

Ten lessons for a nanodialogue

The Dutch debate about nanotechnology thus far

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Foreword

Developments in nanotechnology, the study, design and manipulation of materials at the nanoscale, raise many social and societal issues, such as safety (to both human health and the environment), privacy and patient interests. Nanotechnology holds out the promise of great advances, but we also hear misgivings and even prophecies of doom. That's why a plea for a broad social debate is often made.

The Dutch government also wishes to engage the public in a dialogue about nanotechnology. This is no simple task. What are we to discuss? The impact of nanotechnology is likely to be felt in many diverse areas, from new materials and cosmetic products to (yet) smaller computers and molecular medicine. Moreover, any public dialogue about nanotechnology must consider not only new issues, but also several 're-emerging' questions.

In addition it is still unclear how NGOs (Non Governmental Organizations), consumers and the general public can be involved in the nanotechnology debate. Many people do not know what nanotechnology entails, nor even that there are already products on the market which contain nanoparticles. Who can say what opportunities nanotechnology will bring for the Netherlands... or what threats?

In short, there is no 'off the shelf' formula for a useful societal debate. By publishing this report, which examines the nanotechnology debate thus far, the Rathenau Institute nevertheless wishes to establish a starting point for such a discussion. Throughout the world, scientists, technology assessment institutes and (more recently) NGOs have been discussing nanotechnology for many years. Who are the key actors in the debate? What positions have they adopted? What are their wishes and their agendas? What can we learn from them? What bearing does the international discussion have on the situation in the Netherlands?

The final chapter of this report presents ten 'lessons learned': recommendations with regard to the role that the Dutch government can and should play in promoting the nanotechnology debate. It seems clear that a distinction must be drawn between the broad debate about the social impact of nanotechnology and the more urgent discussion addressing the potential risks. Any lack of firm direction on the part of the government is likely to undermine the legitimacy of the debate as a whole.

We hope that this report contributes to a fruitful and successful societal dialogue about all aspects of nanotechnology.

Jan Staman

Director, Rathenau Institute

Summary

The Dutch government wishes to stimulate the social debate about nanotechnology. That is no simple undertaking as the impact of nanotechnology will be felt in many diverse areas. The debate must therefore consider both new and re-emerging issues. Moreover, it is far from clear how the NGOs and the general public can be fully involved in such a broad topic as nanotechnology.

The Rathenau Institute has therefore examined how the debate about nanotechnology has developed thus far. There appear to be ten lessons to be learned with regard to the role which the government can adopt in furthering the dialogue.

1 Differentiate between the risk issue and the broader debate about nanotechnology

In considering the most appropriate role for the government, it will be useful to distinguish between a debate which focuses solely on the potential risks of nanotechnology (the 'risk issue') and a broader societal dialogue which considers the general social impact of nanotechnology. Although these aspects are clearly related, they do call for the government to adopt different roles and for a different type of dialogue in each case.

Recommendations with regard to the risk issue

2 Actively address the risk issue

Any lack of government initiative in addressing the risk issue can only undermine the legitimacy of the broader societal dialogue about nanotechnology.

3 Involve NGOs in developing policy

The risk issue demands interactive consultation, whereby NGOs are fully involved in developing policy.

4 Provide clear information about nanotechnology products, the risk governance strategy and the uncertainties that remain

If the government is to maintain public trust and confidence, there must be full openness. Accordingly, it is crucial to provide clear information about the relevant products and the risk governance strategy. The government should also be fully open about any uncertainties that remain in terms of the potential risks (to human health and the environment) posed by nanoparticles.

Recommendations for the broader dialogue

5 Create a public agenda which enjoys wide support

An agenda which can rely on wide support is crucial to any useful societal debate on nanotechnology. The dialogue must be fully open, and the input of all participants must be respected.

6 Build upon ongoing discussions wherever possible

Establish what is to be discussed under the heading of 'nanotechnology' and what issues can be more appropriately examined within other, already existing discussions. This will make the dialogue more manageable and will promote participation on the part of the existing institutions and societal organizations.

7 Facilitate the involvement of smaller NGOs

To ensure that even the smaller NGOs and NGOs are well prepared for the dialogue, the government must help them to develop the necessary knowledge (part of 'capacity-building').

8 Remain open to the societal organizations' own agendas

In any societal dialogue, there will be broader interests, opinions and agendas which must be taken into account. Failure to do so will create mistrust rather than trust.

9 Inform the public about the societal aspects of nanotechnology

Given that public awareness of nanotechnology is currently extremely low, it is still too early to involve the majority of people in the relevant dialogue. At this stage it is therefore more important to ensure that clear and accurate information about the societal aspects is readily available to those who wish to learn more.

10 Give citizens a voice by means of small-scale engagement activities

Given the broad societal impact of nanotechnology, it is important to listen to the views of all sections of the community and to keep a 'finger on the pulse' of public opinion. Focus groups and panel discussions are two means by which the public can be given a voice at the grass roots level.

Contents

Foreword	5
Summary	7
Contents	9
1 Introduction	11
2 Early identification of the societal issues	15
2.1 A first proposal for the agenda	15
2.2 The issues in greater detail	16
2.3 Conclusions	23
3 NGOs in the Netherlands	25
3.1 Involvement	27
3.2 Information flows	30
3.3 The government's role	32
3.4 Structuring the societal debate	34
3.5 Conclusions	37
4 NGOs in other countries	39
4.1 Societal issues	39
4.2 Three pre-eminent societal organizations	41
4.3 Dealing with the risk issue	42
4.4 Conclusions	44
5 Research on public opinion	47
5.1 United States	47
5.2 Europe	50
5.3 Conclusions	53
6 Ten lessons for a nanodialogue	55
6.1 The risk issue demands governmental direction	56
6.2 A broad dialogue demands openness and structure	58
Notes	62
References	63
Appendix: research questions	68
About the authors	71

1 Introduction

Rinie van Est, Bart Walhout – Rathenau Institute

Nanotechnology – the control and modification of matter at the atomic and molecular scale – is now a *booming business*. Like information technology, nanotechnology will enable new advances to be made in extremely diverse areas of human endeavour: from new materials and cosmetics to (even) smaller computers and molecular medicine. New 'nanoproducts' are already being introduced virtually every week, ranging from transparent sunscreens to self-cleaning windows and vitamin supplements. There are now some 250 companies active in nanotechnology in the Netherlands alone. Global sales of nanotechnology products are expected to increase from 25 billion euros in 2004 to some 450 billion euros by 2010. It therefore comes as no surprise that the Dutch government regards nanotechnology as one of the spearheads of the 'knowledge economy' and is making substantial investments in the field.

However, the developments in nanotechnology raise many, often extremely diverse, societal issues. Questions are being asked about safety and the potential adverse impact to human health and the environment, about privacy and patient interests, and about the desirability of certain developments. There are both rosy predictions and prophecies of doom. All such questions call for clear and full debate. Accordingly, the government wishes to promote a dialogue with the public about the consequences of nanotechnology. In its policy document *Van klein naar groots* ('From small to great'; Parliamentary Documents 2006b), the government makes three specific proposals:

- A broad-based commission should be appointed to "identify any unwanted or hazardous consequences of nanotechnologies in the field of health, working conditions, the environment, ethics and social relationships at an early stage¹."
- A process should be commenced, "with stakeholders and a broad representation of the public at large, in order to kick-start the public dialogue about nanotechnologies."
- Various ways should be sought to "engage the public in the development of nanotechnologies."

In proposing these initiatives, the government has set itself a particularly challenging task. After all, the impact of nanotechnology will be felt in so many diverse areas that not only must new issues be addressed, but also a number of re-emerging issues. In a response to the government's policy document, the Rathenau Institute pointed out that, while there is indeed a need for a broad-based discussion, the debate will not always be conducted under the heading of 'nanotechnology' itself (Staman, 2007).

Moreover, the findings of recent meetings organized by the Rathenau Institute ('Nanofood Safety' and 'NGOs & engaging nanotechnology') confirm that it remains far from clear how NGOs (Non Governmental Organizations), consumers and other members of the general public can be fully engaged in such a broad topic as nanotechnology. What is the purpose of the debate? Is it merely to take stock of the various standpoints and opinions? Is it to achieve consensus? What is required in order to get the right people 'round the table'?

There is no standard formula which provides a ready answer to these questions. However, there are various lessons which can be drawn from the debate thus far. A select circle of scientists, researchers, private sector managers, policymakers and (since recently) NGOs has already embarked upon a discussion of the potential effects of nanotechnology. In the current study, we examine this discussion from three perspectives.

- 1 First, we describe the issues which have been identified in recent years and which the government and society may be required to address. We base our deliberations on the list of application areas and relevant issues previously produced by the Rathenau Institute (Van Est *et al.*, 2004). In Chapter 2, we examine which of these issues are now subject to discussion, which have found their way onto the policy agenda, and which have largely been forgotten. In doing so, we focus on the situation in the Netherlands itself, and may therefore be seen to be reflecting on our own work to date. Nevertheless, we also examine the degree to which the issues have permeated the international discussions, with a number of examples given.
- 2 The second perspective is that of the NGOs which choose to assume responsibility for certain issues. It is often these organizations which do most to promote the discussion. For this study, we interviewed a number of NGOs in the Netherlands, asking which particular issues they seek to address and what role, if any, they intend to take in the debate (see Chapter 3). We also examined the activities of NGOs in other European countries and the United States: how have they chosen to become involved in the nanotechnology debate? We devote particular attention to a number of NGOs which now play a key role in the international debate, such as the ETC Group in Canada and the American branch of Friends of the Earth (see Chapter 4).
- 3 The third perspective is that of the general public, in the role of citizen, consumer or patient. How much do we know about the public perceptions of nanotechnology? How has public opinion developed in recent years? There being little information relating specifically to the Dutch situation, we rely on the results of studies conducted in the United States, the United Kingdom, Germany and Switzerland. In Chapter 5 we compare the most recent findings to those published by the Rathenau Institute in 2004 (Hanssen & Van Est, 2004).

The findings of this study are primarily of relevance to the political discussions further to the current government's policy and planning processes. The government's intentions are to be set out in the 'Nanotechnology Action Plan' which is currently being produced by an interdepartmental workgroup, with an expected publication date in mid-2008. The three perspectives listed above are directly related to the three policy lines being pursued by the government.

The final chapter of this report (Chapter 6) presents the main conclusions and findings, from which we may draw certain lessons regarding the most appropriate role for the government in encouraging further societal dialogue about nanotechnology.

2 Early identification of the societal issues

Lucien Hanssen – Deining Societal Communication

A debate about emerging technologies will often begin in a relatively small circle comprising think tanks, technology assessment organizations, technology ‘trendwatchers’ and social scientists. These specialists will reflect on the technological breakthroughs heralded by the visionary scientists. But they must also consider the ‘worst case scenarios’ raised by those scientists or others. This process of reflection is intended to identify all threats and opportunities for the benefit of policymakers and NGOs alike. Nanotechnology is an emerging technology which will undoubtedly have a very broad impact. It is therefore essential to identify the potential ethical, social and legal issues. Are these issues similar to those raised by ICT or gene technology? Are there also specific issues unique to nanotechnology itself?

2.1 A first proposal for the agenda

In 1998, the Netherlands Study Centre for Technology Trends (STT) published the report of its exploration of the future of nanotechnology. This study mentioned the potential adverse impact of nanoparticles on human health and the environment. A broader, international discussion of the societal effects of nanotechnology began to develop in 2003, whereupon the Rathenau Institute published a more comprehensive account of the societal issues entitled *Om het kleine te waarderen* (‘To value the small’; Van Est *et al.*, 2004). This study proposed an initial ‘draft’ agenda for the public discussion of nanotechnology. In this chapter, we take this study as the starting point for describing the further development of the debate.

Table 2.1. (below) presents a summary of the societal and ethical issues identified by the 2004 study, arranged according to application area. The best and worst case scenarios for each issue are listed as ‘ideals’ and ‘nightmares’.

Table 2.1 Societal issues raised by nanotechnology; ideals and nightmares (taken from Van Est et al. 2004)

Application area	Societal issues	Ideals	Nightmares
Nanomaterials / industrial production	Impact on human health and the environment	Sustainability	Nano-asbestos
	Self (re-) production	Universal assembler; personal fabrication	Grey goo (uncontrollable reproduction)
	Privacy	Smart products and environments	Big brother
Bio-electronics	Human enhancement	A world without disability	Discrimination against the disabled
	Hybrid forms of living and non-living entities	Links with and via the internet	Dehumanization Alienation
Nanotechnology in medicine	Predictive medicine	Early diagnostics Personalized pharmaceuticals	Compulsion/exclusion Unequal access to healthcare
Nanotechnology in the military setting	Arms race	A safe world	Proliferation of terrorism
	Ethics of war	War without fatalities	Killer robots Space wars
	Human enhancement	Invincible soldiers	Cyber soldiers
Economy / innovation	Patents	Dissemination of knowledge and distribution of profits	Monopolization of knowledge and profits
	Distribution	Fair distribution of wealth and income	Gulf between North and South (the 'nanodivide')
	Governance / dialogue	Societal governance	Technological determinism

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2.2 The issues in greater detail

2.2.1 Risks

In 2004, the most pressing issue was seen to be the potential adverse health impact of nanoparticles (Rathenau 2004). In that year, both the Swiss reinsurance company Swiss Re and the British Royal Society of Sciences (in association with the Royal Society of Engineering) published reports on nanotechnology which attracted much international attention. Both reports concluded that more scientific research into the risks of synthetic nanoparticles is required, and that such research should be conducted in far greater depth than has previously been the case.

A workgroup of the Royal Netherlands Academy of Arts and Sciences (KNAW) was responsible for another report published in 2004 and entitled *Gevolgen van nanotechnologie* ('Consequences of nanotechnology'). Here too, the focus was on the risk issue. Since 2004, the Rathenau Institute has made several calls for firm action to reduce the level of uncertainty regarding the safety of nanomaterials (Van Est et al. 2004, Staman 2006, Van Est & Walhout 2007a), while the Health Council of the Netherlands also stressed the importance of timely measures in a report published in 2006. More recently, the National

Institute for Public Health and the Environment (RIVM) has launched a website providing information about the risks of nanotechnology. (See: www.rivm.nl/milieuportaal/dossier/Nanotechnology.2)

Urgency

The question of the potential risks associated with the use of synthetic nanoparticles is not only a societal issue. Although an increasing number of products are being introduced almost daily, little is known about which products actually incorporate nanomaterials. To date, researchers and regulators have had to rely on databases (such as that maintained by the Woodrow Wilson Center), which list only products whose manufacturers actually use the term 'nano' in their product descriptions. Moreover, there are no standard, agreed definitions of 'nanoparticle' or 'nanomaterial', although such definitions are clearly required if an effective research agenda is to be established. This lack of definitions also impairs the effectiveness of REACH, (Registration, Evaluation, Authorization and Restriction of Chemicals) the European Union's legislative framework for registration and licensing of chemical substances (EC 2006/1907). At present, the REACH schedule takes no account of the specific characteristics of nanoparticles.

At a European conference held in January 2008, the FNV (a federation of Dutch trade unions) called for better protection of employees who may be exposed to nanomaterials. The first international norms for nanotechnology are now eagerly awaited and are likely to become available in 2008. A subcommittee of the International Standards Organization (ISO), comprising representatives of 34 countries (including the Netherlands), is currently developing monitoring and measurement methodologies for nanotechnology. The subcommittee is particularly concerned with the potential health risks and with standardizing terminology. At the same time, the ISO's Health, Safety and Environment Workgroup is developing a set of 'best practices' for nanotechnology in the workplace, based on current information about detection methods, risks and preventive measures. However, it is likely to be several years before any scientifically responsible risk assessment practices can be implemented further to this research (Malsch 2006).

Risk governance

The process of describing a risk, its acceptability and the necessity of risk limitation measures relies not only on hard knowledge but also on personal judgement. It may therefore be advisable to involve consumers, patients, representative bodies and the general public in risk management activities. The International Risk Governance Council (IRGC) has developed a model for this purpose (Renn 2005, Renn & Roco 2006). According to the Health Council of the Netherlands, this model can also be applied when addressing the societal issues raised by nanotechnology. The government's 2006 Vision Document elaborates on the term 'risk governance', using the principles set out in the

policy document *Nuchter omgaan met risico's* ('A sober approach to risks'; Parliamentary Documents 2006a).

Increasing attention for food safety

Since 2006, the discussion of risks has devoted increasing attention to the use of nanotechnology in the food industry (Malsch *et al.*, 2007). In the United States, the Woodrow Wilson Center has questioned the competence of the Food and Drug Administration (FDA) in this area (Kuzma & Verhage 2006). Several NGOs also openly expressed criticism during a recent FDA hearing. Shortly thereafter, an article written by a representative of the Organic Consumers Group was published in *The New York Times*, claiming that the threat posed by nanotechnology is many times greater than that of genetic modification (Feder 2006). The Consumer Union called for new legislation and standards (based on the recommendations of the Royal Society in the United Kingdom) and for greater transparency by means of mandatory labelling and a debate involving all stakeholders (CU 2007).

In Europe, the first misgivings about the use nanotechnology in food production were expressed in the media (Renton 2006), as well as by a German public panel (BfR 2006) and a Swiss public opinion survey (Rey 2006). In the Netherlands, a number of NGOs expressed their concerns during the 'Nanofood Safety' workshop organized by the Rathenau Institute in association with the Food and Consumer Product Safety Authority (Van Est & Walhout 2007a). More recently, the Soil Association (the United Kingdom's leading environmental non-profit organization which promotes sustainable, organic farming) has thrust nanofood into public opinion (SA 2008). The most recent call for a moratorium on the use of nanotechnology in the food industry has been made by the environmental pressure group Friends of the Earth (FoE 2008a).

Attention from policymakers

Since 2004, the lack of scientific knowledge about the toxicological properties of nanoparticles has been stressed by several scientific advisory organizations, including the RIVM (2005), the Health Council (2006) and, most recently, the Food and Consumer Product Safety Authority's Office for Risk Assessment (VWA 2008a, 2008b).

In early 2008, the Ministry of Housing, Spatial Planning and the Environment (VROM) informed parliament about its strategy with regard to the risks of nanoparticles. The focus of this strategy is on research into the risks and on coordination with the international knowledge agenda in this field. The ministry also intends to take the first steps in involving the private sector and NGOs in the discussion.

In other countries, scientific advisory committees have played an important part in ensuring that the uncertainties regarding the safety of nanoparticles are placed on the agenda of various organizations, including major bodies such as the Organisation for Economic Cooperation and Development (OECD). However, the debate within the scientific community itself also has been stimulated by the results of social scientific studies. For example, concern for risks is now a major consideration within the Project on Emerging Nanotechnologies³ being conducted by the Woodrow Wilson International Center for Scholars (an independent American research institute) and the PEW Charitable Trusts. An article written by its project director Andrew Maynard and fourteen other experts in the November 2006 edition of *Nature* attracted worldwide attention (*Nature* 444, pp. 267 – 269).

2.2.2 Self (re-)production

As the term 'nanotechnology' was beginning to emerge, Eric Drexler, author of the popular science book *Engines of Creation* (1986) offered two alternative scenarios. He suggested that nanotechnology might usher in 'the diamond age', in which the entire world can be redesigned at the very lowest level of scale. However, it could also lead to the 'Grey Goo' scenario, in which nanorobots go berserk, take over the world and leave it enveloped in the eponymous grey goo. When the noted science fiction writer Michael Crichton incorporated this scenario in his 2002 novel *Prey*, 'Grey Goo' assumed a central place in the discussions about nanotechnology.

Influential reports such as that produced by the Royal Society in 2004 soon distanced themselves from the more sensationalist aspects of such scenarios. Instead, attention shifted to the adverse effects of nanoparticles on human health and the environment. The Grey Goo scenario is now acknowledged to belong in the realms of fiction (Van Amerom, 2006). Nevertheless, some scientists believe that a 'Green Goo' variant, which involves the artificial creation and modification of viruses, does deserve serious consideration (KNAW 2004). With the emergence of synthetic biology, this possibility has once again been the subject of discussion (see Section 2.2.4).

2.2.3 Privacy

Countless applications of nano-electronics in our everyday lives seem to reflect the promise of 'smart environments' which can constantly monitor one's whereabouts and requirements, and can take appropriate action. Here, the 'nightmare scenario' is that the technological possibilities will lead to a society in which privacy no longer exists, or that technology will actively be used to control our lives. Privacy issues have already earned a place on the agenda, largely due to the emergence of RFID technology and the forecasts regarding Ambient Intelligence.

RFID

RFID stands for Radio Frequency IDentification. In essence, an RFID system relies on a microchip containing information that can be read at some distance. In some cases, it may also be possible to modify that information. The 'readers' used to access the information are likely to be interconnected via large networks, with one or more databases which can record the whereabouts of people and objects at all times. Examples of existing RFID applications include staff access passes, public transport smartcards (such as Transport for London's 'Oyster Card', a version of which is now being rolled out in the Netherlands) and the new biometric passport. Applications which are linked to an individual's identity are controversial. In Germany, for example, supermarket loyalty cards which incorporate an RFID chip have re-ignited the privacy debate.

In the Netherlands, the Electronic Commerce Platform, the Dutch Consumers' Association and the Rathenau Institute have succeeded in having the use of RFID technology placed firmly on the political agenda. As yet, there is very little public awareness of the possible erosion of privacy or the loss of the individual's right to determine how his or her personal information can be used. The majority of Dutch people state that they are willing to give up some privacy if this will help to improve safety and security, i.e. counter terrorism and crime (Van den Heuvel *et al.* 2007). However, the ease with which the new public transport smartcard can be 'hacked' for nefarious purposes has raised serious concerns about the security of RFID applications.

Ambient Intelligence

Ambient Intelligence is a vision of the future which holds out the prospect of 'smart' environments. Here, technology which relies on (bio)sensors and suchlike quite literally fades into the background. Computers smaller than a postage stamp can be incorporated practically anywhere: in walls, in clothing or even in the human body itself. The Ambient Intelligence vision assumes that these smart environments will be used in the service of people, supporting and 'thinking' with them. One significant application area is in healthcare, both collective and individual. It will be possible to set up large-scale telemonitoring and 'e-health' programmes, and to automate care services in the home setting. Here, the main target group would be those suffering from chronic conditions.

Much international research is being conducted into the use of ICT in healthcare, including the social-scientific ramifications. In the Netherlands, the Rathenau Institute has investigated the societal significance of the developments promised by the Ambient Intelligence vision. If care services are to be truly 'personal', it is necessary to have detailed health information which reveals the correlation between health, behaviour and lifestyle. However, that same information could be used to fuel a 'power struggle' between healthcare providers, health insurers and the government. While there is still no common strategy, it remains far from certain whether the developments can be said to

be in the best interests of patients (Schuurman *et al.*, 2007). Given that the use of ICT in healthcare is intended to result in substantial cost reductions, this discussion will certainly gain in importance during the years ahead.

2.2.4 Human Enhancement

The *Converging Technologies for improving human performance* workshop organized by the American National Science Foundation (NSF) in 2001 sparked heated debate among scientists worldwide regarding the degree to which 'human enhancement' can be seen as ethically acceptable. At the *nanoscale* of molecules and atoms, the distinction between living matter and non-living matter is not distinct. There nanotechnology, biotechnology, information technology and the cognitive sciences converge and complement each other. According to the NSF, this 'NBIC convergence' creates various opportunities for improving human performance (Roco & Bainbridge 2002).

Human enhancement is not concerned with therapy or prevention, but with 'improving' already healthy people in order to overcome their innate restrictions. The interventions required to do so can be both physical and cognitive (Miller & Wilsdon 2006). In other words, we not only improve our bodies but also our brains. Attempts to alter the cognitive self have far-reaching implications, since this could well encroach upon the subject's very identity. The borderline between 'treatment' and 'enhancement' is not hard and fast. It can shift under the influence of technological possibilities and societal views. The tolerance for 'differences' could, for example, become smaller. Modern attitudes to cosmetic surgery, which is primarily concerned with outward appearance, demonstrate that norms and values do change. A comparable evolution cannot be ruled out when considering artificial improvements to the brain.

The topic of human enhancement has attracted ongoing attention in recent years, albeit within a relatively small group of policymakers and social scientists. The Rathenau Institute organized a meeting on the subject as long ago as 2003. In 2007, it joined the British Embassy in The Hague in organizing a workshop. A collection of essays on human enhancement is published jointly by the Rathenau Institute and the British Embassy in July 2008. Human enhancement is also one of the topics being considered by the European Parliament's Technology Assessment organization, STOA.

2.2.5 Synthetic biology and artificial life

The discussion about human enhancement has been given a further boost by the emergence of synthetic biology, a field which clearly reveals how the character of biotechnology is changing under the influence of nanotechnology. Synthetic biologists regard a cell as a collection of 'nanomachines' which can be copied, redesigned and improved. This approach marks the dawn of a new era in biotechnology, and one which demands a reconsideration of issues which had previously been thought resolved, such as biosafety, intellectual property rights and certain ethical aspects.

In 2005, the Netherlands Commission on Genetic Modification (COGEM) expressed doubts concerning the effectiveness of the current risk assessment system should there be any further development of synthetic biology (COGEM 2006). In 2007, the Rathenau Institute requested the government and parliament to devote attention to the societal impact of synthetic biology. The answers to various parliamentary questions prompted by the Rathenau Institute's publication *Synthetische biologie: nieuw leven in het biodebat* ('Synthetic biology: new life in the bio-debate'; Van Est *et al.*, 2007c) reveal that policymakers and politicians are now giving the matter serious thought.

2.2.6 Predictive medicine

When genetic testing first became available, it prompted discussions about the desirability of early-stage diagnostics and possible disparities in healthcare entitlements. Should a predisposition to certain diseases affect a person's eligibility for insurance cover, for example? Similar questions have been prompted by the emergence of molecular (nano-) medicine, which builds upon the insights gained through genetics research, as demonstrated by the advisory report published by the European Group on Ethics (EGE 2007). In the Netherlands, the Health Council has identified a number of issues raised by nanomedicine, including privacy aspects, the doctor-patient relationship, and the widening gulf between diagnostics and the possibilities for therapy (Gezondheidsraad 2006). Notably, the government's 2006 Vision Document on Nanotechnology does not address these topics.

2.2.7 The arms race and the ethics of war

Research into military applications is a significant component of the American nanotechnology programme (Van Est *et al.* 2004). 'Cyber soldiers' and 'killer robots' have featured prominently in the nanotechnology discussion to date. However, now that nanotechnology has shown marked development in a number of other fields, attention for the aspects which relate solely to military technology seems to have waned.

2.2.8 Patents / distribution of knowledge and wealth

The ability to produce artificial structures at the nanoscale would place the existing protection of intellectual property using the patent system under yet more pressure. This discussion is frequently concerned with the distribution of knowledge and wealth at the global level. Will the poorer countries lose yet more ground if scientific knowledge is so jealously guarded? The possibility of patenting biological material such as human tissue also raises certain ethical issues. To date, little attention has been devoted to these issues as part of the general debate on nanotechnology in the Netherlands, although a small number of European development cooperation programmes have been launched (such as those with India and Brazil). In the United States, the Meridian Institute is undertaking international research and debate as part of its 'Nanotechnology and the Poor' programme.

2.2.9 Governance and dialogue

A societal debate about major technological developments, such as the emergence of information technology, biotechnology and most recently nanotechnology and the brain sciences, cannot be confined to the societal issues themselves. It must also consider how the government, scientific field, private sector and society can steer and direct those developments. In this sense, nanotechnology provides a test case for 'good governance'.

In the Netherlands, the Health Council's 2006 advisory report on nanotechnology considered the management of the processes, recommending that the standard model of the International Risk Governance Council should be adopted (see also Section 2.2.1). The government's Vision Document on Nanotechnology bases its governance model on that suggested in *Nuchter omgaan met risico's* (Parliamentary Documents 2006a).

The British organization Demos has experimented with the governance model known as '*upstream engagement*'. As part of the *Nanodialogues* project, various societal organizations, scientific advisory boards and private sector companies joined members of the general public to discuss topics including the role of science in legislation, research funding, technology for the Third World, and product innovation in the private sector. This project revealed that policymakers tend to regard the involvement of the public as a threat rather than as an opportunity (Stilgoe 2007).

Another example of participative governance is the European 'Nanologue' project⁴ in which eminent researchers from various countries were brought together to discuss the social, ethical and legal aspects of nanotechnology. One concrete product result of this project is the NanoMeter, a web-based instrument which enables researchers and developers to perform a brief societal assessment of a new nanoproduct or application prior to its market introduction.

2.3 Conclusions

If we review the list of societal issues presented in Table 2.1, we see that the most urgent question – the uncertainty regarding the risks posed by nanoparticles – has indeed been placed on the policy agenda under the heading of nanotechnology. However, the broad impact of nanotechnology as an enabling technology is sometimes considered under entirely different headings. For example, the issue of privacy has largely been confined to the discussions about RFID and Ambient Intelligence. The use of Ambient Intelligence in healthcare forms part of the debate further to changing practices, such as e-Health and telemedicine programmes, while molecular (nano-) medicine finds links with the ongoing discussion regarding predictive medicine – a debate which, until just a few years ago, was primarily fuelled by developments in genetic science.

The discussion of topics which derive their significance from various ethical implications is still largely the domain of social scientists and a small group of policymakers. Human enhancement is one topic that has attracted considerable international interest, albeit in a relatively small circle. In future, it will be placed on the agenda as part of the broad concept of NBIC convergence. The issue of governance, including public participation, has also attracted considerable attention, but again mostly from the social scientists and policymakers.

Various other questions, including the arms race, the ethics of war, patents and the distribution of knowledge and wealth, have received relatively little consideration to date. While the 'Grey Goo' scenario of uncontrolled self-replication by nanomachines was a 'hot item' in 2003, this discussion is now at an end. However, the emergence of synthetic biology has breathed new life into the parallel 'Green Goo' scenario of self-replicating micro-organisms, and has prompted renewed discussion of artificial life and hybrid forms of living and non-living entities.

3 NGOs in the Netherlands

Lucien Hanssen – Deining Societal Communication

NGOs are taking an increasingly active part in the discussions about nanotechnology. The second perspective examined by the current study is that of the organizations themselves, and the role that they will play in the discussion, both today and in the future. There are various reasons that a societal organization may have an interest in nanotechnology. In many cases, that interest is based on the objectives of the organization itself, such as environmental protection or representing patient interests. In some instances, the organizations may focus on issues which are relevant to several different application areas, such as safety or sustainability. In this chapter, we consider the NGOs in the Netherlands which are concerned with one or more of the issues described in the foregoing chapter. In Chapter 4, we examine the activities of NGOs in other countries.

Research method

A total of 24 NGOs were contacted. They were selected further to their participation in the national nanotechnology debate thus far (attendance at workshops, conferences and meetings), their own communications (newsletters, websites) and prominence in the media. Of the 24 organizations, 14 were found to be actively addressing nanotechnology-related issues. These organizations were asked to complete an e-mail questionnaire. Their responses were then discussed during follow-up interviews by telephone.

Societal organizations	Those which did not participate in this study
1. Netherlands Society for Nature and the Environment	15. CNV (Christian trade union)
2. Milieudefensie (Friends of the Earth NL)	16. Council for the Chronically Ill and Disabled (CG)
3. Consumers' Association	17. EPN Platform for the Information Society
4. Dutch Women's Council / Living with the Earth Foundation	18. Greenpeace NL
5. Health and Environment Platform	19. Hivos (Developing Countries)
6. Vereniging Leefmilieu (Human Environment Society)	20. LTO Nederland (Farmers and agriculture)
7. Dutch Genetic Alliance (VSOP)	21. Oxfam-Novib
8. Biotechnology and Genetics Forum	22. Council of Churches
9. AVS (Dutch Association against Animal Testing)	23. Oikos Foundation
10. FNV (Federation of trade unions)	24. Federation of Patients' and Consumer Organizations in the Netherlands (NPCF)
11. NanoCap	
12. VNO-NCW (Employers Federation)	
13. IKV / Pax Christi (Christian peace movement)	
14. RFID Platform	

The questionnaire was in three parts (see Appendix). The first section examined direct involvement in nanotechnology-related issues, while the second section looked at the organizations' information sources and information provision. The third section included questions about the role that the organizations wish to play in formulating policy. The follow-up telephone interviews were used to request clarification where necessary.

A significant proportion of the organizations taking part in the study, notably the five environmental organizations, are primarily concerned with the risk issue. Most of the Dutch organizations state that their attention was drawn to nanotechnology through attendance at international conferences and/or contacts with international partners and sister organizations. In 2006, the Health and Environment Platform organized its own symposium on nanotechnology. This event prompted several other organizations to explore the topic in greater depth. Several organizations also cited press and internet coverage as sources of information.

The FNV (federation of trade unions) and the Netherlands Society for Nature and the Environment have both been directly involved in nanotechnology through the European *NanoCap* project. This 'Nanotechnology Capacity Building for NGOs' programme has been set up to inform trade unions and environmental organizations throughout Europe about various aspects of nanotechnology, thereby enabling them to form their own independent policy and strategy. The project is being coordinated by IVAM, a research consultancy affiliated with the University of Amsterdam. The participants have undertaken to make their views known within the nanotechnology debate, primarily with regard to the environment, working conditions and health, but also further to policy decisions in such areas as privacy and employment opportunity.

Of the fourteen organizations interviewed, only the Society for Nature and the Environment and the Dutch Association against Animal Testing (AVS) have thus far produced a formal policy statement ('position paper') with regard to nanotechnology. The FNV has published a provisional policy statement, while the Health and Environment Platform is currently working on its policy statement. The employers' federation VNO-NCW is expected to issue its policy statement in 2008.

On 26 March 2008, the Society for Nature and the Environment and *Vereniging Leefmilieu* (Human Environment Society) organized a meeting to discuss the action that environmental organizations should take with regard to nanotechnology. An alliance has now been formed between the Society for Nature and the Environment, the Health and Environment Platform, the *Vereniging Leefmilieu* (Human Environment Society) and Women in Europe for a Common Future (WECF). The other organizations which attended the workshop are currently considering whether to join this alliance (SNM 2008).

3.1 Involvement

Application areas

The organizations were asked to state which particular application areas attract their attention. A list of possible application areas was presented, based on the findings of the *Nanotechnology in focus* study conducted by the Rathenau Institute in 2005-2006, and those of the TA-NanoNed technology programme run by a network of knowledge institutes and private sector companies in the Netherlands.

Table 3.1 presents a summary of the responses. Six organizations omitted to answer this question, some because they have yet to examine nanotechnology in its full breadth, others because they have opted to focus on specific issues which are relevant to several application areas.

Table 3.1 The societal organizations' focus on specific application areas of nanotechnology

APPLICATIONS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	N
Medical applications and healthcare			■		■		■	■							4
Agriculture and food production	■	■	■		■										4
Water supply and energy production	■														1
Electronics and ICT services			■											■	2
Materials and industrial processes	■				■									■	3
Military applications and security													■	■	2

Key: 1. Netherlands Society for Nature and the Environment; 2. Milieudefensie (Friends of the Earth NL); 3. Consumers' Association; 4. Dutch Women's Council / Living with the Earth Foundation; 5. Health and Environment Platform; 6. Vereniging Leefmilieu (Human Environment Society); 7. Dutch Genetic Alliance (VSOP); 8. Biotechnology and Genetics Forum; 9. Dutch Association against Animal Testing (AVS); 10. FNV; 11. NanoCap; 12. VNO-NCW; 13. IKV / Pax Christi; 14. RFID Platform.

Societal issues

The list of societal issues presented to the respondent organizations was based on the draft agenda contained in *Om het kleine te waarderen* (Van Est *et al.*, 2004; see also Table 2.1 in Chapter 2), with the addition of the new topics discussed in the preceding chapter: RFID, Ambient Intelligence and Human Enhancement. The choice of issues was also subject to extensive discussion with Prof. Arie Rip, director of TA-NanoNed and Prof. Theo Rasing, director of the Nijmegen Centre for Advanced Spectroscopy (which includes NanoLab).

Table 3.2 shows the specific societal questions to which the respondent organizations have decided to devote attention. Two aspects – Animal testing and Labelling – were added to the original list by the organizations themselves and are therefore shown in italics.

Risks and precautions

As Table 3.2 reveals, almost all organizations consider it important to apply the precautionary principle. The next aspect in order of importance relates to the risks (to human health and the environment), and specifically to new legislation designed to limit those risks. It should be noted that none of the respondents is in favour of a total moratorium on nanotechnology. Nevertheless, some believe that products containing synthetic nanoparticles which could be emitted into the atmosphere must not be launched onto the market yet. Most respondents are aware that the potential risks to health and the environment are further to the specific properties of these nanoparticles.

Many respondents would like to see the government and private sector investing in further research into nanotechnology which will enhance sustainability. Some respondents, including the Society for Nature and the Environment and the FNV, wish to be involved in formulating the research agenda and policy. At a conference organized by the European Trade Union Confederation (ETUC) in January 2008, the FNV called for better protection for workers handling nanomaterials during production processes. Employees are the first to be exposed to potential risks. The FNV has serious misgivings as to whether the current Health and Safety legislation offers adequate protection against the risks of nanotechnology, and considers further research into nanotoxicity to be a matter of urgency.

Vereniging Leefmilieu (the Society for the Human Environment) and the Health and Environment Platform point out that the risks associated with nanoparticles represent a 'new type of risk'. No appropriate frameworks have yet been developed, let alone adequate monitoring and detection methods. It is possible that synthetic nanoparticles will interact with biological systems in a way that has never previously been envisaged. What are the risks to human health and the environment, and where could these risks emerge?

Table 3.2 The relevance of the societal issues to the respondent organizations

ISSUES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	N
Health risks															9
Environmental risks															8
Sustainability															6
Legislation															9
Precautionary principle															11
Patents															1
Opportunities for innovation															6
Distribution of wealth															1
Good governance															4
Ethical aspects															8
Arms race															2
Privacy aspects															5
RFID															4
Ambient Intelligence															2
Human Enhancement															1
Animal testing															1
Labelling															1
Public information															8
Stakeholder input															7

Key: 1. Netherlands Society for Nature and Environment; 2. Milieudedefensie (Friends of the Earth NL); 3. Consumers' Association; 4. Dutch Women's Council / Living with the Earth Foundation; 5. Health and Environment Platform; 6. Vereniging Leefmilieu (Human Environment Society); 7. Dutch Genetic Alliance (VSOP); 8. Biotechnology and Genetics Forum; 9. Dutch Association against Animal Testing (AVS); 10. FNV; 11. NanoCap; 12. VNO-NCW; 13. IKV / Pax Christi; 14. RFID Platform.

Opportunities for innovation

Alongside the risks, the majority of organizations acknowledge that there are also clear opportunities, particularly in the areas of energy provision, reduced environmental impact, new medical therapies and better distribution of food resources. The Dutch Association against Animal Testing (AVS) points out that scientific advances enable animal testing to be replaced by in-vitro methods (e.g. studying biological processes in cultured tissue). There are already companies which are able to culture human tissue, and which use this material in toxicity testing. The AVS also calls for the available research data on nanoparticles to be shared between companies in order to preclude the necessity of duplicated testing on animals.

Information provision and labelling

The Dutch Women's Council / Living with the Earth Foundation added labelling as a separate issue on the list. The Dutch Society for Nature and the

Environment, FNV, NanoCap and the Health and Environment Platform draw attention to the importance of greater transparency on the part of the private sector, which will entail clear labelling of products which contain nanoparticles.

All respondents consider better public information from both the government and private sector to be important, and state that a broad-based dialogue about nanotechnology should be pursued as a matter of urgency. They are also concerned by the speed with which nanotechnology products are currently being developed, even though there are still no standardized methods to detect and measure the toxicity of nanoparticles. The governments and private sector organizations should no longer hide behind vague definitions, the respondents assert. They also believe that manufacturers should clearly state which products contain nanoparticles or nanomaterials.

Privacy

Respondents regard nanotechnology as an 'enabling technology' which adds new dimensions to certain ongoing discussions. It is acknowledged that many of the issues addressed under the heading of nanotechnology can, and in some cases should, be considered under an entirely different heading. Privacy was cited by several respondents, usually in association with RFID technology. The RFID Platform notes the lack of an independent critical organization within the public discussion on privacy, a role which was until recently filled by the now defunct NGO 'Bits of Freedom'.

Ethical questions

The majority of respondents acknowledge the groundbreaking nature of nanotechnology, whereby new issues may well have to be placed on the agenda. However, they immediately go on to concede that they lack the knowledge required to do so effectively at this time. All organizations report that they have insufficient manpower and resources to (actively) follow developments in the field of nanotechnology.

Only three respondents stated a direct interest or involvement in Ambient Intelligence or Human Enhancement. Two other respondents called attention to the convergence inherent in nanotechnology, citing synthetic biology as an example of a revolutionary, groundbreaking development. Over half the respondents consider ethical aspects to be important but have yet to formulate any specific approach.

3.2 Information flows

The majority of respondents obtain information about nanotechnology through their contacts with sister organizations, universities, research institutes and government departments. They consult websites and read the relevant reports, scientific literature, professional journals and newspapers. They also attend conferences and symposia. A number of respondents report that staff have taken part in some form of field trip to gain information at first hand.

The respondents were asked to name those parties whom they consider to be expert and reliable enough to answer their questions. Table 3.3. provides a summary of the responses, with the number of times that a particular source of information is named shown between brackets. In many cases, the independent university researcher is regarded as the primary source of reliable information.

Table 3.3 Sources of information

Sources cited	Number	Sources cited	Number
Research field		Government	
- Universities / independent scientific organizations	9	- Autonomous government source	2
- Research institutes, e.g. RIVM	3	- Ministry of VROM	1
- Research programmes, e.g. ZonMW	1	- Ministry of Economic Affairs	1
- Corporate research	1	- Food and Consumer Product Safety Authority	2
		- Netherlands Nutrition Centre	1
		- Erfocentrum	1
NGOs		Other	
- Dutch Society for Nature and the Environment	2	- Rathenau Institute	2
- A trade union or professional federation	1	- Foresight Institute	1
- Consumers' Association	1	- Woodrow Wilson Institute	1
- ETC Group	1		

Rathenau Institute

Knowledge of the policymaking process

The majority of respondents (11) are familiar with the government's Vision Document on Nanotechnology. Three even submitted a response, namely the Dutch Society for Nature and the Environment, and FNV in association with NanoCap. The only other organizations to offer a formal response were the Health Council of the Netherlands and the Rathenau Institute.

Eight of the fourteen respondents were aware of the existence of the Interdepartmental Nanotechnology Project Group which is responsible for producing the Nanotechnology Action Plan. The Dutch Society for Nature and the Environment, the Health and Environment Platform, NanoCap and VNO-NCW have all had formal contacts with the project group, primarily with the representatives of the Ministry of VROM. The topics discussed included the environmental risks of nanotechnology, occupational risks to certain groups of workers, ethical aspects and the provision of public information.

Knowledge sharing between the organizations

A number of the respondent organizations share knowledge with each other. There is regular contact between the participants in the European NanoCap project, for example, which include the Dutch Society for Nature and the Environment, the FNV and IVAM. Participants in projects at the European level include organizations with which the respondents are affiliated, such as the European Trade Union Confederation (ETUC), the European Environmental

Bureau (EEB), the European Consumers' Organization (BUEC), the Health and Environment Alliance (HEAL) and the Eurogroup for Animals. The Dutch Health and Environment Platform maintains contact with the ETC Group in Canada and the German organization BUND.

The VNO-NCW employers' federation has a number of internal expert groups, including those for biotechnology and nanotechnology. At both national and European level, the organization is represented in various official consultation platforms for the public and private sectors, including the Euro Nano Trade Alliance (ENTA). The VNO-NCW is also closely involved in the development of the 'Responsible NanoCode', a voluntary code of conduct for private sector organizations that is to be published in 2008.

Information provided by the organizations to their members

The majority of respondent organizations report that they have received very few questions about nanotechnology from their rank-and-file members or supporters. The FNV has received some related questions with regard to working conditions (e.g. the presence of asbestos or fine particulates) but none specifically about nanoparticles as yet. The RFID Platform has received some queries relating to privacy, while the Biotechnology and Genetics Forum has been asked about the societal aspects (notably safety) and ethical aspects of nanotechnology. Within the NanoCap project, participants have themselves raised questions concerning the toxicity of nanoparticles and their contact with humans and the environment, monitoring strategies and equipment, legislation, the precautionary principle, ethics, and the public debate.

Some respondent organizations have plans to inform their members and supporters about nanotechnology. In early 2008, the Dutch Society for Nature and the Environment organized a meeting for Dutch NGOs, at which speakers from its European umbrella organization, the German environmental organization BUND and the European Environmental Bureau described their experiences to date. The Health and Environment Platform intends to hold its second symposium on nanotechnology for 'the public and representative organizations' in 2009. Several other respondent organizations offer information about nanotechnology by means of their websites and members' newsletters.

3.3 The government's role

The respondent organizations were then asked which of the societal issues demand government action in the short term (i.e. within one year) and which do so in the medium-to-long term (five years).

Urgent issues

Which issues relating to nanotechnology should the government address within the coming year? The majority of respondents cited issues of legislation to limit the risks to human health and the environment, the further definition of societal

issues and greater transparency on the part of the private sector. Table 3.4 presents a summary of the responses, with the number of respondents supporting each suggestion shown in brackets.

Table 3.4 Societal issues that the government should address within the next year

Issues mentioned	Number
New legislation and risk governance by the government	
– Legislation to prohibit the licensing of products which may lead to the free emission of nanoparticles	3
– Measures to protect employees against exposure to nanoparticles	1
– Inclusion of a section covering nanoparticles and nanotechnology products in the European REACH directive	1
– Formulation and implementation of an interim risk governance strategy	1
– Reduction of animal testing and encouragement of (the development of) alternative testing methods	1
– Further development of a Life Cycle Assessment (LCA) methodology for nanotechnology products	1
– Identification of the most relevant risk areas and risk governance approaches	1
Articulation of the societal issues	
– Activities further to public information, awareness and discussion	3
– Assisting capacity-building on the part of NGOs (e.g. through subsidies)	3
– Production of an analytical framework for all nanotechnology-related issues including the ‘wider issues’	3
– Greater use of research funding in the public interest	1
Transparency on the part of private sector organizations	
– Transparency (‘right to know’) with regard to risks and corporate interests	3
– Introduction of a ‘nanolabel’	2
– Encouragement of initiatives to produce a code of conduct	1
– Organization of sector-specific nanotechnology workshops	1
– Activities designed to bring private sector companies and NGOs together	1

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Medium-to-long term issues

The respondent organizations were also asked to identify those nanotechnology-related issues which should be addressed by the government within the coming five years. (The answers can be seen to be an extension to those to the previous question about urgent issues.) The recommendations are set out in greater detail in Table 3.5. The precautionary principle is cited by several respondents and is indeed the issue which appears most often in Table 3.2.

According to the respondent organizations, the government should accept its responsibilities as regulator by providing a substantial proportion of the funding required for further research into the risks of nanotechnology. This will enable the development of legislation and guidelines for the safe use of nanomaterials, as well as practical risk assessment methods. In the case of applications which represent great scientific uncertainties, and are thus extremely controversial, the precautionary principle must be applied at all times. In addition, the government must (further) facilitate the societal organizations’ participation in the public debate on nanotechnology.

Table 3.5 Societal issues which the government should address within the coming five years

Issues mentioned	Number
- Implementation of clear legislation further to the precautionary principle	4
- Amendment of Health & Safety and Environmental legislation covering all applications of nanotechnology	1
- Establishment of norms and standards for nanotechnology, coordinated at international level	1
- Formulation of guidelines for safe handling of nanomaterials (including clearing and maintenance procedures)	1
- Introduction of practical risk evaluation methodologies	1
- Identification of persons and groups at risk of exposure, with monitoring procedures	1

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The VNO-NCW is not a proponent of new policy. Rather, the employers' federation wishes to ensure that existing principles (including the precautionary principle and current Health & Safety risk management systems) are followed. As yet, there are no scientifically proven norms for safe handling of nanomaterials. Companies should nevertheless be required to produce a full Risk Inventory and Evaluation (RIE). Employers will continue to be responsible for identifying risks to staff and implementing appropriate preventive measures.

3.4 Structuring the societal debate

Nanotechnology may well be the first scientific domain in which societal groups are being asked (explicitly and regularly) to participate in the public debate. This is the case both in the Netherlands and in other countries. The findings of a meeting organized by the Rathenau Institute (NGOs & Engaging Nanotechnology) reveal that participation by the NGOs cannot be taken for granted. Some encouragement is required. The respondents were therefore asked for their views on three recommendations to the government which were formulated by the Rathenau Institute further to the aforementioned meeting (Van Est & Walhout 2007b):

- 1 Ensure full and adequate information about nanotechnology addressing the broad public.
- 2 Facilitate greater involvement on the part of (smaller) NGOs in the further development of nanotechnology.
- 3 Ensure that societal groups are consulted on policy matters relating to nanotechnology.

All respondents endorse these recommendations, noting that the government has a clear and specific responsibility whereby it should not restrict itself to being the facilitator of the debate, and neither regulating matters by means of covenants or voluntary agreements. The NGOs concede that it is difficult for them to monitor all relevant developments. The government should indeed consult them, but it bears primary responsibility for the safety of man and

the environment. The government is therefore expected to take a clear directive role, particularly now that the private sector is too far ahead to be 'called to heel' by the societal midfield.

Almost all respondents assert that the government must ensure good interaction with societal groups and must implement effective risk communication if it is to retain its authority and the confidence of the public. Good coordination with and between the ministries responsible for nanotechnology policy is essential. Only then can the government put across a clear and unequivocal message. The following paragraphs summarize the respondents' comments and suggestions further to the three above mentioned Rathenau Institute's recommendations.

Information addressing the general public

All respondents acknowledge the importance of good public information. Table 3.6 presents a summary of the suggestions made by the NGOs in this respect. It is seen as important that the specific target groups who are likely to come into contact with nanoparticles receive full information and training. A number of organizations call for the mandatory labelling of nanotechnology products, and for separate information campaigns and websites for consumers. The tried-and-tested communication channels were mentioned and are apparently considered suitable. The information provided should encourage people to think about the topic and enable them to take a more educated approach to the emerging technology.

Table 3.6 Suggestions further to Recommendation 1: ensure good information addressing a broad public

-
- Provide training for relevant professional or occupational groups
 - Inform workers who are exposed to nanoparticles about the potential health risks
 - Provide clarity with regard to the applications and ensure balanced background information is available
 - Information will only become useful if practical applications become available
 - Institute a mandatory labelling system, together with information campaigns and websites for consumers
 - Use the familiar institutes and channels rather than creating separate ones specifically addressing nanotechnology
 - Use indirect communication through entertainment such as films, video games and exhibitions in science centres
 - Lack of knowledge means lack of responsibility
 - The unfamiliar always courts mistrust
 - Information should encourage further thought

Involvement of (smaller) NGOs

For a number of organizations, the opportunity to join in the debate about scientific policy, let alone help to devise that policy, is something entirely new. The spokesman for NanoCap stated that many organizations may be unable to take advantage of this opportunity. Their priorities often lie elsewhere due to lack of resources. As a result, they do not have the expertise required to play a

full part in the discussions. If the government wishes to promote the involvement of the (smaller) societal organizations, it must first facilitate capacity-building. Suggestions in this regard are presented in Table 3.7.

Table 3.7 Suggestions further to Recommendation 2: facilitate greater involvement on the part of (smaller) NGOs

- Create a review group or broad-based nanotechnology platform including both experts and laypeople
- Implement subsidy arrangements for NGOs wishing to undertake their own projects
- Involve local communities and smaller NGOs (as part of a larger network)
- Create a website designed to encourage cooperation between societal groups
- Organize symposia and workshops in which the input of smaller societal groups is especially welcomed
- Facilitate capacity-building (knowledge and expertise)
- Encourage 'unconventional' forms of contact between the private sector and other stakeholders
- Do not organise a discussion just for the sake of having a discussion

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The input of the NGOs

In the past, various organizations have learned that it can take a long time for health and environmental risks to be acknowledged by the scientific field, the private sector and the government. Think of asbestos, for example. Legislation always comes after the risk has emerged and the damage has been done. There is now a unique opportunity for NGOs to help devise new legislation and protective measures. They are indeed willing to do so and have clear ideas about what is required.

However, their participation must bear fruit in the form of concrete results. This raises certain demands in terms of openness on the part of the private sector and its willingness to listen to the societal organizations. Accordingly, both the private sector and the government must accept the results of the discussion and incorporate them into future policy. According to the FNV's spokesperson, many companies follow a strategy which is dominated by the interests of innovation and profit that they are not willing to discuss matters in any great depth or detail. New ways to resolve this impasse must be found, and some suggestions are presented in Table 3.8 below.

Table 3.8 Suggestions further to Recommendation 3: ensure full consultation of NGOs with regard to policy matters

- Organize an effective consultation process designed to produce concrete results, whereby it is clear how those results will influence policy.
- Listen to the views of all sections of the community (with various initiatives involving the general public).
- Appoint a think tank (which does not include government officials) to devise scenarios based on hard scientific facts.
- Consultation must not result in unnecessary bureaucracy which merely serves to delay the process.
- Allow stakeholders to contribute to new legislation and protective measures.
- Do not merely ignore the unwelcome results.

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3.5 Conclusions

The Dutch NGOs interviewed for this study regard the risks to human health and the environment, the relevant legislation, and the application of the precautionary principle as the issues which must be addressed as a matter of urgency. The degree of concern is proportionate to the number of new products being introduced on the market while there is still no clear indication of how safety can be guaranteed. Two organizations, the FNV and the Dutch Society for Nature and the Environment, have recently expressed their concerns in public. The Dutch Society for Nature and the Environment is currently working on concrete follow-up action in association with three other organizations.

'Good governance' in all its many facets – from legislation and the involvement of NGOs to the provision of information to the public – is considered extremely important. Here too, the focus is on the risks. The NGOs believe that the government must fulfil its responsibilities as regulator. They further believe that the government should 'take charge' of the process and should not take advantage of the discussion to postpone taking firm action.

All respondents acknowledge the importance of effective public information. Some call for the introduction of mandatory labelling, and separate information campaigns and websites for consumers. The information should encourage people to think about the topic and adopt a more educated approach to nanotechnology.

The NGOs are willing to play their part in devising policy, provided the consultation process does not give rise to unnecessary bureaucracy. It then becomes necessary to establish in advance how the consultation process will influence policy, and to guarantee that results will not be ignored simply because they are not what the other parties wanted to hear.

For many organizations, the opportunity to participate in the policy process is something entirely new. Often, they lack the necessary expertise. Suggestions to resolve this situation include forming a broad-based review group or platform for nanotechnology. A subsidy scheme would enable the NGOs to conduct their projects and undertake independent research.

The NGOs also attach importance to the ethical aspects, such as those relating to Ambient Intelligence and synthetic biology. However, they have yet to define or address those ethical aspects. Again, this is due to lack of capacity within certain organizations, but it is also due to there being no NGOs active in certain specific areas. In particular, the absence of a critical organization addressing privacy issues is seen as a grave omission.

4 NGOs in other countries

Lucien Hanssen – Deining Societal Communication

The national discussion on nanotechnology cannot be conducted in isolation from the discussions in other countries. A small number of international NGOs have already set the tone for this debate. In this chapter, we identify the issues which have attracted the attention of these organizations. In addition to extensive desk research, a number of key figures were approached in order to gain a more complete picture of the developments in this area.⁵

4.1 Societal issues

In 2006, the Swiss organization *CASIN (Centre for Applied Studies in International Negotiations)* conducted a study which examined the activities of various NGOs in connection with nanotechnology (Lee *et al.*, 2006). This study focused on the organization's websites. At this time, most of the organizations devoting attention to the topic were to be found in the United States and the United Kingdom, although others were active in Germany, Switzerland and Canada. A significant number of the organizations examined were environmental pressure groups.

Table 4.1 presents a summary of the issues and solutions to which the organizations in question devote attention on their respective websites. The table reveals that the area of greatest concern is the impact of nanotechnology on man and human health (17) and on the environment (10). Better regulation (14) and adequate testing methods (7) are the most frequently cited wishes, followed by a moratorium on applications likely to cause the emission of nanoparticles (5), and the necessity of a broad-based public debate (6). Concerns have also been expressed regarding a possible concentration of power in the private sector (5) and disruption of the economic order (7). Ethical issues such as human enhancement are also cited (6).⁶

Table 4.1 Important societal issues, as identified by NGOs in North America and Europe

ISSUES	North America									Europe								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Impact on human health (17)																		
Environmental impact (10)																		
Ethical aspects (6)																		
Disruption of the economy (7) (natural resources, trade flows)																		
Destructive use (5) (military applications)																		
Concentration of power (7) (patents, governance)																		
Overconsumption (1)																		
OPLOSSINGEN	North America									Europe								
Regulation (14) (standards, occupational safety)																		
Moratorium (5) (products, research)																		
Public dialogue (6) (wider issues)																		
Risk research (4) (inc. socio-economic risks)																		
Testing (7) (product safety)																		
International regulation (3) (legislation, patents, detection)																		
Labelling (4) (consumer information)																		
Precautionary principle (2)																		

Key:

North America

1. ETC Group (Canada); 2. Electronic Privacy information Center (US); 3. Environmental Defense Fund (EDF); 4. Consumers' Union; 5. Friends of the Earth USA; 6. Natural Resources Defense Council. 7. Center for Environmental Health; 8. Center for Food Safety; 9. International Center for Agriculture and Trade Policy.

Europe

10. World Council of Churches (Switzerland); 11. BUND / Friends of the Earth Germany; 12. Corporate Watch (UK); 13. Soil Association (UK); 14. Friends of the Earth UK; 15. Greenpeace UK; 16. Practical Action (UK); 17. Trades Union Congress (UK); 18. Privacy International (UK).

Source: Lee *et al.*, 2006

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4.2 Three pre-eminent societal organizations

The CASIN researchers found little difference in priorities between the North American NGOs and their counterparts in Europe. They concluded that this is because three pre-eminent organizations – the ETC Group, Friends of the Earth and Greenpeace had dominated the international nanotechnology debate thus far. Many other organizations had then emulated them in adopting the same topics. In this section, we therefore examine the activities and standpoints of these three organizations in greater detail.

ETC Group

As long ago as 2003, the Canadian ETC Group (Action Group on Erosion, Technology and Concentration) published a report on nanotechnology, entitled *The Big Down*, which called for a moratorium on further development (ETC 2003). According to the authors, the lack of expertise and adequate safety regulations warranted a temporary embargo on nanotechnology further to the precautionary principle, and also justified the immediate withdrawal of all existing nanotechnology products on the market. *The Big Down* attracted much international attention. Apart from the risks to human health and the environment, the ETC Group devotes considerable attention to the socio-economic implications of nanotechnology, including the patenting of DNA, distortion of world trade, and social exclusion due to new medical technologies. The ETC Group also devotes much attention to the converging nature of nanotechnology and the resultant economic and ethical aspects. Human enhancement is considered a particularly important issue.

Friends of the Earth

Friends of the Earth USA supported the ETC Group's call for a moratorium. In 2006, Friends of the Earth (Australia and USA) published a list of cosmetic products which incorporate nanomaterials and again recommended a moratorium (FoE 2006). In 2007, the organization endorsed a call by the International Union of Food, Farm and Hotel Workers (IUF) for a moratorium on the use of nanotechnology in agriculture and food production. The recent report *Out of the Laboratory and On To Our Plates* (FoE 2008a) produced by Friends of the Earth Australia, USA and Europe, reiterates this message. Nevertheless, Friends of the Earth wishes to broaden the debate about nanotechnology and food, and is therefore calling not only for adequate risk assessment, but also for a transition to sustainable biological agriculture and food production. Friends of the Earth also wishes to broaden the discussion about synthetic biology, to include the topical debate in the United States about cloned meat and the prohibition of 'chimeras': human-animal hybrids (FoE 2008b).

In Germany, BUND (*Bund für Umwelt und Naturschutz Deutschland*) is one of the main initiators of the national nanotechnology debate. BUND is affiliated with Friends of the Earth International. It recently published a 'position paper'

(Horn & Kühling 2007) in which it calls for a strict implementation of the precautionary principle and for greater transparency on the part of large corporations. BUND's main focus is on applications in which nanomaterials come into direct contact with consumers – e.g. food and health products, cosmetics and textiles – being those which, in the view of the organization, pose the greatest potential risk. At a later stage, BUND intends to examine applications with potential advantages: energy generation, water purification and new, sustainable materials. BUND is a participant in the NanoCap project (mentioned in the foregoing chapter) which involves fifteen European environmental organizations, trade unions and universities.

Greenpeace UK

Greenpeace UK has been active in the British nanotechnology debate for some time. In 2003, it published the report *Future technologies, today's choices* (Arnall 2003). This gave an account of the status of nanotechnology, artificial intelligence and robotics at that time. The report was written by an independent researcher, Alexander Arnall of Imperial College London. Greenpeace UK considers the entire breadth of nanotechnology, particularly its transformative character, rather than focusing on specific applications. The organization has expressed 'cautious optimism' regarding the possibilities in terms of energy provision, water purification and clean production processes. It is somewhat more concerned about a lack of adequate government control, poor risk governance and the concentration of nanotechnology investments on the western market. Greenpeace UK is not a proponent of a complete moratorium on nanotechnology products, but is in favour of a strict application of the precautionary principle where any uncertainty with regard to safety exists.

4.3 Dealing with the risk issue

Within the worldwide nanotechnology debate in which the international NGOs are engaged, the central point of discussion is the uncertainty with regard to the safety of nanoparticles. Much thought is now being given to the question of what measures should be taken to limit potential risks. In this section, we consider the proposals of various societal organizations, ranging from a complete moratorium to labelling systems and voluntary codes of conduct for producers.

Moratorium

As described elsewhere in this report, several influential societal organizations, including the ETC Group and Friends of the Earth, have called for a complete moratorium on the further development and use of nanotechnology. In the United Kingdom, the Soil Association has also done so, and since January 2008 has refused to endorse any product which incorporates nanomaterials. In the first instance, this applies to health and beauty products, but also includes textiles and food products (SA 2008). One of the main reasons for this decision is the ongoing lack of adequate legislation, despite the promises made by the

British government following the publication of the influential report *Nanoscience and Nanotechnologies: opportunities and uncertainties*, produced in 2004 by the Royal Society and the Royal Academy of Engineering.

Labelling

At present, the risk of exposure to synthetic particles would seem to be greatest during the research and production processes. However, this could change as more and more nanotechnology products are introduced onto the market. During a hearing of the American Food and Drug Administration (FDA) in 2006, the Consumer Union therefore called for new standards and legislation to be developed. One important consideration for the Consumer Union is transparency, which will entail the mandatory labelling of nanotechnology products and the pursuit of ongoing dialogue with all stakeholder groups (CU 2007).

Codes of conduct

Initiatives have been launched in several countries, and at several levels, to resolve the current lack of clear guidelines for handling nanoparticles. They include voluntary codes of conduct, systems which identify products which may contain nanoparticles, and a risk assessment framework. In many cases, these initiatives involve societal organizations.

The European Commission has recently published its *Recommendation on a code of conduct for responsible nanosciences and nanotechnologies research* (EC 2008). Companies, scientific institutes, government departments and NGOs are invited to make their contribution by means of a 'public consultation on nanosciences'. Other than the proposed Code of Conduct, there are no European regulations or guidelines covering nanotechnology. For this reason, the Brussels-based Health and Environment Alliance (HEAL) has produced a *Declaration on the principles for nanotechnologies and nanomaterials oversight* (HEAL 2007).

The European private sector is working on its own voluntary code of conduct, known as the *Responsible Nanocode*.⁷ The initiative was launched in the United Kingdom by the Royal Society, Insight Investment and the Nanotechnology Industries Association (NIA). The process began with a workshop for companies intended to encourage them to address a broad range of nanotechnology-related issues. During this workshop, it was decided to devise a code of conduct based on guiding principles rather than on strictly defined norms. A draft code was then produced by representatives of the private sector organizations, various scientific institutes, the NGO Practical Action, Amicus (the UK's largest trade union for the manufacturing industry) and the consumer organization *Which?*. The purpose of the Responsible Nanocode is to establish 'good practices' and temporary guidelines in the absence of adequate legislation. The Corporate Nanocode is expected to be made available in 2008.

In Switzerland, the sector organization for the retail industry, IG DHS, has produced a code of conduct applying to the purchase and sale of food products based on nanotechnology (Innovationsgesellschaft 2008).

In the United States, the chemicals company DuPont and the Environmental Defense Fund (EDF) jointly published a *Nano Risk Framework* in early 2007.⁸ The purpose of this document is to establish a systematic method of identifying and evaluating the potential risks of nanomaterials throughout the product cycle. It seeks to encourage the 'responsible' development of nanotechnology products, increase public acceptance of such products and thus contribute to official government policy with regard to the safety of nanotechnology. The EDF had previously issued a position paper in 2005, calling for the responsible use of nanotechnology, with a reliable system of risk management and proactive implementation of standards established by the industry itself in anticipation of new legislation, and for the broad involvement of various societal groups. However, a broad-based coalition of NGOs, including Friends of the Earth, the ETC Group and Greenpeace US, regarded the collaboration of EDF with DuPont as more of a PR campaign for nanotechnology. They therefore rejected the proposed 'public consultation under the wing of industry' (ETC 2007).

4.4 Conclusions

CASIN's international study confirms that NGOs worldwide have much the same areas of interest and priorities as those in the Netherlands. The main focus is on the potential risks to human health and the environment. Like the Dutch organizations, the majority of those in other countries are calling for better regulation, adequate testing methods and public involvement. The organizations which are most active in the international debate are those with a specific interest in environmental matters.

Although no major Dutch societal organization has yet called for a moratorium on the development of nanotechnology, there are a number of leading international organizations which have indeed done so. They include the ETC Group and Friends of the Earth, who have supported the idea of a moratorium for many years. Various international activities have been developed to fill the void created by lack of clear guidelines for handling nanoparticles. They include codes of conduct and other provisional guidelines, the development of which has involved both the private sector and the societal organizations. It is not yet possible to draw any conclusions regarding the effectiveness of these initiatives.

Although the risk issue has attracted greatest attention, the socio-economic and ethical aspects have also been considered at the international level. There are concerns about a possible concentration of power and the disruption of the existing economic order. Ethical questions, such as those raised by human enhancement, have also been examined. These somewhat broader normative issues do much to encourage involvement on the part of societal organizations,

Friends of the Earth being a good example. This organization's call for a moratorium on the use of nanotechnology in agriculture has been accompanied by its demand for a transition to sustainable biological food production methods. The question is therefore not only whether nanotechnology is safe, but whether it can contribute to a socially desirable development.

5 Research on public opinion

Lucien Hanssen – Deining Societal Communication

In 2004, the Rathenau Institute analysed a number of studies on public opinion conducted in both America and Europe in order to gain an impression of the current public perceptions of nanotechnology. The report *De dubbele boodschap van Nanotechnology* ('The mixed message of nanotechnology'; Hanssen & Van Est 2004) reveals that nanotechnology was being given 'the benefit of the doubt' at this time. Nevertheless, many people had concerns about almost all the issues set out in Chapter 2 of the current document. Focus group meetings revealed some disquiet regarding the regulation and control of nanotechnology. This was due in part to the increasing influence of industry in directing technological developments.

Since 2004, many other surveys, focus groups and public panels have been organized in various countries. People are making their concerns known during group discussions which delve somewhat deeper into the material than was previously the case, and they are also expressing their wishes and expectations (Gavelin 2007, Bowman & Hodge 2007). Because no data specific to the Netherlands is currently available, this chapter examines the results of a number of studies on public perceptions of nanotechnology conducted in the United States and Europe.

5.1 United States

In this section, we examine the findings of a number of recent studies which reveal what Americans do and do not know about nanotechnology. They also provide an understanding of how perceptions of nanotechnology are formed.

National public survey 2004

In late 2004, the first results relating to public perceptions in the United States were published (Cobb & Macoubrie 2004). Over 1,500 respondents had taken part in this study. Over 80% stated that they had not heard of nanotechnology at all, or only in passing. Nevertheless, some 40% of respondents believed that the benefits of nanotechnology would outweigh the risks. A similar number believed that the advantages and disadvantages would be in balance, while 20% held the opinion that the risks would be greater than the benefits. Respondents with a higher level of education tended to agree with the proposition that nanotechnology would provide more advantages than disadvantages. The researchers suggested that the optimism with regard to nanotechnology was due to the positive view of science and technology held by most Americans.

The respondents were also asked in which application areas the benefits of nanotechnology would be most evident. Five alternatives were given:

- Medicine and healthcare (57%)
- A cleaner environment (16%)
- Security and defence (12%)
- Human enhancement (11%)
- Inexpensive and sustainable consumer products (4%).

Respondents were then asked to state which of five risks of nanotechnology should be given greatest priority:

- Erosion of privacy (32%)
- Arms race (24%)
- Inhalation of nanoparticles (19%)
- Job losses (14%)
- Proliferation of uncontrollable nanorobots (12%)

A clear majority of respondents (60%) stated that they had little confidence that the directors of nanotechnology companies would take steps to protect the public against the potential risks.

Focus groups in 2006

Further to the national survey of 2004, researcher Michael Cobb convened a number of focus groups, after an interval of two years, in order to determine how public perceptions were developing as Americans learned more about nanotechnology and had enjoyed the opportunity to discuss the risks with others. This study revealed that members of the public had a reasonable understanding of the basic facts. They wished to be able to exert greater influence, and felt competent to do so. However, many Americans still knew little or nothing about nanotechnology. As a result, they tended not to embrace new applications. There was a clear susceptibility to negative information. Cobb (2006) therefore concluded that public communication would not be easy. He found it particularly worrying that the informed members of the focus groups had the greatest concerns about those aspects of nanotechnology which they desired the least. The results of the 2006 study (which can usefully be compared with those of the 2004 survey described above) included:

- Arms race (45%)
- Inhalation of nanoparticles (20%).

The influence of personal values

In a 2007 study, some 80% of Americans admitted to knowing 'little' or 'absolutely nothing' about nanotechnology. Nevertheless, they had firm opinions on the subject. An online survey of 1,800 respondents conducted by the Yale Law School and the University of Washington concluded that opinions seem to be informed by the individual's personal values system (Kahan et al., 2007).

Those of an individualistic nature, who support the free market economy and are generally inclined to reject control and regulation, are most likely to see the advantages. People who are more conformist and community-minded tend to emphasize the risks. This is in line with the finding that having little or no factual knowledge about nanotechnology does not greatly influence people's perceptions (Macoubrie 2005).

These findings led the researchers to conclude that, despite information and public dialogue, there is little reason to suppose that there will not be any polarization of American public opinion with regard to nanotechnology. This situation had indeed been noted earlier in the debates about nuclear energy and biotechnology; here too, great promises had been made. The public response to biotechnology made it clear that cultural factors are significant if a technology raises fundamental questions about whether or not it is 'natural' (Keller 2007).

American public less concerned than scientists

In general, scientists' assessment of the risks of a new technology within their own specialist field is lower than that of the general public. This is the case in gene technology and nuclear energy, for example. Strangely, the opposite applies in the case of nanotechnology. American scientists are more concerned about the potential health problems and adverse environmental impact of nanotechnology than the average man in the street. This is the remarkable conclusion of a survey of 363 nanotechnology scientists and 1015 lay respondents conducted in 2007 by the University of Wisconsin-Madison (Scheufele *et al.* 2007). Over 30% of the experts were concerned about health risks, compared to 20% of the non-experts. Over 15% of the experts feared greater environmental pollution due to nanotechnology, against slightly more than ten per cent of the other lay respondents.

According to the researchers, this disparity is due to the fact that the scientists have for many years been engaged in an intense discussion about the lack of any systematic research into the risks of nanotechnology. Moreover, the NGOs have experienced great difficulty in having the topic placed on the agenda. In addition, the scientists believe that the positive image of nanotechnology presented by the media, together with the general optimism with regard to technology, result in a lower risk perception on the part of the public. An analysis of the contents of American newspapers published between 1988 and 2004 shows that 'optimistic' articles presenting the advantages as being greater than the disadvantages outnumber those which emphasize the risks by three to one (Stephens 2005).

5.2 Europe

In Europe, the process of gauging public opinion about nanotechnology has relied on both quantitative research, i.e. a number of public surveys, and qualitative research projects such as the British *Nanojury* and the Swiss *Publifocus*.

Public surveys

The most recent relevant 'Eurobarometer' survey (2005) revealed that over 40% of respondents "had heard of" nanotechnology. Over half (55%) are in favour of its further development. By comparison, support for genetically modified food products was much lower at just 27%. At the time of the survey, the majority of respondents had little understanding of how nanotechnology would change their lives. We may therefore speak of a major 'information deficit'.

A survey of two thousand British respondents conducted by the consumer organization *Which?* in November 2007 presents a similar picture, with 61% of respondents stating that they had never heard of nanotechnology. Over 33% of the respondents were unaware that consumer materials incorporated nanomaterials are already on the market. The researchers noted a major lack of public awareness, despite the promises of the British government to pursue greater public engagement in new technologies (*Which?* 2007).

In a survey conducted in 2007 by the German federal *Bundesinstitut für Risikobewertung* (BfR), two-thirds of the respondent group (n=1000) believed that the advantages of nanotechnology will outweigh the disadvantages (BfR 2008). However, acceptance varies markedly according to the application and the degree to which the product can come into direct contact with the user. The majority of respondents were in favour of the use of nanoparticles in paint and coatings, but not so many wished to see them in textiles or packaging, and fewer still in sunscreens and cosmetics. The lowest acceptance rate was for nanoparticles in food products.

This study also demonstrates that the German consumer attaches greatest value to information provided by consumer organizations (92%). Far fewer trust information offered by the private sector (32%) and fewer still place their faith in politicians (23%). The final report of this study with the results of the qualitative interviews was published in early 2008.

NanoBio-Raise seminars

The *NanoBio-Raise* project concluded recently.⁹ Its aim was to identify the societal issues which have been, or will be, raised by nanotechnology, and to anticipate these issues by means of concrete recommendations for policy, based in part on the lessons learned from the biotechnology debate. The project involved a number of seminars about public participation held in the United Kingdom, Sweden, Poland and Portugal (Godman 2007).

Attendees at the seminars drew attention to the low level of public confidence in governmental organizations and industry. A pressing question is how members of the public can make their voice heard in the early stages of a technology's development, in making decisions with regard to the research agenda, and in devising new legislation. Participation must be regarded as more than just a way of exerting influence over the technology process; it is a means of precluding exclusion and opposition. Panel members noted that the debate about privacy, freedom of choice, human enhancement and social divisions in healthcare is likely to intensify before long.

The British 'Nanojury'

In July 2004, the Royal Society (RS) and the Royal Academy of Engineering (RAE) presented the results of a study into the opportunities and uncertainties raised by nanotechnology (Royal Society 2004). This report, which attracted great international interest, called for early involvement of the public by means of the process known as 'upstream engagement' (Willis & Wilsdon 2004). With the BSE crisis and the debate about genetically modified food still fresh in people's minds, the report prompted the British government to initiate a broad public dialogue. A secondary objective was to restore confidence in (governmental) organizations and in the use of science and technology. The government's *Outline Programme for Public Engagement on Nanotechnologies* was published in August 2005, since when ten projects have been implemented. One, the *Nanojury UK*, is described in brief below. (Another project, the *Nanodialogues* organized by the think tank Demos, was mentioned in paragraph 2.2.8.)

The British Nanojury offered the opinion that research funding should be directed towards long-term solutions to health and environmental problems. The members of the jury (drawn from the general public) also called for more openness about how public research funds are spent, and stated that scientists should do more to explain their activities. Synthetic nanoparticles must be subject to a system of classification, and must be safety tested *before* being used in actual products. Moreover, those products should be clearly labelled as containing nanoparticles. The general feeling among jury members was one of enthusiasm tempered by concern. The general public wishes to see more attention devoted to risk assessment, particularly by the private sector, and expects the government to ensure that nanotechnology serves the general interest.

German consumer panels

German consumer panels have stressed the necessity of a labelling system, not least because companies currently offer too little information about their activities. A 'nanolabel', it is felt, would go some way towards filling this void. The German panel members also suggested that more money should be made available for risk assessment and for more 'positive' applications of nanotechnology, such as water purification, quality control, smart packaging and extended shelf-life of products (BfR 2006).

The Swiss 'Publifocus'

At a Swiss consensus conference – called Publifocus – the panel members expressed very similar reservations about the applications of nanotechnology in food to those raised by their German counterparts (Rey 2006). The conference was attended by representatives of stakeholders such as the environmental movement, consumer organizations, trade unions, the private sector, agriculture and the scientific field. At the time, most of these organizations had yet to formulate any policy or even a clear standpoint on nanotechnology. Overall, there was little actual distrust of the field, but participants called for more knowledge to be developed, and for evidence of the possible risks in order to support new legislation. There were also urgent demands for a clear definition of 'nanotechnology' itself: what does the term entail, and what does it specifically exclude? (Burri 2007). The findings of the Swiss Publifocus reveal that food and food production remain sensitive issues for the general public. At present, the development of food products containing nano-ingredients can reckon on lower support than that of medical applications.

A follow-up to the Publifocus conference focusing exclusively on nanotechnology and food has since been conducted, and the results are expected in 2008. Swiss manufactures (including Kraft, Nestlé, Heinz and Altria) have made substantial investments in research into the possible applications of nanotechnology in their industry. However, they have remained tight-lipped about the results and their future plans. Greater clarity is required before any actual products are brought onto the market.

European public more concerned than scientists and the private sector

In 2006, a Swiss team headed by researcher Michael Siegrist conducted an extensive study into the public perceptions of, and attitudes toward, nanotechnology in food products and packaging. The use of nanotechnology in packaging fares better than that in the food itself. The majority of respondents remain unconvinced of the possible advantages of nanofood. In a supplementary study, the same authors suggest that consumers who regard a product as natural are less likely to accept any 'tinkering' with it. These studies confirm that the level of public confidence in the organizations which regulate and produce nanofood will be a determining factor in whether people are actually willing to buy the products (Siegrist *et al.*, 2007a).

Siegrist and his team have recently conducted a comparative study involving both scientists and laypeople, similar to that previously undertaken by Scheufele in the US. Respondents were asked to consider twenty possible applications of nanotechnology (from car paints, water treatment, energy and packaging to biosensors and medical nanorobots) and state whether they assessed the associated risks to be 'high' or 'low'. The lay respondents tended to assess the risks rather higher than the scientists (Siegrist *et al.*, 2007b). The researchers

also asked 138 companies in Germany and Switzerland to describe their risk assessment practices relating to the use of nanomaterials. They found that a substantial proportion of the companies had no standard risk assessment protocol. The authors warn that this situation is unacceptable in view of the level of public concern, and may well undermine confidence in the nanotechnology industry in the longer term (Siegrist *et al.*, 2007c).

5.3 Conclusions

Public surveys reveal a significant lack of awareness with regard to nanotechnology. Approximately 80% of American respondents and 60% of their European counterparts have never heard of nanotechnology, or are only vaguely aware of what it entails. However, having little or no informed knowledge does not seem to influence people's perceptions. Surveys reveal that views tend to rely on people's prior opinions with regard to technology, government and the business community, rather than on any informed understanding of the specific characteristics of nanotechnology. An individual's personal values and standards appear to be a good predictor of his or her opinions with regard to the likely advantages and disadvantages of nanotechnology.

This finding is in line with the new ideas and models relating to the manner in which public opinion is formed, whereby standpoints are largely determined by affective factors, and rather less by cognitive factors (Slovic *et al.*, 2004, Curren *et al.* 2006). The factual information within a message is often quickly forgotten. The emotional response to that message and the 'messenger' is more likely to be committed to memory and recalled when the subject is asked to state an opinion. It is therefore essential to engender trust and confidence in the messenger. Research shows that the public is more likely to place trust in information provided by NGOs than in that deriving from the government or the private sector.

The various surveys have also provided some insight into the manner in which the general public approaches the risk issue. A survey conducted in the US, for example, reveals that the American public is less concerned about the risks than the scientific community. In Europe, the situation is reversed. Acceptance is far lower in the case of products which come into (direct) contact with humans: clothing, cosmetics and in particular, food. Recent studies in Germany and Switzerland show that the general public's assessment of the risks of these applications is higher than that of the scientific community.

Focus groups and public panels offer a better understanding of the wishes and concerns of the general public with regard to nanotechnology. The results of several recent focus groups and panels confirm the findings of similar qualitative research conducted several years ago, as described in the introduction to this chapter (see Hanssen & Van Est 2004).

The public considers 'good governance' to be of crucial importance. However, confidence in the government and the private sector is conspicuously low. There are distinct calls for public participation, and for the further development of nanotechnology to be based on a social and societal perspective. Accordingly, investments must now be made in research which addresses the areas of urgent public concern, such as global environmental issues and universal access to adequate healthcare provisions. Consumer products and military applications are seen as far less pressing. In the participative settings, the public will also seek to devote attention to societal and ethical questions, such as privacy, social divisions, freedom of choice and human enhancement.

6 Ten lessons for a nanodialogue

Rinie van Est and Bart Walhout – Rathenau Institute

The foregoing chapters have described the development of the nanotechnology debate thus far. In this chapter, we draw ten lessons from the experiences to date and consider the role that the government must assume in order to promote an effective public dialogue about nanotechnology.

1 Differentiate between the risk issue and the broader debate about nanotechnology

In considering the most appropriate role for the government, it will be useful to distinguish between a debate which focuses solely on the potential risks of nanotechnology and the broader societal dialogue which considers the general impact of nanotechnology on society. Although these aspects are not entirely unrelated, they do call for different roles to be adopted by government and for a different type of dialogue.

Both the government and the NGOs regard the possible risks of nanotechnology as the most urgent issue. Indeed, this question has already been placed on the policy agenda and relevant policy is being developed. The crux of the problem is that nanotechnology is now being applied in an ever growing number of products, even though it remains unclear how the government or the private sector can guarantee the safety of those products, or that of the working environment in which they are produced. A number of NGOs have stated the desire to take part in a broader debate about technology, but on the proviso that the government addresses the risk issue immediately and takes concrete action.

To instigate a broader debate about the impact of nanotechnology on our society, it is important to set an agenda which establishes the direction, form and content of the further development of nanotechnology applications. A long list of societal questions about nanotechnology has been compiled in recent years (see Chapter 2). It is now necessary to determine whether this list is complete, and to establish the degree of urgency which the NGOs attach to the various issues.

Because nanotechnology is of relevance to a broad range of applications (from 'smart' medicines and self-cleaning surfaces to the public transport smartcard), it will not be appropriate to conduct the entire public dialogue under the single, all-embracing heading of 'nanotechnology'. In many cases, issues relating to nanotechnology will emerge within other ongoing debates (such as that on 'artificial life' or, in the case of the RFID chip, that on privacy. See Recommendation 5, below). The government must therefore not only

identify the societal issues, but must decide in which of the ongoing discussions they are to be addressed, and what position they are to occupy in subsequent policy. The advantage of this approach is that existing institutions and NGOs will automatically be involved in the dialogue. In this way topics for discussion will become clear, as will the parties who are expected to discuss them.

For both aspects of the dialogue – the risk issue and the broader debate – we have examined what the government must do itself, how it should engage the NGOs in the dialogue, and how it can inform and involve the general public. This process has resulted in nine further recommendations.

Our recommendations relating to the risk issue are:

- Actively address the risk issue.
- Involve the NGOs in developing policy.
- Provide clear information about nanotechnology products, risk governance policy and the uncertainties.

To promote a broader dialogue, we recommend:

- Ensure that there is a public agenda which enjoys broad support.
- Build upon ongoing discussions wherever possible.
- Facilitate the involvement of the smaller societal organizations.
- Remain open to the societal organizations' own agendas.
- Inform the general public about the societal aspects of nanotechnology.
- Involve citizens by means of small-scale engagement activities

6.1 The risk issue demands governmental direction

2 Actively address the risk issue

Any lack of government initiative in addressing the risk issues can only undermine the legitimacy of a social dialogue about nanotechnology.

The government recently informed parliament of its intentions by means of a 'strategy document' (VROM 2008). This not only sets out the position that the government will adopt in the discussion about risks, but also states exactly what is expected of the scientific field, private sector and societal organizations. However, concerted research into the risks has yet to commence in earnest, as has the consultation with organizations. Meanwhile, the burgeoning number of actual nanotechnology products on the market has given rise to increasing uncertainties about the safety of nanotechnology – not only in the media, but more especially among the NGOs themselves. Doubt and scepticism are the basic ingredients for a major controversy. The most effective means of engendering trust and confidence is to display reliable behaviour: the government must therefore take control, exercise clear direction of the processes, and develop a concrete risk management strategy.

3 Involve NGOs in developing policy

The risk issues demand interactive consultation, whereby NGOs are involved in developing policy

The first organizations to involve themselves in the debate about the safety of nanotechnology have been the environmental organizations, which have also established standpoints regarding the possible risks. Now is an appropriate moment to seek contact with these organizations and enter into a discussion. In doing so, it is important to remember that the NGOs are generally sceptical about the government's speed of action. Past experience has shown that uncertainty regarding risks to health and the environment (as in the case of asbestos) have often led to lengthy policy processes. Regulations often come after the event, and after a long struggle to draw attention to the problems.

In the case of nanotechnology, there is now a unique opportunity to involve the NGOs in the approach to the risk issue at a very early stage. However, those organizations will only be willing to take part if their efforts are likely to bear fruit. They are willing to join in the thinking about new legislation and protective measures, but impose three conditions on their participation:

- Consultation must not lead to unnecessary bureaucracy which will only serve to prolong the process.
- The consultation process should therefore be focused, with the topics to be discussed agreed in advance, and a clear indication of how the results will actually influence policy.
- Unwelcome results must not merely be ignored.

4 Provide clear information about nanotechnology products, risk governance strategy and the uncertainties

If the government is to maintain public trust and confidence, there must be full openness. Accordingly, it is crucial to provide clear information about the relevant products and the risk governance strategy. The government should be equally open about any uncertainties with regard to the potential health and environmental risks posed by nanoparticles.

A public debate about nanotechnology in combination with the increase in the number of nanotechnology products on the market is likely to raise two key questions: which products do indeed involve nanotechnology, and what risks to human health and the environment do they pose? The growing uncertainty with regard to the safety of nanotechnology products has been seized upon by the media, whereupon a lack of product information can only exacerbate doubts. Several NGOs have called for greater openness, and wish to see a mandatory labelling system introduced. They also call for specific information campaigns and consumer websites to encourage thought and help the public decide whether they are for or against nanotechnology products. Consumer panels in other countries have reiterated the call for a labelling system. To meet this

demand will be far from simple; the question of what information is deemed useful aside, it is first necessary to define exactly what constitutes a 'nanotechnology product'. Moreover, a labelling system would automatically cast suspicion on nanotechnology in many people's minds, even before it is established whether such suspicion is indeed justified.

6.2 A broad dialogue demands openness and structure

5 Ensure that there is a public agenda which enjoys broad support

An agenda which enjoys broad support is an essential precondition to any useful public debate about nanotechnology. The dialogue must be fully open, and the input of all participants must be respected.

While the risk issue calls for direct action by the government and the involvement of the NGOs in developing policy, the other issues surrounding nanotechnology allow more room for an open debate. Nevertheless, the combination of the scientific field's promises and speculations on the one hand, and the public's lack of knowledge regarding the societal impact of nanotechnology on the other, can lead to mistrust and opposition. Reflection, interaction and an open discussion about the likely social impact of nanotechnology are therefore extremely important. Calls for an effective debate can now be heard throughout the world. Many people believe that such a debate is the only way to avoid repeating the mistakes made in the past, frequently citing the discussion about genetically modified food as an example.

However, promoting the societal dialogue about nanotechnology is no simple undertaking. Clearly, the risks of new nanoparticles themselves do fall under the heading of 'nanotechnology'. However, discussing issues such as privacy or artificial life may, under the heading of nanotechnology, be less evident. These questions are already part of other, ongoing discussions, and are also included on the policy agenda under different headings. This is why it is so important to set a clear agenda for the nanotechnology debate itself. The topics to be discussed must be clearly defined, as must the parties who are to discuss them and the manner in which the outcomes are to be used (see also Recommendation 5). Openness and transparency are essential. It is important that everyone taking part in the societal dialogue is heard and that their input is respected (see also Recommendation 7). To establish a balance between structure and openness will form a particular challenge.

6 Build upon ongoing discussions wherever possible

Establish what is to be discussed under the heading of 'nanotechnology' and what issues can be more appropriately examined within other discussions. This will serve to render the dialogue more manageable, whereupon existing institutions and NGOs can become more fully involved.

The influence of nanotechnology will be seen in many international trends and discussions. One example is Radio Frequency Identification (RFID), which involves the use of microchips in applications such as public transport payment cards and the biometric passport. RFID will inevitably play a role in the privacy discussion, which therefore offers various 'jumping-off points' for a broader discussion of the societal impact of nanotechnology in general.

Another example is the ongoing discussion about Ambient Intelligence, in which various visions of the future uses of information technology are being offered. In such visions, computers – which will become ever small thanks to nanotechnology – can assume many of the routine tasks in the home, the workplace and in healthcare provision. This discussion offers opportunities to raise further relevant questions: will 'smart' environments incorporating computers smaller than a postage stamp actually help us? Will they serve our interests, or will they be used to control us? Once again, this debate enables the broad nature of nanotechnology to be examined within a public dialogue.

The emergence of synthetic biology demonstrates the influence of nanotechnology within the field of biotechnology. Here too, there is an ongoing discussion which does justice to the broad character of nanotechnology. The advantage of addressing synthetic biology separately (over and above nanotechnology itself) is that this will immediately make clear that the discussion has close ties to the biotechnology debate. The policymakers, societal organizations, private sector companies and members of the general public who have long been engaged in the biotechnology debate will therefore be automatically included in the new discussions. Moreover, the issue of 'artificial life', as relevant to the nanotechnology debate, can be institutionalized from the existing basis of the biotechnological domain.

These examples demonstrate that the new issues raised by nanotechnology not only feature in the existing discussions, but also that they can add a useful new dimension to those discussions. 'Dividing up' the societal dialogue in this way kills two birds with one stone: the debate becomes more manageable, while the roles that the existing institutions and NGOs are expected to play become clear.

7 Facilitate the involvement of smaller NGOs

To ensure that even the smaller NGOs are well prepared for the dialogue, the government must facilitate their participation by helping them to develop the necessary capacity and knowledge.

There is no shortage of experts willing and able to undertake an ethical reflection of nanotechnology. However, it is somewhat more difficult to gauge public opinion. The NGOs have a role to play in this respect. Both the government and the private sector should therefore invite them to take part in the nanotechnology discussion. In the Netherlands, the NGOs have stated that

they consider ethical reflection to be extremely important. Nevertheless, they have yet to make any great headway in this respect. As we saw in Chapter 3, ethical issues such as human enhancement, and more general aspects such as privacy, personal identification and smart environments, are not high on the agenda of the societal organizations. Accordingly, we may conclude that the organizations have not yet chosen to devote specific attention to the broader societal issues raised by nanotechnology.

There are at least two explanations for this situation. First, some specific topics have no societal organization devoted to them. In the Netherlands, for example, there has been no critical organization examining matters of privacy and technology since the demise of 'Bits of Freedom'. Second, the smaller NGOs state that they lack the capacity to monitor developments adequately. It is nevertheless important that these organizations are fully involved in the broader nanotechnology dialogue. These small organizations function as the 'thermometer' of social disquiet. Moreover, their involvement offers the opportunity to engage a broader section of the general public. To facilitate full societal participation in the nanotechnology debate, the government should therefore facilitate the involvement of the smaller organizations and help them to prepare adequately.

8 Remain open to the NGOs' own agendas

In any societal dialogue, there will be broader interests, opinions and agendas which must be taken into account. Failure to do so will create mistrust rather than trust.

The starting point of the societal dialogue of nanotechnology is the technology itself. However, many NGOs will wish to take part in the debate based on their own objectives and agenda. A discussion of, say, nanofood, will therefore not be restricted to the risk issue. Friends of the Earth also wishes to discuss the industrialization of food production in general, and is calling for more attention to be devoted to sustainable, biological production methods. In the United States, Friends of the Earth has already linked the discussions about cloned meat and animal-human hybrids to the debate about synthetic biology. These examples illustrate that NGOs will often wish to include the broader societal aspects in the debate. When conducting a full public dialogue, it is essential to take this desire into account and to remain open to the full range of views. The fact that such aspects may not directly influence the resultant policy does not detract from the importance of doing so.

9 Inform the public about the societal aspects of nanotechnology

Given that public awareness of nanotechnology is currently extremely low, it is still too early to involve the majority of people in the relevant dialogue. At this stage it is therefore more important to ensure that clear and accurate information about the societal aspects is readily available to those who wish to learn more.

Recent public surveys in countries such as the United States, United Kingdom, Germany and Switzerland reveal that between sixty and eighty per cent of respondents have never heard of nanotechnology, or have heard of it only in passing. There is no reason to suppose that the situation in the Netherlands is any different. The vast majority of consumers are unaware that products containing nanoparticles are already on the market. Public awareness of nanotechnology is low. Nevertheless, with a view to the forthcoming discussion about the risks of nanomaterials, it is necessary to allow people the opportunity to educate themselves about the relevant issues. The NGOs have also stressed the importance of doing so. Not only must information about the possible applications be made available, there must also be information which fosters greater understanding of the societal issues raised by nanotechnology. Only then will members of the public be able to make a fair and informed assessment of whether the advantages of nanotechnology outweigh the potential risks.

10 Involve citizens by means of small-scale engagement activities

Given the broad societal impact of nanotechnology, it is important to hear the views of all sections of the community and to keep a 'finger on the pulse' of public opinion. Focus groups and panel discussions are two means by which the public can be given a voice.

The lay members of focus groups and public panels convened in other countries have shown a mixture of enthusiasm and concern with regard to nanotechnology. Recurring themes include a call for more and better risk assessment, and for the government to regulate nanotechnology, thereby ensuring that it is used in the public interest (e.g. to promote sustainability). Many of the focus group members have asked how the public can be given a voice in the development of nanotechnology. In the Netherlands, public participation can also be promoted by the use of small-scale focus groups and panel discussions. These will provide a better understanding of the wishes and concerns of the well-informed citizen.

Notes

- 1 In the Government Vision on nanotechnology the broad-based commission was mentioned in the section entitled 'Coördinatie' (coordination)
- 2 www.rivm.nl/milieuportaal/dossier/nanotechnologie
- 3 <http://nanotechproject.org>
- 4 www.nanologue.net
- 5 The authors wish to acknowledge the kind assistance of James Wilsdon (DEMOS, UK), Marion Godman (Royal Institute of Technology, Sweden), Jurek Vengels (BUND, Germany), Hans Kastenholtz (EMPA, Switzerland) and Alain Kaufmann (TA Swiss, Switzerland).
- 6 The CASIN study does not name the German Evangelische Landeskirche, which has organized a number of conferences to discuss the ethical aspects of nanotechnology and has published a discussion document on the topic. In the United Kingdom, the Church of Scotland has also devoted considerable attention to the ethical issues, focusing on the converging nature of technologies and the ethical aspects of human enhancement in particular.
- 7 www.responsiblenanocode.org
- 8 www.nanoriskframework.com
- 9 www.nanobio-raise.org

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Appendix: research questions

NGOs in the Netherlands were invited to complete the following questionnaire. Responses were then discussed during telephone interviews to provide further clarification where necessary.

Part 1: Direct involvement in nanotechnology

- 1.1 How is your organization involved (or interested) in nanotechnology?
- 1.2 Has your organization produced a position paper or other official statement regarding its standpoint on nanotechnology? Is such a document currently in production?
- 1.3 Which application areas of nanotechnology enjoy specific attention within your organization and why? (More than one answer may be selected):

- T1 Medical and healthcare applications
- T2 Agriculture and food production
- T3 Water provision and energy production
- T4 Electronic applications and ICT service provision
- T5 New materials and industrial processes
- T6 Military and security applications
- T7 Other application areas (please specify).

- 1.4 Which issues raised by nanotechnology are of special interest to your organization, and why? (More than one answer may be selected).

- V1 Privacy aspects
- V2 Risks to human health
- V3 Risks to the environment
- V4 Sustainability
- V5 Principle of due caution
- V6 Intellectual property (patents)
- V7 Opportunities for innovation (new products and services)
- V8 Global distribution of wealth
- V9 Good governance
- V10 Ethical considerations
- V11 Legislation and guidelines
- V12 Arms race
- V13 Public information
- V14 Stakeholder participation
- V15 Personal identification (using RFID chips)

- V16 Human enhancement
- V17 Ambient Intelligence
- V18 Other issues (please specify).

Part 2: Information flows

- 2.1 From what sources do you derive information about nanotechnology, its applications and the relevant issues?
- 2.2 Do you maintain contact with other (sister) organizations in the Netherlands or in other countries with regard to nanotechnology, its applications and the relevant issues? If so, please name the organizations and the topic(s) of your discussions.
- 2.3 Do you also consult experts or specific (research) organizations about nanotechnology, its applications and the relevant issues? If so, please name the experts/organizations and the topic(s) of your discussions?
- 2.4 Do you receive questions about technology from your members or supporters? If so, please indicate the volume of questions and the topic(s) to which they relate.
- 2.5 Have you undertaken any activities to inform your members or supporters about nanotechnology, or are there ongoing plans to do so? If so, please state when and how this has/will be undertaken.
- 2.6 In your opinion, which are the most appropriate organizations to inform the general public about nanotechnology (with regard to expertise and reliability)?

Part 3: Policy

- 3.1 Are you aware of the contents of the Dutch government's 'Vision Document on Nanotechnology'. Has your organization produced or submitted a response to this document? If so, would you be willing to provide a copy?
- 3.2 Are you aware of the existence of the Interdepartmental Nanotechnology Project Group which is currently preparing a national Action Plan for Nanotechnology? If so, have you spoken to any of its members? What specific topics did you discuss?

- 3.3** In your opinion, which issues relating to nanotechnology should the government address as a matter of urgency, i.e. within the coming year? Is your organization able to make a contribution in this respect?
- 3.4** In your opinion, which issues relating to nanotechnology should the government address in the medium-to-long term, i.e. within the next five years? Is your organization able to make a contribution in this respect?
- 3.5** The biotechnology debate has given rise to a number of important recommendations for the government with regard to the manner in which the nanotechnology can and should be conducted. Please indicate the extent to which your organization would endorse the following three recommendations, stating your reasons:
- a** Ensure good public information about nanotechnology.
 - b** Facilitate greater involvement on the part of (smaller) NGOs and NGOs in the further development of nanotechnology.
 - c** Ensure full consultation of the societal stakeholders when preparing policy relating to nanotechnology.
- 3.6** Please state how your organization believes the government can best implement these recommendations by means of concrete activities?
- a** Ensure good public information about nanotechnology.
 - b** Facilitate greater involvement on the part of (smaller) NGOs in the further development of nanotechnology.
 - c** Ensure full consultation of the societal stakeholders when preparing policy relating to nanotechnology.

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