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Public Reactions to Nanotechnology in Switzerland

Report on *publifocus* discussion forum

„Nanotechnology, Health and the Environment“

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Since 1992, TA-SWISS has conducted assessments of the impacts of new technologies, advising Parliament and the Federal Council on science and technology issues with an eye to the future. TA-SWISS carries out scientific studies to capture trends in biomedicine, information technology, and nanotechnology and conducts discussion forums and other participatory methods to involve members of the public in the debates. TA-SWISS is affiliated to the Swiss Science and Technology Council and is funded by the federal government.

The results of the discussion forums and participatory methods PubliForum, *publifocus*, and PubliTalk, which TA-SWISS developed and has conducted with interested members of the public since 1998, are published in the publication series TA-Participation (TA-P). Involvement in these participatory processes allows citizens to contribute at an early stage to reasoned discussion of the possible consequences of technological advances.

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Bern, November 2006

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Public Reactions to Nanotechnology in Switzerland

The findings of the *publifocus* discussion forum “Nanotechnology,
Health and the Environment”

Lucienne Rey

Bern, November 2006

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Summary

A great future is predicted for the nanosciences. The predicted economic potential of nanotechnologies is equally high. This has consequences for society. The targeted manipulation of nanoscale structures opens up new perspectives – in cancer treatments, for entertainment electronics, or in the food industry, for example. But up to today, little is known about the health and environmental consequences of nanoscale technologies.

As yet, there is little public dialogue on nanotechnology. When given the opportunity to speak, however, members of the public raise a number of difficult issues.

Hopes outweigh reservations

In accordance with the lack of public knowledge, no entrenched attitudes or fronts can be discerned at present in the discussion on the new technology. Although a number of the participants in the *publifocus* events on nanotechnology express critical opinions and warn of unforeseeable consequences, none of the participants expresses a fundamental rejection of the new branch of technology. Even the skeptics among them do not reject the possibility that nanotechnologies may yield solutions to important problems – namely, in the fields of medicine and protection of the environment.

The greatest reservations expressed by the *publifocus* participants concern nanotechnologically produced foodstuffs. They raise the argument several times that in the area of food, the ratio of potential benefits to potential risks is less favorable than it is for nanotechnology applications in medicine and environmental protection.

Urgent demand for mandatory product declaration

Even though they grant that nanotechnologies have promising potential, only very few of the *publifocus* participants are willing to buy and consume products containing nanoparticles unknowingly. On the contrary, most of

the participants are very worried that they may have already purchased products containing nanoparticles without being aware that this is the case.

The great majority of the participants are therefore of the opinion that rules for declaration and labeling should be established for the new products. They believe that this is the only way to ensure freedom to choose and for people to develop trust in the new technology. While many of the participants emphasize that the establishment of regulation and declaration will be connected with difficulties and that the benefit of doing so is not beyond all doubt, they conclude that there is no other way. One of the suggestions that they propose, for example, is the creation of a new label, coupled with an incentive, or steering, tax that is earmarked for the funding of risk research. Quite a lot of the participants find it conceivable that the industry would make a voluntary commitment to put no products on the market if their consequential damages have not been determined.

Trust in government research

As to the actors that should be involved in the development of nanotechnologies, the *publifocus* participants give quite a lot of credit to the researchers themselves. Their research work should be allowed to proceed unhindered. Researchers are credited with wanting to contribute toward the solution of problems with their work. Especially from independent, government-funded research, the hope is for solution of urgent problems in the areas of medicine and the environment.

However, the participants draw a clear distinction between the development of products and the marketing of products. They suspect that research with close ties to industry and the private economy is more selfishly motivated by profit considerations. Accordingly, many of the participants speak strongly in favor of controls and regulations independent of the private economy and in the hands of the public authorities. They also have strong trust in popular non-governmental organizations like the Swiss Foundation for Consumer Protection.

No use of ready-made recipes

In the discussion on nanotechnology, the *publifocus* participants referred again and again to experiences with other, already familiar technologies. They compared the possible negative effects of nanotechnologies to the

dangers of asbestos or ultrafine dusts and illustrated potential benefits taking examples from information and computer technology. In addition, their suggestions pertaining to possible ways to regulate nanotechnologies were often inspired by other branches of technology, such as the regulations on pharmaceutical products. However, the analogies that they drew to other technologies were not used in the sense of ready-made recipes but instead were further developed and given nuances in the discussion. Although various parallels were drawn to genetic modification (GM), none of the discussion groups called for a moratorium on nanotechnology; instead, a lot of the participants were of the opinion that Switzerland should make use of its leading position in nanotechnology research to also become an international leader in risk research and on the issues of regulation.

Further information and clarification wanted

The participants welcomed the opportunity provided by the *publifocus* project to look into the possible benefits and dangers of this new technology. However, their demand is for more, extensive, balanced, independent, and clearly understandable information on and clarification of the potential benefits and possible impacts of nanotechnologies. Many of the participants also expressed a desire for the opportunity to be actively involved in the development of these new technologies through participation in the policy debate. The *publifocus* participants place importance on the honesty and transparency of all parties that deal with nanotechnology and want to see the opinions of “normal” citizens taken seriously.

Discussion is appropriate also at an early stage

In the framework of *publifocus* “Nanotechnology, Health and the Environment” TA-SWISS – the Centre for Technology Assessment – conducted five discussion rounds – four in different regions of Switzerland and one with people representing interest groups. This report presents the ideas, opinions, hopes, and fears voiced by the participants on the subject of nanotechnology as captured by the *publifocus* method. As the results were highly consistent across the five *publifocus* events in Winterthur, Bern, Lausanne, and Lugano, conclusions can definitely be drawn also about the reactions of the Swiss population as a whole.

The experiences with *publifocus* have confirmed that it is possible and appropriate to hold technology discussions at an early stage of the develop-

ment of an emerging field – even before the professional experts themselves have clarified all questions of definition. With *publifocus* “Nanotechnology, Health and the Environment,” the debate on the new branch of technology has been launched – at an early point in time, when the issues can be examined openly and unhindered by hardened attitudes and inflexible fronts.

The *publifocus* discussions reported on here relate for the most part to what is called the first generation of nanotechnologies, which are generally passive (steady function) nanostructures. Future discussions will have to increasingly examine the consequences of the convergence of various fields of research that has been accelerated by the development of nanotechnology. Some examples of this convergence are nanobiotechnology, Nano2Bio, and Bio2Nano.

1. Nano: A new technology takes off

“Nano” is hot. New products are being extolled, and the latest research findings are raising hopes for new medical treatments, (even) faster and more powerful computers, or simply greater convenience in daily life. The use of the “nano” nomenclature is also increasingly becoming a marketing factor, a trump card in product advertising, which tends to muddle rather than clarify the discussion on what this new branch of technology actually is. And this is all in addition to the enthusiasm for the possibilities emerging through nanotechnology applications in industry (surface coatings), medicine (new “nano” medications), computer technology (chips and monitors), energy (“super batteries”), and the environment (more sparing use of resources, for example).

Nanotechnology refers to research and manipulation of matter at the level of atoms and molecules. At this nanometer scale from 1 to 100 billionths of a meter – a nanometer is one billionth of a meter (10^{-9}) – the properties of substances are in part radically changed. Making use of the special properties of nano-sized substances is precisely what opens up the world of new possible applications. But there are risks. What may be harmless as a microparticle (one millionth of a meter in size) may be harmful to people and the environment as a nanoparticle. In the spring of 2006, the discussion on possible harmful effects of engineered nanoparticles also reached Switzerland.

For one, cases of poisoning in Germany due to a household spray cleaner called “Nano-Magic” made headlines in Switzerland. The product in fact contained no nanoparticles. The respiratory problems experienced by some consumers were probably caused by the tiny aerosol droplets of the solvent that penetrated deep into the lungs. Nevertheless, Nano-Magic had been correctly called “nano” insofar as it creates a sealant layer on surfaces that is only some nanometers thick. This example shows particularly well how confusing it can be for consumers to decide where exactly the problem with “nano” lies.

For another, in the view of the experts, the greatest concern is that nanoparticles could enter the body and cause harm. Especially manufac-

tured nanoparticles that are free (free to move around in the air, for example, as opposed to fixed in a material) could be inhaled or, depending on their size, could enter the body via the digestive system or the skin. If the particles have foreign structural properties and are therefore not easily degraded, these foreign substances can persist in the body for an indefinite period of time. There is particular concern about manufactured, non-soluble carbon nanotubes and fullerenes. However, if the nanoparticles are fixed in the materials that contain them, they appear to be significantly less problematic.

In Switzerland, the public has little knowledge of nanotechnology and takes a largely indifferent attitude towards it. With this, the situation in Switzerland is comparable to that in Germany and the European Union. There, too, the great majority of the population is not interested in nanotechnologies, as a survey revealed last year (Eurobarometer 2005). According to the survey, interest in nanotechnologies is expressed by 12% of the population in Switzerland, 11% in Germany, and 8% in the EU. In contrast, 65% of people in Switzerland and Germany are very interested in medicine. And only one-half of the survey respondents expect positive benefits from nanotechnologies. From medicine, more than 90% of the survey respondents expect positive outcomes.

1.1. Nanotechnology in the media

Swiss television examined nanotechnology and nanoparticles several times in 2006. The television shows “10vor10,” “Menschen – Technik – Wissenschaft,” and “Kassensturz” underlined, among other things, the possibilities of the new branch of technology and its promise for industry and jobs in Switzerland, but the reports also dealt with the problems and risks associated with nanoparticles. That aspect was also emphasized in some articles that appeared in the consumer magazines *Saldo* and *Beobachter*.

Environmental organizations are also beginning to work on the topic and have already published their first articles, primarily in the context of the possible impacts of nanotechnology and nanoparticles on the environment (accumulation of particles in waters and the food chain). The *Kleinbauern-Vereinigung* [Small Farmers' Association] published a position paper on nanotechnologies in agriculture and the food industry. The position paper demands increased public debate, especially on nanotechnologies in foods. Large foodstuff producers and pharmaceutical companies are offering little information. They are maintaining a low profile with regard to their research

and development in the nanotechnology sector. But one thing is clear: the research is ongoing everywhere. However, whether and with what type of declaration the food or health products will be put on the market will also depend decisively on the voice of the consumers. Since at present nano-products do have to be declared as such, we have no way of knowing if a product contains “nano.” Reportage in the Swiss media is more or less balanced. Most articles treat the background, promise, and possible risks with equal weight.

1.2. Nanotechnology in politics and government departments

The debate is also getting underway in politics. The Green Party of Switzerland [Grüne Partei der Schweiz] used the opportunity of the worrying events surrounding the “Nano-Magic” affair in Germany, among other things, to submit a motion in mid-May 2006 requesting the Federal Council to more closely examine nanotechnologies, increase risk research, and consider declaration and labeling regulations. In addition, two further political proposals were submitted at the national level in 2006, and already in December 2004, an “ordinary question” (parliamentary procedure) was submitted in the National Council requesting explanations on the issue of the military application of nanotechnologies and possible harm to the environment and health.

The Federal Office of Public Health (FOPH) and the Federal Office for the Environment (FOEN) are heading the project “Action Plan on Manufactured Nanomaterials, 2006 – 2009.” The goal is to coordinate Switzerland’s national and international activities in the area of risk evaluation and risk management of manufactured nanomaterials. The plan also addresses precautionary measures related to the protection of workers, consumers, and the environment, in coordination with national and international efforts already underway.

1.3. Nanotechnology at the international level

Debate and action plans for nanotechnologies are now increasing across Europe. The European Union and many countries are in the process of defining strategies for nanotechnologies and manufactured nanomaterials. These efforts are cross-linked internationally and aligned with the goals of the Organization for Economic Cooperation and Development (OECD).

Active inclusion of the public in the dialogue on nanotechnology is also slowly gaining in importance – experts have been recommending it for years. While so far this dialogue has been conducted almost exclusively among representatives of science, government departments, and industry, there are now – for example in Denmark, Holland, England, and Germany – debates reaching out to the wider public and inviting their participation. The results of these participatory methods show that the many benefits that nanotechnologies appear to offer should be realized, especially in medicine and in electronics. Possible negative effects and societal or ethical issues, however, have to be thoroughly clarified before nanotechnology products are allowed to become consumer and mass-market goods. Risk research must be expanded to meet the need; independent and balanced information must be promoted; and it must be ensured that the public will be further included in the development of the technology.

In May 2006, a coalition of eight consumer and environmental groups petitioned the United States Food and Drug Administration to tighten oversight of nano-products and to recall sunscreens and cosmetics containing engineered nanoparticles (titanium dioxide and zinc oxide), as they represent a possible health hazard. The American health authorities and the cosmetic industry deny any possible danger. Switzerland has seen similar discussions on sunscreens containing nanoparticles. Although here, too, the authorities have given these products the all-clear, there is as yet no clarification of the issues of regulation and declaration. There is likely to be a need also for discussion on the handling of silver nanoparticles. Silver has bactericidal properties, and the ability to reduce particles of silver into the nano-scale now enables their increasing incorporation into consumer products. Silver nanoparticles pose no danger to people, but they can be very toxic to tiny aquatic organisms.

1.4. Nanotechnology at TA-SWISS

The development of nanotechnology raises questions. While the new technology is raising great hopes, serious objections are being raised against certain areas of the technology branch, in particular with regard to the handling of engineered nanoparticles. Upon this background, TA-Swiss has also been examining this new branch of technology for some time now: the TA-Swiss study report “*Nanotechnologie in der Medizin*” [Nanotechnology in Medicine] (Report TA 47/2003; Short Report TA 47a/2003) provided an initial basis for the assessment and strengthened TA-Swiss in its conviction that broad public discussion is needed to create the prerequisites for a dis-

criminating view of nanotechnologies. This is all the more urgent, as currently also Switzerland is seeing the launching of large-scale industrial production of nanoparticles. It is also not in the interest of the industry to ignore how the public perceives and judges “nano” – because for the success of the new products and of Switzerland as a center of industry and jobs, public opinion could be decisive. For this reason, TA-SWISS prepared for a public discussion forum in the form of *publifocus* “Nanotechnology, Health and the Environment” and in September 2006 conducted five discussion groups in various regions of Switzerland and also with representatives of interest organizations. The project aims to stimulate public discussion at an early stage of the technology development – discussion that considers various aspects and raises the issues. As an information aid to the public, TA-SWISS published “Information Brochure: Know Your Nano!” (also in German and in French) in 2006 (see section 2.4). Together with the *publifocus* project, the brochure provides a good basis for understanding what nanotechnologies are and what citizens see as the challenges involved in dealing with them.

The *publifocus* discussions reported on here relate for the most part to what is called the first generation of nanotechnologies, which are generally passive (steady function) nanostructures such as surface coatings, additives for cosmetics and textiles, but also initial medical applications in the area of diagnosis. The focus is on the application and the effects of engineered nanoparticles, such as carbon nanotubes. Future discussions will have to increasingly examine the consequences of the convergence of various fields of research that has been accelerated by the development of nanotechnology. Some examples of this convergence are nanobiotechnology, Nano2Bio, and Bio2Nano. These nanotechnologies of the second to fourth generation deal with the development of independent, active (evolving function) nanostructures and integrated and molecular nanosystems for utilization, for example, in the production of artificial organs or for nanoscale genetic therapies (see here “White Paper No. 2: Nanotechnology Risk Governance,” International Risk Governance Council, Geneva 2006).

2. *publifocus*: A participatory method used by TA-SWISS

The *publifocus* approach belongs to what are called participatory methods in technology assessment,¹ which aim at increased inclusion of citizens in the technology policy decision-making process. As a method, *publifocus* is based on the focus group. A focus group is a moderated group discussion designed to capture the range of public opinions on a defined topic. As compared to other qualitative methods, the focus group method has the advantage that it can be conducted comparatively quickly and that it is less expensive and easier to organize than, for example, a PubliForum (see

¹ There are a number of instruments designed to generate dialogue and strengthen the inclusion of citizens. Since the late 1960s a wealth of techniques has been developed internationally for inclusion of citizens in the shaping of their world. The best known are creativity techniques such as future workshop, Open Space Technology, or approaches that are designed to contribute towards solution of concrete (regional) conflicts, such as consensus conference, citizen jury, or planning cells.

The focus group method was developed originally by market research to discover the potential market acceptance of new products (and the reasons for approval or rejection). More recently, the focus group method was applied to policy decision-making processes. If, using the focus group method, several discussions on a topic are held with one and the same group, this is called a series focus group. A focus group is usually a group discussion in a group of 6 to 8 people. With *publifocus*, which is based on the focus group method, TA-SWISS works with groups of 12 to 18 persons in order to obtain greater variability in the composition of the groups and in the views and opinions. This requires the preparation of a comprehensive basis of information for the participants and good preparation of discussion facilitation (moderator) and the program of the event. An introduction to conducting focus groups is provided by: Dürrenberger, G., & Behringer, J. (1999). *Die Fokusgruppe in Theorie und Anwendung*. Stuttgart: Akademie für Technikfolgenabschätzung Baden-Württemberg.

Steyaert, S., & Lisoir, H. (Eds.) (2005). *Participatory Methods Toolkit. A practitioners' manual*. Belgium: King Baudoin Foundation and the Flemish Institute for Science and Technology. Available at:

<http://www.eukn.org/binaries/eukn/eukn/research/2006/2/participatory-toolkit.pdf>

Good examples of projects using focus groups on nanotechnology can be found in:

Cook, A. J., & Fairweather, J. R. (2005). *Nanotechnology - Ethical and social issues: Results from New Zealand focus groups*. AERU Research Report No. 281. Canterbury, NZ: Agribusiness and Economics Research Unit, Lincoln University. Available at:

http://www.lincoln.ac.nz/story_images/1330_rr281_s4140.pdf

Kearnes, M., Macnaghten, P., & Wilsdon J. (2006). *Governing at the nanoscale. People, policies and emerging technologies*. London: Demos. Available at:

<http://www.demos.co.uk/files/governingatthenanoscale.pdf>

The participatory approaches developed by TA-SWISS were designed specifically for the technology discussion in the context of Switzerland. What is unique about them as compared to participatory methods as applied in other countries is integration of groups speaking different languages. PubliForum, another TA-SWISS participatory method, has become quite well-known in Switzerland. Organizing a PubliForum event presents great challenges with regard to both content and organization: a panel of about 20 citizens must first be made familiar with the topic and given the opportunity to hear experts that they themselves select. On the basis of this information, the panel writes a report with recommendations addressed to policy makers. Counting the preparatory meetings, a PubliForum lasts about a week.

"Cafés scientifiques" can also be considered a participatory method. They aim to improve information exchange between scientists and the wider public. At the Café scientifiques events, a podium of experts takes questions from the public.

footnote). For the discussion of newer, still rather unfamiliar topics like nanotechnologies, the focus group is particularly appropriate also because it allows the participants in the relatively small groups to develop a stance on the issues jointly, drawing or building on arguments presented by other participants. This can make discussion of complex issues easier. Focus groups with members of the public on nanotechnology have been conducted in other countries, such as the United States, Denmark, the Netherlands, the United Kingdom, New Zealand, and in 2006 also in Germany.

2.1. Sponsors and the Advisory Group

As is the case with all TA-SWISS projects, the *publifocus* on nanotechnology was provided critical support by an advisory group of experts that deal with the new technology from a variety of perspectives – government, research, science, economy, society, media, and consumer protection. The members of the *publifocus* Nanotechnology Advisory Group are listed on the last page of this report. They were responsible, among other things, for deciding the main points of the content of the information brochure on nanotechnology. In addition, they helped the project head to determine and develop the questions to be addressed by the focus group and to choose the groups that were invited to an additional, special *publifocus* event with interest groups. The advisory group was informed of all decisions beforehand and kept up-to-date on project progress.

In addition to TA-SWISS, *publifocus* “Nanotechnology, Health and the Environment” was financially supported the Federal Office of Public Health (FOPH), the Federal Office for the Environment (FOEN), and the Zurich University of Applied Sciences Winterthur (ZHW), which were represented in the advisory group. The sponsors have a direct interest in the findings, which they plan to utilize in the work of their departments and the university.

The Federal Office of Public Health (FOPH) monitors the health of the population and takes appropriate measures to promote and protect the health of people in Switzerland. The Federal Office for the Environment is the federal government’s center of environmental expertise for the protection and use of natural resources. Both of these departments have the task of early detection of the possible risks of new technologies, early identification of possible impacts on health (food, cosmetics, consumer products, chemicals) and the environment (waters, air, soil, food chain, disposal), and the development of proposals for measures. Both of the departments stress

the importance of open information and targeted dialogue. FOPH and FOEN are in charge of the development of the “Action Plan on Manufactured Nanomaterials, 2006 – 2009” (see section 1.2).

At the Zurich University of Applied Sciences Winterthur (ZHW) – one of the largest multidisciplinary universities of applied sciences in Switzerland and a part of the UAS of Zurich – approximately 20 professors in the School of Engineering are at work in research, education, and graduate education the area of nanotechnologies. The Competence Centre for Safety and Risk Prevention (KSR) is a part of this nanotechnology group. As an cross-department, interdisciplinary platform, the Competence Centre aims, in both innovation processes and in the business environment, to promote technologies that are business innovations, high quality, and socially responsible.

2.2. Selection of participants for the groups

publifocus “Nanotechnology, Health and the Environment” consisted of five evening discussion group meetings, each lasting four hours. Four discussion group meetings covered the different regions of Switzerland (in Winterthur for northern and western Switzerland, in Bern for central Switzerland, in Lausanne for French-speaking Switzerland, and in Lugano for Italian-speaking Switzerland). One discussion group was made up of representatives of various national organizations and associations that in their function are confronted with nanotechnologies.

Participants for the different discussion groups were recruited by sending letters to 10,000 persons in Switzerland, inviting them to sign up for the *publifocus* events in the four selected regions. The letters were sent to 6,000 persons in German-speaking Switzerland, 3,000 persons in French-speaking Switzerland, and 1,000 persons in Italian-speaking Switzerland. TA-SWISS procured the addresses for the mailing from a direct marketing company. The letter provided a brief explanation of what nanotechnology is, why TA-SWISS planned to hold a *publifocus* event, and what a *publifocus* event is. The letter invited persons interested in participating to send in the enclosed response form. The response form asked for some information on person, age, occupation, and education as well as memberships in political parties and in clubs or associations. The letter also explained that sending in the response form was no guarantee of participation and that TA-SWISS would be selecting a group of about 15 participants from the response forms received. In order to cover the broadest possible range of

opinions, the group would be made up of persons of both sexes differing in age, education, occupation, and political and social interests.

As a thank-you to the many persons that responded to the invitation but could not be invited to participate in one of the *publifocus* events in Winterthur, Bern, Lausanne, and Lugano, TA-SWISS sent "Information Brochure: Know Your Nano!" (see section 2.3). Detailed information on the composition of the discussion groups can be found in the appendix, section 8.1..

For the one *publifocus* event conducted with interest organizations, in consultation with the Advisory Group 33 national associations were sent a letter of invitation. Sixteen persons from six organizations in the areas of the economy, industry, labor unions, food production, agriculture, consumer protection, and environmental protection took part in this event.

Evaluation of the feedback forms filled out by the participants after the five individual *publifocus* events shows that the participants found the preparatory information, the organization, and the conducting of the discussion events highly satisfactory (see appendix, section 8.2).

2.3. The conducting of a *publifocus* event

In order to conduct the *publifocus* project professionally, the contributions of various specialists were required. The moderator guided the group through the evening and led the discussion according to a set program of questions. Near the start of the event, two experts each gave a 15-minute introductory talk. These experts were also available to provide information during the discussions. All of the *publifocus* events were recorded meticulously by a science journalist to ensure that none of the participants' remarks would be lost for the final report. The TA-SWISS project head and project assistants, together with the Advisory Group, determined the content, setting, and questions of the *publifocus*, instructed the people involved, and made sure that the project ran smoothly.

Each of the four-hour-long *publifocus* events on nanotechnology was conducted following the same program: After an introduction explaining the program for the evening and the goal of the discussion event and a first round in which the participants disclosed any previous contact with nanotechnology or how they are affected by nanotechnology, the two experts gave their introductory talks. In order to launch the discussion, they introduced nanotechnologies from a technical and societal perspective, and showed what makes them new, where they have already been applied,

what products already exist, and what problems and risks under discussion among experts. Then the first discussion block of about one hour took place, facilitated by the moderator according to the participants' inputs and the questions as pre-decided for this block. After a 30-minute break, there was a second discussion block of one hour. In conclusion, the evening was summed up and information was given about the further course of the project. Details on each discussion group and on the question list can be found in the appendix (sections 8.1. and 8.3).

2.4. Information Brochure and talks by experts

The participants did not take part in the discussions unprepared. One month prior to the event, all of the selected participants received an information brochure that was written specifically for the nanotechnology discussion: "Information Brochure: Know Your Nano!" The brochure contains a well-balanced, simply written summary of all important aspects of nanotechnology. In addition to technical information (for example, explanations of the scale and dimensions of nanotechnology and on the technical advances that made nanotechnology possible, the brochure also provided information on where the technology is being utilized and on what products have already been put on the market. The brochure goes on to describe not only the medical and economic promise but also the possible risks of nanotechnologies.

In every discussion round, the participants made reference to the information brochure multiple times. Although the brochure did not mention products by name, a sunscreen, a skin cream, and a pair of sports pants could be identified in the photographs. The participants seemed particularly concerned about the sunscreen pictured in the brochure, which is a well-known and popular product in Switzerland. In any case, the sunscreen was mentioned in every discussion group – either because a participant had used it or because a participant was alarmed to learn that nanotechnology can be found in the most everyday of products.

The introductory talks by the experts essentially refreshed participants' recall of the contents of the information brochure by providing short summaries.

2.5. Strengths of the *publifocus* method...

The *publifocus* method generates qualitative findings: findings on complete strings of argumentation that are typically developed but also on dissent and ambivalence voiced in the remarks of individual persons. The findings also allow conclusions to be drawn about the points that are not understood by the public or that can lead to misunderstandings. With the aid of the *publifocus* method, it is also possible to obtain insights on the range of variation, diversity, and multilayered nature of the opinions and views held by the public on a defined topic.

2.6. ... and weaknesses

Quantitative data can not be obtained using the *publifocus* method. So that the desired lively exchange of ideas can in fact take place, the number of participants has to be restricted to approximately 15 persons per discussion group. This means that the requirements for quantitative analysis of the data and for representative statements are not fulfilled.

2.7. The art of facilitating and evaluating the discussions

In the ideal case, facilitation of the discussion at the *publifocus* events has to meet different, and in part conflicting, demands. For one, the discussions should be guided but not steered in any particular direction. The more skilled the moderator is at adjusting to the flow of conversation and asking the pre-decided questions at the most appropriate time, the more “organically” the discussion will develop. However, this means that the questions can not always be asked in the same order or with identical wording. If, for example, a group answers a question in the negative, the next question on the question list may have to be worded differently than it is in a group that answered the previous question mostly affirmatively.

However, the things that promote the flow of conversation also make analysis of the discussions somewhat difficult. For example, in the different discussion groups, certain arguments were raised in different connections. In the analysis, the different arguments were assigned to the question or the context that was mentioned by the most groups. In order to assure transparency, the table in the appendix provides information how questions

in what discussion group were answered differently by the participants or not asked at all (see appendix, section 8.4).

2.8. Validity range of the method

The report presents the opinions of the participants as could be captured using the *publifocus* method. As mentioned above, *publifocus* is a qualitative approach. This means that results can not be distilled to a set of quantitative-statistical statements, and attention must be paid to the fact that external influencing variables, such as moderators' differing styles of facilitating discussion or also the information as supplied by different experts, can have a strong influence on the course of the discussion. Viewed in this way, each discussion is to be analyzed as a unique event.

The fact that the arguments raised by the participants in the different discussion groups evaluated here in the *publifocus* show remarkable similarities, however, indicates that the views and judgments expressed by the participants may definitely be granted a wider range of validity and applicability. Seen in this way, the present report outlines different stances of the Swiss population on nanotechnology.

2.9. Notes on terminology used in this report

The chosen terminology reflects the fact that *publifocus* is a qualitative method: as a rule, the report does without counting precise numbers of participants' opinions. Numbers are mentioned only in those cases where there are single votes (by one or at most two persons). If a comment or opinion is expressed by at least three and up to one-half of the participants in any one group, we use the words "some" and "several," and if half to two-thirds of the group express the idea or opinion, we use the words "quite a lot," "many," and "numerous".

3. Points of agreement and consensuses

The different discussion events conducted for *publifocus* “Nanotechnology, Health and the Environment” generated a great variety of argumentation and ways of looking at things. Systematic differences among the different discussion groups – in particular, in dependency on the language region – could not be found, however. Instead, there was a remarkable fundamental similarity across the discussions, and all of the discussions developed a wealth of ideas and arguments. It was characteristic that numerous participants brought forward their arguments from a position of feeling personally affected – either as patients hoping for new treatments from nanotechnology (or fearing new dangers arising from same) or as consumers hoping for added value from nanotechnology products (or foreseeing being faced with disposal problems).

Every discussion group put forward identical arguments and concerns – some of them expressed using practically the same wording. The following section describes the points of view and the wants that were shared by all of the discussion groups.

3.1. There is opposition to non-transparent sales strategies

In every one of the discussion groups, several persons express concern that they may have already purchased nanoproducts without realizing it: “To my knowledge, I haven’t used any. But there is the danger that you just don’t know. Or something will be described as a nanoproduct, and it isn’t one,” feared a participant in the discussion in Lugano. Or: “I kept asking myself, what am I using that I don’t know that I’m using? I only heard today about the coatings on food packaging,” said a participant in the discussion group in Winterthur.

Numerous participants in all of the discussion groups agreed that non-transparent sales tactics should not be tolerated. “I asked myself whether I am already using something. Then I looked at the packaging of different

products and noticed that they contain particles. I don't want that and it really bothers me," explained a participant in Lugano. Or: "I would hate to be using something without my knowledge!" The fact that consumers are being faced with accomplished fact with new nanoproducts and, what is more, with nanoproducts that are hidden due to unclear product labeling, is something that numerous *publifocus* participants dislike. In comparison, only a minority voices resignation: "I don't want it for foods. But we probably have it already and we can hardly avoid it," stated one participant at the discussion evening in Bern.

3.2. There is a demand for clear product labeling

In all of the discussion groups there was a unanimous call for declaration of nanoproducts. It was agreed that at least products that contain engineered nanoparticles should be clearly labeled. Opinions differed, however, as to what model declaration should follow (see section 4.3.2.).

3.3. Familiarity with nanotechnology varies, but everyone is affected

The discussion groups also had in common that fact that the participants did not all have the same familiarity with nanotechnology or nanotechnology products. In all of the groups, there were some persons who had never thought about the new technology prior to participation in the *publifocus event*; the TA-SWISS information brochure brought their attention to the topic for the first time. But in all of the groups there were also participants who already had their own experiences with one or more nanoproducts. The most frequently named product was the sunscreen that is mentioned in the TA-SWISS brochure. But a few participants in various groups had purchased clothing or household sprays, particularly waterproofing sprays.

All in all, the group with the greatest number of participants that had never thought about nanotechnologies was the discussion group in the Italian-speaking part of Switzerland. It was here also that no one mentioned having contact with the new technology at work. In the German-speaking (Winterthur) and French-speaking groups (Lausanne), a few participants had at least minimal exposure to nanotechnology through their jobs – whether in industrial manufacturing of products (for example, in Winterthur, the production of oil binders with improved absorption capability thanks to nanotechnology methods) or, in Lausanne, in microtechnology. Quite a lot

of participants – namely, participants in the discussion group in Bern – had come into contact with nanotechnology through purchasing certain products (particularly stain-repellent clothing, sportswear, and household sprays). Also in Lausanne, one participant found herself confronted with the new technology when shopping for a refrigerator, where she found, much to her regret, that all models had nano coatings on the inner surfaces.

But whether they had direct experience with nanotechnologies or not, practically all of the participants were united in that they found the topic interesting – due to concerns about possible consequences, or curiosity, or the feeling that they wanted to learn more about a groundbreaking development setting new technological and economic directions. And two participants in Lausanne explained that they had participated in the *publifocus* event out of principle and civic duty.

4. Arguments based on previous examples

The public has little knowledge or familiarity with nanotechnology. This was shown also by the numerous comments made in all of the discussion groups that confirmed that nanotechnology came to the attention of quite a lot of the participants only through the *publifocus* event, especially thanks to the TA-SWISS “Information Brochure: Know Your Nano!”

In order to judge the unknown, people tend to use arguments by analogy: they fall back on experiences with previous technological innovations. This was the case also in the *publifocus* on nanotechnology: the information brochure on nanotechnology, for example, used familiar objects and examples to illustrate the new technology. The brochure mentions the lotus leaf, which has a nanoscale texture on the surface that causes water to bead, the harmful effects of ultrafine dusts and soot, and the dangers of asbestos.

Independently of the examples given in the brochure, numerous analogies and comparisons with already familiar technologies came to the minds of the participants in all of the discussion groups. These examples were used not only to more clearly grasp nanotechnologies and their potential and risks but also to consider society’s handling of the new technology and the issue of regulation.

Section 4 examines the comparisons that participants drew between nanotechnologies and other branches of technology or with general previous experiences. These comparisons allow us to make a first approximation of various aspects of the public discussion on the new branch of technology; most of these aspects – especially assessment of the promises and risks of nanotechnology and the issue of possible regulation – are examined in depth in sections 5 and 6, independently of any comparisons by example.

4.1. Dealing with uncertainty

In all of the discussion groups, quite a lot of participants express the fear that they may have come into contact with nanotechnology without their knowledge. Here, many participants refer to the numerous things that are unclear about nanotechnology and the lack of experience with the new technology.

4.1.1. Uncertainty: The cell phone example

Like nanoparticles, radiation from cell phones and cell phone antennas are – at least for most people – invisible, and they can not be heard, smelled, or tasted. Participants mention the cell phone, or cell phone antennas, several times as a model for the lack of direct access via the senses to a technology and for the uncertainty felt with regard to possible harmful effects on health. The fear of nanotechnology can be compared to the fear of the cell phone. “You don’t see anything, you don’t really know – and when maybe someday you do know, it’s already too late,” says a participant in Lugano. Or in the same discussion group: “There is the same discussion on the dangers when it comes to antennas or providers. But nobody actually says that the cell phone is harmful – the radiation is much higher there.” “There are studies on the cell phone show that cell phones damage your brain. That could also be the case for nanotechnology,” a participant in Lausanne fears.

4.1.2. Rude awakening after initial euphoria: The asbestos and nuclear power examples

The experience with new technologies up to now leads quite a lot of the participants to a mistrustful assessment of nanotechnology. “I am skeptical. A lot of things were started that were banned fifty years later. The dangers are relatively big,” says a participant in Bern.

As examples of branches of technology that after initial successes resulted in unexpected and unfortunate side effects, participants mention nuclear power and asbestos in particular. “(Nanotechnology) is new – we don’t know much about it (...) That is not necessarily negative. But we don’t know. We have to be very cautious. There’s a parallel here with asbestos, where the problems were recognized only decades later,” says another participant in Bern. In Lugano, a participant comments, “Nanotubes can form fibers, similar to asbestos. Asbestos was greeted with euphoria at first, and the damage was recognized only later. Maybe that will happen with

non-stick pans or the skin creams. Maybe ten years from now, there will be more skin cancer.” One comment made in the discussion group with interest group representatives warned, “The biggest challenge is with the free particles; the problem is also seen with ultrafine powders and asbestos. We can draw parallels here, also with regard to long-term damage that shows up much later.”

In contrast to the asbestos problem, which the participants always use as a negative comparison, nuclear power is taken as a model in an ambivalent sense and in varying contexts. “It’s the same with nuclear energy. What do we do about the problems that we have today? Are we brave enough to give them a higher priority than politics and business?” asks a participant in Winterthur. Another person in Winterthur seconds, “We’re entering a dimension where we have no view; we don’t see anything directly. And we manipulate materials that have a potential, like enzymes and catalysts. That’s like splitting the atom.” And in Bern a participant notes, “Nuclear power and antibiotics were cause for euphoria; we see the consequences only after a very long time. I would be glad if scientists also saw it this way and would conduct their investigations at an early stage.” But another participant, also in Winterthur, mentions nuclear power to point up expressly the difference to nanotechnology: “One risk of nanotechnology could be dangers to health, but they would be locally restricted. You could stop that, which is not the case with nuclear power.” Another comment, from a participant in Lugano, points out the ambivalent character of nuclear power: “Italy decided against nuclear power stations and possibly regrets that today.” There is also a resigned comment that points out the unchanging course of technological development by making reference to nuclear power: “There is maybe an analogy to nuclear power. We had Hiroshima – did we say, we don’t want it anymore? Every technology can have negative consequences, but it can’t be stopped,” a participant in Lausanne is convinced.

4.2. Consequences expected, possibilities hoped for, risks feared

It is practically undisputed among almost all of the *publifocus* participants that nanotechnology will indeed have consequences. Only in one single case does a participant put forward the opinion that the new technology will hardly affect the economy and society: “We will probably just live with it. But the trappings of nanotechnology – the overproduction, for example – will have more consequences than nanotechnology itself.”

4.2.1. Large effect of smallest amounts: The homeopathy example

Almost all of the *publifocus* participants agree that nanotechnology will indeed have consequences. Some of the participants, however, do not want to speculate about the type of effects: “Impacts it has. The question is, whether they are positive or negative,” says a participant in Winterthur. Or, in the words of a participant in Bern: “We know too little. It has to be researched. I think that it will impact the environment, but I don’t know how.”

Some of the participants explain the fact that even the smallest quantities of material can result in big effects, and consequently also the smallest nano-scale particles are not likely to have no effects, by referring to homeopathy or alternative medicine. “When you treat an animal homeopathically, you know that very small interventions will have an effect. That is the reason why we can not actually assess the risks of nano,” says a participant in the discussion in Bern. A comment from Lausanne points in the same direction: “Sometimes you only need traces of a material to obtain a reaction. But they are the smallest of traces. And sensitive people can have a reaction.” In the discussion group in Winterthur, finally, one person changes tack in the argumentation: she hopes that nanotechnology will provide conclusive evidence for the effects of alternative medicine: “I would be interested in whether the use of nanotechnology methods could contribute towards producing evidence for homeopathy. Homeopathy works, after all, at the molecular level. I hope for positive effects,” she says. And somewhat later in the discussion, when she is asked about her visions, she seconds, “It is my hope that thanks to nanotechnology, the evidence can be found for homeopathy.”

4.2.2. Positive potentials: Technologies that make life easier

Some of the participants’ comments mention explicitly the positive potential of technological innovations and rate previous technological developments positively: “I think it’s good that something is happening; we are actually lucky. There was the Industrial Revolution, an information technology revolution – and now we are possibly experiencing the nanotechnology revolution,” a participant in Lausanne is pleased to say. In Bern, also, a positive example of an innovation comes to the mind of one participant, who applies it to nanotechnology: “Yes, I find the use of nanotechnology defensible. The miniaturization trend in computer development was a good thing.” Some participants in the group of interest group representatives also refer to good experiences up to now with technology innovations: “If we look at Malthus, then we see that technology has produced progress. We have to take flanking measures – but in a global world, if we don’t seize opportunities, then

others will.” And finally, a participant in the Italian-speaking part of Switzerland points up the conflicting potentials of the technology: “The internal combustion engine was a great invention. But today, we have problems with traffic. Where will nanotechnology lead us? To something good – which we cannot predict – or do we need more time?”

4.2.3. The risky side of the technology: Chemicals, ultrafine dusts, dying forests

The participants take a greater number of negative examples from the history of technology than positive ones. Here, however, it is often the same persons that refer to multiple bad outcomes in the history of technology. “When I think that in the 1960s people placed so much trust in technology... they said ‘we’ll be independent of nature.’ Technology creates illusions. But remember Thalidomide [Contergan] or DDT. Between 1969 and 1970 there was also no concept in medicine of radiation protection. Then it was discovered that mammograms themselves can cause breast cancer. These things fascinate me, but fill me with a certain amount of fear,” says a participant in Lugano. Somewhat later, she adds, “There is a certain separation to be made between science and application and sales. I feel concern about sales. For there, there is great pressure. Bhopal and Seveso also came about under economic pressure.” Another participant in the discussion in Lugano takes the example of the dying forests to find fault with the lack of oversight by society: “Already in the 1950s it was predicted that the forests would die. First they thought that the bark beetle was responsible, but it is the imbalance of acids and bases in the forest soil. But we knew already in the 1950s that the problems were coming.”

Examples of the dangerous impacts of technology are also mentioned in other discussion groups. Soot and ultrafine dusts are mentioned particularly frequently: “I am worried about engineered particles – somewhat like the problem of ultrafine dusts. If it were to increase – for example, through an accident, that worries me. The particles unite with other materials,” fears a participant in Bern. “Today the talk is diesel soot; before it was smog – weren’t those also nanoparticles? And don’t they have consequences for health?” asks a participant in Winterthur. Participants in the discussion with representatives of interest groups also bring experiences with ultrafine dusts in connection with nanotechnology.

4.3. Examples used for society's handling of nanotechnology

The discussion participants refer to examples of experiences with other technologies not only in order to assess the advantages and disadvantages of nanotechnology. They also find examples and models for society's handling of the technology.

4.3.1. Taking the debate on genetic modification as an example

The group made up of representatives of interest groups, especially, sees genetic modification as a model for society's dealing with technological innovations. "Nanotechnology has come along similar to genetic modification. Back then, the farmer's association formed groups of well-known experts – this raises the question of whether this would also be important to do for nanotechnology," a participant in the interest groups discussion group offers for consideration. Somewhat later in the discussion, she adds – once again referring to genetic modification – "We shouldn't be late starting legislation. We were in part pioneering when it came to genetic modification legislation. But we should begin as soon as possible." Another participant in the same discussion group says: "(Mankind) has never learned enough. But there are sufficient experiences with genetic modification and asbestos that we could learn from – for example, conducting a good dialogue." Another participant in the same discussion group explains that she would like to see "...information gathered objectively, we don't want panic to arise like with genetic modification." Genetic modification is also mentioned in the group in Lugano, but only summarily: "I haven't heard much yet about nanotechnology, and then I learned from the brochure that there are specific products already on the market. I am also interested in the dangers; it's a little bit like with genetic modification, you want to know – for the children's sake."

4.3.2. E numbers, "Bio" label, and clinical trials (drugs)

The participants refer to a number of examples for regulation and declaration measures in the narrower sense. The examples range from warning labels on cigarettes to E numbers for food additives to the "Bio" label for organic products to declaration of genetically modified organisms (GMO) and the clinical trials required for medications prior to placement on the market. Against the idea of enforcing a declaration requirement at the present time, however, it is asserted we do not have the technical and scientific basis for doing so: "First, they would have to jointly define what nano

actually is. Screws have been standardized, for example,” says a participant in Winterthur.

The issue of what form declaration should take is not undisputed. Most of the participants are in favor of transparent sales and purchasing conditions and support at least clear labeling: “You choose a risk: cigarettes, car, alcohol – but you are given a warning when it comes to cigarettes. In contrast, you don’t read anything about nanotechnology,” faults a participant in Lausanne.

Various comments expressly emphasize that simple labels and declarations would be preferable to detailed information in small print. A participant in the discussion group in Lausanne puts the issue as follows: “What is needed is something simple, something people understand. In the United States there are product labels for chewing gum. Even though it is there, 80% of the people don’t know what it is. The label doesn’t protect people. Something simpler is needed – like with genetically modified products. The label has to be simple. The producer could then use it in advertising and explain it.” Another participant in the same group seconds this, saying, “There is the Bio label; we could create an analogous nano label. This could also be positive for the product. Because it would satisfy people to know that they can choose the product knowingly.” The association with the Bio label also comes up in other discussion groups, such as in Bern: “Conceivable is also a nano label, similar to the Bio label. The label could be tied to a catalogue of requirements.” This same speaker says again later: “What we need are not precisely detailed laws but instead general guardrails.”

However, skeptical voices are raised when it comes to all-too detailed labeling. “For food, they introduced the ‘E.’ There were some people that stopped buying anything that had an E number on it,” says a participant in Lausanne, looking back. A participant in Lugano reports the opposite experience: “With the introduction of the ‘E,’ people saw that ‘E’s are in everything – but they kept using the products anyway.” In the discussion group in Italian-speaking Switzerland, some participants doubt the benefits of warning labels and information: “It is often pointed out that many people choose to smoke despite the warning label,” says one. Another participant in the same discussion group says, “I’d like to ask: who knows today what ‘Bio’ actually means? I am not sure that I understand it correctly. On the ‘E’s, too, there is a lack of knowledge. We can’t read everything, we have to trust.” Somewhat later she adds, “Too much information leads in the end to disinformation. Therefore, I say no declaration – that can be paralyzing. That we want to know, that’s clear. But I actually only want to know if it is harmful. Not even what’s in it. But with nanotechnology, we don’t yet know

what the effects are. With all the labeling of ingredients and the declarations, we'll have to take a technical dictionary along when we go shopping." For another participant in this group, reliable controls are more urgently needed than labels and declarations: "Maybe labeling isn't all that important. For me to trust a product, I would have to be able to assume that it has been well tested. I don't need warning labels on my products like the one on cigarettes."

Declaration is therefore a concern of many of the participants, and reliable control is another. Here, again, there are models: participants in the discussion groups in both Lausanne and Lugano mention the clinical trials that must be conducted for pharmaceutical products before they are approved for the market. "It should be handled in the same way as for drugs. Double-blind studies on side effects and so on have to be conducted," states a participant in Lausanne. A fellow group participant, however, points out difficulties: "The analogy with medications doesn't work – since the tests would have to be conducted on every product, because the particles behave differently in different surroundings." Somewhat later in the discussion, a third person in this same discussion group says, "It takes a long time to bring medications to the market. And here, things are just thrown on the market. That's a big experiment in releasing." In the Lugano group also, the idea is voiced that controls following the example of clinical trials for pharmaceuticals, under government oversight, could be a passable way to handle nanotechnology products. In the view of one participant in Lausanne, however, control following the clinical trial model could have economic disadvantages, in that the nanotechnologies could then be in the exclusive grip of larger corporations: "If the controls are handled as with medications, only large corporations could afford it; the trials are extremely expensive; we shouldn't go too far."

5. Potential benefits heavily weighted, risks not argued away

Although the range of opinion was wide in all of the discussion groups, polarized, hostile discussion never arose. On the contrary: the largely undisputed concern for transparent declaration and control created a relaxed discussion climate. Only a very few participants rejected the new technology completely; if it promises solutions to “world problems” or treatment for serious diseases, it seems acceptable to practically all of the participants.

Despite the fundamental goodwill, however, numerous participants voiced warnings. In part, they rejected the use of nanotechnology in specific areas (for example, in food) or warned of unforeseeable consequences for the environment and health. As a guideline for dealing with nanotechnologies, quite a lot of participants recommended step-wise introduction of new products – giving top priority to promotion of those products where the benefits are so great that they outweigh possible risks.

5.1. Potential benefits for medicine, environment, and quality of life

All of the participants in all of the discussion groups can see opportunities and possible benefits of nanotechnology. Medicine is named as a very promising area of application: here nanotechnology could offer new treatment methods and aids. Two examples of the participants’ comments are these: “It is a chance for the ill, for research, in the fight against cancer,” said a person in Lausanne, and in Lugano a participant is of the opinion, “Nanotechnology in medicine, monitored by physicians, suits me fine. But the therapeutic benefit has to outweigh possible damage. Windows that are self-cleaning are also okay. But I’d be really cautious about everything that isn’t of much use. I’d take a reserved stance on foods and cosmetics.”

The participants see further potentials of the new technologies in the area of environmental protection. Various mentions are made in the different discussion groups of more targeted and sparing use of resources and energy. But the participants also list more efficient filtering techniques, possi-

bilities for cleaning and processing water, and new possibilities for generating energy. They also mention possible benefits that nanotechnology may open up for science itself. A comment by a person in the discussion group in Lausanne can serve as an example here: “One of the possibilities is that we may discover new laws of nature. That must be fascinating for young researchers. (It also offers possibilities) for treatment of cancer, diabetes, for better artificial limbs. For photovoltaics. There are also potential benefits for art, new jewelry, new metals.”

The third area of application that numerous participants rate as positive can be described as “increasing the quality of life.” New materials and surfaces make housework easier; people do not need to spend as much time cleaning, and they also profit from more stable materials that, for example, will benefit traffic safety. One person in the discussion group in Bern describes her view of the potential benefits as follows: “(I see potential benefits for) health and well-being, and for materials and surfaces. Glass, for instance, that you don’t have to clean. Then there are also possible benefits in the area of the environment, such as for water processing.” Or, in the words of participant in Winterthur: “Higher personal quality of life – at work, in private life, and in health.”

Finally, the economic promise of the new technology is rated to be high. In the opinion of a number of participants in all of the discussion groups, it could offer opportunities for Switzerland as a center of research and also for Swiss industry and employment: “(Nanotechnology offers a chance) for Switzerland to take advantage of its leading position and to develop innovative products, promote interdisciplinarity. (That’s an) opportunity for products, jobs, and profits,” says one voice in Winterthur. Participants also mention the advantages of nanotechnology for computer science and information technology.

5.2. Potential negative consequences for health and nature

“There’s a good and a bad side to everything” – This saying sums up quite well the way that the *publifocus* participants review the opportunities and risks of nanotechnology. Every area of application for which the new technology could have undreamed of benefits in store proves also to be a delicate matter in the participants’ view.

In medicine nanotechnologies could cause side effects – for instance, if particles were to accumulate somewhere. But more than medical side effects the participants fear direct negative consequences of nanoparticles for human health. Various participants refer to the fact that many people already suffer from allergies – nanoparticles could become a further source causing over-sensitive reactions in the body: “We already have a lot of allergies. If there are more particles, we’ll have new illnesses as well,” fears a participant in the discussion group in Bern. At the personal level, the fear that nanoparticles could cross the brain-blood barrier and enter the brain appears to be the participants’ greatest concern: “The issue of the brain-blood barrier makes me afraid. I had a stroke and had a good recovery. But if that is treated with nano, small vein and capillaries get destroyed. That makes me afraid,” says a voice in Winterthur. A participant in the discussion group in Bern says: “I would be afraid if, instead of through the lungs, it got into the brain directly when you sniffed.” A person in the interest groups discussion round comments: “The idea of buckyballs in the brain makes me afraid.” This concern is shared by a participant in Lausanne: “Do we know what effects the particles have in the brain?” the participant asks of the experts on hand to take questions at the discussion evening.

In all of the discussions, the participants also brought up concern about the environment. The participants do not deny that nanotechnology may have the potential to improve the environmental situation with better filters and ingenious techniques. But the unregulated entry of nanoparticles into the environment is problematic in the view of many of the participants – and they also see possible problems with regard to the disposal of objects containing nanoparticles. “I asked myself, how can you protect yourself if the particles can’t be filtered at all? In large production, there is the question of release of the particles, during disposal, too. After all, there are disposal sites that today themselves have to be disposed of – we didn’t know that when we made the disposal sites,” considers a participant in Winterthur. And the comment is made in Bern: “We have to think about consequential damages, the problem of accumulation, etc. As optimists, we assume that it’s safe. But we would have to also think about the safety of the consequences; during disposal, the silver particles could enter the environment and kill animals.”

The potential economic consequences are also not assessed as only positive. Nanotechnology could result in a drastic reduction in the number of jobs – for instance, in the cleaning business due to self-cleaning surfaces and façades. Some participants in the discussion groups also see a danger in the possibility that Switzerland could lose its lead in nanotechnology de-

velopment. Finally, various participants also find reprehensible the thoughtlessness with which advertising and marketing are using the term “nano.” “(I fear) that the term “nano” is being gravely misused, which could stir up aversion to technology. “Nano” could then hinder the technology,” as a participant in Winterthur puts it. There is a concern among some participants that there is a seductive quality about the term “nano” that could be exploited by marketing specialists to flood the market with unnecessary and ultimately environmentally harmful products: “ridiculous applications for marketing reasons,” or “advertising could force things on us, dazzling us” is the way that two participants in Winterthur describe this risk.

That nanotechnology also has the potential to increase the capacity of information technology, especially storage media, is seen as not only positive by quite a lot of participants in the different discussion groups. Even if potential benefits in the computer area could be utilized in medicine, this could have unpleasant effects: “More diagnosis is not always an advantage, also because of the insurance companies, which would then no longer insure certain things. In computers, miniaturization also brings advantages, but on the other hand, there is the risk of perfect surveillance,” says a participant in Bern. A discussion participant in Lausanne puts it this way: “We can be tracked better; tracking (data tracking) is a problem – the information gathered on consumption behavior. Here there are data protection problems.”

Finally, the possible risk of unequal access worldwide to the new technology is also mentioned. This could once again leave the countries in the southern part of the globe empty-handed. Also mentioned in the different discussions are military applications of nanotechnologies, or the risk that they could be misused by terrorists. A participant in Bern describes the risks that she fears as follows: “It’s diffuse, you don’t see it, and the effects are not yet visible either. It could get into the wrong hands, for example in the military area or nanoterrorism.”

5.3. Separate the necessary from the dispensable

To derive the greatest benefit from nanotechnology, some participants in the different discussion groups propose that we should weigh up what is necessary and what is superfluous. They give preference to nanotechnological innovations that can be utilized in medicine or that benefit the environment. “The risk has to be worth it. In medicine, for example, it is worth it if raises quality of life in old age,” says a participant in the discussion group in Bern. A person in the group of representatives of interest

groups takes a similar view: “We have to ask if it is pressing for a particular product to be available. In medicine it can be pressing. As to other products in other areas, that can wait.” Quite a lot of participants see advantages not only in medical applications but also in the self-cleaning surfaces and products making things easier in the household.

But many of the participants are skeptical when it comes to the use of nanotechnology in foods. “Nano in foods does not increase quality of life,” says a person in the discussion group in Bern. A participant in Lugano suggests: “It is important to see whether products are introduced for commercial reasons or because they are truly useful. If they actually improve the quality of life, then there’s a point. And I want to know what I am buying. I can do without the pizza that changes flavor depending on the temperature of the oven.” In the same discussion group, another participant says: “(We) should (...) do more research on the environment and less in the area of foods – there, there is less benefit.” On this same issue, a participant in Lausanne says that he greatly prefers a good cook over nanotechnologically prepared food. And another participant, in Bern, emphasizes the loss of cultural lifestyles as a risk of nanotechnology: “(There is the risk of) losing lifestyle: you cook differently.”

5.4. Potential benefits slightly outweigh risks

At the *publifocus* event in Winterthur and during the discussion with the representatives of interest groups, the participants were asked to rate potential benefits and risks on scales from 1 (low potential benefits; low risks) to 10 (high potential benefits; high risks).

The weightings in the two groups are in agreement insofar as in both groups potential benefits slightly outweigh risks, whereby ratings on the extreme ends of the scales are the exception (the rating “10” was given to potential benefits three times in the group in Winterthur; there were no ratings of “1”. In Winterthur nanotechnologies were rated somewhat more positively, with an average rating of 5 for risks and 7.2 for potential benefits, than by the group of interest group representatives.

The representatives of interest groups are slightly more skeptical. Their average rating of potential benefits was 6, and the average rating of risks was nearly the same, 5.6.

6. How society should handle nanotechnology

Although in all of the discussion groups there were critical voices expressing reservations against nanotechnology, none of the participants rejected nanotechnology out of hand. Even the most severe critics granted – even if reservedly – nanotechnology certain positive potential outcomes, particularly in the field of medicine.

The comparison with genetic modification was drawn repeatedly, particularly in the discussion group made up of representatives of interest groups. In that group, there were more references to the debate on GM and fewer to the technology of GM itself.

In contrast to the debate on genetic modification, in the *publifocus* discussion groups we did not find people taking clear positions as proponents versus fundamental opponents of nanotechnology.

Transparency – both in the declaration of nanotechnology products and in information on research in this new field – is the most important requirement for the building of trust in the new branch of technology.

6.1. Make use of Switzerland's lead also in the area of regulation

In the debate on genetic modification, opponents agitated for a 5-year moratorium on deliberate release into the environment of genetically modified organisms in agriculture – a measure that was passed by the voters of Switzerland in the fall of 2005. For nanotechnologies, however, that way of proceeding does not seem appropriate in the view of the *publifocus* participants. In none of the discussion groups was a moratorium put forward for discussion – and when asked about this explicitly by the moderator, the participants rejected the idea of a temporary stop on research & development in nanotechnology: “On the contrary; if Switzerland is in a leading position, it can also be a leader in introducing labeling. We shouldn't wait,” says a participant in the discussion group in Bern.

The argument that the lead in research could stand Switzerland in good stead also for exemplary and progressive regulatory measures was made in various discussion groups also independently of any reference to genetic modification: “Since we are already leading, we shouldn’t cut ourselves short,” confirms a participant in the discussion group in Bern, and another person in that group supports this, saying: “In Switzerland education is good – the people should be better informed in order to retain our lead. Switzerland can also become a leader in regulation.” A participant in Lausanne says: “It’s a problem worldwide. We are in a good position; we could be pioneers. We should do something at the global level.”

6.2. Laws or code of conduct?

The majority of participants in all of the discussion groups agree that nanotechnologies require regulation. But some individual voices also point to the self-regulating powers of the market: “The market will decide. The market is the most important. Whether it does any good, the market will decide,” says a participant in the discussion group in Winterthur, and in Lausanne a participant explains: “Part of it is auto-regulation. If people do not buy foods containing nanoparticles, they will disappear from the market. Otherwise, the democratic process works well. That will happen anyway worldwide, and if Switzerland participates, it can have a part in establishing the regulations.” Some voices also speak of the self-responsibility of industry and its interest in safe products: “Companies have no interest in catastrophes occurring, such as allergic reactions,” says a participant in Winterthur, who is also in favor of an industrial code of conduct: “Regulation always comes too late. Companies have to fulfill their responsibility. If a moratorium is decided on, that will happen abroad. A code of conduct is needed.”

But the majority of the participants support control and regulation by government, independent of the industry. In the view of some participants the international, global aspects of the technological development also have to be taken into account: “A law would be Swiss – but what is needed is an overall solution, international control,” says a participant in Winterthur. In Bern, a participant comments: “Supranational works the best. At the least, EU-wide. Regulation in one single country is better than nothing, but supranational works better. If other countries approve nanotechnology, we’ll have the consequences, too, in the end.” Some similar comments are heard in Lausanne: “An international codification would have to be developed

quickly. Together with scientists and the industry. And it would then have to be declared, on the products.”

Finally, a few, isolated persons in various discussion groups spoke out in favor of using and expanding existing legal regulations: “I want to see legal liability regulations,” says a person in Winterthur, and a person in Bern goes this far: “From the beginning, product liability should be established. Then making a law would be superfluous, you could forget that.” Some of the representatives of the interest groups are also of the opinion that the existing legal regulations are sufficient: “People are discussing as if we were standing in a wide open field. But product liability already exists and other regulations, too – the law on foods, the law on pharmaceutical products, etc. At the moment the existing laws are enough. If wholly new particles start being used, then we might have to go back to the books,” says a participant in that group, and another person in the group confirms: “I am convinced that our law on foods is flexible enough that it can cover the nano area. There is already close contact with the authorities and with European organizations. In nature, everything is nano – and if engineered particles came into it, we could cover that, too.”

6.3. Ensure freedom to choose through product declaration

Most of the participants in all of the discussion groups find declaration of nanoparticles indispensable. For in the end, that is the only thing that will ensure consumers’ freedom of choice: “We have to be able to choose. I don’t know if (nanoparticles) have negative repercussions. That’s why I don’t use those products,” says a participant in Lausanne, and another participant underlines: “We don’t know if nanoparticles have positive or negative impacts. But it has to be declared, and over time, we will see. In any case, we can’t trust industry. Control is needed.” A person in Bern comments: “Laws are needed, exposure limits, even, for people exposed at work. And therefore it should also be declared.” In Lugano, too, various participants make the same comment: “There has to be at the least mandatory product declaration. Then at least I’d have the freedom to choose.”

Speaking against early-stage product declaration, it is asserted that too little is known about the new technology at present and that research has to first generate the basis and definitions necessary before declaration can be required. Quite a lot of participants also feel that the issue of meaningful exposure limits can only be resolved through additional research.

In any case, only very few participants believe that self-control by the private economy and producers is sufficient to avert the danger of possible negative repercussions of nanotechnology. Some of the participants even mistrust government regulation, due to interconnections between the private economy and the state: “I have no trust in the government – the chemical industry is too strongly represented there,” says a person in Lausanne. A participant in Lugano is sure that “Government regulatory control does not create trust; the politicians are dependent on the industry. We need scientific commissions that control the information and clarify any dangers.”

6.4. Researchers themselves should provide open information

Only open information that verifies that citizens and consumers are being taken seriously can give people a feeling of trust in the new technology. However, not all communication partners are assessed as equally trustworthy. The researchers themselves are given comparatively a lot of credit. With regard to nanotechnology, it appears that the notion of researchers as magician’s pupils whose creations escape their control is less widespread than it is with regard to genetic modification. In any case, quite a lot of the participants in the different discussion groups make a clear differentiation between research and commercial exploitation of nanotechnology and, accordingly, also demand different regulations for the two areas. “Regulation is needed. The question is how far it should go – as far as personal liability on the part of the researcher? But research shouldn’t come to a standstill,” considers a participant in Bern, and another participant corroborates, “I am in favor of research – but as soon as things go into production, regulation is needed.” A third participants finds: “The label would have to distinguish between natural and manufactured nanoparticles. And as Switzerland is in the lead, researchers have to be relatively free.” “You have to differentiate between science and technology,” says a person in Lugano. “We can’t bring science to a halt, also because a lot of things are discovered by chance, and much of it is good. We can’t stop these advances.” Another participant in the same discussion group shares that opinion: “There is a certain line to be drawn between science and applications and sales. It is the sales market that worries me. There is great pressure there. Bhopal and Seveso also came about under economic pressure. If a certain type of technology is developed and spread, it becomes uncontrollable.”

Consequently, some participants in the different discussion groups speak in favor of the researchers playing a central role in informing the public and in regulating society's handling of nanotechnology. "There would have to be guidelines that emerge from the international network of scientists," is the opinion of a participant in Winterthur. "There is a need for a culture to develop in which researchers tell us what they are doing. I have more trust in the researchers than in slick PR consultants. That would be a part of regulation – not in the legal sense but as a part of the research culture," finds a participant in Bern. A comment in the Lugano group goes in the same direction: "Research (should) be made independent of the industry, Research should be conducted by independent institutes, and the information should be provided to consumers by them."

Comparatively much credit is also given to consumer protection organizations and the media. Some people in the different discussion groups speak in favor of giving the consumer organizations more resources and call upon the media to provide extensive information on nanotechnology to the public. "The government should support non-governmental organizations and scientists, as they work out information," suggest a participant in Lausanne. "We all have responsibility. Consumer protection should be given a lot of power. And the government must monitor the development, with commissions," says another participant in the same discussion group.

6.5. Create trust through transparency and independent research

The fact that nanotechnology is being developed in a global environment raises mistrust in some of the participants. All too easily, negative consequences of the new technology could weigh heavily on everyone, without the guilty parties being named and called to account. "If the planned and existing mechanisms worked well, we would have the persons responsible. But today, they can flee to Guadeloupe. Take, for example, Swissair, which went bankrupt – nobody was punished," recalls a participant in Lugano. In the same discussion group, another person explains: "In globalization – which in my opinion is a step backwards – big multinational corporations shouldn't be allowed. I can't look them in the eye. If I can't accuse someone of their errors, then I have no trust." That trust is ultimately an issue that in a certain sense seems almost personal – and that economic enterprises that have an individual face can certainly be rated as trustworthy is voiced by a participant in Winterthur: "Nano is justified, if it contributes towards saving energy and materials – also when washing dishes, etc. And also, if

foods keep fresh longer or are kept free of bacteria due to coatings with silver particles – than I am in favor. As to the sunscreen: I trust the Spirig Company and I weigh nano against skin cancer.”

The reservations that some participants express towards industry-supported research are reflected in the demand that independent, government research should be more strongly supported. “I expect of nano no clean bathtubs and no self-cleaning underpants, but it could offer solutions to big problems, if the research comes from the government. The industry wants to sell products – it is moving ahead at full throttle. In contrast, government research should focus the research on the big problems,” demands a participant in Bern. “Research should not be conducted exclusively by the industry; it should be independent research,” says a participant in Lugano. Another person in the same group seconds, “In all dynamics it is so that if someone shrinks back, somebody else takes his place. Here’s where the problem lies: Parliament has cut back research funding – and this pushes the industry forward. Spending for government research should be strongly increased. Then we could be somewhat more at ease. That means that we should not always want to take away more funds from the government.”

6.6. Visions: Swiss Silicon Valley or global Big Brother?

When asked about their visions, the *publifocus* participants paint a mixed picture of nanotechnology. Frightening scenarios imagine nanoparticles becoming autonomously self-replicating and defeating the human-machine barrier. “You start to feel apprehensive when you think of foods or the human-machine. That makes you afraid,” says a participant in Bern, and a participant in Lugano fears, “(The biggest danger is) that with nano a ‘super race’ will emerge that keeps all others as slaves.” Also seen as threatening is the vision of police state employing nanotechnology-supported total surveillance.

In the positive future scenarios, nanotechnology appears as a basis for a healthy life, a prospering economy, and the solution of environmental problems. “It would be fantastic, if nano could fulfill some of its promises. There would probably also be developments that we can not yet even imagine. Switzerland could become a little Silicon Valley,” hopes a participant in Winterthur.

But when asked about their visions, several of the participants also gave pragmatic responses – with looks to the future that are shaped by previous experience. “The question about my visions makes me think of Mani Matter’s song “dass si Hemmige hei” [that they have inhibitions]...,” says a participant in Winterthur. Another person in the Winterthur group says: “My vision is that the conditions of life can not change that rapidly. We are a throw-away society; so many jobs depend on that. Nanotechnology will not change that very soon.” Some of the participants’ visions can be called pragmatic, as they derive suggestions for the practical handling of nanotechnology from everyday experience: “Nanoproducts would have to be taxed, with the money used for informing the public and for testing. Or for control” – is a suggestion of this type made by a participant in Lausanne.

6.7. The most various interests were represented in all of the groups

In addition to the regional groups in Winterthur, Bern, Lausanne, and Lugano, where the participants were selected so as to be as diverse as possible in terms of age, education, occupation, and sex, a fifth *publifocus* group was made up of representatives of interest organizations and associations concerning nanotechnology. The participants in this group represented various economic and industry-related organizations, labor unions, food and farmers’ associations, and consumer and environmental organizations. Some of the participants in the interest organizations group specifically mentioned that their associations have not as yet decided on strategies or taken fundamental positions on nanotechnology. It seems, therefore, that examination of the new branch of technology is just getting underway also in professional organizations.

The lines of thinking brought forward in this discussion group were hardly any different than the thoughts expressed by the citizens in the four regional discussion groups. At the most, they may have weighted the policy dimension somewhat more strongly; none of the other groups mentioned the debate on genetic modification as frequently (this was in regard to society’s handling, or legal regulation, of GM and not the technology itself). Or, to put it another way: also in the regional discussion groups the whole spectrum of interests was represented, so that in all of the *publifocus* discussions, the entire range of argumentation was raised, from ecologically oriented opinions to pragmatic/practical explanations.

7. Conclusion: Differentiated reactions on basis of feeling personally affected

Nanotechnology is not yet a very concrete topic in the public discourse. This is not very surprising, insofar as much is also unclear to the professional experts, the authorities, and interest organizations. Nevertheless, the *publifocus* on nanotechnology conducted by the Centre for Technology Assessment (TA-SWISS) shows that social dialogue on new technologies is of value at an early stage in the development of a technology: citizens are indeed in a position to engage in differentiated discussion on novel branches of technology and to develop proposals on how they should be handled – even before professional experts are of the opinion that all definitional fuzziness has been clarified.

For the public, being personally affected is a decisive motivation to participate in the technology debate. In *publifocus* “Nanotechnology, Health and the Environment” many of the participants draw their arguments from their direct experience as patients or as consumers. They hope that nanotechnology will provide new solutions for urgent problems in medicine and in protection of the environment, and they also see simplification of household tasks as a potential benefit of the new technology. On the other hand, they worry about possible detriments to health and environmental damage caused by manufactured, free nanoparticles, particularly during the disposal phase of nanoproducts.

The *publifocus* participants take a skeptical view of nanoparticles in foods; in this area possible advantages of the new technology seem to them hardly likely to outweigh the risks.

Seen overall, the participants take mostly a critical-positive view of the new technology. Even the participants that express skepticism do not reject the novel branch of technology out of hand – on the condition that it contributes towards solving truly urgent problems in (world) society. However, the overwhelming majority of the participants are not willing to purchase nanotechnology products unknowingly: they make an urgent plea for product declaration, and many participants demand the establishment of bind-

ing regulations. The participants also mention transparency and information as important prerequisites for the development of trust in the new technology. Here they clearly give more credit to research – in particular, independent, publicly funded research – than to industry-funded research or the promises of corporate PR and marketing. There was no demand for a moratorium on nanotechnology in any of the discussion groups. On the contrary, some of the participants are convinced that Switzerland should expand its leading position in nano research, not least in order to utilize its economic potential for Switzerland as a center of research and industry/employment and to also take the lead in risk research and issues of regulatory control.

8. Appendix

8.1. The discussion groups

Discussion group	Date	(Invited) / Participants	Sex women / men	Age	Education, occupation (where reported)	Memberships (where reported)
Winterthur	1 Sept 2006	(18) / 17	6 w 11 m	31 - 40: 5 41 - 50: 4 51 - 60: 5 61 - 70: 3	Computer specialist, travel agent, teacher, pilot, social scientist, physician, student, laboratory technician, process metals engineer, hairdresser, sales manager, self-employed, sales director, company director, social worker	Firefighters, WWF, Pro Natura, Greenpeace, ski club, Triathlon Club, FDP
Bern	6 Sept 2006	(17) / 13	7 w 6 m	21 - 29: 1 31 - 40: 5 41 - 50: 1 51 - 60: 4 61 - 70: 2	Physiotherapist, salesperson, building envelope foreman, commercial clerk, swimming teacher, farmer, chauffeur, teacher, social pedagogue, IT project manager, nurse, biologist, construction foreman	Professional organization, ice hockey association, traditional costumes group, water sports club, nature and bird protection, SD, Bio Buure [organic farmers], environmental protection association, Toastmaster club
Lausanne	7 Sept 2006	(17) / 11	6 w 5 m	31 - 40: 4 41 - 50: 2 51 - 60: 3 61 - 70: 2	Lawyer, occupational therapist, hotel business employee, business school, architect, laboratory technician, hotel manager, researcher (engineer), mechanic, tailor, practitioner of alternative medicine	Association suisse bioéthique, Blé pain prochain, S.P.A., MENSA, Institute of electrical and electronics engineers, Centre prévention et santé
Lugano	19 Sept 2006	(15) / 12	5 w 7 m	31 - 40: 4 41 - 50: 3 51 - 60: 3 61 - 70: 1	Commerciale, Impiegata di commercio, Segretaria di direzione, Docente, IT Manager, Contabile, Programmatore, Impiegato Funicolare, Venditrice, CFC Agricoltura	Società Federale Ginnastica, Partito Socialista, PLR, ATED
Interest organizations and associations	25 Sept 2006	(33) / 16	6 w 10 m	No information reported	Associations: consumer protection (3), industrial, diverse (5), economy (1), labor union (1), farmers' association (2), environmental protection (1)	No information reported

8.2. Evaluation of the feedback forms

Overview

Total response rate 62%

	Number of feedback forms distributed	Number of completed forms sent back
Winterthur	17	11
Bern	13	6
Lausanne	11	9
Lugano	12	7
Interest organizations	16	10
Total	69	43

1. How do you rate the quality of “Information Brochure: Know Your Nano?,” which you received in advance of the *publifocus* event?

	Very good	Satisfac- tory	Insuffi- cient	Very bad	No re- sponse
Winterthur	9	2			
Bern	4	2			
Lausanne	8	1			
Lugano	5	2			
Interest organizations	5	4			1
Total	31	11	0	0	1

Respondents' comments on question 1

In the respondents' comments, positive feedback predominated; some of the comments spoke for distributing the brochure and making it available to the wider public. Isolated comments complained that certain aspects are covered too briefly (for example, the brochure lacks historical information on the development of the technology) and that the brochure lacks a global view (North-South relations).

2. Is the content of “Information Brochure” well-balanced?

	Yes	No	No response; Don't know
Winterthur	10	1	
Bern	5		1
Lausanne	7	2	
Lugano	7		
Interest organizations	7	1	2
Total	36	4	3

Respondents' comments on question 2, (If your answer is “no,” on what points was the content not well-balanced?)

Here complaints were made that social aspects missed out; also missed were voices from abroad; and one comment expressed the wish that some thoughts on the interdisciplinary, or multidisciplinary, nature of the new branch of technology had been presented.

3. How do you rate the first introductory talk (on technical aspects)? Was it:

	Easy to understand	Sufficiently easy to understand	Not easy to understand	Impossible to understand
Winterthur	8	3		
Bern	4	2		
Lausanne	4	5		
Lugano	4	3		
Interest organizations	8	2		
Total	28	15	0	0

Respondents' comments on question 3

In the German-speaking part of Switzerland, the expert who gave the first talk was given a very positive rating; one person, however, missed more detailed explanations on the networking of scientists. One person in the French-speaking part of Switzerland complained about the language competency of the expert; one person in the Italian-speaking part of Switzerland thought that the talk was too little precise.

**4. How do you rate the second introductory talk (on social aspects)?
Was it:**

	Easy to understand	Sufficiently easy to understand	Not easy to understand	Impossible to understand
Winterthur	9	1		
Bern	1	4		
Lausanne	7	2		
Lugano	6	1		
Interest organizations	8	2		
Total	31	10	0	0

Respondents' comments on question 4

The second talk was also rated positively; it was said to show humor and clarity; one person, however, complained that there was not sufficient weighing of interests. The second talk received much praise also in the French-speaking part of Switzerland, except for one person, who found that nanotechnologies were depicted too advantageously.

5. How do you rate the moderator? Overall and during the discussions, was he/she:

	Very good	Good	Rather unsatisfactory	Unsatisfactory
Winterthur	8	2		
Bern	2	3		
Lausanne	9			
Lugano	3	3		1
Interest organizations	3	6	1	
Total	25	14	1	1

Respondents' comments on question 5

The moderator received mostly good ratings – a respondent from the French-speaking part of Switzerland commented that she was elegant and cheerful, for instance. One critical voice in Lugano commented that the moderator too often gave the floor to the same persons. One of the people in the interest organizations discussion group commented that the moderator had somewhat of a know-it-all manner.

6. Could you speak your opinion during the *publifocus* event?

	Yes, every time that I wished to	Yes, in part	No, not really	No, not at all
Winterthur	9	1		
Bern	4	1		
Lausanne	7	2		
Lugano	4	3		
Interest organizations	10	0		
Total	34	7	0	0

Respondents' comments question 6, (If your answer is "no," why couldn't you speak your opinion?)

There were complaints that in Lausanne a few participants had nearly monopolized the discussion. But another person in the Lausanne group commented that the moderator had responded attentively to all of the participants.

7. Has your opinion on nanotechnology changed since June, when you signed up for the *publifocus* event?

	Yes	No
Winterthur	5	5
Bern	1	4
Lausanne	5	4
Lugano	1	6
Interest organizations	1	9
Total	13	28

Respondents' comments on question 7, (If your answer is "yes," how has your opinion changed?)

Here, a considerable information gain was mentioned the most ("my knowledge changed"). Changes of opinion in both directions were reported – some respondents said that they had somewhat less fear; others reported having more fears.

8. Further comments by the respondents on *publifocus*

Several respondents gave *publifocus* high praise as a participatory method: they said that the discussion had been quite objective and constructive. Quite a lot of the respondents appreciated the organization. Some persons expressed the hope that the report would report the core ideas from the discussions accurately. One person (from the interest organizations discussion group) raised the question of whether a written questionnaire would not have been possible and possibly more efficient.

8.3. Question list (guide for the moderator)

Goal, topics, and questions

The goal of the discussions is to allow the participants to assess the current situation and describe the desired situation. This will yield an outlook on the desired development of the technology. The participants should give us their assessments of the current situation and on future development and communicate and describe to us their open questions, hopes, and concerns, in particular with regard to the further development of the technology. Participants should always answer the questions from their own personal viewpoints (not standing in for anyone else).

The following questions have been grouped by topic to aid the moderator, should the discussion need structuring, and in order to ensure that the moderator does not forget to ask any of the pre-set topics and questions. The order in which they are discussed is up to the moderator, who will decide according to the course that the discussion takes and the mood of the participants.

The questions in bold typeface below must be asked by the moderator and answered by the participants. The other questions will help the moderator to deepen the discussion, where needed, and to steer the discussion, should the participants not do this themselves.

(Questions in italic typeface are questions that should be asked only of the discussion group of representatives of interest organizations.)

A Participants' connections to nanotechnology

- 1. How does nanotechnology affect you personally? What contact have you had with nanotechnology?**
(How is your association / organization affected by nanotechnology? Does your association / organization already have a strategy or position on nanotechnology?)

Goal: Capture participants' backgrounds with regard to nanotechnology and whether and how they are personally affected by nanotechnology.

B Products and everyday applications

2. What nanoproducts do you know of?
3. **What nanoproducts do you yourself use? What nanoproducts do you not use?**
(What nanoproducts do the members of your association produce or process, or what nanoproducts give rise to discussion in your association / organization?)
4. What products might you use – and what products would you never use?

Examples for the moderators: fabrics / clothing, cosmetics, household products, foods, and medications with nano (nanoparticles or nano engineering)

Goal: Capture whether and what nanoproducts the participants know about, what nanoproducts they use in daily life, and what nanoproducts they have never heard of. *(Capture what interest organizations have contact with what products (production, trade, protection, etc.)*

C Effects of current products on health and the environment

5. **What do you think: Do these products (or the nanoparticles that the products contain) affect health?**
6. **Where do you see possible effects of these products (or the nanoparticles that the products contain) on the environment (soil, air, water)?**

Examples for the moderator: nano fabrics / clothing (worn next to the skin), nano cosmetics, nano household sprays (applied to the skin and/or inhaled), nano foods, nano medications (ingested), nanoparticles from sunscreens in lakes or rivers (food chain, entry into the environment).

Goal: Capture participants' knowledge about and attitudes towards possible impacts of today's products and applications.

D Opportunities and risks, regulation and declaration

7. **What is your estimate of the ratio of opportunities to risks of nanotechnology? List opportunities and risks.**
8. What advantages make up for what risks? (What risk would you accept for what advantage?)

9. **In your opinion, do we need new regulation/control or legal foundations for nanotechnology products and applications?**
10. **What should regulation/control involve, what not? Who should make the decision on the issue of product declaration?**
11. What do you think about product **declaration**? (general, according to product, required, voluntary)

Goal: Capture how participants assess opportunities and risks and what advantages make up for what risks. Find out what forms of regulation/control and/or declaration the participants want.

E Trust and mistrust and future development

12. **When you weigh the advantages and disadvantages: Is the use of nanotechnology justifiable? If the answer is (more) yes, where is it most justifiable? If the answer is (more) no, where should it definitely not be used?**
13. **Who should be involved in the policy debate and decision-making process on the further development of nanotechnology?**
14. What creates trust and mistrust?
15. In what areas should research be increased? In what areas should the development not be supported?

Goal: Nanotechnology is a new technology. New technologies always offer hopes and risks, and a way must be found to handle them. Capture participants' trust in or mistrust towards nanotechnologies. Capture participants' assessment and description of the advantages/risks ratio.

F Products and applications in the future (visions)

16. **What will the future bring? What new products do you see on the horizon? What new visions raise hopes, and what new visions raise concerns and reservations?**
17. On a scale from 1 to 10, how great are your hopes? On a scale from 1 to 10, how great are your concerns and reservations?

Possible examples for the moderator: cancer treatments, nano implants, construction of nerve cells (paralysis treatment), fabrication of artificial bone using nanotechnology, novel energy systems.

Goal: Capture what future applications and visions of nanotechnology the participants have heard of and what they think of them; what triggers hopes and what raises concerns and reservations?

8.4. Analysis of the *publifocus* discussions: Compilation of the arguments

The table below provides an overview of the participants' arguments in the different *publifocus* discussion groups. Whenever possible, each response or argument was assigned to the question with which it was directly connected in the course of the discussion. However, the analysis had to take into account that some of these arguments and responses were voiced in connection with different questions. Where possible, these were not listed under multiple question blocks but listed under the question that overall most frequently triggered the response or argument.

The information in the table does not say anything about the frequency of the individual responses/arguments. What is noted (indicated by X) in the table is only that the response or argument was made in the individual discussion groups. No distinction was made between whether a response was made by one individual or by several participants. Quantitative counting of the responses does not make sense not only due to the small number of participants but also because the "dynamics" of the discussions and the style of facilitation by the moderator varied widely.

(Question) Argument	Winterthur	Bern	Lausanne	Lugano	Interest gr.
What are the participants' connections to nanotechnology?					
None; never had occasion to come in contact with nanotechnology				X	
Only through the Information Brochure	X	X	X	X	
Interest, because everybody has heard of it except me; interest in the unfamiliar; curiosity	X	X	X		
Interest, because it is about the future				X	X
My job has something to do with nanotechnology	X	X	X		X
I have already purchased nanotechnology products (sealants, clothing, cosmetics...)	X	X			
I have read articles (besides the TA-SWISS information brochure), heard reports in the media		X		X	X
Friends, relatives, colleagues, or related branches have something to do with nanotechnology		X			X
Learned about nanotechnology at school				X	
Scientific interest, "not knowing" (how would toxicological tests be conducted?), inquiry (looking things up)		X			X
Interest in the product life cycle, including disposal	X				
Interested in employee protection, protection against harm – parallels to asbestos	X				X
Brought to my attention through inquiries					X
Interest, because the products sound interesting/promising: "windows that you do not have to clean"	X				
Question of risks, became alert due to previous technology experiences (nuclear power, asbestos)	X				X
Interest in whether nano can be used in medicine / interest in whether nano alternative methods are effective	X				
Legal interest, confronted with the topic in connection with consumer protection organization			X		X
Interest in <i>publifocus</i> method; duty as a citizen to participate			X	X	
Fear of dangers (giving example of ultrafine dusts)			X		
When purchasing products (in part: confronted with lack of freedom to choose (refrigerators))			X		X
Indirect connection, as food producer		X			
What nanoproducts have the participants already used, and what products would they use?					
None				X	X
Unclear, because unknowing use possible	X		X	X	
Sunscreen	X		X	X	X

(Question) Argument	Winterthur	Bern	Lausanne	Lugano	Interest gr.
Sports clothing, fabrics	X	X	X		
Bicycle helmet	X				
Water-resistant product, waterproofing product, sealants	X			X	X
Tires (in the conjunctive tense: I would use them if they were safer)			X		
In pharmaceuticals (nanotechnology is a good thing)					X
Solar cells, Grätzel cells	X				X
Glass coatings	X				X
Dental fillings, other medical applications	X	X			
What would the participants not purchase, and what do they find extremely problematic?					
Nanoproducts in food production: categorical no, also for longer shelf-life	X	X			
Nanotechnology modified foods		X			
Nanotechnology in weapons				X	
Nanotechnology for a police state					
Opportunities of nanotechnology					
Materials research, new materials and surfaces, new building materials	X		X		
Medicine (artificial limbs/materials, treatments, targeted/more sparing use of medications)	X	X	X	X	
Less costly diagnostic methods for the countries of the South			X		
Consumer goods applications	X				
Switzerland as a center of research, technological leader	X				X
Exciting research, fostering interdisciplinarity	X		X		
New scientific findings, new molecules					X
Innovation and jobs, economic growth	X	X			X
Better use of energy and raw materials, new sources of energy	X	X	X	X	
Greater convenience, less cleaning in the household, saves time	X	X		X	
Longer shelf-life of products	X				
Novel methods of finding evidence for alternative medicine (homeopathy, among others), new scientific findings	X	X	X		
Replacements for harmful products		X			
Information Technology		X	X		
Traffic safety		X	X		
Water cleaning and treatment		X			
Bactericidal effect			X		
Environmental protection				X	
Reducing costs (more targeted use of materials)					X
Switzerland can be pioneering, also in the regulation of nanotechnology		X	X		
Risks of nanotechnology					
Overestimation of the technology	X				
False product declarations, deliberate misuse of the nano label, risk of manipulation	X	X			

(Question) Argument	Winterthur	Bern	Lausanne	Lugano	Interest gr.
Excessive demand on science, loss of image	X	X			
Opportunity loss, technological-scientific	X				X
How handled by insurance companies					X
Loss of cultural lifestyle, such as eating habits		X			
Nutritional dangers			X	X	
People dazzled by advertising, creation of non-genuine needs, artificial markets	X	X	X		
Loss of / destruction of jobs		X		X	
Misuse, terrorist and military uses, can "get into the wrong hands"	X	X	X		
Not having the technology under control, humans serving as guinea pigs	X				
Medical side-effects (for example, if nanoparticles accumulate)	X		X		
New medical problems, danger to health, new allergies		X	X	X	
The engineered combining with the natural; merging of human-machine			X		
Disadvantages due to greater computer storage capacity: "police state"	X		X		
No one bears responsibility, unclear responsibility, no guidelines	X				
Nutritional dangers	X				
Polarization of society, highly equipped elites, countries if the South have no access	X		X	X	
Too much diagnosis, pressure on parents-to-be (prenatal diagnostics)		X			
Too few independent researchers	X			X	
Not yet foreseeable consequences, unimagined and unexpected consequences	X				
Loss of human identity		X			
Dangerous molecules					X
Isolated nanoparticles in the environment, transfer of particles, effects on ecological balance, pollution	X	X	X		X
Disposal problems, difficult recycling			X		
Is regulation needed – and if yes, what form?					
Too early for regulation, we know too little, more research needed first					X
Too much information is available anyway, no one pays attention, can also misinform				X	
For now, the existing laws suffice					X
A (global) law is needed	X	X	X		X
A law that can be continuously updated is needed		X			
Guidelines are needed, not detailed laws		X			
International control is needed	X				
Guidelines from the scientists themselves are needed, as a part of the research culture, self-responsibility	X	X	X		X
Code of conduct is needed	X	X			
Liability regulations are needed	X	X			X
Product declaration, mandatory declaration is needed	X	X	X	X	
Exposure limits are needed	X				
Clear definitions are needed	X				X
Approval process is needed					X
Something simple is needed, not complicated declaration – something like the Bio label (or GMO)		X	X		

(Question) Argument	Winterthur	Bern	Lausanne	Lugano	Interest gr.
Double-blind trials are needed (as in medicine)			X		
Regulations should be established for all technologies, not only nanotechnology	X				
Privacy protection necessary					X
The public must be informed	X		X		
Regulation is needed that does not bring science to a standstill		X		X	
Regulation that distinguishes between the necessary and the superfluous is needed				X	X
Who should bear responsibility for the further development of nanotechnology?					
Scientists, scientific institutions	X			X	X
Commissions of experts		X	X	X	
Ethical councils	X				
Politicians, elected representatives of the people	X		X		X
Insurance companies, SUVA (independent, non-profit company under public law, provides compulsory accident insurance)	X				
Informed citizens, citizens' groups, consumers		X		X	
The market ("The market will decide") / auto-regulation	X		X		
Institutions that provide information; journalists; independent institutions	X		X		
Consumer protection organizations			X		
The industry, the chemical industry		X			
Private economy, private economy associations		X			
"The people who are involved in the usual democratic processes"			X		
"All of us"					X
Is the use of nanotechnology justifiable?					
Clear yes	X				X
It depends, the criterion is benefit	X				
Yes, if the risks are examined	X				
Yes, if exposure limits are established	X				
More no than yes, improvement of quality of life is not on the horizon		X			
Not in foods	X	X			X
Yes, because the level of education in Switzerland is high		X			
Depends on the goals and on who is using it				X	X
What would create trust in the new technology?					
Broad support by government, the private economy, and the public		X			
Government control does not create trust, because too many dependencies on the private economy				X	
Scientific commissions				X	
Good information and communication				X	X
Not confronting the public with <i>faits accomplis</i>					X
Clearly designated those responsible; regulating responsibility				X	

(Question) Argument	Winterthur	Bern	Lausanne	Lugano	Interest gr.
Openness, declaration, regulation				X	X
Taking the public seriously					X
What visions do the participants have?					
Unforeseeable things could occur			X		
Tax nanoproducts in order to finance information and testing			X		
That using nanotechnology you could light up the entire city of Winterthur; society using resources sparingly	X				
Hope that the researchers "have inhibitions" ... (well-known song title)	X				
Sensible use worldwide, without misuse	X				
Switzerland becomes a little Silicon Valley	X				
Good research funding, also for "eccentric types"	X				
Interest and engagement in the development by a large part of the public	X				
That we have it under control	X				
Conditions of life do not change, also not with nanotechnology. We are a "throw-away society"	X				
Great hopes, relatively small concerns		X			
Challenges that we can match ourselves against		X			
Perhaps life without pain and a better environment		X			
Solution of big problems, if the research comes from government		X			
Companies' have greater sense of responsibility; consumers exercise control; that gives hope		X			
Social scientists should be a part of the expert commissions		X			
Better uptake of nutrients through nanotechnology					X
Good opportunities for reducing costs, materials savings					X
Cancer treatment options					X
Job creation due to nanotechnology (that makes up for lost jobs)					X
Frightening scenario: nanoparticles reproduce themselves, nanotube lungs, if they are inhaled...				X	X
Horror vision: electronic surveillance of all people					X
Horror vision: human-machine		X			
New materials, steel from cobwebs					X

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