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# Public Engagement and Risk Governance of Nanotechnologies- revolution or illusion?

## A COMPARISON OF RISK DIALOGUES IN AUSTRIA, SWITZERLAND AND THE UNITED KINGDOM

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**Abstract**

Public engagement in risk communication concerning controversial science and technological issues, such as nanoscience and nanotechnologies (N&N), has become increasingly popular over recent years. Particularly in the case of nanotechnologies, several governments, the European Union (EU) and international organizations such as the International Risk Government Council (IRGC) emphasize the importance of involving the public in the risk communication process. N&N are still in an early state but it is the first time in history that an emerging technology such as N&N has been accompanied by so many public dialogues. Therefore, in literature nanotechnologies are often seen as a test case for so called 'upstream engagement' - a new form of participation where the public is involved in an early stage before final political decisions are made. Countries such as Switzerland (CH) and the United Kingdom (UK) already have a long tradition of engaging the public to discuss possible impacts of emerging technologies. In Austria (A), public dialogues to discuss science and technology (S&T) development are not a common practice. This study analyses public engagement (PE) efforts around N&N in the UK, CH and A by asking three main questions: (i) What is the motivation to involve the public in the risk communication process about N&N?; (ii) Which practices are common in CH, the UK and A?; and, (iii) How can public engagement be measured? The aim of the study is not only to demonstrate and evaluate which methods and tools are used in the three selected countries, but also to identify PE efforts around N&N among countries.

Comparing the three countries the study concludes that compared to A, in the UK and CH, significantly more public dialogue and PE efforts with N&N took place, what doesn`t necessarily mean better PE. Methods such as consultations, information events, workshops and educational web pages are the most common tools used for engaging the public with N&N. However, most of these practices are characterized by one way communication flow and a low level of public engagement. The study found that most of the PE activities around N&N did not directly involve citizens in decision making and there was no direct political output.

Key words: Public engagement, upstream engagement, public understanding of science, nanoscience and nanotechnologies, risk governance, Austria, Switzerland, United Kingdom

*The*

*environment shapes individuals,*

*Individuals shape the environment,*

*technological invention shape the environment and individuals.*

*Nanoscience and Nanotechnologies*

*Will shape the environment and individuals,*

*and, as a consequence:*

*the identity of a*

*Society.*

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# 1. Introduction

*"The future of Nanotechnology: We need to talk" (Nanologue,2010, p.1)*

The range of applications of nanoscience and nanotechnologies (N&N) is very diverse and promising. Some scientists and researchers call N&N a key technology for the 21st century and forecast that it will have a profound impact on our society. On the one hand, this new technology has an enormous potential to create new and innovative products, improve medical healthcare and advance technological leadership. On the other hand, there are uncertainties and lack of knowledge about environmental, health and safety exposures arising from nanomaterials throughout their life cycle (CRO Forum, 2010). The International Risk Governance Council (2006) indicates that at the present time, the public does not have a strong awareness of the potential benefits and risks of nanotechnologies. In order to build trust between governments, businesses, academics, organizations and civil society, an open dialogue with the public is necessary (International Risk Governance Council, 2006, p. 32). During recent years, it has become increasingly common practice to involve the public to discuss controversial science and technological issues. The European Commission, in particular, is committed to promote public debates on N&N and believes that public policies need to be responsive to evolving public opinion (Schomberg & Davies, 2009). In the European Union, there is a wide range of different approaches and projects aiming at supporting public dialogues around N&N. Countries such as the Netherlands, Denmark, Switzerland and the United Kingdom already have a long tradition and experience in public engagement practices. (Sciencewise-ERC, 2010). Particularly in the case of N&N, different forms of dialogues about possible risks and benefits of this new technology have taken place.

What are the expectations and motives for political institutions, private organizations and the science community to foster public dialogues around N&N? What is the outcome of such dialogues? Do they aim to increase acceptance and trust of the general public in order to avoid refusal? Or, do they help to foster a critical debate about controversial science and technological issues? In the relevant literature, there are conflicting opinions about successful public engagement practices, particularly because there is a lack of clear definitions of how public engagement should be organised (Rowe & Frewer, 2004; Delgado, Kjolberg, & Wickson, 2010). It is the first time that emerging technologies such as N&N has been accompanied by so many dialogues (Hauser, Gazsó, & Kaiser, 2010). It is valid to state that N&N represent an important test case for public engagement practices, also called "upstream engagement" (Pidgeon & Rogers-Hayden, 2007).

## 1.1 Research question and outline of the study aim

By analysing public engagement practices in the United Kingdom (UK), Switzerland (CH) and Austria (A) I want to contribute to the current debate about public engagement with N&N and want to answer the following research questions*:*

- What is the motivation to involve the public in the risk communication process about nanotechnologies?
- Which practices are common in CH, the UK and A?
- How can public engagement be measured?

In this study I aim to provide insights into different public engagement practices, their advantages and disadvantages and enable a means to evaluate PE practices in the UK, CH and A. Although information events such as conferences, workshops, lectures and public hearings as well as online education portals or web blogs are not typically 'public dialogues', these engagement methods are also included in the discussion because they improve public access and understanding of N&N and also emphasise a dialogue between scientists, politicians and the public.

First of all, I will introduce the reader to N&N by providing historical background information and giving some examples of areas of applications, potential risks and benefits of this technology. Furthermore, I will investigate the theory of public engagement (PE) and risk governance. I will answer the following question: What has been done at the European level and what is the motivation to promote 'upstream engagement' from a political and scientific point of view? In the following I will describe the special case of risk governance of N&N and I will try to figure out why it is becoming such an essential tool in risk communication policy. In the third chapter I will explain the methodological approach used for the empirical analysis. Part four of this study is the country by country analysis of public dialogues and PE efforts with N&N such as: consultations, citizen juries, web blogs, workshops, conferences, etc. in the UK, CH and A. The last part of the study is the comparison of PE efforts around N&N between the countries.

The following table illustrates the research process.

**Table 1: Research Process**

| Research Question | Methodology | Chapter/ section |
|---|---|---|
| What is the motivation to involve the public in the risk communication process of nanotechnologies? | Literature review and qualitative expert interviews | 2.2<br>2.2.1<br>2.2.2<br>4.3 |
| Which practices are common in Switzerland, the United Kingdom and Austria? | Literature review and qualitative expert interviews | 4.1<br>4.2<br>4.3<br>5.0 |
| How to measure public engagement? | Compare the output of public dialogues around N&N as well as the level of communication and participation based on selected criteria. | 2.2.3<br>3.0<br>4.1<br>4.2<br>4.3<br>5.0 |

This masters thesis might be seen as part of the Science and Technology Studies (STS) discourse which analyses science-society relationships within the historical, social, political and cultural context. Main interests in this research area are, for example: the role of scientific uncertainty, the social construction of science/technology/environment and the development of novel forms of public engagement such as 'upstream engagement'. Furthermore, it is also part of a risk science discourse with focus on risk communication and risk governance. The leading question of this masters thesis is to investigate public engagement practices based on a comparison between different countries to develop synergy effects, to enable a comparison between different engagement-tools and practices as well to highlight strengths and weaknesses in the various approaches to public engagement.

## 2. The theory behind nanotechnologies and public engagement

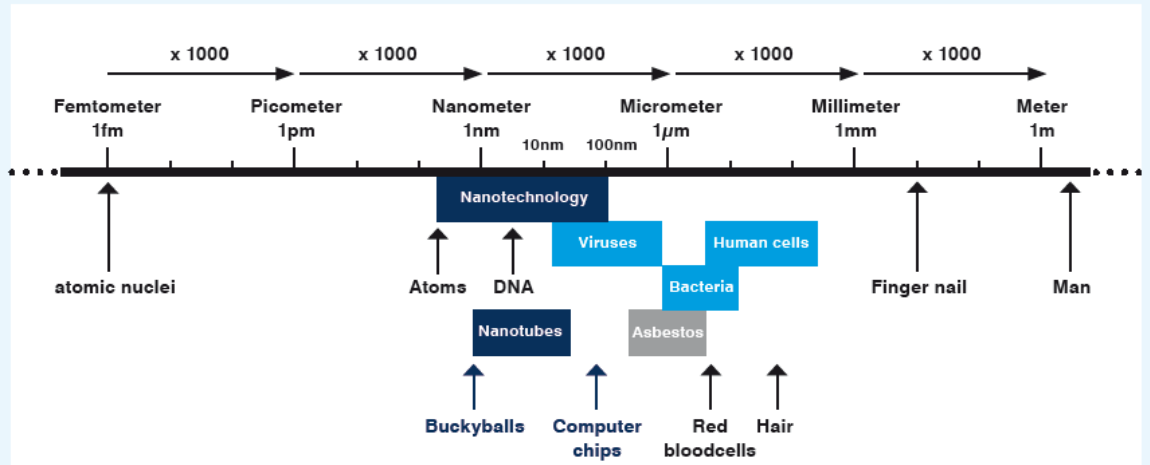
In the first part of this chapter I will introduce the reader to N&N by offering historical background information and giving some examples of potential risks and benefits of this technology. Furthermore, I will identify the expectations for and the outlook of N&N, and give examples of future application areas. In the second part of this chapter I will look behind the theory of public engagement (PE) and risk governance and its current political reality in the EU to gain insights about the motivation to promote 'upstream engagement' from a political and scientific point of view.

### 2.1 What are nanotechnologies and what is so special about them?

*"Applications of Nanotechnology are emerging and will impact the life of every citizen"*
*(European Commission, 2004, p. 3)*

N&N refers to any technology done on a nanoscale that has applications in the real world. The prefix *nano-* derives from the Greek word *nannos* meaning dwarf (Park, 2007). A nanoparticle represents an aggregation of atoms bonded together with a radius between 1 and 100 nm. A nanometer is one-billionth of a meter (Foresight Institute, 2011). For example ten nanometers is 1000 times smaller than the diameter of a human hair (NASA, 2011) Figure 1 illustrates a size comparison of different sizes from decimeters to picometers.

**Figure 1: Nanotechnology size comparison**




Source: CRO Forum (2010)

Materials with a size below 100 nm have different properties which opens a completely new world of possibilities. *"When the dimension of a material is reduced from a large size, the properties remain the same at first, then small changes occur, until finally, when the size drops below 100nm, dramatic changes in properties can occur"* (Bhusan, 2007, 1-2).

The advantage of working with downsized materials is that the same chemical elements change their mechanical, optical, magnetic and electronic properties, as well as chemical reactivity (Renn and Rocco, 2006). For example silver on a large size is inert and therefore used for jewelry and cutlery, though silver nanoparticles, demonstrate antimicrobial and antibacterial activity. Furthermore they have been used in a number of applications including medical science and also to produce non-smelling socks (Park, 2007, 7). There are more than 500 entries of products on the market containing nanomaterials and several studies forecast that this is only the beginning of a new technological revolution (Shatkins, 2008). For example, searching the term 'nano' in the internet brought 61 million hits in the year 2008 (Shatkins, 2008, p.25) compared to 2012 where the term 'nano' brought already 302 million hits. Public and private organizations, governments and several scientists from different disciplines call N&N the most important technology of the 21st century. Several scholars argue that N&N will have a profound impact on our economy and society in the 21st century (Hauser, Gazsó & Kaiser, 2010). Science and technological research forecast breakthroughs in areas such as nanoelectronics, medicine and healthcare, energy, biotechnology, information technology, national security, material sciences and monitoring systems. Over the last years, research and development (R&D) in N&N has increased significantly. Worldwide most universities offer programs in nanoscience. Current studies made by Mitsubishi Research Institute (Japan), Deutsche Bank (Germany), Lux Research (U.S.) and other organizations forecast that by the year 2015 about $1 trillion worth of products worldwide will incorporate nanotechnologies in key functional components (Rocco C., 2005; 2011). Financial investments in N&N have increased significantly, from $432 million in 1997 to about $4.1 billion in 2005 (Siegel, Hu and Rocco, 1999; Rocco 2005). N&N might be seen as the next industrial revolution (Bhusan, 2007; Rubahn, 2003; Poole and Owens, 2003). However, several scholars not only forecast benefits, but also risks arising from this emerging technology that might have a huge impact on human health and the environment.

### 2.1.1 History

*"For better or for worse, the greatest technological breakthrough in history is still to come"*
*(Drexler, 1986, Chapter 1)*

Although the term nanotechnology is relatively new in history, this does not mean that for the first time human kind began to take advantage of nanosized materials. In 1661, the Irish-born chemist Robert Boyle recognized the importance of particle and how single elements might change their characteristics under certain conditions. In his book Sceptical Chymist published in 1661 he argued that*:*

*[… ] there may be some Clusters of Particles, wherein the Particles are so minute, and the Coherence so strict, or both, that when Bodies of Differing Denominations, and consisting of such durable Clusters, happen to be mingl'd, though the Compound Body made up of them may be very Differing from either of the Ingredients, yet each of the little Masses or Clusters may so retain its own Nature, as to be again separable, such as it was before […]*(Boyle, 1661, p. 42).

Furthermore it is known that as early as the fourth-century AD, already nanosized materials were used by Roman glass-makers (Poole and Owens, 2003.p.1) For example, the famous Lycurgus Cup developed by Roman glass- workers, which changed colour when held up to the light and turns from a green to a glooming red when light is shown through it, is a historical witness that already in the fourth century nanoparticles were used, which made this effect possible (Freestone et al., 2004). However, it was Laureate Richard P. Feynmann with his lecture: *„There`s Plenty of Room at the Bottom" who in 1959* for the first time in history, presented the technological vision of extreme miniaturization. He talked about manipulating and controlling things on a very small scale (Bhushan, 2007). The actual term 'nanotechnology' was used for the first time in 1974 in a conference paper entitled *"On the Basic Concept of 'Nano-Technology,"* by Tokyo Science University Professor Norio Taniguchi (Dixon, 2011). In 1986, a cover story by F. Hapgood ("*Nanotechnology: Molecular machines that mimic")* published by the science-oriented magazine OMNI made sure that for the first time nanotechnology was introduced to a broad public audience. Also, the well-known book "*Engines of Creation: The coming area of Nanotechnology"* by Eric Drexler, published in 1986, made nanotechnology quite famous and promoted research in diverse nano-related fields (Drexler, 2009). Drexler`s book achieved a lot of attention not only because of its provocative claims about possibilities and dangers associated with engineering at the molecular scale but also because it was the first comprehensive work which laid a theoretical foundation for the modern field of nanotechnology. In *Engines of Creation* Drexler articulates that nanotechnology is still in its initial state and that the greatest technological breakthrough is still to come. Though, he indicated, however, that this might not only entail benefits*: "For better or for worse, the greatest technological breakthrough in history is still to come"* (Drexler, 1986, Chapter 1). Drexler was aware that new technological inventions often create new risks too. Therefore he proposed also the development of regulations and policies to deal with such risks. To improve the dialogue about future transformative technology Drexler and his wife Cristine Peterson founded the Foresight Institute in 1986, which is a non-profit think tank and public interest organization, whose mission is to discover and promote the benefits and help to avoid the dangers of nanotechnology (Foresight Institute, 2011).

### 2.1.2 Defining nanotechnologies

*"Definitions are not only concerning the wording in discussing scientific or societal problems but also influence the ways in which these problems are dealt with" (Europäische Akademie, 2003, p. 19*)

As mentioned above, N&N refers to any technology done on a nanoscale that has applications in the real world. The main problem about N&N is that it is such a far-reaching multidisciplinary discipline with several fields of applications that a clear, comprehensive and internationally accepted definition of N&N is still missing. Defining N&N varies from country to country as well as from discipline to discipline. There are no regulations for the prefix 'nano', therefore every science discipline or product development agency can attach the 'nano' label if wanted (Schummer, 2007). To ensure a common understanding of what N&N is about and to provide a clear and comprehensive definition of N&N, the Europe Academy (2003) published a comprehensive booklet which aimed to define N&N beyond the length scale of a 'nanometer'. The importance of a definition is that it has a strong influence on how things are interpreted and how things could be made operable (Europäische Akademie, 2003). Especially when communicating N&N to the public a clear definition which gives adequate information about N&N remains crucial. It further has a strong influence on politics dealing with N&N*. "Definitions do not only describe something they also shape something"* (Europäische Akademie, 2003, p. 19). In the literature, many definitions use the term 'nanotechnology' – rather than and its plural version 'nanoscience' and 'nanotechnologies' - However, in the latest publications about nanotechnology, there is a trend towards using the plural form with its abbreviation N&N. The meaning is the same but using the plural version may improve the understanding that N&N is a widespread research area with a variety of different applications rather than one single technology. In this document I will use both versions. Following I will consider some well-known definitions of nanotechnology. The National Science Foundation (2000) defines nanotechnology as follows: *"Research and technology development at the atomic, molecular or macromolecular levels, in the length scale of approximately 1 - 100 nanometer range, to provide a fundamental understanding of phenomena and materials at the nanoscale and to create and use structures, devices and systems that have novel properties and functions because of their small and/or intermediate size."* The European Commission (2004, p.6) defines nanotechnology as follows:*"…Nanotechnology refers to science and technology at the nanoscale of atoms and molecules, and to the scientific principles and new properties that can be understood and mastered when operating in this domain"*

In the Austrian Action Plan (2009, p.10) nanotechnology is defined as follows: *"Manufacturing or processing internationally manufactured nanoscale materials, such as nanotubes or nanoplates, including products made of such materials.* Nanoscale means having at least one spatial dimension of 100 nm or less."

The different quotations mentioned above, give a clear picture, that a uniform definition of N&N remains elusive. Each country or institution uses its own definition of nanotechnologies. An internationally authoritative definition is lacking. This might be problematic not only for political and regulative issues but also for the communication of N&N to the public.

### 2.1.3 The emerging field of nanotechnologies

*"Nanotechnology encompasses a dizzying array of individual technologies, integrated into products in virtually every industry we can define" (Shatkins, 2008, p. 14)*

As shown above there are many different applications of nanotechnologies, which means that talking about one nanotechnology might even be misleading. There are several nanotechnologies with multiple functions and multiple directions (Kenneth, 2008, 6). Nanotechnology is called the new scientific revolution of the 21st century and will affect almost every aspect of our lives (Holister, 2002). There are already hundreds of products and some six-hundred nanomaterials and additives on the global market (TA-SWISS, 2011). Nanotechnology will be present in almost every product we use. The diversity of nanotechnology breaks new ground in almost every conceivable technological discipline. Nanoscience is a multidisciplinary cooperation between chemistry, biology, physics, biotechnology, material science and engineering. Due to its expansive application it requires the integration of many scientific, engineering and technical disciplines and competencies. N&N are some of the fastest growing technologies in the 21st century. N&N is a cross-sectional technology and provides innovation potential for nearly all sectors and industries (Federal Ministry of Education and Research, 2009, p. 7). However, several scholars forecast that the application of nanotechnology will be accompanied by huge chances in the social, economic, ethical and ecological spheres (IRGC, 2006, 20).

The following table 2 summarizes some examples of breakthroughs of N&N in different areas:

**Table 2: Examples of breakthroughs of N&N in different areas**

| **Environment** |
|---|
| • Solar panels with greater efficiency by using nanotechnology materials<br>• Water purification bottles, with filters only 15 nanometers in width, allowing military personnel as well as civilians hit by disasters to create safe drinking water (even if that water comes from a filthy source)<br>• Nanostructured catalysts used to make chemical manufacturing processes more efficient, saving energy and reducing waste products |
| **Medical** |
| • Improvements in delivery of drugs<br>• Nanotechnology surfaces which are highly resistant to bacteria, dirt and scratches<br>• Pharmaceutical products reformulated with nanosized particles to improve their absorption and make them easier to administer.<br>• Bio-chips for in-vitro diagnostic |
| **Electronic** |
| • Hard-disk storage units with GMR-reading heads<br>• Silicon electronics (structures smaller than 100nm)<br>• Flash-storage |
| **Textiles** |
| • Dirt-repellent textiles through nanoparticles<br>• Antibacterial textiles through nanosilver |

Source: Rubahn (2003), Shatkins (2008), Federal Ministry of Education and Research (2009) and Fox (2011)

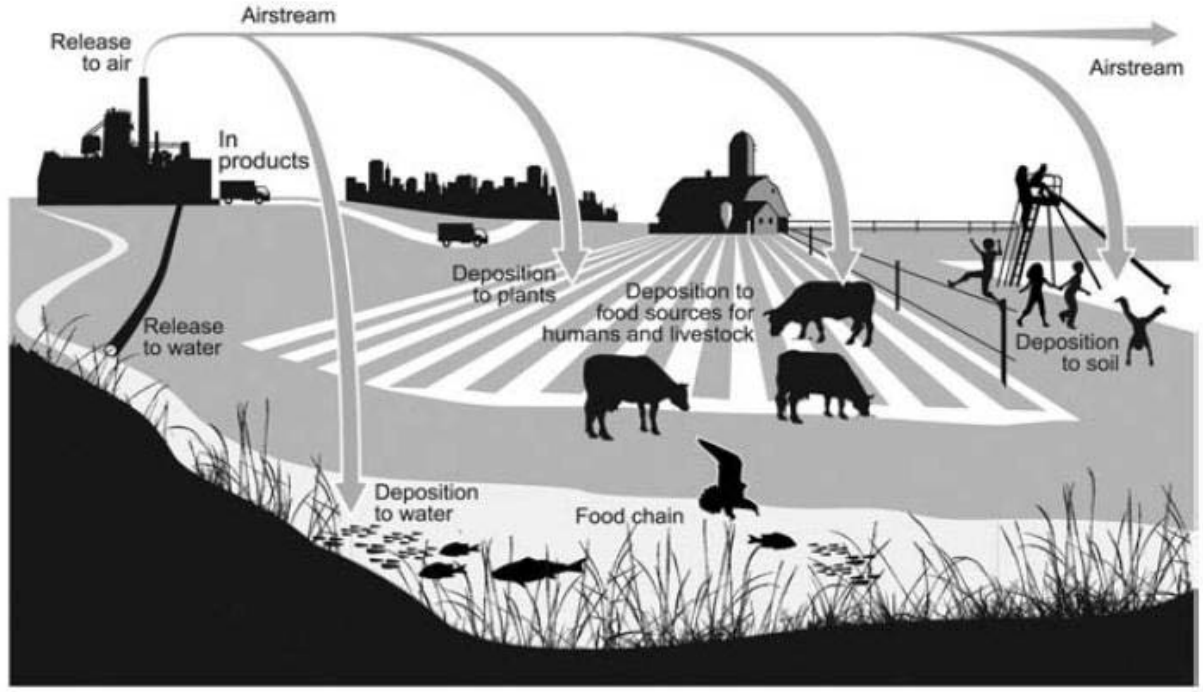
N&N holds promises for applications which have the potential to solve many technical, economic, ecological and social problems and has become one of the main drivers for technological and economic change (IRGC, 2006, 23). In the next ten years products such as: self-healing protection materials, textile integrated digital assistance systems (human interfaces), quantum computing, artificial organs through tissue engineering, high-efficient quantum dot solar cells and much more (Federal Ministry of Education and Research, 2009, p. 7) are forecasted. Because of the wide-ranging area of N&N an exact listing of future applications is impossible and even for experts an exact forecasting of how N&N will affect our future life is difficult.

### 2.1.4 Potential risks, hazards and ethical issues about nanotechnologies

*"As the science leaps ahead, the ethics lags behind" (Mnyusiwalla, Daar, & Singer, 2003)*

There are several studies, showing that there is still little understanding of potential risks and hazards for nanomaterials. In several governmental and non-governmental publications the authors not only refer to the benefits arising from these technologies but also point out potential risks (European Commission, 2004; IRGC, 2006; Lloyd`s, 2007; Park 2007; Shatkins, 2008; CRO Forum 2010).*"At present, considerable uncertainty exists regarding risks from nanoscale materials and the products that incorporate them"* (Shatkins, 2008, p. 84). At this point the gap in all national and transnational regulations about health and environmental issues concerning new nanomaterials is very problematic. Nanoscale particles of exactly the same chemical composition have different properties. These include optical, mechanical, electromagnetic, thermodynamic, chemical, catalytic and biological properties. Nanoscale particles differ also in the way they can propogate in the environment and through biological membranes. The problem is that national regulations for chemicals, consumer products and work safety disregard the size – and shape-dependence of properties and focus only on chemical composition. This means that a substance can pass the required toxicity test for new chemicals if the tests are performed on large particles, even if small particles of the same substance are toxic (Schummer, 2007, p. 7). There is insufficient scientific knowledge and data base to predict the effects of nanoparticles and other nanomaterial's on human health and the environment. For example there are no established systems to monitor in situ nanoparticles in air, water, soil or eco systems (International Risk Governance Council, 2006, p. 28).Nanomaterials could enter into the environment via several pathways. Figure 2 illustrates how nanoparticles can enter the environment and can affect the whole ecosystem.

**Figure 2: Potential exposure pathways for nanomaterials**




Source: Shatkins (2008, p.14)

For example, if nanoparticles are washed away with water or flushed down the drain, they are released into the environment. From drain pipes, these materials enter the ground water and eventually can move to the nearest rivers and streams. They might be absorbed by fish and could easily enter the food chain and might affect drinking water sources and oceans as well as affect human health. Nanoparticles may also be disseminated by the airstream where particles easily could deposit in soil, plants and food sources for human livestock (Shatkins, 2008, p. 14-15). At this moment there are no specific metrology tools to allow for effective measurement of exposure of nanomaterials and nanoparticle delivery methods (International Risk Governance Council, 2006, p. 28). Furthermore, the risk landscape of N&N should not only be viewed from a technical, toxicological or environmental perspective, but also from an ethical and socio-economic one. There are ethical and social questions too, such as: data abuse, intellectual property rights (IPR), access and liability. The expected advances in medical diagnostics make the collection of highly sensitive data possible; these raise serious questions about information provenance and distribution. Advances in information and communication technology (ICT) may also cause possible threats to civil liberties in the form of increasingly advanced surveillance capacities (Nanologue, 2010). Regarding IPR and access there is concern that the technology will remain prohibitively expensive and only those who can afford it will have access as well as benefits. For example: enterprises and countries using N&N technology are expected to have competitive advantages compared to other countries and companies.

Among other things this poses questions about distributional justice. Concerning liability the main problem is that often new inventions, once demonstrated, could be used in ways not originally intended. Further ethical questions arising from N&N might be the risk exposed and the risk beneficiary of this technology. With each risk management problem there are people who are potentially exposed to a risk and there are people who make decisions that affect the risk. Hermansson & Hansson (2007) argue that the relationships between those who have these three roles- namely the risk-exposed, the decision maker and the beneficiary - are essential for identifying the ethical aspects of a risk management problem. Communication to the public about risks arising from N&N is an essential ethical issue. On the one hand, people who are exposed to a risk should have sufficient information and the right to say if they want to take a certain risk or not. On the other hand, researchers such as Kasperson (1988) found out that, although most governments promote programs and bureaucracies aim at managing risks, people today feel more vulnerable to the dangers posed by technology rather than less. Involving the public in the discussion about N&N could help to fill the gap between science fiction scenarios and real N&N risks and concerns.

## 2.2 Nanotechnologies- opening up for the public?

*"The future of Nanotechnology depends on public acceptance, so the nanotechnology community needs to listen to public opinion" (Toumey, 2006)*

Including the EU, international organizations such as the IRGC, the Organisation for Economic Co-operation and Development (OECD) and the scientific community emphasize the importance of involving the public in the risk communication process concerning N&N. A two-way dialogue is needed at all stages of the risk handling process. This includes:

*"… communication between those responsible for taking risk-related decisions and those responsible for providing the knowledge on which the decisions are based"* (International Risk Governance Council, 2005, p. 6).

The White Paper on Nanotechnology Risk Governance (2005) published by the IRGC also clearly indicates that there are still risk communication deficits. According to IRGC (2005, p.32) there is a gap in communicating the state of the art in science and development between the scientific community and other network members, particularly regulators, members of NGO`s, the media and the public. Often risk communication lags behind the technological development. Further, there is low trust in governmental regulation. Most people think that profit may be more important than health and environmental impacts. An effective public debate and communicating what has been and will be done to reduce and control risks remains an important issue for successful risk communication and may help to reduce this gap. Therefore, engaging the public with N&N may help

to launch a non-prejudicial open debate. For this purpose the EU-Commission held the conference "*The future of science and technology in Europe"* to debate PE practices in Europe in 2007. In the Foreword it stated:

*"There is not one single answer to respond to people's growing queries. Investing in teaching and communicating science is important but it needs to be complemented. I believe that we have to go deeper by revisiting the relationship between the public and science. [… ]The current limitation in the dialogue between science and civil society has to be overcome. And it is our task to set up new ways which both empower the public and reward those scientists who engage constructively with civil society".*

In 2008 the OECD organized a conference on public engagement with nanotechnologies in Delft (Netherlands) to discuss different PE practices in Europe (OECD, 2008). It is impossible reading an official European document about N&N and not to encounter a chapter which underlines the importance of establishing a more dialogue oriented policy. For example, The European Commission calls for more dialogue to prevent eventual prejudices: *"Dialogue with the public is essential to focus attention on issues of real concern rather than "science fiction" scenarios".* (European Commission, 2004, p.5). Furthermore, the EU Code of Conduct recommends: *"…to encourage dialogue amongst policy makers, researchers, industry, ethics committees, civil society organisations and society at large"* (European Commission, 2008, p.3).

The Austrian government also recognized the importance of a dialogue oriented policy, especially in the case of new technological inventions such as N&N, which are characterized by many uncertainties. A main objective of the Austrian Nanotechnology Action plan (2009) is to foster an open communication about benefits and risks of N&N among all stakeholders and the general public (Federal Ministry of Agriculture, Forestry, Environment and Water Management, 2009, p. 16). For this purpose, several projects promoting citizen dialogues about N&N take place throughout Europe, mostly promoted by the European Commission or European Governments. What is the motivation for political institutions to foster an open dialogue with the public? In the literature there are conflicting opinions about the motives. Recently, several scholars from different disciplines, but most notably from the Science and Technology Studies (STS) community, investigated the question of why the public should be involved in the discussion about controversial technological issues before final political decisions are made.

### 2.2.1 Why public engagement with nanotechnologies?

*"The public trust and acceptance of Nanotechnology will be crucial for its long- term development and allow us to profit from its potential benefits. It is evident that the scientific community will have to improve its communication skills" (European Commission, 2004b, p. 21)*

There are conflicting opinions about public engagement with nanotechnologies. One main argument is that an open dialogue with the public helps to improve the public understanding of science (PUS) which raises the quality of public and private decision making (Irwin, 2009, S. 3). The idea that society needs more knowledge about science is mostly associated with the publication of the 1985 Royal Society report on Public Understanding of Science (PUS), where the authors underlined the importance of public understanding of science. In the Foreword it says:

*"Our industry and thus our national prosperity depend on them. Almost all public policy issues have scientific or technological implications. Everybody, therefore, needs some understanding of science, its accomplishments and its limitations"*. The authors not only emphasise the importance of communication between the science community and the public they even call it a *'duty to do so'. "Improving the general level of public understanding of science is now an urgent task for the well-being of the country, requiring concerted action from many sections of society including, most importantly, the scientific community itself"* (The Royal Society, 1985, p. 7).

The science and communication price, initiated by the European Commission (2004) aiming to support scientists or professionals engaged in communicating science to the public also proofs the evidence that science communication with the public is becoming substantially important. The message is: being a scientist means studying and communicating science and no progress without communication (Moore, 2005). The citation by Felt (2010): *"Society shapes technology and technology shapes society*", reveals that these two spheres should be considered equivalent. Therefore PE with N&N is an important step to build a bridge between science and society. Another argument is that an open dialogue with the public helps to build trust in science (e.g.: Kasperson, Golding & Tuler 1992). The language used in the dialogues about N&N can determine the way how people perceive and estimate risks arising from N&N (compare: Szerszynski, 1999). Controversies over bovine spongiform encephalopathy (BSE), genetically modified (GM) crops or the use of nuclear power have shown that society is more critical and is questioning scientists more and is trusting them less (Stilgoe & Wilsdon, 2009). According to the deficit of trust, several STS- scholars refer to the Third Report of Science and Society by the House of Lords (2000) where the authors called it a 'crisis of trust' between the public and the world of science and technology.

The report starts with the assumption:

*"Society's relationship with science is in a critical phase [… ] .On the one hand, there has never been a time when the issues involving science were more exciting, the public more interested, or the opportunities more apparent. On the other hand, public confidence in scientific advice to Government has been rocked by a series of events, culminating in the BSE fiasco; and many people are deeply uneasy about the huge opportunities presented by areas of science including biotechnology and information technology, which seem to be advancing far ahead of their awareness and assent. In turn, public unease, mistrust and occasional outright hostility are breeding a climate of deep anxiety among scientists themselves"*.

Consequently, it can be assumed that public engagement is used to maintain trust in the science that possibly underpins possibly controversial policy (Jones, 2011) and may help to improve acceptance for new technological interventions. According to Irwin (2009, p.7) trust can only be generated by openness. Therefore PE practices should preferably be widely accessible by citizens. The three rationales summarized by Fiorino (1990) are helpful to categorize the previously mentioned motives for public engagement (compare: Stirling, 2008). If public engagement is used to build trust and makes decisions more legitimate it is an *instrumental rationale*. For example, if companies want to find out what people think about a new product then that indicates an instrumental rationale. If the aim is to create more socially robust scientific and technological solutions, it is a *substantive* rationale. In this approach citizens are seen as subjects of the process, they should actively be involved in the decision making process. They actively work to shape decisions. From a *normative* perspective public engagement is seen as the right thing to do according to democratic ideals (Wilsdon, J. and Willis, R., 2004, p. 40). These three rationales for public engagement may be a useful distinction but, in practice, setting boundaries is not always easy (Delgado, Kjolberg, & Wickson; 2010). In an essay about nanotechnology and society, Ulrike Felt (2010) also questioned the reason for engaging the public with nanotechnologies and refers to the book by Brown, Rappert, & Webster (2000) where the authors, amongst other things, asked the questions: Who has the right to decide about the future? And who should be involved in the decision process? Burgess (2006) also argued that: *"…risk is a site of decision about human identity, about who we are and what we want, what is dispensable and what is indispensable".* In an essay about public engagement, Jones (2011) argued that PE is part of an explicit process of democratising science and should not only be seen as a way of promoting public support for new technological inventions. *"Rather, it imagines that the future is still open, and that society can have an influence on which of the many possible forking paths science and technology may take as the future unfolds"* (Jones, 2011).

In the context of N&N it poses the ethical questions: Who has the right to decide about future N&N development and applications and who does not? A very persuasive argument for PE is that judgements are made at all stages of the risk management process and that the public can be involved in most of the stages to decide which risks evaluating (Levidow 1994; Kunreuther & Slovic 1996; McCallum & Santos 1997, Rowe & J. Frewer 2000). As described in the first chapter, N&N holds both promises and risks. Referring to several documents N&N will affect the life of every citizen. According to democratic ideals and ethical concerns, should not the public - the main consumer and exposure of N&N products - participate in the discussion about its applications? Or should only an elite group of scientists and politicians make the decisions? According to Burgess (2006), Brown, Rappert, Webster (2000) and Felt (2010), public engagement in the risk communication process about N&N may help to give citizens a voice to decide about the identity of a society.

### 2.2.2 Public engagement with N&N - The new panacea for risk governance?

*"Legitimacy today depends on involvement and participation*" (European Commission, 2001)

Since the late 1990s 'governance' has become a mainstream policy term in the EU (Levidow, 2007). According to Renn and Roco (2005, p.5) 'governance' is seen as:

*"implying a move away from the previous government approach (a top-down legislative approach which attempts to regulate the behaviour of people and institutions in quite detailed and compartmentalised ways) to governance (which attempts to set the parameters of the system within which people and institutions behave so that self-regulation achieves the desired outcomes), or put more simply the replacement of traditional "powers over" with "power to"*.

The European Commission (2001, p. 8) defines 'governance' as: *"…rules, processes and behaviour that affect the way in which powers are exercised at European level, particularly as regards openness, participation, accountability, effectiveness and coherence*". According to Lewidow (2007), the debate about improving governance responded to a legitimacy crisis of risk regulation in public debates and scandals over food and health security. The following statement in the EU-Commission White Paper on Governance illustrates this problem very well: *"Recent food crises have highlighted the importance of informing people and policy makers about what is known and where uncertainty persists. But they have also undermined public confidence in expert-based policy-making"* (European Commission, 2001, p. 19).

Recent literature debating 'risk governance' and 'upstream engagement' shows that both concepts are used in a very similar way. Both concepts suggest more active citizen involvement. As mentioned in section 2.2.1, scholars suggest that PE practices are often misused to govern techno-scientific risk issues, in a way that it is not used to improve openness, transparency and democratise technology- but rather in order to -avoid public distrust in science-technological issues. Especially The broad public resistance to genetically modified organisms (GMO) was a traumatic event on a political level. Several politicians argued that it was due to a delayed communication about the positive impact of genetic engineering (Felt, 2010). The following summary from the Report on Public Engagement in Society (2007, p.17) by the EU-Commission underlines this assumption:

*"More recently, there has been a wave of interest in moving public engagement 'upstream'– to an earlier stage in the processes of research and development. There is a sense that earlier controversies have created a window of opportunity, through which we can see more clearly how to reform and improve the governance of science and technology. Most immediately, policymakers and the science community are desperate to avoid developments in fields like nanotechnology, neuroscience and synthetic biology becoming 'the next GM'. The wounds of that battle are still raw, and there is little appetite for a rerun".*

In consequence a discussion about new forms of governance mainly supported by the European Commission was initiated. Therefore PE with N&N may also be misused in risk governance politics to convince citizens and trivialize potential hazards and risks in order to achieve acceptance and improve industrial competiveness. After all, worldwide public investment in research and development in nanotechnology (R&D) is estimated to some €3 billion (European Nanotechnology Gateway, 2004). N&N is such a promising field (see also section: 2.1.3) that declination by society would be fatal. The survey conducted by Nanoforum (2004) with a total of 720 participants, concluded that nanotechnology will have a strong impact on European industry (90%) as well as on European citizens (80%), within ten years on industry and citizens. This points out very well how important the acceptance of EU citizens for N&N is. Therefore it is not surprising that the EU commission is interested in promoting citizen dialogues about N&N to build trust. The *Annual Nano Safety for Success Dialogue: Building Trust in nanotechnologies held* in 2011 is a good example. The importance of public trust in risk governance politics is also highlighted by Renn and Roco (2006, p.9) when the authors refer to communication and engagement deficits*:*

*"Public awareness of risk tends to be higher if it is felt that individuals or societal institutions are not able to exercise personal or institutional control over it (e.g. lack of labelling on products containing an engineered nanostructure), if the technology is stigmatised (e.g. uncertain scientific knowledge and media hype); and if insufficient information is communicated to them concerning how risks are*

*and can be controlled. It is therefore essential that the potential for risks and the governance systems being put in place to deal with these potential risks are communicated to the public as soon as possible. Trust between governments, businesses, academics, international organisations and the public needs to be enhanced though open dialogue and public involvement".*

However, PE should not only be used to build trust, it must also give citizens a voice and allow them to have an impact on policy, asserting a democratic rationale for engagement. The dilemma with public engagement will be discussed in the following.

### 2.2.3 Approaches to PE- the ambiguity of its interpretation and evaluation

*"Who will take responsibility if things go wrong?"* (Rogers Hayden,2009)

There is no consistent definition of 'public engagement'. In the literature, STS scholars such as: Irving J., Wynne B., Rogers-Hayden T. and Pidgeon N. often use the terms: '*public participation', 'public engagement'* or '*upstream engagement'* simultaneously to describe efforts of different engagement practices with the public. Most of the definitions of PE are very vague and 'fuzzy'. They do not offer criteria to measure successful PE. For example, The British Science Association (2011) defines public engagement as follows: *"To engage members of the (multiple) publics and stakeholders in dialogue about emerging technologies, before final political decisions are made."* In this definition the term 'engagement' is not specified. It only refers to dialogues with the public and stakeholders. A more detailed definition of PE is given by the definition of the NCCPE:

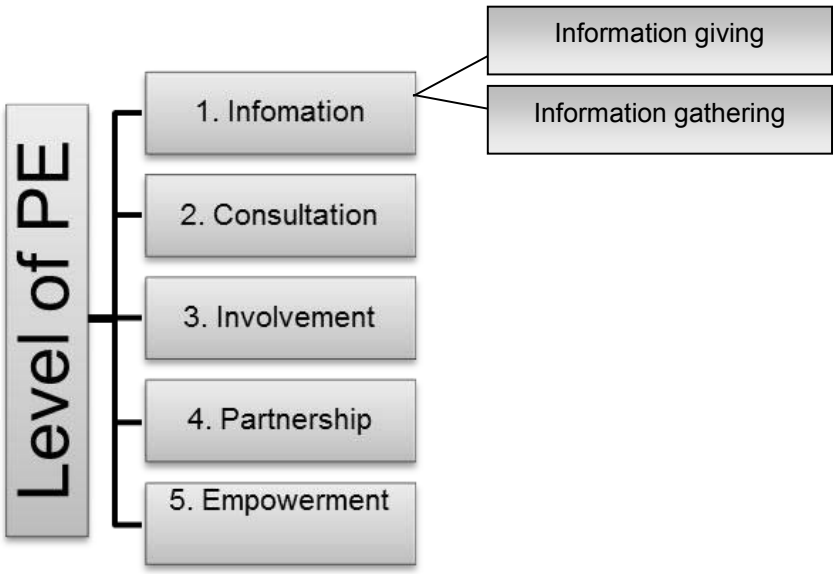
*"Public engagement describes the many ways in which higher education institutions and their staff and students can connect and share their work with the public. Done well, it generates mutual benefit, with all parties learning from each other through sharing knowledge, expertise and skills. In the process, it can build trust, understanding and collaboration, and increase the sector's relevance to, and impact on civil society"* (National Co-ordinating Center for Public Engagement, 2011).

This definition does only refer to public engagement organized by educational institutions. However, public engagement is reaching further. The Royal Society (2004) defines PE as follows: *"Dialogue and deliberation amongst affected parties about potentially controversial technological issues at an early stage of the Research & Development process and in advance of significant applications or social controversy"*. This contrasts with 'downstream' engagement, which is a post-product discussion when decisions have already been made. Thoughts about moving dialogue up-stream are typically guided by the following questions: Why this technology? Why not another? Who needs it? Who owns it? Who will benefit from it? Can they be trusted? Who will take responsibility if things go wrong? (Rogers-Hayden, 2009).

Wilsdon (2007) points out that public engagement is not simply about better communication. The author points out, that institutions need to provide meaningful opportunities for the public to influence decision-making.*"They need to ask, how effectively the changing values, hopes and aspirations of society are being incorporated into the products and trajectories of science and technology"* (Wilsdon, 2007, p. 17).

Other scholars such as: Rowe and J. Frewer (2000, 2004, 2005), Rowe et al. (2005, 2008), Jones et al. (2007) and Tait (2009) also argue in their publications, that criteria for successful PE evaluation are still missing. There are no appropriate benchmarks for an evaluation. 'Rules for engagement' that set standards for the quality of involvement are needed. In Europe, several different approaches to engaging N&N with the public exist. Methods such as informative events, public opinion surveys, consensus conference, citizen's jury/panel and focus groups are very common techniques. Because of different socio-political structures PE methods vary in different countries (Sciencewise-ERC, 2010). There is a consistent tendency that institutions and scholars who analyse public participation processes often use the level of participation as a framework to figure out if PE is successful or not (Bruns, 2003; Central Office of Information, 2008). In the literature, however, there are different interpretations of public engagement. According to Burns (2003), there are five levels of engagement: 1. no participation, 2. information, 3. consultation, 4. involvement and collaboration and 5. empowerment. The Central Office of Information (2008) categorizes six levels of engagement: 1. information giving, 2. information gathering, 3. consultation, 4. involvement, 5. partnership and 6. empowerment. Figure 3 summarizes the previous PE levels.

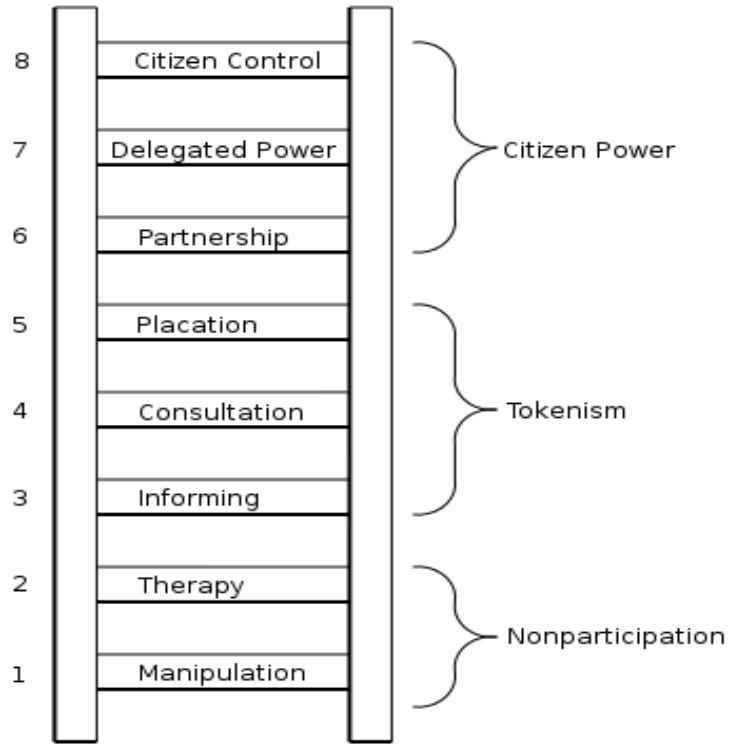
**Figure 3: Levels of PE**



As illustrated above, the first level of participation is sharing **information**. Information about N&N might be shared (e.g. by internet, newspapers, magazines and television). The main idea is to improve the understanding and discussion about N&N. The next step is **consultation**. This may involve a shift from one-way to two-way communication. Typical consultation methods are: public hearings, focus groups and internet chats which allow a communication between interested parties. A likely disadvantage of consultations is that primarily the people who are already interested in public policy issues use this possibility to join the discussion. Public **involvement** programmes go beyond the first two steps. They actively engage stakeholders in identifying their concerns and ensuring they are addressed in the final decision. They should be more actively involved in the process. Well-known methods are: citizen juries, forums, summits and workshops. In contrast to the previous steps, **partnership** is even a stronger form of PE. At this point citizens do have a 'seat at the table'. Citizens are directly involved in decision making, including the development of alternatives and choice of a preferred solution. The output should have a political impact. The highest form of PE is **empowerment**. In comparison to the other steps of engagement, empowerment refers to citizens not only being engaged in participatory processes. They are not restricted to join a certain participation event e.g.: web forums, selected dialogues, panels etc. but rather they can actively take part in the process. They have a greater or even complete influence on final policy solutions (Bruns, 2003; Central Office of Information, 2008).In contrast, some scholars such as Felt (2010), Rogers- Hayden (2009), Wilsdon & Willis (2004) and Wilsdon (2007) argue that PE is not only about good communication and enlightenment (see also chapter: 2.2.2). They claim that institutions must give citizens a voice and the outcome of dialogues must have an influence on policy-decision making.

Based on this definition, public engagement starts not until stage 2 which represents consultation. The early article: *"A ladder of citizen participation"* by Arnstein (1969) also discusses the participation dilemma. His main argument is that participation without redistribution of power is frustrating for the powerless and allows the power holders to claim that all sides were considered but does not change the status quo. Figure 4 illustrates the eight rungs on the ladder of citizen participation by Arnstein (1969).

**Figure 4**: Eight rungs on the ladder of citizen participation




(Source: Arnstein, 1969)

The first rungs of the ladder on citizen participation are (1) Manipulation and (2) Therapy. This level is “nonparticipation”. Due to Arnstein their real objective is not to enable citizens to participate but rather to ‘educate’ or ‘cure’ people. The following rungs are (3) Informing, (4) Consultation and (5) Placation. The last level mentioned is ‘tokenism’ that allows people to be heard and have a voice, however there is lack of power to insure that their views will be heeded by the powerful. The highest level of citizen participation is level three: ‘citizen power’ characterized by the rungs (6) Partnership, (7) Delegated Power and (8) Citizen Control. This might be what now, in the literature, is described as ‘empowerment’. The categorization by Arnstein (1969) is a simplification but it is a good example to call attention how public engagement practices on N&N might be used. Table 3 illustrates the previously mentioned engagement steps and gives a brief and more detailed description of:

- the level of engagement;
- its characteristics;
- methods;
- and the consideration behind the theory.

**Table 3: Level of PE and methods**

| Level of engagement | Characteristics | Methods | Consideration |
|---|---|---|---|
| **1. Information giving and gathering** | Provides information to the public and interested parties. Collecting information on attitudes and opinions. This may assist understanding and decision making by providing relevant information from the public. Information flow tends to be one way. | • Blogs<br>• Public meetings<br>• Reports<br>• Media advertising<br>• Fact sheets<br>• Exhibitions<br>• Legal notice | Information should be honest, accurate and up to date. It should be clearly presented as well as formally and structurally adequate so it can be easily understood by the target audience. |
| **2. Consultation** | To get detailed feedback on specific issues<br><br>Responses are welcome, information flow tends to be two way. | • Consultations<br>• Focus groups<br>• Public hearings<br>• Web Blogs | Information should be treated responsibly and reported objectively and transparent. If a consultation was made, policy decisions will be influenced and people taking part will be clearly informed of outcomes. |
| **3. Involvement** | Involvement of participants in the analytical process and development of potential policy/service options.<br><br>Provides deep insights into concerns and aspirations of the audience. The communication must be two way, to create a greater sense of participant empowerment. | • Citizen juries, forums and summits<br>• Workshops<br>• Consensus conference | The role of the participants is clearly articulated.<br><br>There should be some influence on decisions, as participants may be part of the solution. |
| **4. Partnership** | Direct involvement in decision making, including the development of alternatives and choice of a preferred solution. Two way communications is essential. | • Citizen juries<br>• Advisory panel/committee<br>• Workshops | All parties should have clear roles and powers, usually for a shared purpose or goal. There will be some influence on final policy |

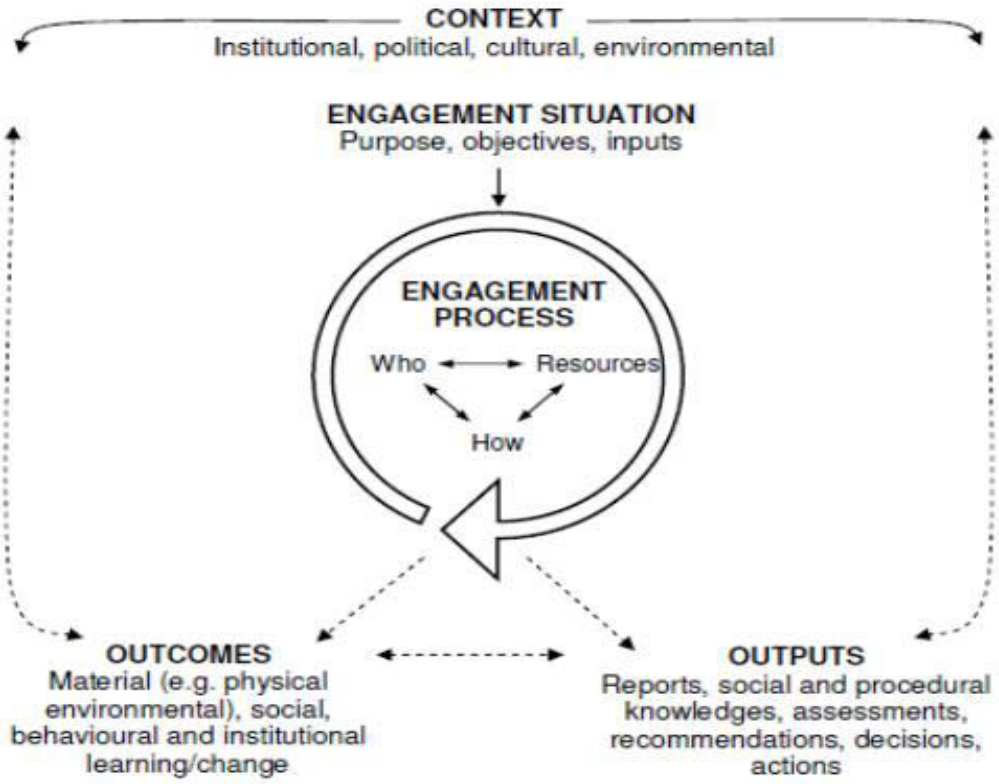
| | | | |
|---|---|---|---|
| | | | solutions. |
| **5. Empowerment** | Decision-making and control are eventually placed in the hands of participants.<br><br>Engaged parties have a greater or even complete influence on final policy solution. | • Ballots<br>• Grant-giving<br>• Participatory budgeting<br>• Tenants management association | There must be clear lines of accountability, with two-way communication with those assigning the authority. |

Source: Adapted from: Central office of information (2008)

The main characteristic of all engagement practices is that engagement is often achieved through one-off events rather than a continuous process (Rowe, Horlick-Jones, Walls, & Pidgeon, 2005). The evaluation of the actual benefit of public engagement is very difficult. As mentioned in section 2.2.1, there are several reasons and different concepts for PE. Depending on the field of applications there are also different views of how PE should be organized and from which point it actually can be seen as PE. The evaluation of public dialogues on N&N may help to set standards for further PE practices. There are many reasons why PE practices should be evaluated, e.g.: financial aspects (the proper use of public or institutional money), practical (learn from mistakes to improve the procedure for further PE practices), ethical (to establish a fair representation, evaluate who had the right to participate), etc..

Unfortunately, the literature offers only a relatively small number of publications dealing with this topic (Rowe, Horlick-Jones, Walls, & Pidgeon, 2005). At this point the publications by Burgess & Chilvers (2006), Chilvers (2006), Horlick- Jones et al (2007) and Rowe et al (2000; 2004, 2005; 2008) should be mentioned. In the case of PE with N&N several methods might be useful to analyse public engagement efforts. As mentioned above the level of communication and participation might be one criterion but also the frame and settings in which public engagement took place are important. For this purpose, Burgess and Chilvers (2006) developed a contextual model of participatory process.

**Figure 5**: A conceptual model of participatory process design and evaluation




Source: Burgess and Chilvers (2006)

This framework makes a comprehensive analysis of PE possible. It emphasises an analysis in a wider context. First, it assesses the context of PE, whether it is institutional, political, cultural, environmental, etc.. It further defines the decision situation (purpose, objectives, inputs), as well as the engagement process (who? how? resources?), the output (e.g.: plans, recommendations) and the outcomes (material changes - e.g., social/institutional capital, regulations, behaviour). Figure 5 outlines the contextual framework for the design and evaluation of public and stakeholder engagement processes. In summary, there are several approaches to evaluating public engagement practices can be evaluated. For the following case study of public dialogues on N&N in A, CH and the UK I developed a set of criteria based on the previously mentioned approaches which will be explained in detail in the following chapter.

# 3. Methodology

## 3.1 Case Selection

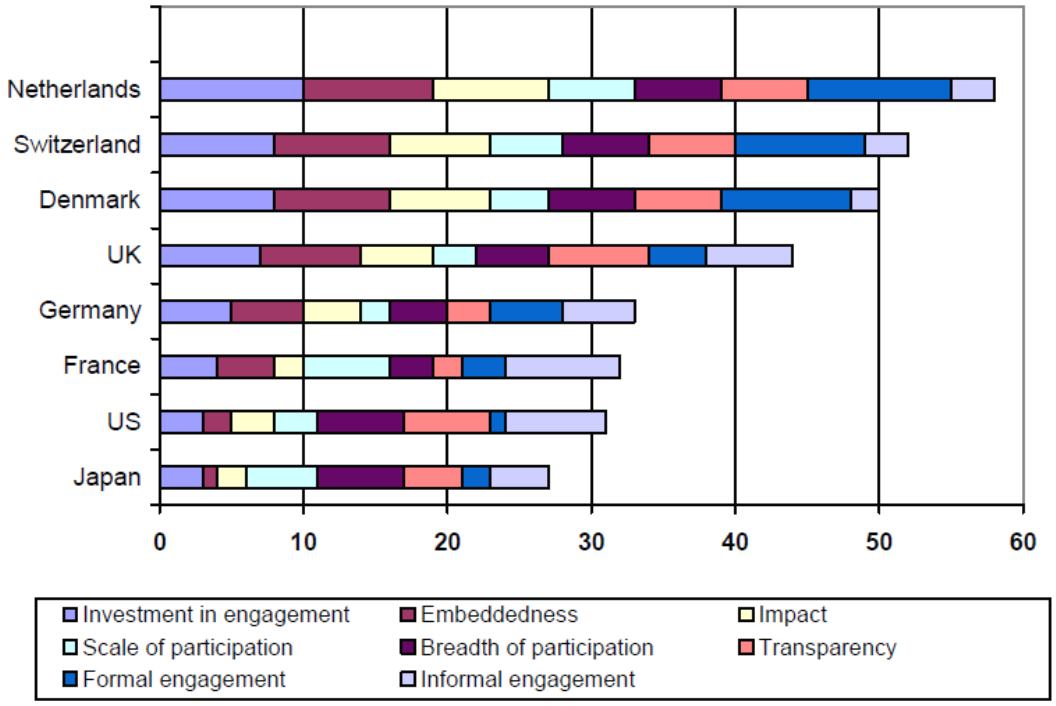
I decided to analyse PE around N&N for two reasons: Firstly, because it is the first time in history that an emerging technologies such as N&N has been accompanied by so many public debates and, secondly, because several governmental and non-governmental organizations emphasize the importance of involving the public in the risk communication process of N&N. Therefore, analysing public dialogues about N&N might be an important step to review PE practices based on a real case. For my case study I needed countries where risk dialogues of N&N took place and therefore I set up **five criteria** for the appropriate selection.

1. **Geographic area**
2. **Actuality**
3. **Comparability**
4. **Accessibility**
5. **Feasibility**

I decided to evaluate PE efforts in **three different countries**, because for a period of six months the evaluation of more than three countries would have been hard to realize.

The study "*International Comparison of Public Dialogue on Science and Technology" (2010)* by the Sciencewise expert resource centre supported me with the selection of the countries. In the study the institute analysed PE in eight countries across certain key features in public dialogue and engagement. The authors came to the conclusion that the Netherlands performs best on PE followed by Switzerland, Denmark and the United Kingdom. Countries such as: Germany, France, the United States and Japan do not have a good PE infrastructure. For detailed information about data collection and analysis see Sciencewise (2010, p.13). Figure 6 outlines briefly the outcome.

**Figure 6: Public dialogue on science and technology in selected countries**




Source: Sciencewise-ERC, 2010

In the working process Austria emerged as an interesting case because research brought up that PE practices are not really common in Austria, though the Austrian Action plan on Nanotechnology (2009) calls up for more participation with the public. Therefore I thought Austria would be an interesting case to look at. Selecting the other two countries was much more difficult. I wanted to compare countries that are geographically close to Austria and made a comparison of PE practices useful. Furthermore, the countries included should already have a tradition in PE with science.

As I already have chosen Austria which is not even part of the previous mentioned study, possibly because of the lack of PE infrastructures and efforts. I tried to focus on two countries which do already have tradition in PE. Therefore my first choice was the Netherlands and Denmark. Unfortunately, the access to information in both countries was restricted. They do have projects on public engagement with N&N but most of the information was only available in the local language (except for summaries which were available for download in English). With respect to my five criteria I have chosen Switzerland and the United Kingdom. With both countries, access to information was very easy. Documents were available in English and most notably, in the United Kingdom well-known scientists already put this topic on their research agenda.

Summarized regarding my five criteria, I have chosen Austria, Switzerland and the United Kingdom because of**:**

1) Geographic area: A, CH and the UK are situated nearby and part of a homogenously cultural area.

2) Actuality: As well A, CH and the UK do have actual projects on PE with N&N.

3) Comparability: Because of the given cultural and geographic affinity a comparison of PE practices on N&N is possible and useful.

4) Accessibility: In all countries access to information was easy and most notably in the UK there is a well-known scientific community which has already done research in this area, therefore sufficient material was available.

5) Feasibility: As all countries do have projects on PE with N&N, available information regarding the risks dialogues on N&N and a scientific body which already did research on this topic it was possible to realize the project.

## 3.2 Methods of data collection and analysis

For this case study I used two methodological approaches:

1) **literature review**; and

2) **qualitative expert interviews**.

In Switzerland and the United Kingdom, there is sufficient literature and information regarding PE with N&N available. Therefore interviews with key-actors were not implicit necessary. In contrast, for Austria qualitative expert interviews were needed to answer the research questions. I interviewed eleven persons from different fields of activity (see also: chapter7).The interview partners were even involved in PE research around N&N and/or policy or consumer representatives. The interviews were carried out from November 2011 to January 2012 in Vienna. They were fully taped but not transcribed. For the analysis of public engagement practices in Austria, Switzerland and the United Kingdom, furthermore I developed two sets of analytical criteria which I adopted from section 2.2.4. Set one should evaluate the context of PE events. The leading questions were: Who initiates it? What is the purpose? Where takes it place? Who participates? And what design/method is used? What is the output? Table 4 illustrates the procedure.

**Table 4: Analytical criteria for PE set 1**

| Criteria's | Questions |
|---|---|
| 1) Who? | • Who initiates it? |
| 2) What? | • What is the purpose? |
| 3) How? | • What design is used? |
| 4) Where? | • Where does it take place? |
| 5) Output? | • What is the output? (e.g., official document, recommendation letter…) |

The second part of the analysis is supposed to categorize public dialogues on N&N. Therefore, the following categories, also adopted from the previous chapter, are developed: **information**, **consultation, involvement** and **partnership**. Further on, each method is characterized by **a level of participation and communication** as well as **Arnsteins classification** regarding his ladder of participation (see fig. 4 in section 2.2.3).

These arrangements allow an evaluation of the degree of PE. While, the first method (information) is characterized by passive participation, one way communication and a very low level of PE, the second method (consultation) enables active participation and two way communication although only passive participation and one way communication is used. This represents still low PE. The third and fourth method - involvement and partnership - enable active participation and two-way communication. According to the literature (see section: 2.2.3) they are good respectively very good PE practices. The fifth step called 'empowerment' is characterized by an independent group of people organizing a PE event. This should have direct influence on political decision making. This step of PE is not part of this study.

The evaluation also includes PE efforts such as consultations, web blogs, online education portals, information events etc., despite the fact that they are not typically 'public dialogues', I argue that they are aiming to inform citizens about N&N. They are methods and tools to emphasise a public debate and a dialogue between scientists and citizens, though the level of PE is rather low as represented in section 2.2.3.

**Table 5: Analytical criteria for PE set 2**

| Method | Level of Participation | Level of Communication | Valuation | According Arnsteins Ladder of Participation (1969) |
|---|---|---|---|---|
| **1. Information** | passive participation | one way communication | very low PE | Tokenism |
| **2. Consultation** | active/passive participation | One way and two way communication | low PE | Tokenism |
| **3 .Involvement** | active participation | two way communication | good/very good PE | Citizen power |
| **4. Partnership** | active participation | two way communication | very good PE | Citizen power |
| **5. Empowerment** | active participation/ independent | one way communication/two way communication | not part of the discussion | Citizen power |

# 4. Public engagement with regard to nanotechnologies in practice

In this chapter I will analyse public dialogues and engagement practices with N&N in the UK, CH and A. As outlined above, two sets of criteria were developed to allow a coherent elaboration of the different public engagement practices with N&N. First, the selected dialogues will be explained in detail to assess the context. This helps to define the purpose and objectives as well as the engagement process, by whom and how the dialogue was implemented, and what and if there was an output in terms of plans, recommendations, etc. Second, the dialogues will be characterized in terms of the level of public engagement and participation and according to Arnsteins ladder of participation (1969). Based on the case studies the implementation and understanding of public engagement with N&N will be illustrated. The aim is not only to demonstrate and evaluate which methods and tools are used, but also to show PE efforts and progress around N&N among countries.

## 4.1 The United Kingdom

In the United Kingdom, N&N emerged as a focus of public interest in 2003 (Jones, 2009). This was mainly promoted by critical comments by the Prince of Wales published in a newspaper:

*"Fears by the Prince Wales that armies of microscopic robots could turn the face of the planet into an uninhabitable wasteland have promoted the nation`s top scientists and engineers to launch an inquiry"* The Daily Telegraph (2003).

In response to the growing public discussion, the UK government commissioned the Royal Society (RS) and the Royal Academy of Engineering (RAE) to carry out a study on the environmental, health, safety and ethical aspects on nanotechnologies. The team included fourteen scholars from different disciplines, such as: mechanical engineering, environmental studies, chemistry, social science, etc.. The public was also embedded in the working process. In a civil society workshop, people were consulted and discussed issues with a variety of civil society organizations. The team prepared questions they wanted to discuss, and participants had the opportunity to help setting the meeting's agenda. Later on, there was a public consultation, where the market research company BMRB International was commissioned to research public attitudes on nanotechnologies. Two workshops with members of the public were held to explore their ideas about N&N, and to identify as well as to discuss any potential concerns or questions that might arise. A survey was conducted were the opinions of 1000 people aged over 15 years was collected. All summary reports of workshops, meetings and other oral evidence sessions were posted on the webpage (www.nanotec.org.uk), comments and evidence were requested. Further, the Royal Society and Royal Academy of Engineering called for written comments to the study. This was followed by several oral sessions, meetings and workshops. Reports were posted on the website. All individuals and organisations who gave comments and oral evidence to the study were documented by name and institution (about 200 people). The study took about one year and was conducted independently from the government. The Government was not involved in the selection of the team members nor its methods of working, and did not review the report before it was printed (The Royal Society & The Royal Academy of Engineering, 2003, pp. 95-107). Finally, a report entitled *Nanoscience and Nanotechnologies: Opportunities and Uncertainties, was* published in 2004, *and* recommended, as did other previous UK reports (House of Lords 2000; POST 2001; Cabinet Office 2002; National Consumer Council 2003 etc.), to encourage public dialogues on N&N.

In the report it says*:*

*"… we recommend that the Government initiates adequately funded public dialogue around the development of Nanotechnologies"* (The Royal Society & The Royal Academy of Engineering, 2003, p. 67).

Following this recommendation, the UK government published its *Outline Programme for Public Engagement on Nanotechnologies (OPPEN) in 2005*. The report highlighted six main aspirations for PE on nanotechnologies in the UK:

1. Enable citizens to understand and reflect on issues related to N&N through processes such as citizen involvement
2. Enable the science community and the public to explore together both aspirations and concerns around the development of N&N
3. Enable institutions working in the area of nanotechnologies to understand, reflect on and respond to such public aspirations and concerns
4. Establish and maintain public confidence in the development of technologies by understanding the public`s concerns and showing their impact on government regulation
5. Contribute to wider government initiatives to improve the general trustworthiness of science and technology related institutions
6. Support wider government initiatives to support citizen participation in public policy and service delivery (Gavelin, Wilsdon, & Doubleday, 2007, p. 20)

Further, the report suggested strategies and methods such as citizen juries, panels, participatory technology assessment, and research into public attitudes to achieve the target. Three projects were funded by the government:

- Nanodialogues;
- The Nanotechnology Engagement Group (NEG);
- Small Talk.

Participatory projects with public engagement not funded by the UK government were:

- Democs;
- Citizen Science @ Briston;
- NanoJury UK;
- Nanotechnologies, risk and sustainability;
- Nanologue;
- Nanoforum;
- Institute of Nanotechnologies;
- Global Dialogue for Nanotechnologies and the Poor (GNDP).

Some projects took place entirely independent of government funds. Most projects took place mainly between 2004 and 2007 and had different motivation for PE (UK Department for Business, Innovation and Skills, 2005; CIPAST 2008). Two of the projects mentioned above - the Institute of Nanotechnologies and the Global Dialogue of Nanotechnology and the Poor (GDNP) - will not be analysed in detail here, because the first represents an institution and not an explicit public dialogue and the second is an international dialogue which was organized by the Meridian Institute in the USA and not by a British institution.The *Nanotechnology Engagement Group (NEG)* also did not involve the public itself. However, it is briefly explained at the end of this chapter as well, because it is an important project funded by the UK government to document what was learnt from the previously mentioned dialogues on N&N.

### 4.1.1 Nanotechnology, Risk and Sustainability: Moving Public Engagement Upstream (NRS)

*Nanotechnology, Risk and Sustainability: Moving Public Engagement Upstream* which endured from January 2004 to April 2006, was a two years project organized by the Lancaster University and DEMOS. It was supported by the Economic and Social Research Council via its Sustainable Technologies Program (Lancaster Unversity, 2005). The project team involved Matthew Kearnes and Phil Macnaghten, both from the Sociology Department at Lancaster University, and James Wilsdon, the head of science and innovation at Demos as well as senior research fellow in the Institute for Advanced Studies at Lancaster University. Furthermore, the project incorporated input from journalists, scientists, members of industry and the public.

The aim of the project was to understand the social and scientific visions that are influencing nanotechnology research as well as develop opportunities for 'upstream' dialogue between scientists and the wider public (DEMOS, 2006). The main starting questions of the projects were: (1) At what stages in scientific research is it realistic to raise issues of public accountability and social concern? (2) How and on whose terms should such issues be debated? (3) Are dominant frameworks of risk, ethics and regulation adequate? (4) Can citizens exercise any meaningful influence over the pace, direction and interactions between technological and social change? And (5) How can engagement be reconciled with the need to maintain the independence of science and the economic dynamism of its applications (DEMOS, 2006)?To answer these questions the project was organized into four stages: a study of the biotechnology experience based on research and interviews with stakeholders; a study of the social assumptions embedded in nanotechnology R&D; five focus groups focused on how attitudes towards science and technology are formed, using concept boards that included definitions of nanotechnologies and three contrasting future scenarios of Nanotechnology developed by scientists and policymakers in early stages of the project; an interactive workshop (CIPAST, 2008). The focus groups were divided into five groups, each of which met twice, with a gap of one week between the sessions. Participants were recruited on the basis of their existing participation in the local community or political issues. They included a group of professional men (doctors, architects, civil servants, etc.), a group of professional women (mostly employed as middle managers in business), a mixed group with demonstrable political interests, a group of mothers with children of school age, and a mixed group with an interest in technology. The participants had no knowledge in nanotechnologies. The groups were designed to allow space for participants to develop a collective imagination on a topic that was likely to be seen as unfamiliar and esoteric. For this reason, the groups were run over two consecutive sessions. The first session began with a general discussion of new and emerging technologies, how they were affecting everyday life, in what ways they were giving rise to 'social' questions, and what people imagined to be the key issues for the future. Halfway through the session, the concept of nanotechnology was introduced. Then some everyday consumer products that had been fabricated using nanotechnology were shown to the participants. Using a set of concept boards as a stimulus, people discussed three different visions of nanotechnology: (i) a mainstream view, focused on incremental developments and economic benefits; (ii) a radical utopian perspective, which emphasised more disruptive implications for society; and (ii) a sceptical outlook, which focused on potential risks and negative social implications. At the end of the first session, participants were asked to spend the week before the next session exploring the issues with friends and colleagues, consulting websites and keeping a journal for any reflections arising. The second session explored how participants perceptions and responses had evolved through their own discussions and research, followed by a discussion of particular social and ethical dilemmas.

A second set of concept boards was designed to stimulate discussion in three areas: privacy and security, therapy and bodily enhancement, and the relationship between scientific progress and 'meddling with nature'. The session finished with a discussion of wider governance implications. A third phase involved the selection of twelve people from across the five focus groups who were willing to take part in the day-long meeting with nanoscientists at the Natural History Museum (DEMOS, 2006, S. 43-44). The aim of the organizers was to understand the underlying factors that will shape future public responses to nanotechnologies (Gavelin, Wilsdon, & Doubleday, 2007). The project ran from January 2004 to April 2006 and took place at several places such as: Lincoln University, the Cambridge Nanoscience Centre and the Department of Material Science at Oxford University. The final discussion of the project took place at the Natural History Museum in London (DEMOS, 2006). The output of the project was the report: *Governing at Nanoscale- People, policies and emerging technologies* (2006).

The dialogue process *Nanotechnology, Risk and Sustainability: Moving Public Engagement Upstream (NRaS)* used two different methodological approaches: **information** and **consultation**. Information was collected with the study of the biotechnology experience based on research and interviews with stakeholders and the study of the social assumptions embedded in nanotechnology R&D. The organization of the focus groups and the day-long meeting with nanoscientists are typical consultation methods, where citizens had the chance to ask questions and discuss the topic without any direct political influence. As reported above the aim of the organizers was to understand the factors that will shape future public response to N&N and not to active involve citizens in decision making about future N&N applications and development. According to the analytical criteria, developed in chapter 2.2.3 and 3.2 the level of public engagement has been low. There was a clear lack of power and according to Arnsteins ladder of citizen participation 'tokenism'- that allows people to be heard and have a voice but where still a lack of power exists, because people's views are often not be heeded by decision makers- was still predominant.

Table 6 illustrates the outcome. The shaded rows represent the evaluation of the programme.

**Table 6: Evaluation of NRS**

| Method | Level of Participation | Level of Communication | Valuation | According Arnsteins ladder of participation (1969) |
|---|---|---|---|---|
| **1.Information** | passive participation | one way communication | very low PE | Tokenism |
| **2.Consultation** | active/passive participation | two way communication | low PE | Tokenism |
| **3.Involvement** | active participation | two way communication | good/very good PE | Citizen power |
| **4.Partnership** | active participation | two way communication | very good PE | Citizen power |

### 4.1.2 Small Talk

*Small Talk: Supporting science communicators to facilitate dialogue about Nanotechnologies* was a three year project (between September 2004 and November 2006), funded by the UK government through a Corpus Grant scholarship and partner organisations. It was a programme of public debate activities on nanotechnology managed by Think-Lab, in collaboration with The British Association for the Advancement of Science, Ecsite-UK, the Royal Institution, and the Cheltenham Science Festival (CIPAST, 2008, Small TALK, 2006).The purpose of the project was to support science communicators to facilitate dialogue about nanotechnologies between members of the public and scientists. *Small- TALK* should help organizations and policy makers to make use of good practices when planning events about discussing N&N issues and to improve the quality of those events. Furthermore, it aimed at learning more about people's views on nanotechnologies.

In the project several engagement methods were used.

- A project website (http://www.smalltalk.org.uk/index.html)
- e-letters (regular e- letters were sent to around 50 individuals who had registered an interest in the project)

- Events (around 20 different events, attended by over 1200 participants, took place, this events ranged from large-scale debates at the Chaltenham Science Festival and Royal Institution to school visits by nanotechnology experts)
- Providing questions for event organisers, based on the issues raised in the RS/RAEng report
- Collecting opinions of audiences and speakers with the use of speech bubble postcards
- Electronic Voting (this method was used to engage students at the Young People`s Parliament event to gauge how much prior knowledge of N&N they had and to explore their attitudes regarding science and society)
- Electronic surveys (electronic questionnaires were distributed to organisers and individuals, -selected from the public -aiming to collect feedback)

*Small TALK* events took place at several different places such as schools, museums, Life Science Center, Festival of Science, Cheltenham Festival of Science, Dana Center in London, Biomedical Centre in Sweden, Royal Institution, etc.. All events with the exact date, participants, organisers and venue are listed in the final report (Smallmann & Niemann, 2006, p. 30-36). The output of the project is a webpage (www.smalltalk.org.uk/page26g.html) where all materials and information about the project is available and the final report: *Discussing Nanotechnologies- Small TALK (2006),* where project findings (such as people's view and attitude regarding N&N) are documented and also available for download. Furthermore, the report includes a transparent list of all organized events and participants. According to the authors of the final report, a main output of the three year project was that the relationship between different organizations and policymakers has improved significantly. The project *Small TALK* was presented to policy forums such as the Nanotechnology Engagement Group and the Nanotechnology Issues Dialogue Group. The project was also highlighted in the UK Government`s response to the Royal Society/Royal Academy of Engineering report: *Nanoscience and Nanotechnologies opportunities and uncertainties (2003)* (Smallmann & Niemann, 2006).

The project was mainly guided by giving and gathering **information.** Information was collected via literature research, electronic surveys and votings. Information was shared via events, project webpage and e-letters. During events citizens were actively involved in the discussion about N&N but only by asking questions to the speakers, which I characterized as an information event with a one-way communication flow. However, the aim of the Small TALK project was not to actively engage the public with N&N but rather to improve PE methods and build bridges between different stakeholders. Nevertheless, the project itself was characterized by very low public engagement, according the selected criteria in chapter 2.2.3 and 3.2.

According to Arnstein (1969) there exists a clear lack of citizen power because peoples view was only heard, but there was no direct political influence. Citizen had only marginal possibilities to actively discuss N&N related issues but could not actively take part in decision making. In table 7 the shaded rows represent the outcome of the evaluation.

**Table 7: Evaluation of Small TALK**

| Method | Level of Participation | Level of Communication | Valuation | According to Arnsteins ladder of participation (1969) |
|---|---|---|---|---|
| **1.Information** | passive participation | one way communication | very low PE | Tokenism |
| **2.Consultation** | active/passive participation | two way communication | low PE | Tokenism |
| **3.Involvement** | active participation | two way communication | good/very good PE | Citizen power |
| **4.Partnership** | active participation | two way communication | very good PE | Citizen power |

### 4.1.3 Nano Jury UK

The idea to organize a Nano Jury came from Doug Parr of Greenpeace UK and Mark Welland of Cambridge University`s Nanoscience Centre. It was the first citizen's jury on nanotechnology in Europe. Main partners of the Nano Jury were the UK Guardian newspaper as media partner, the Policy, Ethics and Life Science Research Centre (PEALS) of Newcastle University, the IRC (Interdisciplinary Research Collaboration) in nanotechnologies based at Cambridge University and the FRONTIERS Network of Excellence. The Nano Jury UK was held in West Yorkshire in June and July 2005. In contrast to most of other public dialogues on N&N - where the evaluation of people`s attitudes towards nanotechnologies was the main focus of the discussion - the organisers of the Nano Jury emphasised a questionnaire dealing with issues such as distributional justice and possible environmental effects of N&N.

Examples of questions asked by the organisers are:

- Who is shaping the agenda of nanotechnology?
- Who will benefit?
- Will it improve the lives of the many?
- Is it pro-poor?
- What will be the effect on the environment?

Furthermore, the Nano Jury was an attempt to allow an open discussion through a deliberative jury process (Singh, 2008). A citizen jury enables people to discuss and debate public issues. It works as legal jury and was developed by the Jeferson Centre (USA) in the 1970s. However, unlike a legal jury, the deliberations of a citizen jury are not legally binding. For the Nano Jury, 25 people from West Yorkshire were selected randomly from the PEALS team. Some were selected from the electoral roll and other participants were recommended by the facilitators. The aim was to involve people from marginalised groups within this area. The jurors participated in two juries, the first being on a topic of their own choice and the second on nanotechnologies. For the nanotechnology jury, 16 jurors met for two and a half hours, twice a week in a time span of five weeks between June and July 2005. During these 10 meetings scientists introduced the jurors to nanotechnology. This was followed by six `witness sessions` and the final three sessions defining recommendations. In each of the `witness sessions` the witness spoke for about 15 minutes, afterwards the jury broke into small groups and raised further questions for the witness. Some critique arouse about the fact that only the view of one single scientist is represented. It was claimed that two or more witnesses at one session should be preferred. In the end, the jurors developed a series of recommendations on the development of nanotechnologies (Pidgeon & Rogers-Hayden, 2007; Singh, 2008). The Nano Jury took place for five weeks in June and July 2005 in Caldera, West Yorkshire. One output of the Nano Jury UK was a series of recommendations which were developed by the jurors during the process. The Nano Jury gained media attention as a pioneering process of upstream engagement. Singh (2008) argues that the Nano Jury should serve as a gentle reminder of the need to ensure that PE is not an expensive public survey, or worse a marketing exercise, but a worthy attempt to strive for democracy. Unfortunately, the final recommendations of the jurors are not available for free public access.

The *Nano Jury UK is characterized* as a public **involvement** programme. In the *Nano Jury* participants were not only informed or consulted, but they were also actively engaged in identifying their concerns. During the meetings citizen were actively engaged and a two way communication flow was possible. As previously mentioned, the deliberations of a citizen jury are not legally binding. Therefore it depends upon the power holders in businesses and governments to voluntarily 'take on' the findings from the jury. According to Arnsteins ladder of participation (1969), citizen power was restricted and tokenism was still predominant. The evaluation of the *Nano Jury UK* was quite difficult, because on the one hand a citizen jury is a method which, according to literature allows a very high level of engagement (compare table 3) and should guarantee some influence on final policy solutions. On the other hand in the *UK Nano Jury* there was no direct political influence. Therefore this study does not characterize the *Nano Jury UK* as a good/very good PE event. In table 8 the shadowed rows represent the outcome of the evaluation.

**Table 8: Evaluation of the Nano Jury**

| Method | Level of Participation | Level of Communication | Valuation | According to Arnsteins ladder of participation (1969) |
|---|---|---|---|---|
| **1.Information** | passive participation | one way communication | very low PE | Tokenism |
| **2.Consultation** | active/passive participation | two way communication | low PE | Tokenism |
| **3.Involvement** | active participation | two way communication | good/very good PE | Citizen power |
| **4.Partnership** | active participation | two way communication | very good PE | Citizen power |

### 4.1.4 Nano Dialogues

The *Nano Dialogues* were organised by the DEMOS think tank and Lancaster University and were supported by a grant from the DTI's Sciencewise programme, including matched funding from other partners. It built on work funded by the Economic and Social Research Council (ESRC) (UK Department for Business, Innovation and Skills, 2005; CIPAST 2008). The *Nano Dialogues* were an experiment in public engagement, focusing on nanotechnologies. The aim was to explore public values, concerns and aspirations about N&N. Furthermore, the project should help to get to know

the values and limitations of public engagement (Stilgoe & Kearnes, 2007, p. 3). The project aimed to answer the following research questions:

1. What are the sorts of questions that are likely to determine future public responses to N&N?
2. What should PE with early-stage scientific research look like and how can Research Councils embed public values into their work? (Stilgoe & Kearnes, 2007)

The *Nano Dialogues* involved four different PE experiments:

Experiment 1 was called: At a glance: The Environmental Agency. This was a survey on nanotechnology and the environment. It took place in January and February 2006 in London. The aim was to see how members of the public understand novelty, uncertainty and regulation. For this dialogue, 13 people were randomly selected for discussions on three Saturdays (Stilgoe, 2007, p. 23).

Experiment 2 was called: At a glance: Practical Action. This dialogue took place in Harare, Zimbabwe and was a three-day stakeholder workshop with seven scientists and six community representatives. The aims of this experiment were to figure out the problem of getting clean water in two Zimbabwean communities as well as to identify the conditions under which nanotechnology might work for these communities (Stilgoe, 2007, p. 39).

Experiment 3 was called: At a glance: BBSRC and EPSRC. The aim of this experiment was to explore the potentials for PE with research council science. The dialogue took place in May and June 2006 in Swindon and Bristol, where 14 people participated. The deliberative dialogue process involved scientists, members of the public and Research Council staff. In the beginning, it was organized how citizen juries are normally organized. The participants were selected randomly and a wide range of different backgrounds were requested. A focus group methodology was developed, where people could discuss N&N issues. The sample consisted of two groups, each of which met twice, with a gap of two weeks between the sessions. A third session was organized as a final workshop where recommendations were developed (Stilgoe & Kearnes, 2007).

Experiment 4 was called: At a glance: Unilever. The aim of this experiment was to assess the potential for upstream public engagement in corporate science. Scientists were interviewed and four public focus groups and workshops were organized. In total 10 scientists and 28 members of the public participated. The dialogues took place in December 2006 and January 2007, respectively, in Port Sunlight, Newcastle and London.

The different experiments took place between May 2005 and January 2007 in London, Swindon, Briston, Port Sunlight, Newcastle and Harare. The output of the project was the report:

*Nanodialogues- Experiment in public engagement with science* which was published on the DEMOS website (www.demos.co.uk). The report includes recommendations and highlights some open questions. One main recommendation was that PE should be embedded within Research Councils decision-making structures.

In the *Nanodialogues experiment* two methodological approaches were used: **information** and **consultation**. In all four experiments people had the possibility to participate and actively discuss. In experiment 3 and experiment 4, focus groups were organized which is a typical consultation method. The *Nanodialogues experiment* was also evaluated by Dr. Jason Chilvers from Birmingham University. Chilvers (2006) argues that the project was well designed and facilitated but *"…unfortunate, however, that it did not fully meet initial expectations about encouraging participant engagement throughout the experiment and in delivering final recommendations".* Furthermore, he states that the real value of this experiment lies in its possible influence on learning about the role of PE in shaping research agendas in N&N. In table 9 the shadowed rows represent the outcome.

**Table 9: Evaluation of the Nanodialogues experiment**

| **Method** | **Level of Participation** | **Level of Communication** | **Valuation** | **According to Arnsteins ladder of participation (1969)** |
|---|---|---|---|---|
| **1.Information** | passive participation | one way communication | very low PE | Tokenism |
| **2.Consultation** | active/passive participation | two way communication | low PE | Tokenism |
| **3.Involvement** | active participation | two way communication | good/very good PE | Citizen power |
| **4.Partnership** | active participation | two way communication | very good PE | Citizen power |

### 4.1.5 DEMOCS and Citizen Science @Bristol

In the following chapter, the projects DEMOCS and Citizen Science @ Bristol will be analysed. Both projects were funded by Welcome Trust and the EU 6th Framework. DEMOCOS was organized by the new economics foundation (nef) and Citizen Science @ Bristol by the Bristol Science Center and Bristol University (CIPAST, 2008).

DEMOCOS (originally an acronym for Deliberative Meetings Of CitizenS) is a freely-available card game to enable small groups of people to engage with complex science policy issues, including nanotechnologies (ISOTOPE, 2011; nef, 2011). The game which can be played independently of any location, allows people to learn about a topic and express their views. Experts assist by writing down the information included in the game. Participants have a number of cards and are asked to pick the most important for the discussion. Participants make clusters to represent key themes and at the end they state their preferred policy position (Gavelin, Wilsdon, & Doubleday, 2007, p. 22). The game has been played six times on the topic of nanotechnologies since February 2005. It has been played five times at the Dana Centre and once at the new economics foundation (nef) offices, involving 36 to 48 people in total (UK Department for Business, Innovation and Skills, 2005).The DEMOCS card game can be downloaded for free from the nef website. Furthermore, Citizen Science @ Bristol was a project seeking to engage young people in discussions about the role of science and technology in society. Participants debate, in order to form opinions about scientific issues and their social and ethical implications, and to encourage active citizens by teaching them how to act on their views (Gavelin, Wilsdon, & Doubleday, 2007, p. 34). Citizen Science @ Bristol was a three-year programme of activities using various methods, such as: website resources, teacher´s materials and online games. The first nanotechnology event included 100 sixth-form students and was a day-long event at which DEMOCS card games were also used and plenary sessions were organized. In the end, the students voted on areas of nanotechnology they would like to see funded. They also voted on the degree of regulation they believed nanotechnologies should have (CIPAST, 2008). The DEMCOS card game activity and Citizen Science @ Bristol allowed the collection of sensitive information such as people's attitudes and opinions about N&N.

In both projects people were actively engaged in discussions about N&N. Nevertheless the level of participation and engagement was still very low, because there was neither direct output, such as a final report or a letter of recommendations, nor a link to policy-making. Therefore I decided that both projects did not go beyond the information level, which is the lowest form of PE. In table 10 the shadowed rows represent the outcome.

**Table 10: Evaluation of DEMCOS and Citizen Science @ Bristol**

| Method | Level of Participation | Level of Communication | Valuation | According Aronstein's ladder of participation (1969) |
|---|---|---|---|---|
| **1.Information** | passive participation | one way communication | very low PE | Tokenism |
| **2.Consultation** | active/passive participation | two way communication | low PE | Tokenism |
| **3.Involvement** | active participation | two way communication | good/very good PE | Citizen power |
| **4.Partnership** | active participation | two way communication | very good PE | Citizen power |

### 4.1.6 Nanotechnology Engagement Group (NEG)

The *Nanotechnology Engagement Group- Understanding public engagement with Nanotechnologies* was a two year project (2005-2007), funded through a Sciencewise programme. The NEG involved the Cambridge Nanoscience Centre, the University of East Anglia, the Policy Studies Institute, and a forum of approximately 20 people, plus a wider network of those interested in and affected by its work (UK Department for Business, Innovation and Skills, 2005). The NEG team consisted of a Core Team (Robert Doubleday, Cambridge Nanoscience Center; Malcom Eames, Policy Studies Institutes; Nick Pigeon, UEA; Faye Scott, Involve; Richard Wilsdon, Involve), a Forum (20 individuals representing projects or organizations) and a Network (100 + stakeholders) (Involve, 2005). The aim of the project was to document the outcome of six PE projects in the UK on development and governance of nanotechnologies: Nano Jury UK, Small TALK, Nanodialogues, Nanotechnology Risk and Sustainability, Citizens Science @ Bristol and Democs.

The NEG was focussed on mapping the current practice of public engagement on nanotechnologies and understanding stakeholders' expectations of public engagement with N&N. The NEG produced bi-annual reports. It was a programme of outreach, involvement and research, which aimed to ensure that the Government's programme builds upon best practice in public engagement, supports the development of that practice and ensures that public engagement feeds into policy and decision-making (UK Department for Business, Innovation and Skills, 2005; Involve 2005). The output of the project was a 172 page report: *Democratic technologies?- The final report of the*

*Nanotechnology Engagement Group (NEG)*. Although, the public was not directly involved in the NEG, it was an important step to promote public engagement in the UK because the project evaluated previous PE practices with N&N and made the process transparent.

### 4.1.7 Outcome of the UK case study

The UK was an excellent case study to analyse PE in regard to nanotechnologies for several reasons: First, STS scholars such as Richard Jones, Rogers-Hayden Tee, Nick Pidgeon and Jason Chilvers already examined PE in the UK. Secondly, the UK government commissioned the NEG which also analysed public dialogues around N&N from 2005 to 2007 and gave important insights into PE practices. In the final report of the NEG, the previously mentioned dialogues are analysed in detail. Strengths and weaknesses, as well as recommendations to the government and institutions are reported. According to Gavelin, Wilsdon, & Doubleday (2007) the different dialogues allowed the gathering of information about public attitudes towards N&N and thus provided useful insights into the aspirations and concerns that may arise, once the wider public of the UK becomes more aware of nanotechnologies and their implications. The study also demonstrated that dialogue can help the public to learn about areas of science and technology they previously knew little or nothing about. The projects: *Nano Jury, Small Talk* and *Nanodialogues* made efforts to inform the public. All three projects have reported their findings to the government and other relevant institutions. According to the NEG report, they have received mixed responses. To this date, only one institution has responded formally to its findings. The *Nano Jury* presented its recommendations to an audience of policy makers, journalists and social researchers. *Small Talk* did not write a recommendation for politicians. They gathered public views from the different events and the organisers reported their findings to the Nanotechnology Issues Dialogue Group (NIDG) and to Defra`s Nanotechnology Stakeholder Forum. The outcomes of the *Nanodialogues* were presented to several UK institutions (Gavelin, Wilsdon, & Doubleday, 2007, pp. 80-82). The NEG argues that clear definition of the purpose, aims and aspirations of the public dialogue were often missing. Jones (2009) also points out that, after reviewing a number of PE activities related to nanotechnologies, some practical and conceptual difficulties were highlighted. Sometimes a lack of clarity about the purpose of PE became apparent; this leaves space for the cynical view that such exercises are intended to not have a real influence on genuinely open decisions, but simply to add a gloss of legitimacy to decisions that have already been made. The NEG study found out, that there are still different interpretations of the term ‘policy impact’. Some participants and organizers defined policy impact as being able to see a clear link between project outputs (e.g. written reports or recommendations) and subsequent decisions or policy documentation. According to the NEG study, such direct links between PE activities and decision-making rarely happen. However, the authors believe that PE

activities influence policy and decision-making indirectly. The term ‘public’ also lacked clarity. Each previously mentioned project had its own criteria. Some people were selected on the basis of demographic criteria and were paid to be there. Other audiences were self-selected and paid a fee to attend. Some projects made efforts to involve a diverse cross-selection of the population; others did not put their focus on that issue. Therefore, the NEG recommends that for successful public engagement, it is essential that efforts are made to ensure that the participating people represent a diverse cross-selection of society (Gavelin, Wilsdon, & Doubleday, 2007, p. 83). According to the NEG, the public dialogues around N&N, also helped to make decision-making processes more transparent to the public and stakeholders, and thus increased the opportunity for groups to influence science policy. A central benefit of such PE practices is that citizens became more aware and more critical of new technologies and, often, also more interested in taking part in social and political activities elsewhere. Another main outcome of the NEG report is that the public dialogues around N&N helped to overcome negative perceptions and cultural barriers between scientists, members of the public and decision-makers, because the NEG also consulted members of the public and scientists who had negative experiences with PE. However, according to the NEG report, ten of eleven members of the public and seven of eight scientists interviewed, said that they would get involved in a similar initiative again (Gavelin, Wilsdon, & Doubleday, 2007, p. 98). The NEG argues that the challenge now is to help civil servants and others, to better understand and appreciate the different kinds of valuable impact that PE can deliver. Therefore the NEG recommends that the government should develop and disseminate a comprehensive Impacts Assessment Framework for public engagement in science and technology. A central point of criticism regarding the NEG is the **lack of clear links to nanotechnology policy-making**. In the OPPEN report, there was no overall strategy to ensure that the government`s goals for PE in regard to N&N were met, and there was also no shared definition of what success would look like. Therefore, the NEG recommends that future PE processes should be better connected to institutional decision-making. Nevertheless, according to Chilvers (2010) and Sciencewise-ERC (2010), the UK has lacked historical experiences in public dialogue practices but has witnessed a significant opening up for public dialogues contributing to science and technology policy making, especially in the past 15 years. Chilvers (2010) states that the UK has developed a leadership position in PE in a relatively short space of time. According to several scholars, this was caused by the controversies about bovine spongiform encephalopathy (BSE) and genetically modified (GM) crops, when public trust in science was very low and the UK government felt constrained to open up public discussions before final political decisions were made (see section 2.2.1) to avoid eventual public refusal. This might be the reason why, during recent years, several governmental and non-governmental institutions emphasised public dialogues around nanotechnologies. However, the public dialogues on N&N in the UK were realized beyond government departments and also through various actors, such as research councils, the Royal Society, independent research organizations,

environmental organizations (e.g., Greenpeace), science museums, universities, think tanks, etc.. Furthermore, the UK has a number of highly influential STS academics, which also contributed in emphasizing PE in the UK. All in all, my analysis of public dialogues on N&N in the UK showed that most of the events were still characterized by a **low level of PE**, which is illustrated in the following table 11.

**Table 11: Outcome of the UK case study**

| **Name** | **Method** | **Level of Participation** | **Level of Communication** | **Valuation** | **According Aronstein's ladder of participation (1969)** |
|---|---|---|---|---|---|
| Nanotechnology, Risk and Sustainability | Consultation | Yes, active citizen participation was possible | Two way communication | Low PE | Tokenism |
| Small Talk | Information | No, active citizen participation was possible | One was communication | Very low PE | Tokenism |
| Nano Jury UK | Involvement | Yes, active citizen participation was possible | Two way communication | Low PE | Tokenism |
| Nano Dialogues | Consultation | Yes, active citizen participation was possible | Two way communication | Low PE | Tokenism |
| DEMOCS | Information | The active participation was very restricted | One way communication | Very low PE | Tokenism |
| Citizen Science @ Bristol | Information | The active participation was very restricted | One way communication | Very low PE | Tokenism |

As illustrated in table 11, numerous dialogues around N&N took place; citizen **rarely had the possibility to engage actively**. Additionally, citizens were **not involved in the decision-making process**. There was **no direct political influence**.

This may relate to the political culture, where direct democracy is not a significant feature of the political system. In the UK, instruments of direct democracy are limited and rarely employed. Citizens do have the possibility to 'have a say' in the UK parliament through sending a petition, but there is no obligation that a Member of the Parliament will present the petition (UK parliament, 2011; Brown & Beynon- Jones, 2011). In the UK there is an active civil society but its impact upon policy is questionable, given the UK's tradition of closed policy networks (Brown & Beynon- Jones, 2011, p. 11). However, recently the political culture in the UK has been changing. It is evident that there is a trend towards a more transparent and participatory decision-making process. Furthermore, numerous public dialogues around nanotechnologies indicate that the UK government recognized the need for more collaboration with the public – as several controversies over BSE, GM crops or nuclear waste have shown that citizens do not uncritically accept new technologies. However, the UK government and the industry depend on citizen acceptance, which might also be a reason for the numerous dialogues around N&N that took place.

## 4.2 Public engagement with regard to N&N in Switzerland

*"It is also not 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 centre of industry and jobs, public opinion could be decisive"* (TA-Swiss, 2006c, p13)

Switzerland holds a leading position in nano-research, nanotechnology and nano industry. There are several centers of competences and research programs. A number of Swiss companies such as Novartis, Roche, Phonak and Bühler AG in Uzwil - a worldwide pioneer of industrial nanotechnology - are developing nanotechnology applications or are already working with them (TA-Swiss, 2006a; 2006b). The public perception of N&N will have a major influence on the success of new applications of nanotechnology and subsequently on the Swiss economy. In a study by Siegrsit, Wiek, Helland & Kastenholz (2007) the authors found out that, in CH, people's perceptions of the risks associated with nanotechnology were significantly higher than the expert's perceptions of the risks. This public concern about N&N may undermine public trust in the nano-industry. Consequently, the lack of trust may be a key reason why the public is often hesitant to accept new technologies. Therefore, it is not surprising that several public dialogues around N&N took place. In CH, any legislation that may be necessary for N&N, must take into account the views of the population (CIPAST, 2008). Consequently, there is a possibility that decisions about N&N that are

made in the representative system are outvoted by the public. In contrast to the UK, where direct democracy is not a significant part of the political system, CH has a long tradition of direct democracy and consultation (Sciencewise-ERC, 2010). According to Sciencewise-ERC (2010) there is a responsive climate for participation and dialogue in all policy fields in the country. For example, the TA-Swiss - a center for technology assessment - is a well-established institution which regularly prepares decision-making bases for the Parliament and the Federal Council. The TA-Swiss is financed by the Swiss Federal Government under the auspices of the Swiss Science and Technology Council and has been assessing the impact of new technology since 1992. The TA-Swiss gives regular advice to the Swiss Federal Assembly and the Federal Council (TA-Swiss, 2006b). It conducts scientific studies to capture trends and it hosts discussion forums and other participatory methods such as PubliForum, publifocus or Publitalk to involve members of the public in the debate. Politicians seem generally receptive to the results of TA-Swiss projects, and the media also disseminates findings by TA-Swiss (CIPAST, 2008). One reason for this responsive climate for participation and dialogue might be that direct democracy plays a central role in the Swiss political system. The political culture in CH is characterized by a consensus democracy. According to Sergio Beluccii (2007), the director of TA-Swiss, the institute made nanotechnology a subject of discussion already in the year 2000. Compared to other European countries, was this at a very early stage. The first scientific study called *Nanotechnology and medicine* was carried out in 2003 and represents the outcome of a three years project where experts, dealing with N&N in medicine, were interviewed. The report provided the basis for assessment, and according to TA-Swiss (2006c) it also emphasised the importance of a broad public discussion to create the prerequisites for a discriminating view on nanotechnologies. Therefore it seemed not surprisingly that two years later, the TA-Swiss carried out the *Publifocus: Nanotechnology, Health and Environment* to evaluate people's attitudes towards N&N, before the Swiss *Action Plan: Synthetic Nanomaterials* was published in 2008. Besides the efforts by the TA-Swiss, a variety of dialogues with different field of attentions concerning nanotechnologies took place. Important institutions promoting citizens dialogues and expert studies around nanotechnologies are .e g., the *Risk Dialogue Foundation, St. Gallen,* the *Innovation Society*, an internationally active management- and technology consulting company, and the *University of Lausanne.* The Risk Dialogue Foundation organized several events, conferences and public dialogues around N&N, not only in CH, but also in other European countries like Germany and Belgium. Furthermore, several publications dealing with N&N issues were published by the foundation. In CH, two important studies about N&N were carried out: The report: *Nanotechnologie im Spiegel der Medien - Medienanalyse zur Berichterstattung über Chancen und Risiken der Nanotechnologie (2003)* and the *BASF Dialogueforum Nano - Final Report 2009/2010: Information and Transparency Along the Product Life Cycle of Nanomaterials*. The Innovation Society sponsored the project: Swiss *Nano Cube,* an interactive learning platform for students and teachersand 2009 they organized *The Nano Regulation Conference*. The University of

Lausanne initiated *Nanopublic – Nanotechnologies and society,* an interdisciplinary platform which started in 2006. In the following, the previous mentioned public dialogues on N&N will be analysed.

### 4.2.1 Publifocus: Nanotechnology, Health and Environment

The *Publifocus, Nanotechnology, Health and the Environment* was organized in 2005 by the TA-Swiss with support from the Federal Office of Public Health (FOPH), the Federal Office for the Environment (FOEN) and the Zurich University of Applied Sciences Winterthur (ZHW) (CIPAST, 2008). As mentioned above, any legislation that may be necessary for N&N must also take the view of the Swiss population into account. Therefore, the TA-Swiss decided to organize a publifocus on nanotechnologies to inquire into initial public views, concerns, priorities and reservations regarding the acceptability and desirability of nanotechnologies, their regulation, and other open questions (CIPAST, 2008; TA-Swiss, 2005) such as:

- Where do citizens see opportunities for themselves, their health and the environment?
- Where do the possible risks lie?
- Does nano research cross ethical boundaries?
- Is there a need for regulation or a standardised declaration for products containing nanomaterials?

A publifocus is a method based on focus groups, which is a moderated group discussion designed to capture the range of public opinions on a defined topic (TA-Swiss, 2006, p15). The publifocus was a two-step process. The first step covered literature and internet research. This was used as a basis to determine the state of nanotechnological development and initiate the debate on opportunities and risks (TA-Swiss, 2005). The second step compromised the organization of the focus groups. The TA-Swiss organized five publifocus round-tables. Four groups made up of randomly selected citizens, covering different linguistic regions (in Winterthur for northern and western Ch, in Bern for central CH, in Lausanne for French-speaking CH, and in Lugano for Italian-speaking CH). Another group was open for interested stakeholders from different areas such as: areas of the economy, industry, the scientific field, trade unions, food production, agriculture, consumer protection and environmental protection. In total, 10,000 letters were posted to different households. The addresses were procured from a direct marketing company. Afterwards, 15 persons with different backgrounds were selected for participation. For the selection of the advisory group, a total of 33 national associations were invited. In total 16 persons were selected. After the successful selection, the TA-Swiss sent out the brochure: *"Know Your Nano!"* one month in advance, to provide the participants with information about N&N. One month later the focus groups were held. At the start, two experts gave a 15 minute introductory speech. They were also available

for questions during the discussion. A journalist recorded all publifocus events to ensure that no piece of information would get lost. All four publifocus events lasted about 4 hours (for detailed information see: TA-Swiss, 2006c).Publifocus events were held in all parts of the country during September 2006. The outputs of the *"Publifocus Nanotechnology, Health and Environment*" were:
(I) media briefings such as:

- Lay thinking about nanotechnologies and what follows from it (2006d)
- Publifocus Nanotechnologien, Chancen und Risiken frühzeitig erkennen (engl.: Publifocus nanotechnology, opportunities and risks) (2006a)

(II) the information brochure:

- Know Your Nano (2006b

and (III) final reports:

- Public reaction to nanotechnologies in CH (2006c)
- Nanotechnologien in der Schweiz: Herausforderungen erkannt – Bericht zum Dialogverfahren publifocus "Nanotechnologien und ihre Bedeutung für Gesundheit und Umwelt" (engl.: Nanotechnology in Switzerland: challenge identified- the final document of the citizen panel: publifocus „Nanotechnology, Environment and Health") (2006d)

In the *Publifocus: Nanotechnology, Health and Environment* I identified three methodological approaches: **information, consultation and involvement.** Although focus groups are not a typical involvement method, I characterized the Publifocus as an involvement programme because selected citizens had the possibility to discuss actively about future N&N applications and development and the Publifocus was held before the *Swiss Action Plan: Syntheitic Nanomaterials* was published 2008. According to literature and other studies such as Science ERC (2010) and Griessler (2011), the TA- Swiss is a well-established institution in CH which regularly prepares decision-making bases for the Government and for TA-Swiss studies, there is a responsive political climate. Therefore, by attending publifocus events, certain citizens do have power and the ability to influence the political agenda. In thable 12 the shadowed rows represent the outcome.

**Table 12: Evalutaion of publifocus**

| Method | Level of Participation | Level of communication | Valuation | According to Arnsteins ladder of participation (1969) |
|---|---|---|---|---|
| **1.Information** | passive participation | one way communication | very low PE | Tokenism |
| **2.Consultation** | active/passive participation | two way communication | low PE | Tokenism |
| **3.Involvement** | active participation | two way communication | good/very good PE | Citizen power |
| **4.Partnership** | active participation | two way communication | very good PE | Citizen power |

### 4.2.2 Nanopublic- Nanotechnologies and society interdisciplinary platform

*Nanopublic*, started in 2006 and is run by the Science-society interface of the University of Lausanne. The project is funded by the Anthropos programme, an intern scholarship, and supported by a research team from the University of Lausanne (UNIL), the Lausanne Federal Institute of Technology (EPFL) and the Institute for Occupational Health Sciences. It is a platform for dialogue between different Swiss Nanotechnology stakeholders, NGOs and citizens. The aim of the project is to set up a platform for discussion. During the project several workshops were organized, where researchers in the fields of nanotechnologies such as social sciences, engineers, representatives from private companies and NGOs attended. The aim was to debate different topics, such as research and innovation policies, governance, risk assessment and management, socio-economic and cultural issues. Furthermore, the project team organized public conferences and conducted fieldwork investigations in laboratories and private companies in order to identify which views of society were shaping the research agenda in N&N (University de Lausanne, 2011). The Nanopublic research team works at the University of Lausanne and the workshop took place at several places around Switzerland. There is no specific output or final report compared to usual projects. However, the project has an official web page (http://www.unil.ch/nanopublic/page32013.html), where publications related to Nanotechnology are available, unfortunately not for download. The web page also informs about past and future Nanopublic events.

According to my criteria, in the *Nanopublic* project only one methodological approach was used. By attending public conferences and workshops, citizens had the possibility to participate, in a way of getting informed, rather than to ask questions and to debate about N&N issues. They were not actively engaged and involved, there was no final outcome such as reports or letters of recommendations for political purpose. In table 13 the shadowed rows represent the outcome.

**Table 13: Evaluation of Nanopublics**

| Method | Level of Participation | Level of Communication | Valuation | According to Arnsteins ladder of participation (1969) |
|---|---|---|---|---|
| **1.Information** | passive participation | one way communication | very low PE | Tokenism |
| **2.Consultation** | active/passive participation | two way communication | low PE | Tokenism |
| **3.Involvement** | active participation | two way communication | good/very good PE | Citizen power |
| **4.Partnership** | active participation | two way communication | very good PE | Citizen power |

### 4.2.3 Swiss Nano Cube

*Swiss Nano-Cube* is developed and coordinated by The Innovation Society, St.Gallen, and the Swiss Federal Institute for Vocational Education and Training (SFIVET). It represents an education online platform for micro- and nanotechnology. It addresses teachers and students from vocational schools, secondary schools as well as higher professionals. The aim of the platform is to raise interest in micro- and nanotechnologies among students and to provide comprehensive and coherent information to teachers. The educational contents of this project are elaborated and implemented together with partners from industry, education, science as well as Swiss Federal Offices and governmental organizations. A detailed listing of all project partners is available at the web site. The web site (http://www.swissnanocube.ch) offers information regarding products, applications, research, development and possible risks of N&N.

The *Swiss Nano Cube* is not a public dialogue but engages citizen with its informative character. Citizens can only passively participate, therefore PE rarely exists. The aim of the Swiss Nano Cube is more to raise interest in nanotechnologies rather than to promote a critical debate. Therefore I characterized the project as a very low PE practice with a one way communication flow, and passive participation. The shadowed rows in table 14 represent the outcome.

**Table 14: Evaluation of the Swiss Nano Cube**

| Method | Level of Participation | Level of Communication | Valuation | According to Arnstein's ladder of participation (1969) |
|---|---|---|---|---|
| **1.Information** | passive participation | one way communication | very low PE | Tokenism |
| **2.Consultation** | active/passive participation | two way communication | low PE | Tokenism |
| **3.Involvement** | active participation | two way communication | good/very good PE | Citizen power |
| **4.Partnership** | active participation | two way communication | very good PE | Citizen power |

### 4.2.4 The BASF Dialogforum Nano and the Nano Regulation Conference

The *BASF Dialogueforum Nano* was organized by *BASF – The chemical company* and led by the Risk Dialogue Foundation, St Gallen. BASF is one of the world`s leading companies in the field of chemical nanotechnology and is already applying N&N in many established areas (BASF, 2008). According to the Risk Dialogue Foundation (2010), the background to this dialogue was the call for more information on nanotechnologies from policy-makers, authorities, NGOs, the media and consumers. Therefore, BASF initiated the BASF Dialogueforum Nano. The starting point for the dialogue was the following key question: *"Who should be provided with what kind of information, by what means, from whom, for what purpose and when?"* (Risk Dialogue Foundation, 2010, p. 4). In order to give an answer to this question, representatives of environmental and consumer organizations, trade unions, scientific institutes and churches worked together with employees of the chemical company BASF on various issues related to the subject of nanotechnologies. The output of the conference was the report: *BASF Dialogforum- Nano Information and Transparency Along the Product Life Cycle of Nanomaterials (2009/2010),* a recommendation on how

transparency and information can be guaranteed along the life cycles of products. The *Nano Regulation Conference* was organized by the *innovation society*, co-organized by *Nano Europe* and supported by the *Swiss Confederation*, *State Secretariat for Economic Affairs (SECO), Amt für Umweltschutz Fürstenstum Liechtenstein, Baudirektion Kanton Zürich* and *suva pro*. The conference was addressed to executive representatives from international regulatory bodies, the industry and insurance companies, scientists, NGOs, associations, politicians, the media and the interested public. The purpose of the conference was very similar to the objectives of the BASF Dialogforum. Due to the increasing calling for transparency, declaration and labelling from consumers, politicians and retailers about nanomaterials, different stakeholders should discuss what kind of nanospecific information is needed at different stages in the product`s life cycle and how this information should be delivered (the innovation society, 2009). The conference lasted for two days encompassing different fields of attentions. On the first day, different speakers gave a lecture on topics such as: political and regulatory background of nanotechnology governance on national, European and global level. The second day brought together different members of the nanotechnology value chain to discuss the topic of: who needs what kind of information. Three workshops were held to offer the participants the opportunity to point out their opinions, discuss and suggest strategic guidelines for a feasible and effective information policy along the value chain and towards external stakeholders (the innovation society, 2009). The 5th international *Nano Regulation Conference* took place in Rapperswil (CH) from 25th to 26th November 2009. There was no specific outcome. I characterized both conferences by very low public participation efforts. Interested citizens had the possibility to join the events but could only contribute to the discussion by asking questions. In the first conference the public was indirectly represented by NGOs. In table 15 the shadowed rows represent the outcome.

**Table 15: Evaluation of the Nano Regulation conference**

| **Method** | **Level of Participation** | **Level of Communication** | **Valuation** | **According to Arnsteins ladder of participation (1969)** |
|---|---|---|---|---|
| **1.Information** | passive participation | one way communication | very low PE | Tokenism |
| **2.Consultation** | active/passive participation | two way communication | low PE | Tokenism |
| **3.Involvement** | active participation | two way communication | good/very good PE | Citizen power |
| **4.Partnership** | active participation | two way communication | very good PE | Citizen power |

### 4.2.5 Outcome of the Swiss case study

The previous case study analysed five different engagement practices with regard to N&N in CH. In only two of the five PE practices, was active citizen participation possible, namely in the *Publifocus: Nanotechnology, Health and Environment* organized by the TA-Swiss and in the *Nanopublic* initiated by the University of Lausanne. The *Swiss Nano Cube* as an online platform is a good project to inform citizens about N&N applications and developments and therefore this project can also be seen as an important tool to support PE with science. Nevertheless, citizens were not able to actively participate. In the *BASF Dialogforum Nano* the public was indirectly represented by NGOs and consumer representative's organizations. Citizens were able to join the *Nano Regulation conference*, however, the day fee was very expensive and active participation was not possible. The following table 16 summarizes the outcome of the Swiss study, whereby it can be said that most of the public dialogues around N&N are characterized by a low level of PE. The purpose of most of the dialogues is information and education, rather than to incorporate the public in the decision process. According to Aronstein's ladder of citizen participation (1969) four of five public dialogues are still guided by "tokenism". Only the *Publifocus: Nanotechnology, Health and Environment* initiated by the TA-Swiss made active citizen participation possible. Citizens were not only restricted to join a certain event and "have a say", but rather the outcome of the dialogue was reported to Parliament and the Federal Council. As reported in literature there is a very responsive political climate for TA-studies. Therefore, by attending publifocus events, citizens have the power to influence decisions about future N&N development.

**Table 16: Outcome of the Swiss study**

| Name | Method | Level of Participation | Level of Communication | Valuation | Accoding to Arnsteins ladder of participation (1969) |
|---|---|---|---|---|---|
| Publifocus: Nanotechnology, Health and Environment | Involvement | YES, active participation was possible | Two way communication | Good/very good PE | Citizen Power |
| Nanopublic | Information | Active citizen participation was very limited | One way communication | Very low PE | Tokenism |
| Swiss Nano Cube | Information | NO, active participation was possible. | One way communication | Very low PE | Tokenism |
| BASF Dialogeforum Nano | Information | NO, active participation was possible | One way communication | Very low PE | Tokenism |
| Nano Regulation conference | Information | NO active participation was possible | One way communication | Very low PE | Tokenism |

## 4.3 Austria

*"In Austria we have to do as if the public is involved, but in fact it does not happen" (interview 3)*

In contrast to CH and the UK, the techno-political culture in A has little tradition in public discussions on science and technology policies (Felt und Fochler, 2009). While in other European countries citizen dialogues are seen as 'good governance practices' and good forms, not only to enable a better understanding about the fears and hopes of a society, but also to gain important insights to possible social and ethical concerns of N&N. In Austria such practices are not common and marginal attention has been given to promote citizen dialogues concerning nanotechnologies, even if the scientific community points out the importance of public participation (interview 2, interview 3).

The CIPAST (2008) study, which compares different PE practices in Europe, also highlights that *"In several countries, investigations of aspects of risk, societal and ethical issues of N&N have been conducted, and the European Commission explicitly called for «the incorporation of the societal dimension». So far, Austria has seen few such efforts"* (CIPAST, 2008, p.23). This lack of research and awareness of ethical, legal and social aspects of N&N might be the reason, that compared to CH and the UK, A is not an innovation leading country. In a study by the EU Scientific and Technical Research Committee (2008) the authors argue that: *"Austria ranks as an 'innovation follower' rather than an 'innovation leader" (*CREST, 2008, p. 4). However, the European trend which calls for more PE on techno-scientific issues did not pass over Austria. Therefore, the Austrian Government (2011, p.4) declared in its new strategy for research, technology and innovation (RTI) that a dialogue between science, business and society is needed to achieve the goal to move up from an "innovation follower" to the position of "innovation leaders" and states:

*"If knowledge today represents society's most important resource, then the production of know - ledge and its distribution becomes a crucial societal function. Science, as the institution of knowledge production, therefore faces the challenge of reporting on its activities to society. Dialogue is demanded, and participation, transparency and responsibility are expected. The relationship between science and the public has shifted fundamentally in recent decades and actively shaping this relationship has become a task for policy management. It revolves around "scientific citizens", citizens who have the right to be informed about science and technology, as well as make decisions about it"* (The Austrian Federal Government, 2011, p.44).

The previous quotation can work as an indicator, that the Austrian Government has recognized the importance of public understanding of science (PUS) and PE when it states: "*citizens who have the right to be informed about science and technology, as well as make decisions about it"*, compared to previous official documents such as "Grünbuch zur Österreichischen Forschungspolitik" (1999) where PUS and PE with regard to science have not yet been a big issue of interest. Recent policy documents have demonstrated that in Austria scientific policy is becoming increasingly important (Fochler and Müller, 2006) and therefore, interest in emphasising public dialogue with scientific issues rises. The brochure "Land of Research" by the Federal Ministry for Transport and Innovation and Technology (bm:bmk) also highlights that fact and states: *" Dialogue with the public will become an indispensable element…"* (bm:bmk, 2006, p.20). Therefore it is not surprising, that a key package of the Austrian Nanotechnology Action Plan is also *"… to developing cooperation and reinforcing the dialogue and transparency among all stakeholders, including the general public*" (Federal Ministry of Agriculture, Forestry, Environment and Water Management, 2009, p.4).

However, what is the Austrian understanding for public dialogue? In a study by Fochler and Müller (2006) the authors also draw attention to this question and found out that the Austrian interpretation of *"dialogue"* - as a way of communication - is very limited. In a way that the public is not seen as an equal communication partner but rather as extend of people who should be informed and enlightened.

The authors argue that in Austria public dialogues are often used:

- to inform citizens,
- to enlighten citizens,
- to reach consensus and,
- to educate citizens,

but not to emphasize an interactive learning process between the participants (Fochler & Müller, 2006, p.14-19). Compared to CH and the UK, where several public dialogues and engagement efforts around N&N have taken place, this study only identifies two appreciable projects with PE efforts around N&N in Austria. The *dialogue on nanotechnology within the initiative Risiko: dialogue* and *NanoTrust.*

### 4.3.1 Dialogue on nanotechnology within the initiative Risiko: dialogue

The project was founded by the Umweltbundesamt as well as Radio1 and was supported by the Federal Ministry of Science and Research, the Federal Ministry of Economics and Labour, the Federal Ministry for Transportation, Innovation and Technology, the Federal Ministry of Agriculture, Forestry, Environment and Water Management, the Austrian Research Promotion Agency, the University of Natural Resources and Applied Life Sciences, Verbund Austrian Power Grid AG and the newspaper *DER STANDARD* (Umweltbundesamt, 2008, p.31). The aim of the project was to discuss the positive and negative impacts of N&N with representatives of science, public administrations, regulatory bodies, the economy, NGOs, media and civil society (Umweltbundesamt, 2008, p.31). Different events such as a radio show and podium discussions took place between September 2007 and Oktober 2008 (Umweltbundesamt, 2008, p.31). There was a radio programme on Radio Österreich 1 called "Radio Kolleg" from the 3rd to the 6th December 2007. A "Kinder Uni", a format addressing the topic of discussions and experiments with experts and children and a panel discussion on 5th December 2007 where five experts (Wolfgang Heckl, Deutsches Museum; Andreas Kovar, Kovar & Köppl Public Affairs; Antonia Wenisch, Österreichisches Ökologieinstitut; Wolfgang Luther, Verein Deutscher Ingenieure; Antje Grobe, Stiftung Risikodialog Schweiz) discussed N&N. About 100 people joined the panel discussion (Umweltbundesamt, 2008, p.33-36). On the 6th of December a stakeholder workshop took place to discuss how to improve communication concerning N&N. About 145 representatives from different organisations were invited. The output of the project was the report *Nanotechnologie im Risiko:dialog*, which is a summary of the dialogue. There was no recommendation for the industry or politicians. The project can be clearly identified as an information event which is characterized by a very low level of participation. In a study by Hauser, Gazsó and Kaiser (2010) the authors came to the same results and argue that informational events such as the *dialogue on nanotechnology within the initiative Risiko: dialogue,* rarely qualify as a dialogue even they are labelled as 'dialogue'. In table 17 the shadowed rows represent the outcome.

**Table 17: Evaluation of Risiko: dialogue**

| Method | Level of Participation | Level of Communication | Valuation | According to Arnsteins ladder of participation (1969) |
|---|---|---|---|---|
| **1.Information** | passive participation | one way communication | very low PE | Tokenism |
| **2.Consultation** | active/passive participation | two way communication | low PE | Tokenism |
| **3.Involvement** | active participation | two way communication | good/very good PE | Citizen power |
| **4.Partnership** | active participation | two way communication | very good PE | Citizen power |

### 4.3.2 NanoTrust

*NanoTrust* was originally designed to be a three year project (2007-2010) but was extended for three additional years (2010-2013). It is carried out by the Institute of Technology Assessment (ITA) and funded by the Ministry of Transportation, Innovation and Technology (BMVIT). The project team consists of three full-term scientists and one project leader, all working at the ITA. The aim of the project is to continually survey, analyse and summarise the state of the knowledge regarding potential health and environmental risks of nanotechnologies. Further on, *NanoTrust* was supposed to promote a discussion about N&N with the research community and the general public (Gazsó, 2009). *"For the first time in Austria, these important aspects of technology development will be under systematic scrutiny and beyond single R&D projects, that is investigated on a meta level"* (CIPAST, 2008, p. 28). For the distribution of information, the ITA offers a web site where literature about the current research topics about N&N is available for download. The web site also informs about past and previous events.

The web site offers:

- Literature database
- Link collection, FAQ, glossary
- Event programme

The ITA also organizes events of different formats such as: public conferences, workshops on specific subjects and has conducted presentations on national and international events (Gazso, 2009, ITA, 2009). Compared to other projects, such as the *Swiss Nano cube* the *NanoTrust* project does not have its own web site. Information about the project and publications are available at the ITA web site (http://nanotrust.ac.at/projekt.html).The main output might be the dossiers which are short summaries of the recent state of knowledge about a specific N&N topic. The target audience are political decision makers, science journalists and the interested public. Although *NanoTrust* is a very comprehensive, long-running project, which uses several different channels to reach the public, the level of public participation and communication is very low. The aim of the project was not to involve the public; primarily it was initiated as a research project (interview 11). *NanoTrust* does not offer the possibility to be engaged actively. The interested citizens can only read the dossiers and join some workshops, therefore, they can only passive participate. In table 18 the shadowed rows represent the outcome.

**Table 18: Evaluation of Nano Trust**

| **Method** | **Level of Participation** | **Level of Communication** | **Valuation** | **According to Arnsteins ladder of participation (1969)** |
|---|---|---|---|---|
| **1.Information** | passive participation | one way communication | very low PE | Tokenism |
| **2.Consultation** | active/passive participation | two way communication | low PE | Tokenism |
| **3.Involvement** | active participation | two way communication | good/very good PE | Citizen power |
| **4. Partnership** | active participation | two way communication | very good PE | Citizen power |

The *dialogue on nanotechnology within the initiative Risiko: dialogue* and *NanoTrust* are both excellent examples, which particularly highlight the Austrian understanding of *'dialogue'* as explained previously by Fochler and Müller (2006). It can be said that the first barely qualifies as a dialogue (Hauser, Gazsó , & Kaiser, 2010). The labeling *'risiko'* and *'trust'* already determines the discussion in advance, in a way that the scope of the dialogues is firstly about potential risks and secondly to build trust in N&N. Such a dialogue setting does not allow for debates about whether a future with N&N is even wanted or not. This question has already been answered with *'yes'* and the

public can only participate by asking questions to the experts and reading information brochures such as the Nano dossiers. Both projects have more an informative and educational purpose rather than a participative (interview 4, interview 11).

### 4.3.3 The Austrian Nanotechnology Action Plan

The Austrian Nanotechnology Action Plan (ANA) was developed in 2009 mainly by representatives from different ministries. NGOs and consumer organizations were rarely represented (compare: Federal Ministry of Agriculture, Forestry, Environment and Water Management, 2009, p.83). The Nanotechnology Action Plan was open for a three week online consultation where several organisations and interested citizen could take up a position. To involve the public in the discussion about N&N a Nanotechnology Information Platform (NIP) which integrates knowledge of various experts is in progress. The main interest of the NIP is to collect process and disseminate information related to N&N (Lebensministerium, 2009, p.4). Even the NIP is already not accessible for the wider public during the development - PE within ANA was possible. Interested citizens had the chance to take up a position via an online consultation.

**Table 19: Evaluation of ANA**

| Method | Level of Participation | Level of Communication | Valuation | According to Arnsteins ladder of participation (1969) |
|---|---|---|---|---|
| **1.Information** | passive participation | one way communication | very low PE | Tokenism |
| **2.Consultation** | active/passive participation | two way communication | low PE | Tokenism |
| **3.Involvement** | active participation | two way communication | good/very good PE | Citizen power |
| **4. Partnership** | active participation | two way communication | very good PE | Citizen power |

In following, I will quote some statements from the online consultation. The first statement is from a representative of the Austrian consumer Information Association (VKI) and the second from an interested citizen.

*„Als Vertreterin einer NGO, die sich an der Erstellung des Österreichischen Nano-Aktionsplan "intensiv beteiligt" hat (S.22 des Entwurfs), wende ich mich entschieden dagegen, dass auf Seite 65 beim "Monitoring des Aktionsplans" (desgleichen bei anderen Maßnahmen, wie Vernetzungen etc.) von NGOs keine Rede mehr ist - dieses soll von "Politik, Ministerien und Sozialpartnern" erfolgen. Es ist sicher nicht zielführend, wenn der Eindruck entstehen würde, dass NGOs zur Mitarbeit und Diskussion eingeladen werden, aber bei der Konkretisierung der Schlussfolgerungen bzw. deren Begleitung kein Mitwirkungsrecht haben“* (Stark, 2009).

(In engl.: As a representative of an NGO, which was “intensively involved” at the development of the Austrian Nano-Actionplan (S.22, draft) I object to the fact, that on page 65 when it comes the “Monitoring of the Actionplan” there is no mentioning of the involvement of NGO`s, - that should be done by the politicians, ministries and the social partners. It is unrewarding if there is the impression that NGO´s are invited to contribute and discuss at the beginning but aren`t involved in the end to contribute to the conclusion”.)

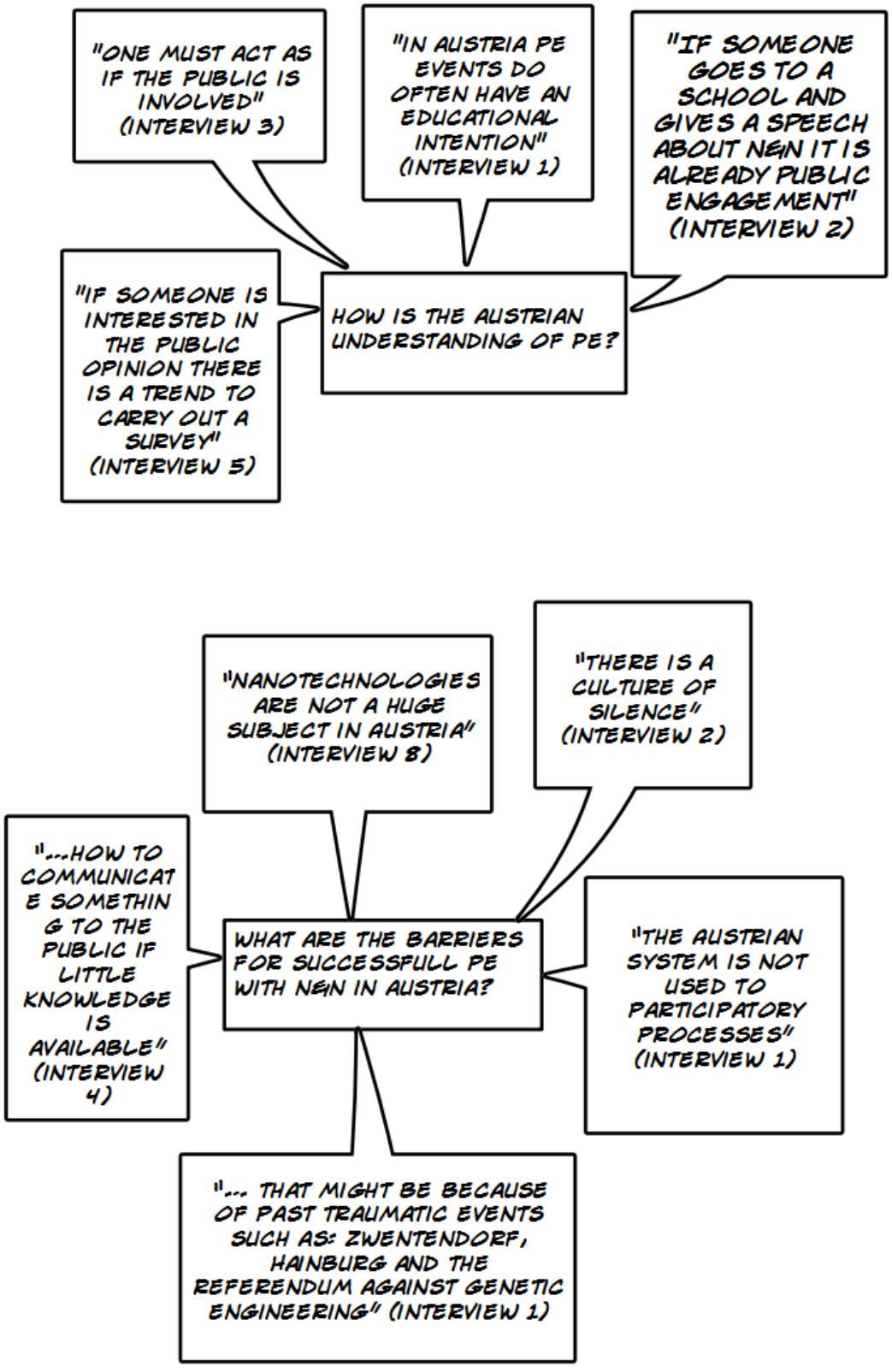
The following statement also points out that even the Action Plan calls for more public involvement and cooperation between different stakeholders; during its development little attention was given to involve the public. *„Es wird immer alles ohne den Verbraucher / Kunden entschieden für den dass eigentlich gemacht werden soll. Bedauerlich, dass daher im Redaktionsteam keine Verbraucher eingeladen wurden“ (*Rescheneder, 2009). (In engl.: Decisions are always made without the contribution of consumers and clients, even those who are concerned. Unfortunately, no consumers were invited to be part of the editorial team”. )

**What are the reasons of the evident low effort to engage Austrian population with nanotechnologies?**

One reason might be that in A, compared to the UK and CH, important infrastructure is missing (interview 1). What institution should organize PE events such as a citizen jury or a publifocus? And who should financially support it? From a political perspective, there is little interest in engaging the public (Interview 5). The Austrian system is still very traditional and there is the predominant perspective that if the social partners are asked, the public is asked (Interview 8, Interview 9). Ministries might be afraid to loss power if the public is involved and do not know how to deal with the outcome of such PE events (Interview 1, Interview 7).For example, in Austria 2003 the first citizen conference ‘genetic data’ was initiated by the Austrian Council on Research and Technology (RFT) and organized by the agency communication matters. The output was a report with a

summary and recommendations which was sent to all members of the parliament, in total 165 persons and to Elisabeth Gehrer, the former Minister of Education. The return rate was very low and negative. Only the former president of the council, Andreas Kohl answered, but after an invitation and a photo-shooting nothing happened. In fact, Kohl, a president of the council who claims that citizen participation is important, did not ask one single question about the outcome of the citizen conference. On the part of politicians, there was no interest at all (Interview 5). A good example of the Austrian understanding of *'public participation'* is also the procedure of the Bioethical Commission. The only possibility for the public to be engaged is by attending certain information events, whereby most of the events are mainly visited by members of the Bioethical Commission itself, and in the best case by a handful of interested people. Furthermore, the Bioethical Commission does not publish its records of meetings and does not hold public hearings (Interview 1), which is in contrast to the UK common practice. As illustrated, in A public participation does not have any tradition; therefore it is not surprising that in the debate about N&N the public is not involved at all. This dilemma is also well represented in the ANA where public participation is only an empty phrase. The government has to act as if the public is involved, but in fact it is not. This is very problematic, because we pretend to do something what in reality does not happen (Interview 3). Following thought bubbles reflect some of the main statements from the interview partners about the Austrian understanding and barriers for PE with N&N

**Figure 7: Thought bubbles of the understanding and the barriers of PE with N&N in A**



### 4.3.4 The outcome of the Austrian case study

It can be stated that Austria has a very traditional understanding of PE with nanotechnologies, which is limited to the organization of information events such as dialogues on nanotechnology within the initiative *Risiko:dialogue* and awareness-raising campaigns with an educational purpose such as *NanoTrust*. Both projects are characterized by a very low level of PE which is illustrated in table 20. When generating the ANA (2009), NGOs and consumer representative organizations, that indirectly represent the public, were also rarely involved. Although, the Europe 2020 strategy explicitly calls for more public participation, in A such efforts with nanotechnologies cannot be figured out yet (interview 8). The Austrian case study on PE concerning N&N is not in accordance to the Federal Ministry of Agriculture, Forestry, Environment and Water Management, when it states that *"The path Austria has taken in the field of nanotechnology goes hand in hand with recommendations and developments at an European and international level which clearly call for an improved dialogue and more cooperation among the decision-makers in public institutions, science, business and other stakeholders"* (Federal Ministry of Agriculture, Forestry, Environment and Water Management, 2009, p.6). The outcome of this analysis is that the current development in Austria does not go hand in hand with developments at European level, which clearly brings up the need for improved dialogues and more cooperation.

**Table 20: Outcome of the Austrian case study**

| Name | Method | Level of Participation | Level of Communication | Valuation | According to Arnsteins ladder of participation (1969) |
|---|---|---|---|---|---|
| Dialogue on nanotechnology within the initiative Risiko:dialogue | Information | Passive participation | One way communication | Very low PE | Tokenism |
| NanoTrust | Information | Passive participation | One way communication | Very low PE | Tokenism |
| The Austrian Nanotechnology Actionlan | Consultation | Active/Passive participation | Two way communication | Low PE | Tokenism |

# 5. Comparative Findings and Conclusion

The three case studies have shown, that compared to A, in the UK and CH, significantly more public dialogues and PE efforts with N&N took place. Methods such as consultations, surveys, information events, workshops and educational web pages are the most common tools used for engaging the public with N&N. However, this study also concludes that, doing more PE doesn`t necessarily mean better PE. As illustrated in table 21 most of the PE practices characterized among the countries are still guided by a low level of public engagement.

**Table 21: Country comparison**

Level of public engagement is increasing →

| Country/Method | 1.Information | 2.Consultation | 3.Involvement | 4.Partnership |
|---|---|---|---|---|
| UK | 3 | 2 | 1 | 0 |
| CH | 4 | 0 | 1 | 0 |
| A | 2 | 1 | 0 | 0 |

Furthermore the study indicates that most of the public dialogues around N&N analysed are characterized by a one-way communication rather than a two-way communication flow. Austria shows the lowest level of PE around N&N which might be because of the political culture and the economic impact as well as due to the lack of established institutions dedicated to PE and a small STS-scholar's community. CH and the UK have an influential STS-community and well established institutions dedicated to PE. In A, compared to the UK, the STS scientific community is relatively small (ITA, 2006, p.56). STS-scholars such as Ulrike Felt and Maximilian Fochler from the University of Vienna, Erich Griessler from the Institute of Higher Education, Andre Gazsó and other scholars of the Institute of Technology Assessment (ITA) investigate PE practices but all in all, little attention has been given to this topic. The political culture and the economic impact of N&N also vary among countries. While CH has a leading position in nano-research and nano-industry, A does not have such an infrastructure and acts as an 'innovation follower' rather than an 'innovation leader'. Public acceptance for N&N is essential for the Swiss and UK economy. While CH has a long tradition in direct democracy and consultation, there is always the threat that decisions can be overruled by the public. In the UK and A, direct democracy is not a significant feature but media

attention to N&N has been much higher in the UK than it has been in A. As illustrated in the UK case study, the government is afraid that negative reporting on N&N could lead to refusal by society. The UK was particularly traumatized by controversies over BSE and GM grops. A very persuasive argument for the UK's emphasis on public dialogues around N&N might be to build trust in this new technology. The analysis of the different public dialogues also found out, that most of the public engagement practices had an informative and educational purpose rather than a participatory. Only the *UK Nano Jury* and the *Swiss publifocus* are characterized as public involvement programs, where citizens were actively engaged. However, the outcome of the *UK Nano Jury* was not binding and therefore citizen power was still restricted. The *Swiss Publifocus: Nanotechnology, Health and Environment* must be figured out, by its character, as the best practice on PE with N&N, for two reasons: firstly, because it is, next to the *UK Nano Jury,* the only PE practice where active participation and citizen involvement was possible, and secondly, because literature review has shown that there is a very responsive climate for TA-studies. So citizens are in power and have the ability to influence the political agenda.

Nevertheless, the study found out that **most of the PE activities around N&N did not directly involve citizens in decision making and there was no direct political output**. I agree with Arnsteins argument that if the outcome of dialogues do not have a political influence, not even if it is a very small influence (e.g. that it is mandatory that civil petitions respectively recommendations are presented by Members of the Parliament), then PE events are frustrating for the participants because no redistribution of power takes place and power holders may claim that all sides were considered, however, status quo does not change. Therefore I also agree with scholars such as Felt (2010), Rogers Hayden (2009), Wilsdon (2007) and Wilsdon and Willis (2004) that PE is not only about good communication and enlightenment, but rather institutions must give a voice to citizens and the outcome of such dialogues must influence the political agenda. However, this study found out that the motivation to involve the public in the risk communication process about nanotechnologies was mostly an instrumental rational, aiming to build trust in N&N and gather information about people's attitudes and concerns. Rather to actively engage citizens in the decision making process about N&N according to democratic ideals which is a substantial and a normative rational for PE with N&N. Finally, the study also concludes that 'rules' and standards for PE are missing and that there is a high potential that, PE with N&N is misused in risk governance politics to convince citizens and trivialize hazards and risks in order to archive acceptance and improve industrial competitiveness.

# 6. Recommendations

In this section I want to give some recommendations that have emerged from this research. As mentioned above there is a high potential that PE with N&N can be misused in risk governance politics to convince citizens and trivialize hazards and risks in order to archive acceptance and improve industrial competitiveness. Therefore I argue that, PE with N&N:

- should be embedded with Research Council decision- making structures;
- should be done before significant research and development decisions are made;
- should allow a broad framing of the issue;
- should be well documented and evaluated;
- should actively engage citizens;
- should allow a two way communication flow;
- should be integrated in political decision making;
- should be done by organizations independent from industry and politics.

Further, I recommend that the science community, politicians and employees of ministries need skills and knowledge for PE with science. According to democratic ideals, society should be more involved in decision making, but especially in Austria important infrastructure and independent organizations – such as the TA- Swiss, for example- are missing.

In summary, I recommend to the government:

- the government should be more focused on how citizens can be engaged more actively to take part in social and political activities;
- the government should develop a ‘plan’, how independent financial support for PE activities might be possible;
- the government should ensure that, if NGO´s or consumer representative organizations are invited for a hearing that they get financial supported for their time;
- the government should improve the cooperation with the science community- a better relationship between this two partners might improve significantly the outcome for future Action Plans.

In summary, I recommend to the science community:

- the science community should focus on research how PE with science might be improved;
- as PE with N&N is an interdisciplinary issue the science community should as well improve the cooperation with the government, the industry and private organizations;
- STS- scholars' should work on how PE can be embedded with Research and Council decision making structures;
- the science community should as well work on how successful PE could be evaluated, at the moment there is a clear lack of academic literature.

As stated in the beginning: *"Public engagement and Risk governance of Nanotechnologies- revolution or illusion?",* I argue that, public engagement with N&N is a highly interdisciplinary issue, which can only become revolutionary if different stakeholders work together and if the public is seen as an equal partner. Science communication is not complicated and social and ethical questions such as: Do we want this technology? Who will benefit from this technology? Will it improve the lives of the many?, are questions, that can be discussed also by people without an academic background. However, it is the duty of a government and the science community to guarantee that methods for successful PE with N&N are developed. And, that citizens are more involved in decision making processes, especially when it is about a technology which is predicted to shape the live of every individual.

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# 8. Annex

This appendix includes an alphabetic list of all interview partners for the Austrian case study.

**Interview partners**

**MMag. Dr. André Gazsó,** works at the Institute of Technology Assessment in Vienna. He participated in several EU Concerted Actions ("Biomedical Ethics", 1997/98 and "Trustnet2", 2001/2002, the EU-project "Trustnet in Action" (TIA), since 2003 and Nanotrust, 2008). Main research interests include risk communication and technological change, especially the relationship between scientists and non-scientists (expert-lay-dilemma, public understanding of science). Furthermore he gives lectures on Risk Theory at the University of Vienna and is co-author of the book: Nano: Chancen und Risiken neuer Technologien (2007).

**Dr. Erich Griessler,** works at the Institute of Advanced Sciences in Vienna. His research fields are in the area of social studies of science and technology with a focus on the development and regulation of transplantation, xenotransplantation and stem cell research as well as participatory efforts such as pTA and PE in these areas. Recently he worked on the project: Impact of Citizen Participation on Decision Making in a Knowledge Intensive Policy Field (2009-2011).

**Univ. - Prof. Dr. Ulrike Felt,** works at the University of Vienna. Her research area is public understanding and up-take of science, science policy, science and technology and institutional development. She published several papers on Nanotechnology and society and works currently at the project: Making Futures Present: On the Co-production of Nano and Society in the Austrian Context (2008-2012).

**Dr. Maximilian Fochler,** works at the University of Vienna. His dissertation was dedicated to “Participating in which kind of governance” where he analyzed the perspectives and possibilities of citizen`s participation within the life sciences. His main research interest is the relationship between techno-science and the public. He analyses as well the relationship between science and democracy and the governance of innovation processes.

**Dr. Veronika Haunold,** joined 2008 the EU-Environmental Bureau in Vienna as head of department. Previously she worked for the Austrian Railway Association ÖBB and as lobbyist for NGOs on EU policy issues in Brussels. As head of the department of the EU- Environmental Bureau she has experience with European environmental politics and functions as point of intersection between European and Austrian environmental politics. Nanotechnologiess are also one of the research areas of the institute.

**Dr. Stefan Hanslik,** works at the Federal Ministry for Science and Research. He was a member of the editorial team of the Austrian Actionplan on Nanotechnology (2009).

**Dr. Thomas Jakl,** is the Director of Austrian Ministry responsible for environmental protection relating to Chemicals Policy and the Chairman of European Chemical Agency (ECHA). His field of activity includes legislation on chemical substances at the national, European and UN level. He contributed to the Austrian Actionplan on Nanotechnologies(2009) as part of the editorial staff.

**Dr. Katja Lamprecht,** works at the Umweltbundesamt in Vienna and was responsible for the project management of the dialogue on nanotechnology within the iniative Risiko: dialog.

**Mag. Peter Menasse,** has long experience in media relations, lobbying, science PR and strategic communication consultancy. In 1998 he was spokeman for Caspar Einem, Austrian Minister of Science and Transport. Furthermore he taught several courses on lobbying and PR at the University of Salzburg and Vienna as well as on science and communication at the Institute for Interdisciplinary Research and Continuing Education, Vienna. Since 2010 he is shareholder in the communication firm: communication matters. In 2003 he organized on behalf of his agency the "BürgerInnenkonferenz": "Genetic data- wherefrom, whereto, where for? It was the first consensus conference at national level in Austria.

**Dr. Susanne Stark,** works at the Verein für Konsumenteninformation in Vienna. Her focus lies on projects such as: Regulation of nanomaterials.

**Dr. Doris Wolfslehner,** works as head of the field office of the Bioethical Commission in the Office of the Federal Chancellor in Vienna. Before that she carried on a job at the European Commission as constant delegate at the Center for Migration and Policy Development.

The following table summarizes the interview partners. To preserve anonymity, the synonyms interview 1 to interview 11 for each interview partner is used.

**Table 22: Interview Partners**

| First name | Last name | Academic title | Institution | Date of the interview |
|---|---|---|---|---|
| Katja | Lamprecht | Dr. | Umweltbundesamt | Vienna, 23.11.2011, 12:00 |
| Ulrike | Felt | Dr. | University of Vienna | Vienna, 23.11.2011, 10:45 |
| Erich | Griessler | Dr. | Institute for Advanced Studies, (IHS) Vienna | Vienna, 07.11.2011, 13:00 |
| Doris | Wolfslehner | Dr. | Bundeskanzleramt, Geschäftsführerin der Bioethikkomission | Vienna, 08.11.2011, 10:00 |
| Susanne | Stark | Dr. | Verein für Konsumenteninformation (VKI) | Vienna, 17.11.2011, 10:00 |
| Veronika | Haunold | Mag. | EU- Umweltbüro | Vienna, 21.11.2011, 10:00 |
| Peter | Menasse | Mag. | agency: communication matters | Vienna, 14.11.2011, 10:00 |
| Stefan | Hansik | Dr. | Federal Ministry for Science and Research | Vienna, 25.11.2011, 14:00 |
| Thomas | Jakl | Dr. | Federal Ministry of Agriculture, Forestry, Environment and Water Management | Vienna, 06.12.2011, 10:30 |
| Maximilian | Fochler | Dr. | University of Vienna | Vienna, 23.11.2011, 10:00 |
| Andre | Gazsó | Dr. | Institute of Technology Assessment | Vienna, 25.01.2012, 12:00 |