogue, awareness	Public	Information, solicit public opinions	Democratising decision making on science	?
NIDG (Nanotechnology Issues Dialogue Group)	Go Science and DIUS 2005-2010	Policy coordination	Policy makers of different departments and bodies	Implement and monitor government nanopolicies	coordination	?
NSF Nanotechnology Stakeholder Forum	Coordinated by DEFRA Until 2010	dialogue	stakeholders	EHS issues		Until 2007: stakeholder comments taken into account by government. 2007-10: confusion about aims of forum.
RCEP study nanomaterials	Royal Commission on Environmental Pollution 2007-2008	Expert advice, consultation	Government	EHS issues, life cycle aspects, governance	More coordinated risk assessment research, more coherent governance in EU framework. More from public engagement projects to social intelligence gathering	Influential study at the time, RCEP has been abolished by the government and closed 31 March 2011.
NCG (Nanotechnology	Announced from 2010?	dialogue				?

Collaboration Group)						
House of Lords report Nanofood	Parliament, national, 2009-2010	government	Government, stakeholders	Nano in food, EHS	Lack of transparency in food industry, organise stakeholder dialogue	FSA took over most recommendations and set up discussion group in January 2011
UK Government nano strategy 2010	National	Government	Parliament, industry, stakeholders	Funding, research, socio-economic benefits, EHS research, public engagement	Governance	Implementation by government / public engagement unclear
FSA nanofood discussion group 2011	National	Dialogue, governance	Stakeholders, government	Governance, public engagement	Citizens forum, regulation, register of nano in food	Discussion feeds into policy making

USA

Exercise	Scope	Aims	Groups	Issues	Concerns	Uptake & Impact
NNI workshop Societal Implications of Nano 2001	Federal government, global	Explore nano ELSI issues	Policy makers, scientists, industrialists	Broad inventory of EHS and ethical, legal and societal issues	Responsible nanotechnology development	NNI funding for 2 Centers for Nanotechnology in Society, ASU and UCSB
Center Nano in Society ASU	National	Real Time Technology Assessment	Social scientists, natural scientists and engineers, general public	Embed humanists / social scientists in nanoresearch worldwide	Equity, public dialogue / perception, awareness of EHS and ELSI among natural scientists and engineers	Cf Roco et al 2010: Has contributed to a change in vision on nano governance between 2001 and 2010. From technological and economic to moral progress. Institutionalisation of global governance and cooperation
Center Nano in Society UCSB 2006-2012	National	Study ELSI, methods for public dialogue	Natural and social scientists, stakeholders, public	Equity, global distribution of technological benefits and risks, social and environmental sustainability		
Meridian Inst Nano and the poor 2004-2007	Internet	Information, dialogue	stakeholders	International justice	Opportunities and threats of nanotechnology for poor people in developing countries, water purification, impact on commodities markets	High visibility among stakeholders and policy makers worldwide, impact unclear
Woodrow Wilson Nanotech project 2005-2012	Internet	Information, dialogue	stakeholders	EHS, governance	Gaps in knowledge, regulation, balanced public and stakeholder dialogue	High visibility among stakeholders and policy makers worldwide, results (e.g. nanoproducts database) are used by policy makers worldwide

Other countries

Exercise	Country	Scope	Aims	Groups	Issues	Concerns	Uptake &
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							Impact
Nanotruster	Austria	national	Clearing house for information about nanosafety and societal aspects, catalyse discussions	General public, public administration, nanoscience community	Health and environmental aspects, societal issues	Inform, identify gaps in knowledge, Raise public awareness	Project has been extended from 2010 until 2013.
NANOETHICS	Norway	university	ELSA	Nano Researchers, students	Ethical and societal aspects of nano, nanoethics education for natural scientists	Understanding, policy making	Resulted in scientific publications, nanoethics education course is continuing in 2012.
Teknologiradet project 2005-2009 Nanotechnology product register	Norway	National	regulation	Policy makers, stakeholders, general public	Product register including nanomaterials, public awareness	Regulation and governance	Teknologiradet recommended implemented by Norwegian Pollution Control Authority
NTNU, NANOTRUST project 2007-2011, Nanoethos project, 2009-2010	Norway	University	reflection	Philosophers, social scientists	Trust in nanotechnology for aquaculture, challenges for ELSA	Understanding	Resulted in scientific publications
Centre for Bioethics and Nanoethics	Denmark	University	reflection	Philosophers, social scientists	Nanoethics	Understanding	Resulted in scientific publications
Danish Council of Ethics Website on Man and Machine	Denmark	Government, national public	Dialogue	Policy makers, stakeholders, general public	Cyborgs, social robots	Ethics, public perception, governance	Resulted in policy advice Danish Council of Ethics
Danish Board of Technology	Denmark	Parliament, national	Governance	parliament	ICT and Privacy, responsible innovation, chemical safety	Governance	DBT will be abolished in 2012
Friends of the Earth Nanotechnology Campaign	Several countries, esp. Australia, Europe, USA	internet	dialogue	Stakeholders, parliament, government, public	Nanomaterials in consumer products (cosmetics, food, energy)	Risk governance	Positions are heard and taken into account by policy makers
ETC group	international	Internet	Dialogue	Stakeholders, parliament, government, public	EHS risks, implications for poor people in developing countries	Risk governance	Agenda setting, shapes policy and stakeholder dialogue
I2TA project ¹⁶	Japan	national	Technology Assessment	Government; parliament	Shift field based to issue driven S&T policy	Uncertainty; waiting games; privacy;	fragmented

¹⁶ Discussed in Steeghs, 2011

					Nano-electronics; nano-materials; nano life sciences	safety; biomedical ethics	
CNECV ¹⁷	Portugal	National	Nanobio-ethics	Nat. Bioethics Cie	Nanobioethics	?	?
UNESCO COMEST since 2006	International	International	Ethics of Emerging S&T	UNESCO Member States governments	International ethical and societal aspects, human rights	Nano and the poor, human rights, nanobioethics	?
NanoUNAM ¹⁸	Mexico	University	Public awareness	General public, youth, natural and social scientists	How to educate the public?	Low public awareness, low literacy	Small, lacking dissemination channels
NanoDYF ¹⁹	Ibero-America	Universities	Public awareness, education	General public, youth	Review of public communication on nanotechnology worldwide	Disseminate and popularise nanotech in society	Lacks visibility

Annex 3. List of public dialogue / engagement projects 2001-2012

European Union

Relevant ongoing and finished projects in Europe

Ineke Malsch, version 21 March 2012, postbus@malsch.demon.nl

European level

Nanoethics and ELSA:

Ongoing:

European Group on Ethics: opinions on synthetic biology, nanomedicine and ICT implants etc http://ec.europa.eu/european_group_ethics/index_en.htm

EST-FRAME (2012-2014) Integrated Framework for measuring societal impacts of emerging S&T including nano in food, http://cordis.europa.eu/projects/rcn/100425_en.html

Finished:

EGAIS (2009-2012): <http://www.egais-project.eu/>

¹⁷ EGE 2010 includes an announcement of a national conference on “Nanotechnology and Genetically Organised Organisms”, organised in November 2010 by the national bioethics committee in Portugal CNECV.

¹⁸ Source: Noboru Takeuchi, cited in ICPC-NanoNet 4th annual report on Nanotechnology in Latin America, to be published at www.icpc-nanonet.org

¹⁹ www.nanodyf.org. Also discussed by Pedro Serena, cited in ICPC-NanoNet 4th annual report on Nanotechnology in Latin America, to be published at www.icpc-nanonet.org

DEEPEN: <http://www.geography.dur.ac.uk/projects/deepen>
SIAMPI (2009-2011): <http://www.siampi.eu/Pages/SIA/12/625.bGFuZz1FTkc.html>

Communication about Nanotechnology:
Nanochannels (2011-2013): analyses nano-public engagement projects:
<http://www.nanochannels.eu/>

Nano-TV <http://www.nano.org.uk/news/feb2009/latest1786.htm>,
<http://www.youris.com/Nano/Nanotechnologies.kl>

<http://www.youris.com/Nano/NANOTV>

NanoYou <http://www.nanoyou.eu/>

Time for Nano <http://www.timefornano.eu/>

NanoToTouch <http://www.nanototouch.eu/>

Dialogue / codes of conduct about Nanotechnology:

Ongoing:

PERARES: Public Engagement with Research and Research Engagement with Society, 01-05-2010 – 30-04-2014 <http://www.livingknowledge.org/livingknowledge/perares>

ETUI Nanotechnology activity (Trade Unions): <http://www.etui.org/Topics/Health-Safety/Nanotechnologies>

EEB Nanotechnology activity (Environmental movement):
<http://www.eeb.org/index.cfm/activities/industry-health/nanotechnology/>

CEFIC stakeholder dialogue (chemical industry): <http://www.cefic.org/Policy-Centre/Environment--health/Nanomaterials/>

iNTeg-Risk: <http://www.integrisk.eu-vri.eu/>

CONSIDER (Civil Society Organisations in Designing Research Governance, 2012-2015)
http://cordis.europa.eu/projects/rcn/101821_en.html

Finished:

MATTER: <http://www.matterforall.org/>, <http://www.nanoandme.org/home/> (Follow-up of Responsible Nano Forum)

Nanoplat: <http://www.nanoplat.org/>

EC code of conduct responsible nanotechnology & Nanocode project:
<http://www.nanocode.eu/>

Nanomed Round Table: <http://www.nanomedroundtable.org/>

Nanologue: www.nanologue.net

DECIDE: <http://www.playdecide.eu/>

Framing Nano: www.framingnano.eu

Nanocap: www.nanocap.eu

NANOETHICS 2011, Conference on 20-21 October 2011 on the EC Code of Conduct for Nanotechnology, and dissemination of results, Polish Academy of Sciences, Warsaw
<http://www.nanoethics2011.pan.pl/>

ICT / Security:
Ongoing:

PRACTIS: Privacy-Appraising Challenges to Technologies and Ethics, 2010-2012,
<http://www.practis.org/>

PRESCIENT: Privacy and Emerging Sciences and Technologies 2010-2012,
<http://www.prescient-project.eu/>

SETICS (Security Ethics in new I&C Technologies) Institute for the Protection and Security of the Citizen (IPSC), JRC, EC <http://ipsc.jrc.ec.europa.eu/index.php/530/0/>

SURCIT (Surveillance Systems and the Citizen), IPSC,
<http://ipsc.jrc.ec.europa.eu/?id=552> (2011-...)

Finished:

RISE: Rising Pan-European and International Awareness of Biometrics and Security Ethics 2009-2012, <http://riseproject.eu/>

HIDE: Homeland Security, Biometric Identification and Personal Detection Ethics 2008-2011 <http://www.hideproject.org/>

DETECTOR: Detection Technologies, Counter-Terrorism Ethics and Human Rights 2008-2011, <http://www.detector.bham.ac.uk/>

CPSI (Changing Perceptions of Security and Interventions, 2007-10) <http://cpsi-fp7.eu/>

FESTOS: Foresight of Evolving Security Threats Posed by Emerging Technologies, 2009-2011, <http://www.festos.org/>

ETICA: Ethical Issues of Emerging ICT Applications, 2009-2011,
<http://ethics.ccsr.cse.dmu.ac.uk/etica>

PRISM: Privacy-Aware Secure Monitoring: <http://www.fp7-prism.eu/>

TECHNOLIFE: Social and Ethical Implications of 3 technologies including body modification and enhancement (nano, bio, cogno): www.technolife.no

ICTethics: <http://www.ictethics.eu/>

PRISE (Privacy Enhancing Shaping of Security Research in Europe, until 2008):
<http://www.prise.oeaw.ac.at/>

International cooperation:
Ongoing:

GEST (Global Ethics in Science and Technology, 2011-2014),
http://cordis.europa.eu/projects/rcn/96890_en.html
http://www.uclan.ac.uk/schools/school_of_health/research_projects/gest.php

ICPC NanoNet (2008-2012): www.icpc-nanonet.org and www.nanoarchive.org
EICOON (2009-2012): <http://www.eicoon.eu/>

Eulasur: <http://www.icmab.es/eulasur/>

NanoLINEN (cooperation in EHS and ELSA between Europe and India, 2011-2012),
<http://www.nanolinen.org/>

Finished:

NanoforumEULA (finished): www.nanoforum.eu
NanoRucer (2009-2011): <http://nanorucer.de/nanorucer/inhalte/start.php>

Nanoroadmap: <http://nanoroadmap-cyted.com/>

Nanobioethics / converging technologies:
Ongoing:

ETHENTECH (Ethics of Enhancement Technology, 2009-2012):
http://www.kth.se/abe/om_skolan/organisation/inst/philhist/phil/research/bioethics/projects/ethentech-1.64802

Sybhel (Synthetic Biology for Human Health: Ethical and Legal Issues, 2009-2012)
<http://sybhel.org/>

HEALTHGOVMATTERS (2009-2012):

<http://www.healthgovmatters.eu/>

SYNTH-ETHICS (2009-2012):

<http://synthethics.eu/>

EPOCH (Human Enhancement, 2010-2012):

<http://epochproject.com/>

P4L (Photonics for Life), including Task Force on Ethics (2010-): www.photonics4life.eu

NanoDiaRA Development of Novel Nanotechnology Based Diagnostic Systems for Rheumatoid Arthritis and Osteoarthritis (includes ELSA 2010-2014)
<http://www.nanodiara.eu/>

HIGHTECH EUROPE (1st European Food Processing Network of Excellence, includes nano and ELSA aspects) <http://hightecheurope.com/> (2009-2013)

ARTIVASC 3D Artificial Vascularised Scaffolds for 3D-Tissue Regeneration, includes alternatives for animal testing (2011-2015)
http://cordis.europa.eu/projects/rcn/101209_en.html

INLIVETOX Intestinal, liver and vascular nanoparticle toxicity development and evaluation of a novel tool for high-throughput data generation (include alternative for animal testing (2009-2012), <http://www.inlivetox.eu/>

European Parliament, STOA projects on Human Enhancement and on Converging Technologies:

An ongoing STOA project on “Making Perfect Life” coordinated by the Rathenau Institute <http://www.rathenau.nl/themas/project/making-perfect-life.html>

Finished:

Results of earlier STOA projects:

<http://www.itas.fzk.de/eng/etag/document/2009/coua09a.pdf>

http://www.europarl.europa.eu/stoa/publications/studies/stoa183_en.pdf

NanobioRaise: <http://nanobio-raise.org/>

Knowledge NBIC: <http://www.converging-technologies.org/>

Nanomed Roundtable (2009-2010): <http://www.nanomedroundtable.org/>

Euronanobio (European scale infrastructure in Nanobiotechnology, 2009-2010) <http://www.euronanobio.eu/>

EforTT (Ethical Framework for Telecare Technologies for older people at home, 2008-2011) <http://www.lancs.ac.uk/efortt/index.html>

Nano in consumer products:

NANOBARRIER (Extended shelf life biopolymers for sustainable and multifunctional food packaging solutions, 2012-2016) http://cordis.europa.eu/projects/rcn/102276_en.html

NANOSUSTAIN (Development of sustainable solutions for nanotechnology based products based on hazards characterisation and LCA, 2010-2013) http://cordis.europa.eu/projects/rcn/94362_en.html

General nanotechnology:

European Commission nanotechnology pages:

http://ec.europa.eu/research/industrial_technologies/index_en.html

http://ec.europa.eu/nanotechnology/index_en.html and

<http://cordis.europa.eu/nanotechnology/>

Ongoing:

Nanofutures: <http://www.nanofutures.eu/>

NanoCom: <http://www.nanocom-eu.org/NanoCom/Homepage.html>

ProNano: <http://www.pronano.eu/>

JRC Inst Health & Consumer Protection project Nanotechnology:

http://ihcp.jrc.ec.europa.eu/our_activities/nanotechnology (2011-)

HIERARCHY (Hierarchical Assembly in controllable matrices, training network in nanosciences including ELSA, 2008-2012) <http://www.hierarchyweb.org/>

Finished:

Nanoforum: www.nanoforum.org
EuroNanoforum: <http://www.euronanoforum2011.eu/>

<http://www.euronanoforum2009.eu/>

Nanoroad SME:
(nano)Photonicroad SME: <http://www.photonicroad.eu/>

STOA/ETAG project Nanosafety (2010-2011): <http://www.itas.kit.edu/english/etag.php>

Austria:

Nanotrust: <http://nanotrust.ac.at/> ; <http://www.oeaw.ac.at/ita/ebene4/e2-2c21.htm>

ITA – OEAW also runs other projects including “Privacy Reloaded” (2009-2011):
<http://www.oeaw.ac.at/ita/>

Belgium:

NanoSoc: <http://www.nanosoc.be/>

Denmark:

Centre for Bioethics and Nanoethics (in Danish):
<http://www.teo.au.dk/cfb/enhed/praesent>

Danish Council of Ethics Website on Man and Machine: www.homoartefakt.dk (translated in English since August 2010) www.etiskraad.dk

Danish Board of Technology www.tekno.dk projects 2011 include “Privacy protection in the ‘things’ internet”, “responsible innovation” and “harmful chemicals”

France:

Vivagora citizens alliance on nanotechnology (ACEN): www.vivagora.org
Vivagora - CNAM Nanoforum, Vivagora project COEXNano on nanosilver and TiO₂ in coatings

CNDP, National Debate on Nanotechnology: <http://www.debatpublic.fr/> and
<http://www.debatpublic-nano.org/>

Ile de France Nanocitoyens:
<http://espaceprojets.iledefrance.fr/jahia/Jahia/bca/NanoCitoyens/site/projects>

FMSH, project Security – Technology – Society, <http://www.msh-paris.fr/en/research/thematics/security-technology-society/?taillepolice=2%2Fincludes%2Ferrors.php%3Ferror%3D%2Ferrors.php%3Ferror%3D.%2F>

Germany:

TAB projects on Nanotechnology, on Converging Technologies and on Human Enhancement:

TAB is still working on the topic of enhancement, in an ongoing TA project
<http://www.tab-beim-bundestag.de/en/research/current-research.html>

Nano Office (Technical University Darmstadt) project on nano regulation:
<http://www.philosophie.tu-darmstadt.de/nanobuero/nanobuero/ueberuns/Index.de.jsp>

Fraunhofer ISI: Convergence of Nano- Bio- Information Technology and Cognitive Sciences, <http://isi.fraunhofer.de/isi-en/t/projekte/bb-fri-converging-strat.php>

NanoKommission (stakeholder dialogue on nanotechnology) 2006-2008, 2009-2011 and 2012: <http://www.bmu.de/chemikalien/nanotechnologie/aktuell/37643.php>

Information platform Nanosafety: <http://www.nano-sicherheit.de/>

Netherlands:

TA NanoNed (2005-2010): <http://www.nanoned.nl/ta.html>

NanonextNL RATA (2011-2015): <http://www.nanonextnl.nl/>

Rathenau Instituut: <http://www.rathenau.nl/nanodialoog>

Government nanotechnology pages (in Dutch):

<http://www.rijksoverheid.nl/onderwerpen/nanotechnologie>

Nanopodium (national nanodialogue, including 35 projects by civil society and companies in 2010): www.nanopodium.nl

Nanosociety: (secondary education project 2010-2013): www.nanosociety.nl

New technologies as Social Experiments... 3TU Centre for Ethics, 2011-...

<http://homepages.ipact.nl/~ibovdpoel/cv/summaryvdpoelvici.pdf>

Integrating social and ethical reflection in nanobiotechnological practice, 3TU Centre for Ethics, 2007-2011,

http://www.ethicsandtechnology.eu/research/projects/nanobiotechnological_practice/

Norway:

NANOETHICS: Bergen Interdisciplinary Studies of Ethical and Societal Implications of Nanotechnology: <http://nano.uib.no/NANOETHICS.php>

Teknologiradet project Nanotechnology product register

<http://www.teknologiradet.no/default1.aspx?m=116>

NTNU, NANOTRUST project 2007-2011, Nanoethos project, 2009-2010

<http://www.ntnu.edu/employees/bjorn.myskja>

<http://www.springerlink.com/content/x0267q0m4t5l6456/>

Switzerland:

TA-Swiss project Nanotechnology and Environment, 1-4-2011 – 1-12-2012,

Finished project nanotechnologies: <http://www.ta-swiss.ch/en/projects/nanotechnologies/>

current projects <http://www.ta-swiss.ch/>

Risiko Dialog, nanotechnology activities: <http://www.risiko-dialog.ch/Themen/nanotechnologien>

Swiss Nano Cube, platform for nanotechnology knowledge and education:
<http://www.swissnanocube.ch/en/home/>

Innovationsgesellschaft, nanosafety projects including NanoRisk Check, CENARIOS, 360 degree risk monitoring: <http://www.innovationsgesellschaft.ch/index.php>

UK:

DEMOS, the Nanodialogues: <http://www.demos.co.uk/projects/thenanodialogues>

Small Talk project: <http://www.smalltalk.org.uk>

Nanojury: <http://www.nanojury.org.uk/>

Royal Society/Royal Academy of Engineering study on nanoscience and nanotechnology (2004): <http://www.nanotec.org.uk/>

International:

(International projects or non-European projects with international visibility)

OECD: Working Party on Nanotechnology WPN: www.oecd.org/sti/nano and Working Party on Nanomaterials WPNM:

http://www.oecd.org/department/0,3355,en_2649_37015404_1_1_1_1_1,00.html

UNESCO Ethics of Science and Technology: http://portal.unesco.org/shs/en/ev.php-URL_ID=1373&URL_DO=DO_TOPIC&URL_SECTION=201.html

International Risk Governance Council: <http://www.irgc.org/-Nanotechnology-.html>

International Nanotechnology and Society Network INSN:

<http://www.nanoandsociety.com/>

Society for the Study of Nanoscience and Emerging Technologies S-NET:

www.theSNET.net

FONAI, stimulating nanotechnology in Africa and the Caribbean's: <http://www.fonai.org/>

Nano Ethics Network: <http://www.teo.au.dk/cfb/forskning/omraader/nanoethics>

Nanobank: www.nanobank.org

Meridian Institute, Nano and the Poor: <http://sites.merid.org/nano/>

ReLANS Latin American network on Nanotechnology and Society:

<http://www.relans.org/inicio.html>

Woodrow Wilson Institute, Project on Emerging Nanotechnologies:

<http://www.nanotechproject.org/>

Commission on the Ethics of Science and Technology, Canada, update of report on nanotechnology and agrifood (2012):

http://www.ethique.gouv.qc.ca/index.php?option=com_docman&Itemid=24&lang=en

Friends of the Earth nanotechnology campaign: <http://www.foe.org/>

DaNa: information portal about nanomaterials and EHS

<http://nanopartikel.info/cms/lang/en/page3.html>

Annex 4. Workshop Responsible Research and Innovation Programme

Dates: 1-2 February 2012

Location: European Commission, CDMA building, Rue de Champ de Mars 21, 1049 Brussels, Belgium

Day 1: ObservatoryNano tools for Responsible Innovation

13.00: Lunch
14.00: Ineke Malsch: Introduction to the workshop
14.15: Alexei Grinbaum: Responsible Research and Innovation: using the ObservatoryNano Ethics Toolkit
15.00: Discussion: The place of ethics in responsible innovation
15.45: Coffee/tea
16.00: Brigitte Biermann: ObservatoryNano Nanometer Demonstration
16.45: Discussion: The place of communication in responsible innovation
17.45-18.00: Anne Mette Fruelund Andersen: Reflection on the first day

20.00 Dinner

Day 2: European Roadmap for Responsible Innovation

9.00: Ineke Malsch: introduction of the second day
9.20: Mr Philippe Galiay, (Unit B.6 Ethics and Gender, Directorate B European Research Area, DG Research): European Commission and Responsible Research and Innovation
9.40: Roundtable discussion round 1: Expert views on EU policy on Responsible Research and Innovation with invited experts. Chair: Alexei Grinbaum. Invited experts: Dr Françoise Roure, OECD, France, Dr Fern Wickson, Genok Centre for Biosafety, Norway, Prof Dr José Manuel de Cozar Escalante, Univ. de la Laguna, Spain
10.40: Coffee / tea
11.00: Roundtable discussion round 2: ObservatoryNano's Contributions to Responsible Innovation. All participants are invited to contribute actively to the discussion.
12.30: 5 minute reactions by representatives of EU projects: Robert Geertsma, Nanofutures, Jan Mehlich, NanoDiaRa
13.00: Anne Mette Fruelund Andersen: Conclusions.
13.15: Lunch and farewell

Participants

Dr Brigitte Biermann ObservatoryNano, DE
Dr Jorge Costa David, EC DG EMPL, Lux
Prof Dr Jose Manuel de Cozar Escalante, Univ La Laguna, Spain
Dr Anne Mette Fruelund Andersen ObservatoryNano, DK
Dr Philippe Galiay (EC Nanocode project officer)
Mr Robert Geertsma, ObservatoryNano, NL
Dr Alexei Grinbaum ObservatoryNano, FR
Dr Ineke Malsch ObservatoryNano, NL
Dr Jan Mehlich, DiaRa project
Ms Nathalie van Neck (EC, project officer ObservatoryNano)
Dr Maj-Inger Nilson, EC, NMP
Mr Hans Hartmann Pedersen, EC, NMP
Dr Françoise Roure, OECD, France
Dr Fern Wickson (Genok centre for biosafety, Norway)

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European Commission, "Special Eurobarometer 73.1: Biotechnology" Conducted by TNS Opinion & Social for DG Research, October 2010, http://ec.europa.eu/public_opinion/archives/eb_special_359_340_en.htm

French government, Les engagements du Gouvernement sur les suites a apporter au debat public relative au developpement et a la regulation des nanotechnologies, French government, 13 February 2012, http://www.developpement-durable.gouv.fr/IMG/pdf/Les_engagements_du_Gouvernement_sur_les_suites_a_apporter_au_debat_public_relatif_au_developpement_et_a_la_regulation_des_nanotechnologies.pdf

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Grenelle 2, "Le Grenelle Environment; Grenelle 2 Law", Ministry for Ecology, Sustainable Development, Transport and Housing, Paris, France, December 2010, http://www.developpement-durable.gouv.fr/IMG/pdf/Grenelle_Loi-2_GB_.pdf

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