Public dialogues on nanotechnology in a STS perspective: The social construction of a governance technology

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Abstract

In recent years, there is increasing attention for the engagement of the public with science and (emerging) technology. In academic literature, public engagement with science (PES) is often perceived as the new and royal road for a responsible development of technology. Also in society, there is an increased implementation of PES projects in various formats and on several levels of policy-making. Large parts of literature focus on the normative discussion on PES. However, a smaller portion discusses how PES projects play out as a result of the perceptions and the interactions of the various actors involved. This study aims to provide a better understanding of the way PES is adopted by the involved actors and how this relates to the intended format of the organizers. The inquiry focuses on a specific project: the Dutch 'Nanokaravaan'. This is one of the first public dialogue events on nanotechnology in the Netherlands and is organized by five science cafés.

In this thesis, a social constructivist approach is developed to explore the social shaping of PES. Initially, PES projects are 'designed' in a specific way as an instrument to facilitate certain social interactions. Hence, this thesis conceptualizes PES as a specific type of technology, namely a 'governance technology'. On the basis of this analogy, the inquiry draws on conceptual and methodological insights from technology studies. The approach is mainly based on the social construction of technology (SCOT) approach. SCOT focuses on the way a new technology is constructed by its attributed meanings. These meanings matter substantially for how a technology is constructed and adopted. The first part of the developed social constructivist approach focuses on the attributed meanings of the Nanokaravaan by the involved actors. The second part analyzes the social construction of the project as the result of the meanings that the actors attach to their own roles and those of others in setting up public engagement.

The empirical inquiry examines three meetings by separately interviewing an organizer, an invited speaker and two visitors. The Nanokaravaan is intended as an informal and open dialogue, but the analysis showed that the format of the Nanokaravaan holds much interpretative flexibility. Although the formats of the meetings had much in common, it appeared that different factors influenced the actual public engagement during the meetings. The main factors were: the 'stage' setting of the speaker; the structuring of the interaction by the organizers and the speakers; and the urgency of the discussed topic. Finally, these findings showed that the Nanokaravaan holds openings for public engagement but these openings needed effort.

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1. Introduction

In the context of the governance of new and emerging technologies, there is increasing attention for the relationship between science and the public[1]. From the 1990s onwards, the dominant approach to the conceptualization of this relationship has changed more and more from a public understanding of science (PUS) approach into a public engagement with science (PES) approach (Dijkstra, 2008). Instead of trying to turn public attitudes towards science more positively by raising their knowledge, in the latter approach public engagement is perceived as the royal road to improve the science-public relationship (Sto et al, 2010). Increasing public engagement is seen as a need to realize a two-way exchange of insights between experts and the public on the regulation of technological developments (Hanssen, 2009). The PES approach on the science-public relationship is not only a turn in contemporary academic literature. It has also resulted in the increased implementation of public engagement projects that have various formats. This development has introduced new ways of interaction between science and the public.

While large parts of academic literature on public engagement take a normative perspective in analyzing the formats of PES activities, there appears to be an empirical gap on PES. Only a small part of literature has focused on how these formats play out in social practice as a result of the perceptions and the interaction of the various participants involved (Scope 2009; Carpini 2004; Delgado et al. 2010; Prpic 2010). It seems all but evident that the different participants involved in such an activity, such as organizers, scientists and participants, share the same perceptions of the project. The aim of this thesis is to contribute to the empirical gap on PE events by examining how the perceptions and interpretations of the participants affect the process and outcome of these projects.

Following from the foregoing, this thesis examines the tension between the intended format and the social dynamics of PES activities. The proposed inquiry uses the Dutch 'Nanokaravaan' as a prime case study. The Nanokaravaan is one of the first public dialogue projects on nanotechnology in the Netherlands. The empirical inquiry aims to give an insight in the actual adoption of this specific PES project and to provide a qualitative analysis of the possible tension between design and actual adoption of a specific PE event. Finally, these

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[1] I'm aware of the different definitions in academic literature of what I call the 'science-public relationship'. Dijkstra (2008) shows that some authors perceive the public not as a single, homogenous group of people, but rather speak of various publics that relate differently to science. The science-public relationship is also referred to as the science-society relationship. Because the focus of my analysis is on a specific PES project and the involved subset of society that shapes this project, I decided to make use of the concept 'science-public relationship'.

findings will be used to reflect on the implications of this tension for future public engagement projects with science.

This leads to the following research question:

How do the format and the perceptions of the involved participants influence the outcome of a PES project, such as the Nanokaravaan?

This research question is developed further in Chapter 3 after the discussion of the theoretical framework in Chapter 2.

Relevance and contribution of study

Recent technology controversies, in the field of genes and nanotechnology, have resulted in a shift towards a more democratic engagement of the public with emerging technologies (Kurath & Gisler, 2009). Not only scientists see a need for supporting public acceptance of technological developments, but political actors do so as well. This has resulted in a growing attention for the science-public relationship and for PES projects. Contemporary studies on PES largely focus on the growing concerns of deliberative democratic theories. These studies tend to ignore that these deliberation processes are not only structured by their format, but by social dynamics as well. This calls for more empirical research to explore how PES is shaped in social practice.

This study contributes to filling out this empirical gap in literature on public engagement by focusing on the way these projects are adopted by the involved actors. A small amount of literature has focused on this topic and investigated how a specific group of actors related to PES. Some of the articles, for instance, have focused on the public and their attitudes towards and during public engagement projects, like Mejlgaard & Stares (2009); Kleinman et al (2009); and Michael (2009). Other articles have focused specifically on experts and their involvement with public engagement, like Scopus (2009) or Bruchell (2006). As such, the studies have only analyzed a specific part of the spectrum of the adoption of PES projects. The presented study focuses on the uptake of all actors participating in the project. The conducted literature review revealed that this has not been done before. As such, this study on the attributed meanings of the participants in setting up public engagement contributes to a better understanding of the construction of PES projects.

Besides increasing attention for the use of public engagement, also the attention for the development of nanotechnology is growing. Nanotechnology is often framed as a revolution in science and the everyday lives of humans. The growing expectations of nanotechnology have resulted in upcoming engagement projects on nanotechnology. So,

nanotechnology and public engagement initiatives find themselves in a developing trajectory. The case study on the Nanokaravaan provides an opportunity to explore both phenomena, because it is the first project in the Netherlands that aims to engage the public with nanotechnology. In this way, the findings of the case-study can provide insights in the social dynamics and outcomes of public engagement projects on nanotechnology.

Outline of thesis

Following this introductory chapter, Chapter 2 introduces the theoretical framework of the conducted study. This theoretical framework presents a literature review on PES and develops the analytical approach for the conducted study. Chapter 3 elaborates on the central research question and the various research questions. How this research question is studied, is described in Chapter 4 and expounds on the research design of this thesis. The analysis of the empirical inquiry is discussed in Chapter 5, 6 and 7. These chapters present the analysis of the findings from the empirical inquiry and draw subconclusions on the separate research questions. Finally, Chapter 8 elaborates on the final conclusion and presents a reflection on the conducted study.

2. Theoretical framework

The relationship between science and the public and its turn towards a more deliberative approach, is discussed in different academic disciplines. The first part of the theoretical framework discusses this deliberative turn by the review of literature on the rising attention for public engagement with science. It provides an insight and overview of the changing relationship between science and the public. The second part presents the analytical approach for the empirical inquiry. This approach entails a social constructivist perspective on PE events that is used to generate a better understanding of the actual adoption of PES. The approach does not only focus on the format of a public engagement activity, but also on the way in which it is socially constructed by the participants.

2.1 The turn to public engagement with science

This paragraph presents a study on the growing attention for the science-public relationship in literature. The first subsection focuses on the changing relation between science and the public. This relationship is a topic of discussion and is conceptualized differently in academic disciplines. The second subsection examines the shift from the 'public understanding of science' (PUS) approach to the 'public engagement with science' (PES) approach of the science-public relationship to explore how they differ.

The science-public relationship

Science does not only relate to scientists and their research, because scientific knowledge is everywhere in the everyday surroundings of human beings. Even if people are not interested in science, they will use knowledge or products that are produced by science. During the 20th century, the influence and importance of science in our modern industrial society grew rapidly (Felt, 2000). As a result, we started to need a basic understanding of science and technology at different levels in our everyday lives. Although science is not believed to be a popular topic of public debate, science has become an integral part of our society. In modern society, science and technology have often been the source of many, increasingly complex problems that have put mankind at risk. However, paradoxically, scientists have tried to solve these problems. Therefore the public attitude towards science is not simply negative or positive, but is marked by ambivalence and instability (Felt, 2000). Particularly in the second half of the 20th century, the legitimacy of science was questioned more often and the public could no longer be regarded as an anonymous crowd of people eager for scientific or technological progress. Politicians started to realize the need of research on the public understanding of science in

order to be able to legitimize their policy on science. Attention for public understanding was also increasing due to the interest of the scientific community itself. They became more interested in reflecting on the public acceptance of their own expertise (Von Grote & Dierkes, 2000).

In discussing the science-public relationship, not only a deficit of scientific knowledge of people was stressed. Also, a deficit of trust of the public in science started to become a subject of discussion. In the 1990s, Ulrich Beck added a new dimension to the ambivalence of the public's attitude towards science (Stø et al., 2010). Beck argued that in our modern society the relationship between science and the public is in a 'crisis of confidence'. Although modern societies are much safer for people, there are still concerns about (man-made) risks. Paradoxically, these risks are produced by trying to maintain control over other risks, which shows that the solution to one problem often generates new risks. Consequently, people largely lost faith in science. But people have no-one else to trust other than the scientists who both solve problems and create new risks at the same time. So, although people might get more sceptical about the development of new technologies and the regulation of potential risks, at the same time they are also becoming more dependent on science and technology.

In contemporary literature, the science-public relationship is studied from multiple angles. Different academic disciplines have developed various conceptualizations of this relationship. Despite these various conceptualizations, there has been a shared paradigm shift in approaching the relationship between science and the public. The following subsection elaborates on this paradigm shift.

From public understanding with science towards public engagement with science

The shift to public engagement with science is often referred to as a deliberative turn in society and this shift has not been the only transition. The science-public relationship has experienced three major paradigm shifts. Bauer et al. (2007) provide a historical overview of three different phases in the relationship between science and the public. The first phase, between the 1960s and the 1980s, approached science as part of the cultural stock of knowledge. This phase attributed a knowledge deficit to an insufficiently literate public. Education was perceived as a way to qualify people to participate in policy-making on science. This perspective legitimized technocratic attitudes for officials and experts in governing science and technology.

The second phase started in 1985 and entailed the 'public understanding of science' (PUS) approach. PUS shared the assumptions of the first phase and also had a focus on

education of the public. However, PUS included public attitudes towards science as an important parameter for the science-public relationship. This approach showed that despite the increase of factual knowledge, people can still have negative attitudes towards science. The second phase turned from a focus of the measurement of scientific literacy to the measurement of public attitudes. Despite this new focus, PUS still emphasized public education and technocratic attitudes for officials and experts were still legitimized.

During the second phase, the critique on the PUS approach was growing (Bauer et al., 2007). One part of the critique focused on the correlation between the knowledge of people and their attitudes towards science. It was believed that increasing knowledge would turn the public attitude more positive. Critics argued that the PUS approach did not pay enough attention to the importance of knowledge-in-context. They underlined that the attitudes on science are not only dependent on factual knowledge: local controversies or concerns also influence attitudes towards science. Another part of the critique was based on the deliberative turn in democratic theory. The deliberative democratic theory argues that democratic legitimacy is found in the deliberation of the public. The development of this turn to more deliberative democracy does not have a long history. Bessete was the first who originally coined the term 'deliberation' in 1980, while Habermas was also linked to the start of the use of this term in his work on public debates in 1989 (Stø et al, 2010). Even though Bessete and Habermas have used the term early on, Dryzek (2005) must also be mentioned as an important contemporary author on deliberative democracy. He was the first to formulate the deliberative turn in democratic theory that appeared in the 1990s.

Stø et al. (2010) argued that the deliberative turn includes two turns. The first turn entailed a change from vote-centric models of democracy towards a model that gave place for the discussing of reasons instead of votes. The second turn pleaded for more engagement with the people who are affected by a political decision. For a decision to be called deliberative, Renn emphasized the need of the mutual exchange of arguments and reflections on policy by empowering participants, instead of policy-making based on the authority of the political elite (Stø et al, 2010).

As a result of the criticism on PUS and the call for more public deliberation, the focus on the science-public relationship shifted from the PUS approach to the PES approach. This happened in the mid 1990s. Bauer et al. (2007) stated that the focus shifted from a public deficit to a focus on the deficits of the experts and policy-makers. People should not only learn something, the experts and policy-makers should learn something from the lay-knowledge of the public by up-stream engagement. Public deliberation with science was seen

as a way to provide socially robust science and technological development (Hanssen, 2009). As such, the input of lay-knowledge can enrich the development and regulation of emerging technologies. The main message of the PES approach was that science should not only be interesting for the public, but science should also become interested in the public (Hanssen, 2009). This turn to PES is conceptualized differently in academic literature and focuses on various aspects of the science-public relationship. These different conceptualizations of PES are discussed in the following paragraph.

2.2 Studies on public engagement with science

This paragraph elaborates on the different conceptualizations of the 'public engagement' approach. This is done from two different disciplines: science communication and policy studies. These disciplines focus on two different aspects of the relationship between science and the public. Science communication focuses on the renewed interaction between science and public. Policy studies focus on the new way in which PES enables people to engage in the policy-making process of science.

Science communication: PES as a new way of interaction for science and the public

In the field of science communication, there are two communication formats that deal with the science-public relationship: the 'deficit model' and the 'interactive model' (Dijkstra, 2008). Both formats share the assumption that the improvement of the relationship between public and science is needed in a democratic society. In the deficit model, which originates from the PUS approach, the need of factual knowledge to improve the perceptions of the public is stressed. The knowledge is communicated in a linear, persuasive process to a passive receiver. The interactive science model is influenced by the PES approach and in this model scientific knowledge is presented with more nuances and placed in a social context. Instead of a top-down communication process, the model advocates a two-way communication process that involves different kinds of knowledge. In this process, the public is not only positioned as a receiver of a message, but as a sender as well. Consequently, the interactive model emphasizes a symmetrical communication process that leads to a mutual understanding of experts and lay-people. This is believed to create more trust between the two groups.

The interactive model regarding science communication is often seen as a replacement of the deficit model (Dijkstra, 2008). However, in empirical research it turned out that both models are not mutually exclusives and there is certain ambiguity between the two models. It is better to position the two models as polar endpoints on a continuum. Instead of focusing on

one of the models, a communication process is characterized by different degrees of engagement, depending on the space that is offered for the public to participate. This implies that in the case of the Nanokaravaan, the focus should not only be on the way the communication process is framed by the organizers. It is important to analyze the way a PES project plays out and what degree of public engagement is adopted by the involved actors.

Policy studies: PES as a new way of engaging public with policy-making on science

The second account on the science-public relationship that is discussed comes from the field of policy studies. Since the late 1990s, engaging the public in scientific and technological change became fashionable in policy circles (Hagendijk & Irwin, 2006). Hoppe (2010) shows that in modern theories of governance, the turn to public deliberation is often discussed as a major tenet when dealing with the increasing complexity of modern society. From a democratic perspective, the turn to public engagement argues for a greater and earlier involvement of the public in policy-making processes. In this way they can reason and learn with politicians about issues of the common good. As a result, public engagement with science argues for more democracy and the empowerment of people. Hoppe (2010) argues that public engagement in modern governance promises more equal power sharing and finds its implementation in different policy instruments. Besides discussing the democratic rationales of public engagement from a normative perspective, there is also a lot of attention for the different designs of these activities in literature. Public engagement initiatives can be implemented in different stages of the decision-making process, in various formats and degrees of participation (Rowe & Fewer, 2005; Hagendijk & Irwin, 2006).

Like science communication, policy studies also show that the division between PUS and PES is ambiguous. The PES approach is often used and discussed as a policy instrument or tool to improve policy-making. There are two reasons why politicians have the final hand in the degree a PES meeting is deliberative. Firstly, the politicians can decide what type of participation will be used. Arnstein´s ladder of participation (1969) shows that there are different opportunities to influence during the policy process. PES projects can be used to inform, consult, involve, collaborate, or empower people, or a combination of these traits. Secondly, politicians choose the moment the public is allowed to engage. For example, when public engagement is introduced during a policy-making process and there is not much left to decide, public engagement will be less influential on the final outcome of a policy.

Concluding remarks

The turn to public engagement with science is prominently discussed in communication studies and policy studies. Although both disciplines emphasize different aspects in their conceptualization of public engagement, PES mainly involves a more symmetrical interaction between science and the public that can eventually lead to symmetrical learning. However, both disciplines show that the actual public engagement is really depending on the adoption of the format by the actors. In this way, public engagement has a certain ambiguity. PUS and PES do not appear to be mutually exclusive. There are different degrees of public engagement and the science-public relationship will be influenced by both elements of the PUS and PES approach. In the analysis of the Nanokaravaan, it is important to be aware of this ambiguity. Therefore, the analytical approach should not only focus on the intended format of a specific PES project, but also its adoption by the actors will influence the actual interaction during a PES meeting. This social shaping of a PES project is discussed in the following paragraph.

2.3 A constructivist approach on PES projects

This paragraph introduces the analytical approach on public engagement activities, and more specifically the Nanokaravaan. The first subsection further conceptualizes public engagement from an instrumental perspective. In the second subsection, the first step is taken towards a social constructivist perspective by redefining PES projects as a governance technology. The third subsection elaborates on social constructivism, which forms the foundation for the presented analytical approach. This social constructivist framework is followed by the introduction of the methodological insights from the 'social construction of technology' (SCOT) approach. The next section explains the way the empirical study on 'governance technologies' can benefit from the methodological framework of SCOT. Finally, the last subsection expands the focus on the social constructivist approach, by arguing that the approach should also look at the perceptions of the roles in shaping public engagement.

Public engagement as an instrument

The PES approach is not only a shift in literature, but also in the way the relationship between science and the public is constructed. This shift resulted in the introduction of several public engagement projects in society. These events vary in design with regard to its level of implementation in policy-making and its degree of participation with the public. Because these engagement events can be designed differently by its organizers, they can also be used for various policy purposes dealing with emerging technologies. Politicians often see public

engagement as an opportunity to bridge the gap with the public (Hoppe, 2010). By bridging this gap, it is believed that there will be more legitimacy for policy and it restores public's trust. However, politicians do not see participation as a substitute for representative democracy, but more as an optional add-on within policy-making (Hoppe, 2010). These add-ons are shaped by politicians themselves as they decide how and when they are used. As a result, PE events can be approached as tools aiming for a certain intended outcome by politicians or other organizers (Voss, 2007a).

The possible outcomes of the use of policy instruments and the way these outcomes are established, is an ongoing academic discussion. One can distinguish two perspectives on the way policy instruments influence governance (Voss, 2007a). The first perspective approaches the outcome of a policy instrument as the result of its intended design. From this view, policy instruments like PE events can be seen as tools for organizers to reach certain desired effects. This perspective explains the outcomes and effectiveness of public engagement by the way it is constructed by its facilitators. In the case of the Nanokaravaan, this approach would explain the outcome of the project by its intended format, which shaped its degree of public engagement. The second perspective approaches the outcomes of a policy instrument as the emergent result of complex dynamics in society. From this perspective, the outcome of a certain PE is interpreted more as an organic, evolutionary process of different forces from society. For the case-study, the outcome of the Nanokarvaan should be investigated by its conditions and the adaptation by the involved actors. However, both perspectives are relevant for understanding the roles of policy instruments in governance (Voss, 2007). This underlines the need of a social constructivist approach for examining the outcomes of policy instruments.

The analytical approach in this thesis takes up the social constructivist approach and focuses on the outcomes of the Nanokaravaan as a result of its design and its social dynamics. This approach will be explained in the next sections. Large parts of the literature on public engagement take a normative perspective on public engagement and focus on its design. Fewer parts of literature have focused on how these events play out in social practice as a result of the perceptions and the interaction of the various actors involved (Scope 2009; Carpini 2004; Delgado et al. 2010; Prpic 2010). It does not seem evident that all the involved actors in the Nanokaravaan have a shared opinion on public engagement and act according to it. The first step is to investigate how a specific PE event is initially designed to take place. The next step is to empirically investigate how these formats are adopted by the involved actors. To make this second step, I use the conceptual insights derived from the social

constructivist approach in technology studies. But before this can be done, the next subsection elaborates on the conceptualization of a PES project as a governance technology.

Framing public engagement as a governance technology

The instrumental perspective on PE projects showed that the turn to more public engagement with science faces a paradox (Felt & Fochler, 2010). Public engagement is seen as a way of breaking down the linear model of the PUS approach. However the public engagement model seems to fall in the same trap as the PUS model. The reason for this is that there appears to be a one-way perception of participation because the so-called 'experts of community', who organize the public engagement events, end up designing the format. In this way, the bottom-up influence of the public on the governance of a new technology is still organized top-down.

In the analytical approach of this thesis, PES is viewed as an instrument, because PES projects are initially set up as a tool to facilitate certain social processes. Besides facilitating a certain social process, the interaction can also be structured by the organizers to aim for an intended outcome of this interaction (Voss, 2007). In relation to this instrumental view, researchers have reflected on PES as a political machine, which is designed by its organizers to try to appropriate certain publics (Felt & Fochler, 2010). The conceptualization of PES projects as political machines can be argued to be too deterministic. Instead of perceiving PES projects as political machinery, this thesis approaches PES as a specific type of technology: a 'governance technology'. From this perspective, an analysis of the actual adoption of PES projects by the participants can be complimented with the conceptual insight from technology studies. Within technology studies, the development of a technology is perceived to be influenced by its designers and stakeholders, as well as by the final users and their ways of using the technology. This elucidates that a technology is not only constructed by its design, but is constructed by its use. This perspective on technology is applied on PES to constitute a social constructive approach on the outcomes of public engagement.

To conclude, there is much attention for the normative discussion on the various formats of PES projects in academic literature. A social constructivist approach does not only discuss the format of a PES project, but also the meanings that are attributed to the project by the participants. A social constructivist approach enables the examination of the actual adoption of a specific PES event by all actors. The conceptual framework for this approach is introduced in the next paragraph.

2.4 A social constructivist perspective on public engagement projects

This paragraph introduces my conceptual framework for analyzing public engagement events. The conceptual framework is mainly based on the social constructive perspective in technology studies: the 'Social Construction of Technology' (SCOT) approach. SCOT is a social constructivist framework for studying the development of technologies. It does not investigate the development of technology as the outcome of certain intrinsic characteristics. SCOT studies the way a technology is socially constructed by the meanings that are ascribed by the relevant actor groups to a technology. This paragraph explains how the analysis of public engagement, as a governance technology can also benefit from this social constructivist framework from SCOT. Ultimately, the proposed approach aims to uncover and study the social construction of public engagement.

Technology studies

In technology studies there has always been a tension between the deterministic and the constructivist view of technology. The classical philosophical image of technology, e.g. by Jaspers and Heidegger, presented a rather deterministic perspective on technology. In this classical image, technology is supposed to develop autonomously while creating certain effects on society (Verbeek, 2005). The classical view approaches technology as a finished product with inevitable characteristics. Roughly, you can distinguish two academic accounts on technology, which originate from this deterministic perspective (Sismondo, 2004). One account approaches technology as the application of science. This account shows that technology is enabled but also limited by scientific knowledge. Such a perspective puts science in a central position in determining the shape of technology. Another, more debated, account views technology as the result of social structures. This perspective underlines that technology enables most human action. It is believed that people act in the context of available technology. This account explains the relations between people in the context of technology. So, it turns out that in dealing with technology, both deterministic views mostly emphasize the effects of technology on human beings. These effects on society and individuals are perceived to have one single direction.

Around the 1980s, a social constructivist perspective on technology was introduced (Pinch & Bijker, 1984). This new perspective was a reaction on the deterministic accounts that turned out to be limited for analyzing technological innovation, due to the limited role of the public on the development of technology. Empirical research on the development of technologies underlined the reciprocal interaction between technology and society (Sismondo,

2004). In contrast with deterministic accounts, the social constructivist account believes that technologies have no essential features. As a result, no technology has an essential use that can be deduced from the artifact itself (Oudshoorn & Pinch, 2005). From this perspective, in studying technology and innovation, you can never take technology and its use for granted, because it has no intrinsic properties. It argues that it is rather important to look at the context of use of a technology. Not only does technology influence society, society influences technology as well. An important contributor to this social constructivist approach has been social constructivism. The next section elaborates on social constructivism and the provided theoretical insights for the analytical approach in this thesis.

The social construction of reality

Social constructivism can be subsumed under a broader approach in social sciences, namely phenomenological sociology. Phenomenological sociology originates from phenomenology. Phenomenology is a philosophical framework that questions our taken-for-granted perceptions of the world and our being in it (Wallace & Wolf, 2006). Schutz attempted to make this framework relevant for sociology by introducing phenomenological sociology (Farganis, 2004). Phenomenological sociology tries to understand the world from the point of view of the acting subject and not from the perspective of a researcher. Phenomenologists believe that people understand their social world as a natural order and therefore put attention in their research on the way social reality is conceived by them (Farganis, 2004). Social constructivism originates from this perspective, but focuses more on the way social reality is constructed by people. In addition to this focus on the construction of social reality, it also examines the way this reality is experienced objectively and subjectively meaningful by human beings (Wallace & Wolf, 2006).

Berger studied under Schutz and is the founding father of social constructivism. In 1966, Berger published the book *The Social Construction of Reality* together with Luckmann. This book presents a sociological analysis of the way the reality of everyday life is shared among people (Berger & Luckmann, 1966). This analysis emphasizes common-sense knowledge that guides conduct in everyday life. The focus on common-sense knowledge was chosen reality seems ordered and objectified to human beings. People know that everyday life is as real to others as it is to them. By actions and interactions they continuously create a shared reality that contains objective and subjective elements. In this way, social reality is subjective because it is personally meaningful for the individual and objectively meaningful because there it constitutes social order (Wallace & Wolf, 2006).

There are three distinctive steps that involve the social construction of reality (Berger & Luckmann, 1966). The process of social construction starts when human beings externalize what they perceive. This presumes that social order is not biologically given, but is a product of human activity. During human activities, people constitute patterns of action to carry on social life. This created social order is on the one hand the result of past human activity. On the other hand, social order only exists when human activity continues to produce this order. So, humans are free to act, but as a result of externalization not every situation needs to be defined anew. The second step in the construction of reality is a process of institutionalization. Institutionalization occurs when people start to share externalized actions and these shared actions will turn into institutions. The forming of institutions is able to control human conduct by setting up predefined patterns of conduct. So, these patterns can become objectified for people and construct an objective reality. However, for a researcher it is important to realize that these institutions are humanly produced. The third step in the construction of reality is the process of internalization. This final step occurs when the objectified reality is internalized. Internalization will entail several courses of socialization. This socialization will lead to a growing symmetry between both the objective and subjective reality for an individual. Finally, Berger and Luckmann (1966) summarize the process of social construction of reality by stating that: "*Society is a human product [as a result of externalization]. Society is an objective reality [due to the process of institutionalization]. Man is a social product [because a social reality is internalized]*" (p. 64).

The different steps of the process of social construction of reality can be illustrated by the example of the creation of a new friendship (Wallace & Wolf, 2006). When people find their interaction mutually rewarding they can become friends. This friendship is a new social entity and constitutes a new social reality. While the friends interact, they recreate their friendship. Due to this effort that is put into the friendship, the friendship really is a human product and thus becomes externalized. After this process of externalization, the friends will see the friendship as a social reality. When other people hear about this friendship, they will understand what this means and become internalized as an objective social reality. Finally, when the friendship has turned into an objective reality, it can act back on the two friends and will demand certain needs to maintain this friendship. While a person chooses to meet these demands, the person is re-creating this social entity as a result of internalization.

In conclusion, the constructive approach on technology states that the development of technologies goes through a process of social construction. Because technologies do not have intrinsic properties, the properties need to be externalized in use. In the interaction with a

technology, users will attach a meaning to the use of the technology. When this use becomes more common and people start to share its use, the technology will become institutionalized. This will turn the technology into a social reality and - once the use of technology is not contested any more - it is internalized. The SCOT approach elaborates further on these steps that are specific for technologies and this is explained in the next subsection.

The social construction of technology

In the 1970s, the social constructivist perspective started to enter the field of technology studies. Through time, this has led to several constructivist approaches on technological innovation[2] (Sismondo, 2004). The main approach of this thesis is based on the methodological insights from the SCOT approach. SCOT is a central approach in technology studies and has been introduced by Pinch and Bijker (1984). This approach is inspired by the 'sociology of scientific knowledge' (SSK) discipline. This discipline underlines the social constructivist elements of scientific knowledge in natural sciences. The main proposition is that scientific theories need to be socially supported before they become 'true' and controversy is terminated (Pinch & Bijker, 1984). This shows that, like a successful theory, also an unsuccessful theory is a product of its social context. Within SCOT, technological artifacts are seen as products of their social context and therefore focus mainly on the developing process of a technological artifact. This developmental process is viewed from a multi-directional model. This multi-directional model approaches the developing process of a technological artifact as an alternation of variation and selection.

SCOT entails three core concepts for studying technological artifacts: '*relevant social groups*', '*interpretive flexibility*' and '*closure*' (Pinch and Bijker, 1984; Bijker, 1995). Firstly, to understand the development of a technology, SCOT examines technological artifacts by the way they are viewed by the 'relevant social groups'. A social group is an organized or an unorganized group of individuals that share meanings attached to a specific artifact. An important part of analysis is the identification of the social groups that are relevant for a technology. Because technological development is viewed as a social process, relevant social groups are seen as the carriers of that process. During the developmental process, every technological artifact has its problems and solutions at a certain moment. Social groups play a

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[2] I'm aware that there is no single interpretation or application of social constructivism in technology studies. However, the most sophisticated division between the constructivist approaches can be made between SCOT and 'Actor-Network Theory' (ANT), due to their different methodologies. However, for other constructivist approaches, for example between SCOT and the 'Social Shaping of Technology', this division is much harder to make.

crucial role in deciding which problems are relevant. In this way, the success of an artifact depends much on the strength and size of relevant social groups.

Secondly, during the development of a technology, not only designers attach a meaning or purpose to a technology. Other relevant social groups will attribute their meaning to an artifact as well. The range of different meanings of a technology is called 'interpretative flexibility', which relates to the process of externalization. Interpretative flexibility underlines that for all the relevant social groups there is not one artifact with certain intrinsic properties. One artifact can be seen as different socially constructed artifacts with various properties. By analyzing the interpretative flexibility of a technological artifact, the adaptation and use of a technology is understood and explained as a social construction of different actors. So, the working or failure of a technology is approached as a social construct. The working of a technology thus needs social acceptance by different relevant social groups.

Lastly, the interpretative flexibility of technology may seem to lead to a pluralistic view on technology. You could argue that when all different relevant social groups attach a certain meaning to a technology, many different technological artifacts are constructed. Therefore, the final important concept for the SCOT approach is 'closure', which is related to the process of institutionalization. Like SSK shows, when scientists reach consensus, controversy is terminated and scientific facts are created. By this consensus, interpretative flexibility disappears and one interpretation is accepted. This process is also described in the SCOT approach by the concept of 'closure'. The mechanism of closure shows that the interpretative flexibility of an artifact does not continue forever.

After the introduction of SCOT there have been criticisms on the approach. The main criticism is on the narrow focus of SCOT. The approach mainly focuses on the social construction of technology during the developmental process (Mackay & Gillespie, 1992; Kline & Pinch, 1996). Classical SCOT studies are often executed in the early stage of a technology. However, it is argued that SCOT has failed to look at the social appropriation of technologies by their users (Mackay & Gillespie, 1992). People may reject technologies, redefine their use, or customize them after the design phase. As a result, users can redefine the intended design or purpose of a technology, which is also a part of its social construction. Another study has shown that interpretative flexibility can return when people use a technology (Kline & Pinch, 1996). After a technology has stabilized during the developmental process, it is important to be aware that interpretative flexibility can reoccur at the stage of use. An example is the appearance of relevant social groups which will attribute new meanings to a technology. This makes it important to be aware that the SCOT approach

should not only be applied on the developmental process of a technology. After a technology is stabilized, new social groups can appear or interpretative flexibility may reoccur.

To conclude, the SCOT approach can be seen as a method for analyzing technological innovation rather than a theory. The SCOT approach is based on the theoretical framework of social constructivism applied to the empirical study of technology. SCOT shows that there is more than just a linear path of technical progress that centers on a superior technology. By underlining the social constructivist elements of technological progress, SCOT shows that technology needs to be approached as a social product. The fact that a certain technological artifact 'works' needs more explanation. The premise is that a technology works when it is accepted by relevant social groups and a dominant meaning has been stabilized. An important addition to this approach is that a dominant meaning of a technology can change, due to the reappearance of interpretative flexibility. The following subsection discusses how these analytical insights are applied to the study of a governance technology.

The social construction of a governance technology

SCOT is a specific approach for a specific field of research: the development of technology. The presented approach for the analysis of PES projects, applies the theoretical framework of SCOT to another specific field: governance technologies. The focus of SCOT is on the meanings that are attributed to a technology. Like new technologies, public engagement is an innovation that is not yet institutionalized. SCOT provides tools to examine this stage of externalization, and makes it a useful approach for the analysis of PES. It emphasizes the empirical analysis of the actual adoption of PES projects by all involved actors. Instead of focusing merely on the design of different formats for public engagement, a social constructivist approach enables the examination of how these formats are adopted by the participants and how this influences the outcome of PES.

The first part of analysis of the Nanokaravaan applies the three core concepts of SCOT. The first step is to present an overview of the social groups that are involved in constituting the Nanokaravaan. At first, a rough distinction can be made between the roles of the organizers of the Nanokaravaan, the invited speakers and the visitors. It is important however to question whether this distinction is sufficient or elaborated enough, and whether there are more relevant social groups that can be identified. The second step is to examine the interpretative flexibility of actors' perceptions of the Nanokaravaan. There is no certainty that all relevant social groups attribute the same meaning to the Nanokaravaan. The outcome of the Nanokaravaan will not only be part of the design of the project, but also part of the way it

is perceived and adopted by all social groups. The final step is to investigate the degree of closure and stabilization on the meaning of the Nanokaravaan. The degree of closure analyzes how the interpretative flexibility of public engagement diminishes among social groups and how this leads to a dominant meaning on the project.

It is inherent that the social constructivist approach on public engagement cannot be exactly conceptualized like SCOT, due to the different object of study. This leads to certain implications that need to be stressed. First of all, when introduced to a new technology, people may have a first impression of a technology straight away. For a governance technology this is much less likely. A governance technology is not something physical, but something you need to experience. This will give some delay to the actors in perceiving the meaning of a technology. Secondly, when you are invited to a PES meeting, there is not really time to get used to the situation. For a governance technology it will cost more time to get an idea of its use. Lastly, the implementation of PES projects is a rather new phenomenon. So, one cannot expect the involved actors to be well experienced or trained in participating. Furthermore, interactions are always new and less predictable than a technological artifact.

2.5 The scenario of engagement of PE events

The SCOT approach focuses on the influence of actors on the shaping of a technology. SCOT approaches technology as a product of society. This study approach claims that the social construction of public engagement is not only perceived by its attributed meanings, but also by its format and the attributed roles. The Nanokaravaan is not solely constituted by its perceptions, but also by its format that structures interaction. Besides these preconfigured formats, the interaction will be influenced by the meanings the actors attribute to their roles and those of other actors. So, the second part of the social constructivist approach examines actors' perceptions of their role and the roles of others to reveal how public engagement is perceived to take place.

A core concept for examining the adoption of public engagement by the participants is '*scenario of use*'. This concept is partly based on the concept of 'script', which is well known in technology studies. A script is described as the technical realization of the designer's representation of the use of a technology (Akrich, 1992). In this way, a designer attempts to predetermine the use of a certain technology during the design phase. The concept of script shows that the vision on the use of an artifact can be materialized in the design of an artifact. In this way, technologies can contain a script for their use, which try to influence the behavior of the user. An example is the alarm that rings when you drive your car whilst not wearing a

seatbelt. The only way to stop the alarm is to put on the seatbelt. This safety mechanism is scripted in the car and aims to influence your behavior in the car. The concept 'scenario of use' is based on this notion of script, but focuses more on how the actors can have different perceptions of the intended use of a technology. Scenarios of use look how assumptions of actors about the use of a technology influence a technology (Konrad, 2008). When a designer defines a scenario of use for a technology, this eventually results in a role-based program of action. This predefined scenario creates a realm of possibilities in using a technology. However, after the design phase, users can also play an important role in delineating this realm of possibilities and introduce fictive scenarios of use. This introduction of different scenarios can be approached as a form of interpretative flexibility regarding the use of a technology.

PES meetings are organized in different formats. Like a technological artifact, PES meetings have an intended 'use' that is inscribed by an organizer. A scenario of use that is prescribed in the format of a PES project will entail a division of roles for the involved actors that aim for a certain interaction, which forms a 'scenario of engagement'. These scenarios can initially be adopted by the involved actors, or the actors can attribute different scenarios of use. An example is a PES meeting that is organized as an open debate between visitors and scientists on a certain topic. When the scientists have the idea that the visitors need to be educated first to start an open debate, they will use the PES meeting differently than intended. In the meantime, it can just as well be that the visitors feel rather unsecure about the topic, and will not be eager to join the debate. As a result, the intended scenario of use of the organizers will be perceived differently. It is therefore important, for the analysis of the outcome of the Nanokaravaan, to examine the interpretative flexibility of its use and how this shapes the actual interaction between science and public.

In the case of public engagement, scenarios of use involve the attribution of roles to the actors to make engagement possible. During the process of public engagement, the division of roles can be negotiated between the actors. Because of this focus on roles, it is important to be clear on what the proposed approach understands as 'roles'. A classical perspective shows that roles are mainly formed by expectations (Biddle, 1986). People hold social positions and have shared norms that generate expectations about these roles. Successful role taking means that people take up a role in line with the attributed expectations. The concept of roles that is used is derived from 'positioning theory'. Positioning theory does not really focus on roles and their expectations, but tries to understand and to read the dynamics of human relationships from a social constructivist paradigm

(Merkerk & van Lente, 2008). This approach conceptualizes roles as flexible concepts that are a result of interacting positioning of selves and others. It acknowledges that roles are not fixed, but exist in relation to other roles. To be able to make public engagement possible, all actors need to cooperate and facilitate a symmetrical interaction. This means that on the one hand, the degree of participation during a PE event will be depended on the format of PES projects. On the other hand, the degree of participation is influenced by the way the different involved actors relate to each other. Positioning theory shows that both self-positioning and positioning towards other actors is important for the perception of a person´s own role as well as the role of others.

To sum up, the outcome of a PES project will not only be influenced by the interpretative flexibility of its meaning, but also by the interpretative flexibility of its engagement. Initially, the social construction of public engagement is defined by the intended scenario of engagement. However, during the event this scenario can be negotiated between the participants. Because the involved roles of a scenario of engagement exist in relation to each other, every actor can turn into a co-designer and influence the constructed scenario of a PE event. A first step in analyzing the construction of a shared scenario is to investigate the actors' conceptualization of their own role during the event. This will reveal how the actor groups perceive their own contribution to the event and what they think is their responsibility in constituting interaction. A second step is to investigate to what degree actors had the feeling that their own role was influenced by others. This will show in what way the actors think their contributions were influenced by other actors. A final step is to analyze to what degree the actors were able to maintain their contributions to the process. This last step will reveal how the actors experienced the construction of a shared scenario of engagement.

It is important to note that the analysis of the 'scenario of use' of a PES project differs from an analysis of a technological artifact. Firstly, a scenario of use can be inscribed physically into a technology via design. A PES project is much more centered on social interaction. A designer therefore has fewer possibilities to inscribe an initial scenario of engagement physically. Secondly, the division between the design phase and a use stage of a PE event is much more blurred than for a technology. The design of a PES meeting is prepared before implementation, but is mainly executed during the event. Lastly, if you relate to a technology, you will actually use the technology, but for a PES project this may be less evident. From the beginning, it may be possible that an involved actor does not have any predefined ideas about his role or the scenario of engagement of the project. Perhaps one may not even want to contribute to the event. However, positioning theory explains, that even if a

role is not adopted, this still has an effect on the other roles because roles always exist in relation to each other.

3. Problem statement

Although there is an increasing implementation of public engagement projects with emerging technologies, not much empirical research has been done on the outcome of these projects. The approach on PES that is presented in Chapter 2 aims to contribute to this empirical gap. The premise of the approach is that although a certain PE event is initially designed to facilitate certain social interaction, it is important to examine the attributed meanings of the participants in adopting the project. The aim of this thesis is to examine how a specific public engagement project, such as the Nanokaravaan, is socially constructed. This leads to the following central research question:

> *How do the intended format and the attributed meanings of the involved actors*
> *influence the social construction of the Nanokaravaan?*

The central research question is answered in four stages. The first research question examines the intended format of the Nanokaravaan project. The project is set up by the organizers of the science cafés as a public dialogue on nanotechnology. The prearranged format of the project is not only shaped by the organizers, the format of the project will also be influenced by its context. First of all, there is a discussion on the different types of public engagement formats you can choose. Secondly, nanotechnology is a promising technology and several governments try to stimulate public engagement with nanotechnology. Also, the Nanokaravaan is part of a publicly funded project on the public debate of nanotechnology. Therefore, the first part of the analysis examines the preconfigured format of the Nanokaravaan. This leads to the following research question:

> *(A.) How is the Nanokaravaan constituted by its intended format?*

The second research question examines the constitution of the Nanokaravaan by the attributed meanings. Different actor groups are involved in the shaping of a PES project; such as the organizers, speakers and visitors. The social constructivist approach shows that these different actors attribute (different) meanings to the project. The second research question can be divided in two parts. The first step in the empirical study of the Nanokaravaan project is the analysis of the way the Nanokaravaan is externalized by the actors and is done by examining the interpretative flexibility of the project. The second part of the analysis aims at revealing how various actors perceive the event and to what degree the project is institutionalized. This

research question is the first indicator of how public engagement is socially constructed by the involved actors. This leads to the following research question:

(B.) *What meanings do the actors attribute to the Nanokaravaan?*

The presented analytical approach does not merely focus on the attributed meanings of the Nanokaravaan, but also on its scenario of engagement. The third research question examines the meanings the actors attribute to their own role and the roles of others in shaping the Nanokaravaan meetings. Initially, the organizers will make assumptions in the prearrangement of the meetings about the participants and their way of engagement. However, these preconfigured roles can be negotiated between the different actors during the process as a result of positioning. The actors construct their own role, but this role will also be structured by the role-taking of the other actors. Therefore the third research questions studies how the actual scenario of engagement of the Nanokarvaan is constructed by the actors. This leads to the following research question:

(C.) *What meanings do the actors attribute to their own roles and those of others in setting up public engagement during the Nanokaravaan?*

The last research question aims to synthesize the previous research questions. This research question examines what the construction and adoption of the Nanokaravaan reveals about the possibilities and implications for constituting public engagement with nanotechnology. This last part of the analysis is discussed in the conclusion and aims to get a deeper understanding of the way the attributed meanings of a PES project influence the actual engagement of the public. Finally, this last research questions elaborates on the conditions that are needed to facilitate public engagement and which conditions influence its actual outcome. This leads to the following research question:

(D.) *How do the meanings attributed to a PES project influence the degree of public engagement?*

The next chapter elaborates on the used method for answering these research questions.

4. Research design

This chapter presents the research design of this thesis. The first subsection introduces the research site of the conducted study. The process of gathering data is elaborated in the second subsection and gives an insight in the research method. The third subsection discusses the operationalisation of the research questions and the themes that were discussed with the respondents. Finally, the last subsection explains how the empirical data is analyzed and how these findings are used in this thesis.

Research site

The presented analytical framework focuses on the adoption of PES by the involved actors. This focus puts an emphasis on the social processes that are involved in the constitution of PES projects. The analysis of these social processes is best studied by doing a qualitative study on PES projects. Therefore, this thesis entails an empirical inquiry of a single case of PES; the Nanokaravaan. The Nanokaravaan is a project that is initiated by five science cafés and consists of a series of public dialogues on nanotechnology (MDN, 2009). A case-study enables a researcher to do an intensive examination of a single project. Also, PES projects are not really widespread available and the Nanokaravaan project is one of the few public engagement activities in the Netherlands. The project is used in the analysis as an exemplifying case of PES and presents a suitable research site for the research questions to be studied. It is important to be aware that a case study involves certain limitations as well. Firstly, focusing on a specific project hinders the possibility to examine the research questions on a larger scale. Secondly, PES projects are introduced in various formats and a case-study only deals with one specific type of PES. The following subsection elaborates on the way the Nanokaravaan was studied.

Data gathering process

The meetings of the Nanokaravaan were public and free to visit. Visiting these events provided a fair impression of the project and helped to develop the problem statement. To get access to the organization of the Nanokaravaan, Anne Dijkstra was a great help. She is a researcher at the University of Twente and already had access to the project for her own study on the Nanokaravaan. Her focus of research was on the public attitudes on nanotechnology. With her help, contact was made with the organizers of the project. Also, discussing the

project with Dijkstra and having access to her data was a good way to develop the final research questions.

The data gathering process consisted of interviewing a subset of the involved actors. For the sample selection, the actors were divided in three categories: a group of organizers, speakers and visitors. These categories were based on the main contributions of the actors to the Nanokaravaan. The group of organizers was defined by the people who facilitate science café meetings. The second group of actors was formed by the scientists who were invited by the organizers and voluntarily took the responsibility to give a talk. The last actor group included the visitors of a Nanokaravaan meeting. The sampling of the respondents aimed to interview one speaker, one organizer, and two visitors from three meetings. From the one hand, the selection of respondents from three meetings enabled the study on the social construction of an individual PES meeting. On the other hand, this sampling enabled the comparison of the separate actor groups with the other actor groups.

The first step for the sampling process was selecting three science cafés. The organizers were contacted about the empirical inquiry while visiting the Nanokaravaan meetings and reacted positively. The selection of the three science cafés was therefore based on the willingness of the speakers to collaborate. This choice was made as a result of the expectation that making an appointment with the speakers would be most difficult. After contacting four of the speakers, three scientists were found that were willing to cooperate. Hereafter, the organizers of the related Nanokaravaan meetings were contacted again. All three organizers were still willing to participate and appointments for interviews could be made. These organizers also helped with contacting visitors, but this only worked out for one science café. The organizer of science café B had sent some e-mails to visitors and two visitors reacted positively. For the other two science cafés this did not work out. An extra visit to a science café meeting was made to personally approach possible respondents that had visited the Nanokaravaan. This worked well for science café A. For science café C only one visitor was found. Ultimately, the empirical data was based on the interviews of eleven participants; three organizers, three speakers and five visitors. With nine of these participants, it was possible to make an appointment and do a face-to-face interview. For two visitors, only an interview by telephone could be arranged.

The interviews with the respondents were semi-structured. Semi-structured interviews do not involve a fixed interview protocol. A semi-structured interview does have a list of specific questions, but the sequence of questions is not fixed. This style of interviewing was preferred, because this provides the interviewer with certain flexibility in asking questions.

For the interviewer, this flexibility enables the researcher to turn the interview more into a two-way conversation. Semi-structured interviews also have the advantage that they are a good tool to examine how an interviewee frames and understand certain issues (Bryman, 2004). A more flexible interview guide enables the interviewees to have the freedom to steer and prioritize questions. In this way, the questions can be answered more extensively. Lastly, for the specific case, semi-structured interviews seemed more suitable, because the interviewees all have different levels of experience with public engagement. The flexibility in asking questions provides space to use introductory questions and adapt to someone's former experiences. The following subsection explains how the separate research questions were studied and how the interview protocol was set up.

Operationalisation of research questions

The main research question contains four research questions. The first question focuses on the context and the intended design of 'De Nanokaravaan'. This question was answered in three steps. Firstly, the format of the Nanokaravaan was examined by a document analysis. The organizers have written several documents for the application of their project, before their project was funded. These documents did not only give an insight in the format of the Nanokaravaan but also its context of the public debate on nanotechnology. Secondly, the format for public engagement in 'De Nanokaravaan' was discussed by academic literature on PES. This showed to what degree a science café meeting, like the Nanokaravaan, can set up public engagement with nanotechnology. Lastly, the organizers were interviewed about the organization of the Nanokaravaan. The organizers were asked how they came up with the plan to organize the Nanokaravaan and how the directions for funding the project have influenced its format.

The second research question was studied through interviews. This question focused on the attributed meanings on the Nanokaravaan by the involved actor groups. For this part of the research question, the interview scheme can be divided into three main elements[3]. The first examined the interpretative flexibility of the meetings by asking the actors how they were involved and why they decided to participate with the project. The second part asked about the perceptions of the aim of the Nanokaravaan and whether his project reached its aim. Finally, to get a sense of the degree of closure and stabilization, the respondents were asked

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[3] The interview scheme can be found in Appendix A.

what expectations they had of the project and if this corresponded with their impression of the meeting.

The third research question was studied through interviews. For answering this question, the interview scheme was divided in two main themes. The first theme focused on actor's perceptions of their own role during the meeting. The actors were asked how they prepared themselves and what they thought was their contribution to the meeting. They were also asked if they were satisfied with their contributions and what they would do differently the next time. The second theme focused on the perceptions of others' roles. To get a first idea of their perceptions of the other actors, they were asked which different groups are involved and what they expected of these groups. Next, the interviewees were asked how they experienced the interaction with the other actors and this influenced the process during the meeting. Lastly, the actors were asked how they think they influenced the event for other attendees.

The last research question was not specifically investigated through interviews. This question looks how the social construction of a PES project can influence the degree of public engagement. This is much more a conclusive inquiry and is discussed by synthesizing the answers given on the other questions. However, in the interview schedule one final reflective question was included that asked the respondents how they think that science and society should interact. This question was added to try to elicit some final thoughts of the respondents on the science-public relationship. The following subsection elaborates on the analysis of the gathered data.

Data analysis

All interviews were recorded and transcribed verbatim. The respondents were told that the interview transcripts were used for analysis, but would not be published. To protect the privacy of the interviewers the transcripts were anonymized and only provided to the supervisors of this thesis.

For the analysis of the interview data, a coding program was used: HyperRESEARCH[4]. This software program enabled the structuring and coding of the interview transcripts. This coding was an iterative process. After several rounds of coding, the coding scheme had settled. The identified codes were:

1. *Initial design of NK*
    1.0 ORG - Design NK
    1.1 ORG - Organization SC

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[4] http://www.researchware.com/products/hyperresearch.html

2. Attributed meanings to NK
       2.1 ALL - How introduced
       2.2 ALL - why participate
       2.3 ALL - what experience
       2.4 ALL - expectations
       2.5 ALL - goal and success
3. Perceptions of own role
       3.1 ALL - how prepared
       3.2 ALL - what is your contribution
       3.3 ALL - what do different
4. Perception of roles of others
       4.1 ALL - distinguish groups
       4.2 ALL - how others influenced
       4.3 ALL - how you influenced others

These codes were mainly used to structure the interview transcripts and order the parts of the interviews that relate to certain research questions. Because this study is an extensive report of the attributed meanings of the actors, the analysis focused on the original statements of the respondents. Coding helped to make shortcuts to the transcripts for analysis and made the qualitative analysis of the attributed meanings more manageable. In the upcoming chapters, which elaborate on the outcomes of the analysis, quotes from respondents are included to exemplify the points they made during the interviews. These quotes are taken from the interview transcriptions and the translations of these quotes were done by the author of this thesis.

5. The format of the Nanokaravaan

This chapter explores the context of the Nanokaravaan project and how it is organized as an engagement activity. The first paragraph elaborates on the topic of discussion during the Nanokaravaan; nanotechnology. Nanotechnology is not only a major topic in science but also got the attention of politicians. Accordingly, the second paragraph discusses the policy of the Dutch government on the public debate on nanotechnology. The third paragraph zooms in on the way the Nanokaravaan is organized. This paragraph discusses how the format of the project is prearranged. The fourth paragraph explores how the Nanokaravaan can be conceptualized in academic literature as a public engagement activity. Finally, the last paragraph reflects on the format of the Nanokaravaan and its intended scenario of engagement.

5.1 Nanotechnology as an emerging technology

Nanotechnology is considered by many to be the most promising technology in science (Bowman & Hodge, 2008). This paragraph discusses what is understood as nanotechnology. 'Nano' comes from the Greek word 'nanos', which means dwarf. In science, nano is used as a prefix to indicate 10^{-9} or one billionth. To give an idea of the scale of a nanometre: the diameter of a human hair is about 100,000 times bigger than a nanometre (Kulinowski, 2008). This means that the nano level is on the level of atoms. As an example, one nanometre can be formed by one sugar molecule, which contains 45 atoms. The picture below presents a visual representation of the nano scale.
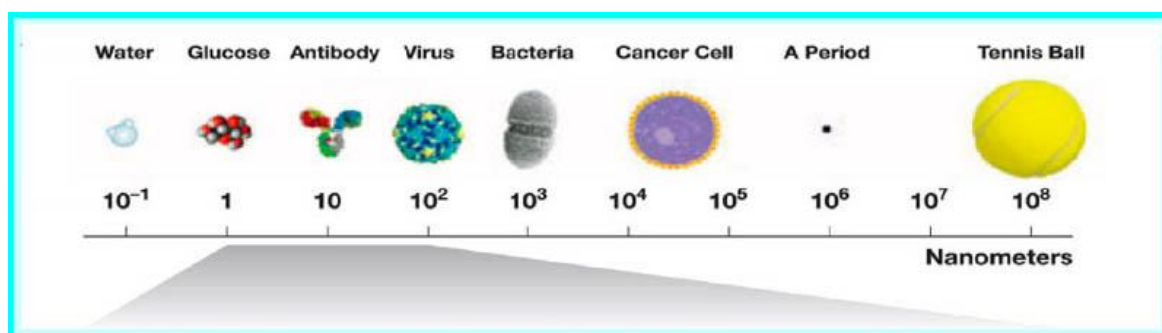
Picture 1 [5]

The first scientist who articulated the essence of nanotechnology – controlling matter on the atomic level – was physicist Richard Feynman in 1959 (Kulinowski, 2008). Later on,

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[5] This picture is derived from the Website of the Department of Chemistry of the University of Kentucky, http://www.chem.uky.edu/facultysearch/images/scale.jpg

Erix Drexler is widely credited for popularizing the term nanotechnology in his 1986 book *Engines of Creation*. He was the first to envision a world in which tiny machines are able to build structures on the level of individual atoms. In the meantime, the meaning of nanotechnology has changed and now comprises all technologies that work on the nano scale, officially in a range of 1 to 100 nanometres (Drexler, 2008). This change had turned the concept of nanotechnology into a rather broad concept.

Engineered nano particles often have quite novel, and even unexpected, properties, compared to the corresponding bulk substances (Hunt & Mehta, 2008). These properties enable new technological developments in all natural sciences and are believed to affect many economic sectors. Therefore, nanotechnology also gained the attention of policy-makers, who perceive nanotechnology as a strategic technology that can transform entire industrial sectors while creating new ones as well (Hunt & Metha, 2008). The novelties facilitated by nanotechnology are not only the source of excitement and benefits, but also of concerns and risk. On the one hand, new physiochemical properties of nano particles potentially give rise to unique characteristics of substances (Bowman and Hodge, 2008). On the other hand, these new particles also possess a hazard potential. This is a result of the fact that the size and shape of nano particles influences its potential toxicity and eco toxicity.

Uncertainties that are related to nanotechnology can produce huge challenges for the regulation of nanotechnology. Not only technical risks but also the perception of risks will urge people to regulate the application of nanotechnology instead of merely consuming its products (Bowman & Hodge, 2008). Besides the concern about the potential toxicological risks of nanotechnology, there are more areas of concern about the development of nanotechnology. The literature review showed that there is much attention for the discussion on the social and ethical implications of nanotechnology (Barnett et al, 2008). These implications are related to the possible disruptive impacts of applications of nanotechnology in society. For example, will the benefits of nanotechnology be evenly distributed? Additionally, there are also critical commentaries about the actual benefits of nanotechnology for society and its costs in the future.

The concerns about the development of nanotechnology are often related to the concerns on other emerging technologies in the past. There is a believe that the development of other technologies, like biotechnology or genetically modified (GM) foods that have caused some serious controversies, can help to predict the trajectory of controversies that nanotechnology might have to deal with. New developments in technology often start out with strong support from society, because the public is made enthusiastic about the abilities of

nanotechnology by nanotechnologists (Kulinowski, 2008). However, every technology that is so promising is bound to generate controversies. Many have argued that nanotechnology should be addressed honestly and transparently at an early stage in development (Balbus et al, 2008). This all has to do with improving the public response by increasing trust and engaging the public through dialogues.

Arie Rip (2006) presents a reflexive account on the generalizations of public responses to new and emerging technologies. He argues that the turn to engagement with nanotechnology will not be so obvious, because the 'world' of nanotechnology is full of folk theories. An example he gives is the reasoning that the development of nanotechnology should learn from the impasses of GM technologies in food production. These lessons are created by people trying to capture patterns in public uptake of other technologies in order to do better the next time. These folk theories are generally accepted and tend to become a part of a repertoire. Consequently, this acceptance could prevent the replacement of earlier folk theories by better and more reasonable theories. Several of these folk theories are present in recent debates on nanotechnology and are dominated by characteristics of the public understanding approach. Experts tend to have interpretations of public concerns and their fear for new technologies. However, these projections of fear for nanotechnology can become a fear itself. Rip (2006) concludes that this can lead to an increasing gap between the people that work with nanotechnology and the public. This shows that it is important for the analysis in this thesis to keep in mind that although there is much support for public engagement with nanotechnology, there are still generalizations about the relation of the public with nanotechnology.

Barnett et al. (2008) identify three recurrent motivations for public engagement. Firstly, there are instrumental motivations to engage the public with nanotechnology, because engagement will improve policy-making. Secondly, there are normative motivations which approach engagement as an extension of democracy to legitimize policy. This view is often related to the more general deliberative turn in policy-making. And finally, substantive motivations claim that engagement will make policy-making more socially robust. Nanotechnology is often presented as a unique opportunity to create a new, socially robust science (Davies et al., 2009). This motivation assumes that non-experts can attribute useful insights to nanotechnology at an early stage and improve its developmental process.

To conclude, nanotechnology is often believed to be a revolutionary technology. Besides its (economic) potential there is also much attention for its risks. The turn to public engagement, which is discussed in chapter two, also focuses on nanotechnology as a new and

emerging technology. Also many governments support PES programs on nanotechnology. In the Netherlands, the government decided to install a committee for engaging the public with nanotechnology: the 'Nanopodium'. The next section elaborates on the program of the Nanopodium and its plan for a public dialogue on nanotechnology in the Dutch society.

5.2 The Dutch dialogue on nanotechnology

In 2008, the Dutch government presented a policy plan on nanotechnology and its development, which is called 'Actieplan Nanotechnologie' (Ministry of Economic Affairs, Agriculture and Innovation, 2008). This document describes the vision of the Dutch government on nanotechnology. The document states that nanotechnologies have huge economical potential. Therefore, the government wants to stimulate the development of this technology. However, they acknowledge that there are also risks and ethical or societal questions involved that need to be dealt with.

The policy on the development of nanotechnology focuses on four domains (Ministry of Economic Affairs, Agriculture and Innovation, 2008). The first domain stresses the interest of the government in developing a research agenda on nanotechnology to contribute to the development of nanotechnology in the Netherlands. The second domain puts attention on monitoring and researching the potential risks of nanotechnology. The third domain focuses on the existing regulation and laws on nanotechnology. The existing juridical framework should correspond with the needs and possibilities of the development of nanotechnology. The final domain elaborates on the need of involving people with nanotechnology. This domain relates to projects like the Nanokaravaan. Politicians seem to be aware of the ethical and social implications of nanotechnology. They aim to deal with these issues in a societal dialogue. On the one hand, they argue that a dialogue will constitute insights on the opinions and attitudes of the public on nanotechnology. On the other hand, they want to enable people to get more insights and become more involvement in the development of policies on this technology.

In the Netherlands, the need for a public debate was not only prompted by the government. The Rathenau Institute[6] did a study on the need for a public debate on nanotechnology (Est et al., 2008). This study was commissioned by the Dutch government. The study underlined that the development of nanotechnology is accompanied by various societal implications. Therefore, the report called for a broad social debate on nanotechnology

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[6] The Rathenau Insitute is an autonomous organization that is founded in 1986 by the Dutch government. Their aim is to promote "the formation of political and public opinion on science and technology", derived from their website http://www.rathenau.nl.

that would evoke new and old questions on the regulation of nanotechnology. The report concluded that it is hard to come up with a prefabricated recipe for a useful debate. Instead they stated ten lessons for a nanodialogue. These lessons showed that it is not yet clear how social organizations, consumers or the public can be engaged with nanotechnology. However, it was strongly recommended that one should distinguish a debate between potential risk issues and a debate on the broader social implications of nanotechnology. Additionally, people should get a voice through small-scale engagement activities. This advice resonates in the policy of the Dutch government on a societal debate on nanotechnology, most particularly in the introduction of the committee 'Maatschappelijk Dialoog Nanotechnologie'[7] (MDN).

Committee 'Maatschappelijke Dialoog Nanotechnologie'

On the March 31st of 2009, the Dutch government initiated the committee MDN. The Dutch government initiated this committee because they wanted an independent committee to organize the societal dialogue on nanotechnology (Ministry of Economic Affairs, Agriculture and Innovation, 2008). The government made the committee responsible for constructing a list of priorities in discussing the issues of nanotechnology (Ministry of Economic affairs, Agriculture and Innovation, 2008). With this public agenda, the committee needed to facilitate the responsible development of nanotechnology by stimulating the public debate on nanotechnology in collaboration with other social partners. The committee believed that there is a need in policy-making for putting attention on several aspects of the nanotechnology: its chances, the involved risks, and the ethical and juridical dilemmas of nanotechnology. They wanted to achieve this by using the input of representatives of societal relevant groups and a broad audience, for the development of policies. The committee argued that a dialogue leads in general to a better informed public, so people can form their opinion on the matter. These opinions can provide insights in the societal questions that are important and which applications are stated as less desirable. The different projects that would be organized are discussed in a final report, which has been sent to the parliament to provide recommendations for policy.

One of the first things the committee introduced was a baseline measure of the public opinions on nanotechnology (Committee MDN, 2009). This survey concluded that consumers do not really know much about nanotechnology, but appear to be very interested in the subject. The development of nanotechnology is looked at with both curiosity and suspicion,

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[7] The committee's name can be translated by: 'Public Dialogue on Nanotechnology'

because emerging technologies will offer new chances and risks. With the condition of openness towards nanotechnology by the government and producers, consumers think they can decide to take certain risks. The respondents believed that the responsibility of handling these possible risks is for companies, people and the government. The closer the product is to the human body, the more emphasis respondents put on its risks. So, this baseline measure showed that the public is excited about nanotechnology but is also aware of its potential risks and their shared responsibility in dealing with its risks.

The 'Nanopodium'

The main responsibility of the committee MDN was to stimulate activities that facilitate a social dialogue on nanotechnology. The committee initiated 'Het Nanopodium', a virtual space[8] in which the public dialogue about nanotechnology and its applications are discussed. On this website, there is an overview of the projects that are granted by the committee and need to facilitate a social dialogue on nanotechnology. Societal organizations were asked to hand in project proposals. The first series of projects were selected and granted in two rounds. The first round was open for organizations to send in proposals. The emphasis in the first round was on informing activities and consciousness-raising activities. For the second round, the committee planned a more directed call for projects.

The activities could be divided up by two criteria. For the first criteria, the committee postulated five themes that relate to nanotechnology. The first theme included health, nutrition, and healthcare. The second theme was nature (flora and fauna) and environment, in combination with a sustainable society. The third theme contained safety and privacy. The fourth theme focused on international issues. And the final theme was about sustainable economic growth of nanotechnology. For the second criteria, the committee proposed three types of activities that entail different formats. Informing activities were the first type of activities. Sufficient knowledge about nanotechnology was seen by the committee as a condition for a societal dialogue. Different channels were believed to be able to contribute to that. The second type of activities consisted of events that raised awareness of nanotechnology for a broad audience. This type of activity was believed to let people form an image and opinion about nanotechnology and its applications. Different types of art were given as an example to stimulate awareness. The last type of activity that was defined by the committee demarked activities that constituted an actual dialogue. These dialogues should be

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[8] This virtual space is hosted on the website http://www.nanopodium.nl

between different parties and the public about issues of specific applications of nanotechnology. Examples of formats that were given were; panel discussions, science cafés, theatre performances with a discussion in the end, and interviews on television. The Nanokaravaan fitted the third type of activities. Picture 2 provides an overview of the criteria of the committee:
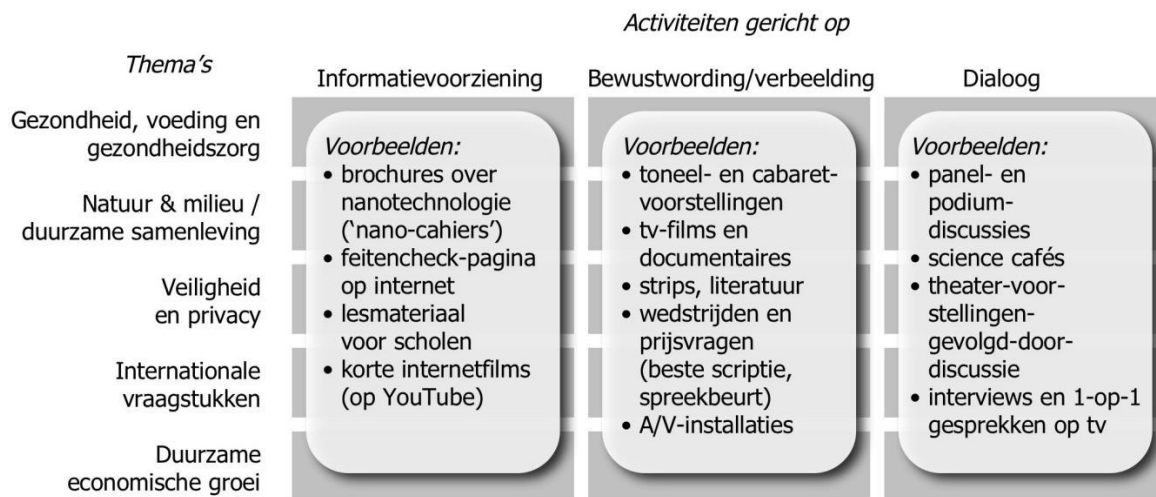
Picture 2 [9]

In conclusion, the Dutch government is aware of the economic potentials of nanotechnology. However, they also put emphasis on the (social) implications of nanotechnology. They aimed for a societal dialogue, but they wanted an independent organization to organise this. The committee was held responsible for stimulating social partners to organize a public debate on nanotechnology. Although the committee provided a framework for public activities on nanotechnology, they were dependent on the proposals that were sent in. In this way, neither the government nor the committee presented a vision or took responsibility on the way public engagement should be facilitated. Societal organizations had to take the effort to propose activities. These organizations could use their existing channels or initiatives for the interaction between science and the public. The Nanokaravaan is an example of an existing channel that facilitates interaction between science and the public. This project is discussed further in the next paragraph.

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[9] Scheme derived from MDN (2009), p.

5.3 The organization of the Nanokaravaan

The collaborating science cafés have submitted a project proposal to the MDN for an engagement activity. This paragraph focuses on the format of the Nanokaravaan that is prearranged by its organizers. The first subsection discusses how the organizers came up with their proposal for the Nanokaravaan and how they worked it out. The second subsection analyzes the scenario of engagement that is described in the submitted proposal.

Organization of the project proposal

A number of science cafés in the Netherlands take place on a national level and together they form a platform for collaborating science cafés[10]. Their meetings are used to keep each other up to date. Science cafés are mainly organized by volunteers and constitute low-budget activities that deal with scientific topics. The organizer of science café A (organizer A) explained that before the idea of the Nanokaravaan was born, the organizers already had discussed the opportunity to organize collaborative activities or to attract external funding. In 2009, organizer A heard of the constitution of the committee MDN and came up with the idea to write a proposal for a joint project that would be funded by the Nanopodium. He argued that science cafés "*would give the possibility to have a dialogue in a different way than normally is obvious*". He perceives science cafés as bottom-up initiatives that have no particular agenda. Therefore, he believed that the Nanopodium offered them a good chance to receive external funding and organize a collaborative project at the same time. The science cafés planned to organize this project together with debate centre 'Tumult' from Utrecht. Tumult is a professional organization that is more experienced with organizing projects like these and helped them with writing the more formal parts of the proposal. So, together with a member of Tumult, organizer A wrote the proposal for the first round. After this proposal was accepted, organizer B and Tumult continued the application trajectory by writing a more detailed project plan.

Organizers A and B both explained that their project proposal had to take care of some guidelines to get admitted. However, these guidelines only affected the choice for the themes and content. The science cafés kept their freedom to organize the meetings in their own format. They could make their own planning, propose a topic and invite a speaker. Despite the fact that these organizations had this freedom, the organizers explained that most of the organizers share their format. All science cafés aimed to organize informal meetings about a specific topic that is free of charge. Periodically, they invite a speaker that provides a talk and

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[10] The website of the platform: http://www.sciencecafe.nl/

the visitors get the space to discuss the topic with the speaker. Often, the first part of the format exists of a lecture by the invited speaker. The second part involves a discussion or dialogue between the speakers and the visitors in an open and informal setting. Organizer A and B explained that to increase their chances for submission, they added two extensions to their regular formats. First of all, they proposed the idea of a live-stream broadcast on the internet during the evening. Furthermore they proposed to order a scientific report by researcher Dijkstra. Dijkstra is a researcher from the University of Twente and is specialized in science communication. Her study analyzed the opinions of the visitors on nanotechnology. Her findings would provide the committee with a deeper understanding of the attitudes of the visitors on nanotechnology and the way these attitudes changed as a result of the Nanokaravaan.

Project proposal

Before the Nanokaravaan project was approved and funded, it was assessed in two rounds by the committee MDN. This acquisition was not public, but the organizers of the Nanokaravaan provided the documents for the analysis. For the first round, the organizers had to describe the first idea of their project. In the first proposal document, the organizers described the Nanokaravaan as a series of science café meetings on different topics related to nanotechnology. They presented the project as a collaboration of different science cafés which all organized their own meeting. They defined the project as a public dialogue on nanotechnology in seven different cities between November 2009 and June 2010. The authors positioned the project within the definition of the committee as a third type of activity; a dialogue activity. They stated their contribution to the societal dialogue of nanotechnology as an accessible activity for a broad audience. Subsequently, they claimed to bring "*scientists in direct contact with the audience, in the course of which the format exists out of the provision of information, discussion and debate in an informal setting*".

After their first proposal document was approved, they needed to hand in a more elaborated version. For this second round, they did not change much of their main idea. The aim of the project was still explained as an activity "*to inform [the visitors] about and make aware of nanotechnology and its application, by means of a dialogue between invited guest speaker(s) and the visitors*". The second proposal presented a much more detailed overview of the planned meetings. It showed that each café discusses a theme from its own perspective and resources. In table 1 you can find an anonymized overview of the different meetings in random order. Science café A, B and C were selected for the empirical study of this thesis.

Science café	Theme	Speaker(s)
A	Nano-particles in the environment: 'What are the real risks?'	- Researcher in the field of eco-toxicology
B	Biological nano-machines	- Professor in the field of molecular biology, department Radiotherapy and Genetics
C	Nano-medicines, a revolution!	- Professor in the field of 'lab-on-a-chip' systems
D	Nano-biology, new possibilities at the borderline of nano and bio.	- Professor in the field of molecular biophysics and nanoscience - Column by a journalist of an university magazine
E	Nano-revolution: Chances and dangers for health and economy.	- Professor in the field of Bio-Organic Chemistry - Project manager of the Rathenau Institute

Table 1

Although the Nanokaravaan consisted of different meetings, the organizers have tried to make it an entity. First of all, for the meetings they planned to use the same introduction film about nanotechnology "*to warm the visitor up for the discussion about nanotechnology*". Secondly, the meetings were streamed live on the internet. And thirdly, at the end of the series of meetings, a final meeting was planned to reflect on the Nanokaravaan with speakers and visitors.

The contribution of the Nanokaravaan to the societal dialogue is explained further in the second proposal. The organizers defined science cafés as informal meetings for people that are interested in science. The project aimed to bring scientists in direct contact with a broad array of visitors. The informal setting was really seen as the strength of the science cafés. The organizers believed that this setting would reinforce the supply of information, the awareness-raising and discussion or dialogue during the meeting. As a result, the meetings can discuss the five postulated themes of the committee in a profound and interactive way. And eventually, because of its popularity, "*science cafés offer a renewed form of contact between science and society*". Organizer A explained that he thought that the existing infrastructure of the science cafés was in the interest of the committee as a dialogue channel. He thought that their approval had largely to do with the fact that science cafés offered the Nanopodium an easy and new way for organizing a public dialogue.

To sum up, the organization of the Nanokaravaan appeared to be almost the same as for regular meetings. The organizers had the feeling they did not really have to change their format, because the committee was already pleased with their existing format. The science cafés were one of the few existing public engagement initiatives with science that fit the third type of engagement activity. In return, for the organizers this project was a nice opportunity to

attract funding and set up a collaborative project. The organizers had lots of freedom in setting up the meetings, only the themes of the meetings were guided by the committee.

5.4 Science cafés as public engagement activity

This paragraph returns to academic literature to discuss science cafés as a way to facilitate public participation. This section elaborates on what degree a science café meeting can be understood and framed as a public engagement activity. The project proposal showed that the general format of the Nanokaravaan consists of an educational part, but also offers time for discussion and debate. The way this discussion and debate will take place, is not much structured in the format. And, the outcomes of this discussion will not directly influence policy-making. Therefore a pressing question is, how do science café events relate to other public engagement activities?

You can distinguish two main types of public engagement with science and technology (Davies et al., 2009). The first one that seeks for a direct influence on policy processes, and a second one that does not. Both types are often described as a dialogue and perceived as a means of communication between science and society. This division is strongly present in the case of the Nanokaravaan as well. It is called a dialogue, but there are no direct links between the project and policy decisions on the regulation of nanotechnology. However, this does not mean that project as an engagement activity is useless. Davies et al. (2009) described three points with respect to the interest in and value of science café meeting as a mode of public engagement. First of all, they show that a shift of focus to the outcomes of a science café on a small scale, will remove many of the implications due to the lack of policy outcomes. From this perspective, science cafés offer space for individuals to learn through social processes. In the case of the Nanokaravaan, the interaction between speakers and visitors during the Nanokaravaan can still be very valuable for both parties to learn about the implications and possibilities of nanotechnology. Secondly, they explain that it is not necessary to interpret dialogue events that do not inform policy as a PUS activity. It is important to look whether the Nanokaravaan involves the potential for symmetrical learning as a result of the direct and informal interaction between the speaker and the visitors. If this symmetry in learning is present, this can lead to more social robust science. The last point they make is that it is important to see learning not only as an accumulation of facts. Learning has many forms, forms that involve emotions, empathy and social understanding. So, the Nanokaravaan should not only be valued as a PUS activity because, but it is important to look for the potential for symmetrical learning.

To conclude, the science cafe meetings, like the Nanokaravaan, can be conceptualized as a second type of public engagement. The project will not directly influence policy, but still has certain qualities that make it valuable as an engagement activity. First of all, science café meetings provide opportunities to the visitors to empower them for further involvement with nanotechnology Secondly, this type of engagement should be approached more as personally beneficial for both parties. Science café meetings provide space for symmetrical learning that can make nanotechnology more socially robust. And thirdly, this all could lead to gradual step change in science and society towards more engagement. Also, the media attention for these events brings more discussion on nanotechnology into the public sphere. And finally, science café meeting could initiate a ripple effect of activity and participation on nanotechnology which eventually can lead to direct policy impacts.

5.5 Former research on the Nanokaravaan

In commission of the Nanokaravaan project, Dijkstra (2010) did a study on the Nanokaravaan. Dijkstra used different methods to analyse the opinions of the visitors about nanotechnology. She compared this data with the analysis of the opinions of visitors of the same science cafés who did not attend the Nanokaravaan. Her findings that are relevant for the study of this thesis are presented in the following overview.

An analysis of the visitors showed some interesting characteristics of the respondents. Firstly, it showed that men are more attracted to science cafes than women (70% versus 30%). Secondly, it indicates that the average age is pretty high; 47.9 years. This is 8 years higher than the average age of the Dutch population. Thirdly, the analysis showed also that the visitors attract mainly highly educated visitors. And finally, it also demonstrates that the Nanokaravaan has attracted some new visitors (more than 33%). Another 33% percent had visited the science café more than once. And less than 33% had visited the café more than five times.

Dijkstra's qualitative study has identified different themes and arguments about nanotechnology that are used by the visitors during the science café meetings. Many different themes appeared to be discussed during the meetings. This can be explained by the different backgrounds and interpretations of the speakers on nanotechnology. Overall, it appeared that the visitors mainly shared a positive opinion about nanotechnology. But also the risks and safety issues of nanotechnology have been discussed. More than once the needs and benefits of a societal discussion and dialogue were underlined. And lastly, the visitors also tend to ask many questions to improve their understanding of nanotechnology.

The quantitative analysis of Dijkstra showed that many visitors explained that they think it is important to engage with nanotechnology. Many visitors had already oriented themselves on nanotechnology. A majority of the visitors stated that they think engaging the public with nanotechnology is a good thing and that engaging the public will also influence policy on nanotechnology.

In conclusion, the study of Dijkstra showed that science cafes do have a specific audience that is interested in science. These visitors are really interested in topics like nanotechnology, but are not yet related to this subject. For them, a science café is a place to have an informal meeting with experts. However, the group of visitors is an old and highly educated audience, so science cafés do not attract an average subset of the Dutch population.

5.6 Sub-conclusion: The constitution of the Nanokaravaan

This chapter discussed the prearrangements of the Nanokaravaan as an engagement activity. The first two paragraphs put the Nanokaravaan in a wider context. This showed that there is much attention for nanotechnology in science, but also in policy circles. Modern governments often approach nanotechnology as a platform technology, which will enable the growth of various economic sectors. The Dutch parliament also puts emphasis on the responsible development of nanotechnology. Besides focusing on the research agenda and risks regulation, they also initiated a committee with the responsibility to stimulate a public dialogue on nanotechnology. The Nanokaravaan project is a direct outcome of this policy. The committee had the responsibility to grant public initiatives and to publish a public agenda about the regulation of nanotechnology. This showed that not only the engagement agenda is organized top-down by the committee, but also the public agenda is organized top-down. Additionally, it appeared that the Nanokaravaan is one of the few engagement activities. Most of the facilitated activities by the committee have an emphasis on public education and awareness-raising. This showed that public engagement activities are still scarce and often organized or judged by experts.

The organizers defined the Nanokaravaan as a public dialogue. The organizers did not come up with a pre-arranged format for all meetings. Therefore, the project did not propose a pre-defined scenario of engagement. The project aimed to use the infrastructure of the collaborating science cafés. The pre-defined scenario of engagement was based on the existing formats of the individual science cafés. However, the formats do have a shared divider. The first part of the meetings was used for education of the visitors by a speaker. As a result, at least half of the predefined engagement scenario is mainly structured as a one-way

communication that engages the public passively. The second part was open for discussion and debate between the speaker and the visitors. Although this part of the dialogue is more interactive, the degree of active engagement is not structured in the formats. Also the contribution of the public in this part of discussion is not defined.

Academic literature on the science café movement showed that you can label the Nanokaravaan as a second type of public engagement. As a second type of public engagement activity, the Nanokaravaan will not directly influence policy. However, it can contribute much more on the level of social learning and a symmetrical interaction between the parties. Nevertheless, the scenario of the Nanokaravaan is not prearranged. It does not structure a specific degree of public engagement. Therefore, the outcome of the meetings will be largely influenced by the adoption of the meetings by the involved actors in social practice. As a result of the lack of structuration the degree of engagement will be highly dependent on the uptake and use of the event by the participants. The next two chapters examine this uptake empirically, investigate the actual degree of public engagement of the Nanokaravaan and investigate what the potential implications can be for further public engagement with nanotechnology.

6. The attributed meanings of the Nanokaravaan

This chapter zooms in on the interpretative flexibility of the Nanokaravaan by examining the way the Nanokaravaan is constructed as an engagement activity by the involved actors. The aim is to analyze to what degree the Nanokaravaan meetings are socially shaped and shared to engage the audience with nanotechnology. The analysis contains several steps and in the first paragraph, the relevant social groups for the Nanokaravaan are explored. The second paragraph examines the way the different actor groups perceive the Nanokaravaan and attribute meanings to it. The final paragraph concludes if there is a shared meaning on the Nanokaravaan and to what degree the Nanokaravaan is perceived to engage the public with nanotechnology.

6.1 The relevant social groups for the Nanokaravaan

Before the start of the empirical inquiry, the involved participants were divided in three groups: organizers, speakers and visitors. The distinction of these three groups was based on the division of the basic tasks of the participants during the meetings. This paragraph questions whether this preliminary division of the relevant social actor of the Nanokaravaan is accurate enough. Firstly, this is done by examining how the actors in the pre-defined actor groups perceive their relation with the Nanokaravaan. Secondly, the paragraph analyzes in what way the actors in the individual actor groups have a shared relation to the Nanokaravaan. Finally, the pre-defined actor groups are evaluated and the relevant social groups for further analysis are identified.

Organizers of Nanokaravaan

The organizers form the first pre-defined group of actors and were identified by their shared responsibility for setting up and organizing science cafés. The interviewed organizers were one of the main organizers of the Nanokaravaan in their own science café. Two of the three interviewed organizers, also took the responsibility to work on the proposal of the project. In this way, the group of organizers did not only facilitate the project, but also took the initiative for the project.

Organizer A had the first idea for organizing a joint project for the Nanopodium. After the other science café organizations decided to collaborate, he wrote the first proposal and worked out the main ideas: "*in first instance you had to submit a page in the format of the Nanopodium with your idea and mission. They [the Nanopodium committee] judged these and about twenty of the best ideas were invited to write an elaborate proposal*" (organizer A).

After their first proposal was approved by the committee, Organizer B worked together with Tumult on a more elaborated project proposal. For the organizers, it was the first time they applied for external funding as a collaborative platform of science cafés. However, the organizers argued that the Nanokaravaan was not much different than other meetings. Organizer C explained that despite certain additions, the actual meetings did not alter from their regular format. Besides writing a proposal, the organizers did not really have the idea they had to put extra effort in organizing the meetings. All science cafés could use their regular format and their responsibilities were not much different: "*from the start we said we wanted to take part [in the Nanopodium] but we will do it our own way [..] they did not insist on a uniform concept [for the science cafés]*" (organizer A). So, besides the addition of a scientific evaluation, an online stream and a shared introduction video, the responsibilities of the organizers were not much different than for a regular meeting.

Although the formats of the different science cafes are quite similar, their organization structures are not. The science cafés do have different backgrounds. Organizer A defined his science café as a civil initiative and an independent organization with no (political) agenda. Their organization aims to be approachable for a regular audience: "*[the science café] is a personal interest. Without relations to anything, it is totally independent. Without an agenda and the concept is to organize it in a rather informal way*" (organizer A). The organizer defined their organization as the product of a group of people with a shared interest in science. The organization comes up with topics and they try to invite speakers that relate to these topics. All work is done on a voluntarily basis. Science café C is organized by volunteers as well. This café has started as an initiative of the local Rotary club. Every year the Rotary chooses a societal theme. As a result of the theme 'knowledge and innovation' they came up with the idea to set up a science café. After the theme was replaced for a new theme, they continued with the science café. Nowadays, the board of the science café is separated from the Rotary: "*That is really the idea; you start something [with the Rotary] and after that it will leads its one's own life*" (organizer C). The meetings are still mainly organized by members of the Rotary and they use their network to contact speakers. The organization of science café B differs the most from the other two cafés. Organizer B explained that she is the only and main organizer of the café. The science café is part of a communication department of a medical faculty of a Dutch university. This department organizes different activities to involve the public in the research the medical faculty executes. They aim to make their faculty more known by the public. This science café often invites researchers from their own university and give them a bit more exposure: "*[our primarily goal] is to schedule as much as*

possible scientists from [our university]" (organizer B). In this way, the meetings are used as one of the channels to get the faculty and their research more into the public domain. For organizer B the science café is a part of her job, but also works with volunteers that are related to the university.

Science café A and B did not have a special relation with the discussed topics of nanotechnology. They approached the meeting as a regular meeting. Organizer C did have a more specific relation with nanotechnology. The organizer is a former employee of the RIVM institute[11]. As a result, he is interested in the risk side of nanotechnology and thinks that the involvement of people and consumers is a good development. Before the Nanokaravaan meeting, science café C already organized a meeting about nanotechnology in collaboration with the RIVM: "*That [meeting] was more about the understanding [of nanotechnology] 'What is it? How do people relate to it?'. Sometime later we invited [speaker C]. And that was more about the technology itself*" (organizer C). Despite this interest in the topic, this did not have much influence on the agenda of the science café.

To sum up, the organizers have a shared interest in organizing science cafés and have taken the responsibility to organize a meeting for the Nanokaravaan project. In this way the organizers have a shared relation with the Nanokaravaan project and form an important social group that facilitates the Nanokaravaan. Despite this shared relation, the organizers do not appear to be a homogenous group of actors. Although they have quite similar formats, on the organizational level the three science cafés deviate from each other. The organizations have their own history of development and their own network of volunteers and speakers. Both science café A and C can be seen as a product of a general interest in science by people. Science café B is not a public initiative, but more intended as a communication channel for a university. Notwithstanding the fact that the organizers have their own agendas and networks, they were all interested in organizing a collaborative project. They jointly took up the responsibility to organize a meeting for the Nanokaravaan. So, you can define the organizers as a social relevant group that has a shared relation with the Nanokaravaan project. Although they form a relevant social actor group, the actors might have different attitudes towards public engagement with nanotechnology due to their different backgrounds as an organization.

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[11] The Dutch National Institute for Public Health and the Environment

Invited speakers

The second pre-defined group of actors was delimited by the invited speakers that shared their expertise during the Nanokaravaan meetings. The three meetings that are examined all included one speaker that discussed a specific topic within the field of nanotechnology. These three speakers have been contacted on behalf of the separate science cafés. The speakers were asked to participate voluntarily with the Nanokaravaan by presenting their research on nanotechnology. This subsection elaborates on this group of speakers and their relation to the Nanokaravaan.

The speaker of science café A is an eco-toxicological researcher. He explained that he was asked to give a talk on his research on the risks and dangers of nano particles in the environment. He was glad to participate, but did not have much experience with public debates. The Nanokaravaan meeting was the first talk he did for a relatively big group of people. He explained that the relation of his research with nanotechnology is his expertise in assessing environmental risks. The speaker was pleased to share his experiences with research on nano particles: *"I think that you first need to know what the risks are before you apply it [nanotechnology] on a big scale. On the other hand, I don't think you should say from a sort of fear that all new technologies are bad"* (speaker A). He believed that when it comes to new technologies, there are always people who are in favor or are against a technology. In his opinion these positions are both wrong. One side emphasizes too much on risks and the other tends to deny these risks. Therefore he thought it was important to present objective information on the risks of nanotechnology in the environment. He believed that in the end the politicians and consumers have to base their opinions on these factual arguments. Besides the contribution of his talk to the public debate of nanotechnology, he also explained that preparing his talk and giving his talk helped him to think the issues more through.

The speaker from science café B was contacted to give a talk about biological nano-machines. The speaker works as a molecular biologist at the medical faculty of a Dutch university. In her research she works in the field of nanotechnology, because she does fundamental research on biological nano machines. Also speaker B was glad to take part in the Nanokaravaan meeting. First of all, because she sees nanotechnology as an interesting element of her work. Secondly, she likes the fact that the science café is quite successful and she could contribute to that. And lastly: *"I think it is important to explain to the public in different ways. Their impression of nano in the public is sometimes limited. A good thing is to try to explain how that fits in the work that I do."* (speaker B). So in her opinion, the meeting was a nice opportunity to explain how nanotechnology enables her research.

The speaker of science café C is a professor and is the chair of the research group of a technical university in the Netherlands. His group works on 'lab-on-a-chip' systems, which are enabled by nanotechnologies. He was contacted by science café C to talk about his research on lab-on-a-chip systems, regarding healthcare applications. He explained: *"I'm really motivated to make the things we do more familiar for a wider audience. And that is also of course because of your enthusiasm for your field of expertise"* (speaker C). Additionally, after winning prizes for his research he is often approached for giving lectures to a general audience. Also, a part of the funds he received, he spent to stimulate the popularization of science and his field of research. Besides his enthusiasm, he is also aware of the ethical implications of nanotechnologies. He argued that these implications need attention because we do not know everything concerning the risks and ethical aspects of nanotechnology, so we need other experts for doing that.

In conclusion, the invited speakers all participated voluntarily and were glad to participate. All three speakers presented their enthusiasm for their research as an important driving force for collaborating and were willing to share their knowledge in the setting of a science café. However, the group of invited scientists turned out to be a heterogeneous group of experts. Their expertise seemed to be linked with their attitudes towards engaging the public with nanotechnology. The research of speaker B executes fundamental research that does not have any applications yet. In her field of research, the public debate is less urgent. Speaker A and C underlined that from their expertise they are aware of the public debate on the implications of nanotechnology, because their research is both concerned with the implications of nanotechnology for society. Speaker C was also really aware of the ethical implications of nanotechnology and he explained that these ethical discussions are also part of his work. As a result of this expertise he appeared to be a more invited speaker for public engagement. So, the agendas of the speakers on the public debate with nanotechnology were rather different. This showed that although the speakers took a shared responsibility, this group of actors is a rather heterogeneous group in relation to the use and experience with public engagement.

Visitors

The last pre-defined group of actors is formed by the visitors of the Nanokaravaan meetings. This group has a shared relationship with Nanokaravaan as attendants of the meetings. During the meetings, the visitors took the opportunity to listen to the talk of the speaker and interact with the speakers and the other visitors. The group is formed by the largest amount of

participants of the project. The amount of visitors per meeting fluctuated between 75 and 120 persons (Dijkstra, 2010). In total, 455 individuals visited one of the organized meetings and were a rather heterogeneous group of people. The visitors can be divided in three groups; visitors who visit the science café regularly, occasionally or visited the café for the first time. During the empirical inquiry of this actor group, only visitors with experience of the science café were contacted. So, from the group of visitors not all three types of visitors were interviewed. However, also among the interviewed visitors there were quite some differences regarding their experience with science café meetings and their social and educational backgrounds.

Although the group consisted of a heterogeneous group of participants, it appeared that the science café meeting attracts a certain audience. Firstly, the visitors did have a shared interest in science. All visitors explained that they like to visit science cafés meetings, because they find the discussed topics and speakers interesting. However, they did not have a specific motivation to attend the meeting about nanotechnology and mainly approached the meeting as a regular meeting. Visitor B1 explained that "*you only have ten months per year [..] And if you start to select a specific topic what interests me, you will not attend [meetings] so much. So from that perspective I just attended*". Many of the visitors defined themselves as visitors that have a broad interest. One visitor argued that in his opinion, nanotechnology did not interest him at all. In his opinion, the talk on nanotechnology is too technical, so he does not really see the value of discussing. Secondly, many of the interviewees praised the educational aspects of the Nanokaravaan meeting. Visitor A1 explained that nanotechnology "*has never been in my interest, but I think it is interesting to hear something about it*". Some visitors also use the science café meetings to develop their knowledge. Visitor B2 explained that attending a science café has one basic goal for him "*to come home more wisely than when I arrived*".

To conclude, the group of visitors appeared to be a rather heterogeneous group due to their various backgrounds. The group of visitors does have a shared interest in science. For the regular visitors, this interest makes the science café meetings worth for them to visit. Nanotechnology is not specifically mentioned as a pressing topic and the visitors did not really distinguish the Nanokaravaan from a regular meeting. So, despite the variety of visitors, they shared the interest in attending science cafés. However, they did not seem to have a particular agenda, but just come in favor of their preference for scientific topics.

6.2 The interpretative flexibility of the Nanokaravaan

This paragraph elaborates on the way the Nanokaravaan is perceived by the different actor groups. The first paragraph divided the relevant social actors in three groups. The upcoming analysis focuses on the way the different actor groups interpret the Nanokaravaan and attribute meaning to it. These interpretations and attributed meanings show how the project is explained and adopted by the actor groups. This forms an important part of the social construction of the project. The next sections present an overview of the meanings that the actors have attributed to the Nanokaravaan. This overview shows to what degree there is yet a stabilized meaning of the Nanokaravaan as an engagement activity or to what degree there is already interpretative flexibility.

Organizers of Nanokaravaan

Organizer A explained the mission statement of the Nanokaravaan in most detail: *"My mission was to use the circuit of science cafés for a confrontation between audience and nanotechnology. The committee called this a dialogue"* (organizer A). He continued that the Nanokaravaan is organized in such a way, that it will entail a dialogue rather than a debate. He defined dialogues as free exchanges of thoughts, in which you listen closely to each other and examine each other arguments. He perceives debates as structured interactions by the use of intentional positions and opinions. Therefore, he wanted the Nanokaravaan to be more open than a debate. From his perspective, an open dialogue would lead to a more informal event that is openly accessible for a wider audience. He believed that the infrastructure and format of science cafés can facilitate this open character for the Nanokaravaan. In the wider context of the public debate on nanotechnology, the organizer categorized the Nanokaravaan as a specific type of dialogue channel between science and society.

Organizer B and C were less elaborate about the main goal of the Nanokaravaan. The organizers did not have varying expectations of the Nanokaravaan compared to a regular meeting. In the execution of the project, the organizers shared the same interpretation of the meeting as being a regular one. They explained the mission of the Nanokaravaan more from a national perspective and defined the project mainly as a contribution to the wider societal dialogue on nanotechnology. Organizer C argued that the goal of the public dialogue on nanotechnology is to make the public more familiar with nanotechnology and to stimulate discussion: *"I understood that the mission is to make the subject [nanotechnology] more public and to have more discussion with the people about this subject"* (organizer C). Organizer C perceived the Nanokaravaan as a means to support this discussion, despite its

small range. Organizer B was more skeptical about the goal of the national dialogue on nanotechnology. She argued that it seemed that this dialogue, of which the Nanokaravaan is a part, is believed to solve the implications of emerging technologies by making it more debatable: "*But my biggest question is, in what way does the public really gets influence and a say in the question whether to apply these types of technologies*" (organizer B). However she thinks that it is a good cause to make nanotechnology more easily discussible, although it is already at a developed stage.

In conclusion, the organizers of the Nanokaravaan meetings did not have a special interest in nanotechnology. For the organizers it was a good opportunity to collaborate and they approached the Nanokaravaan meetings as regular science café meetings. The organizers underlined the value and contribution of the Nanokaravaan for the public debate on nanotechnology as a whole. However, they did not have varying expectations of this particular value or contribution than for other meetings. As organizers, they focused on organizing the event by inviting a speaker and taking care of an informal setting that leaves room for discussion or dialogue. Because the organizers preserved their regular format, they did put emphasis on the contribution of the Nanokaravaan to the public debate in general, but not on the way the Nanokaravaan itself can engage the public with nanotechnology. The meanings that the organizers attached to the project thus mainly focused on public education as a way to facilitate public participation with nanotechnology in general. The organizers aimed to facilitate an open and informal dialogue or discussion. However, the open character of the Nanokaravaan enabled informal interaction, but did not automatically involve a symmetrical relation or two-way interaction between the speakers and the visitors. The option of symmetrical interaction, which opens the way for a higher degree of public engagement, appeared to be left to the initiatives and intentions of the speakers or visitors.

Invited speakers

The speakers voluntarily participated in the Nanokaravaan project and were keen to talk about their research. It appeared that the speakers mainly perceived the meetings as a way to supply information. Speaker C interpreted the Nanokaravaan as a way to make the public more familiar with nanotechnology by showing what nanotechnology means, entails and what the opportunities are. Speaker A explained: "*I think [the goals are] engaging people with the whole development and implementation of nanotechnology. I think that this engagement is a far-stretched goal. [..] I think you should already be glad when you can inform a big group of people. My central goals would be informing.*" (speaker A). Both speaker A and B perceived

the Nanokaravaan as a project that tries to engage people with nanotechnology and its development. Although they are aware they only reach a small group of interested people, they both believe that the interactive approach of the Nanokaravaan is a surplus value. This surplus value of engagement was believed to foster understanding. Also speaker C believed that the room for discussion during the Nanokaravaan would improve the understanding of nanotechnology.

Besides the fostering of understanding, they also valued the Nanokaravaan for bringing their research to the public. Speaker B argued that it is important for a scientist to communicate effectively: "*what I think is more important as a scientist, is to present things, the logic behind it and the facts, which are less scary in my mind, if you understand the facts*". She continued that an event like the Nanokaravaan is a good exercise for her. Also speaker A approached the Nanokaravaan as a valuable feedback for the communication of his research in general. The speakers did not only prepare their talk, they also had some expectations of the visitors of the science cafés and the discussion part. All three expected an interested public with some preconceived opinions on nanotechnology. Speaker A expected an audience with some predefined opinions about the implications of nanotechnology, speaker B expected some concerned visitors, and Speaker C expected an involved and fairly informed audience. Speaker C had much more experience with the public debate on nanotechnology. In his research on nanotechnology, that focuses on new applications, there is much more focus on the social aspects of nanotechnology. Due to his experience, he anticipated much more on the wider discussion on the negative aspects and risks of nanotechnology. Speaker A was a bit more skeptical about public discussions about nanotechnology; he underlined that public engagement with nanotechnology will be a long path and that you should be glad if you eventually can inform a large group of people about nanotechnology.

To sum up, all three speakers took their job seriously and prepared themselves with care. Despite their differences in experience or expertise, they all expected an interested audience with some preconceived opinions about nanotechnology. The speakers expected to go into discussion with the visitors. The speakers valued this and were open to engage in it from their own expertise. However, they mainly focused on educating the audience about nanotechnology and the speakers liked the interaction with the visitors as a way to communicate science. The discussion was especially seen as a way to improve the understanding of the visitors about nanotechnology. However, the speakers did reflect on their learning during the meetings. Firstly, the speakers explained that preparing the meeting was a good exercise in communication science to a broad audience. Secondly, speaker A and C also

underlined the need of a public debate. They were open for learning from the audience and in gaining new insights from the public. However, they did not really expect this to happen or it being of real influence on their work. As a result, the public engagement that was present in the Nanokaravaan was mainly perceived to foster the understanding of the public and to improve the communication of science. In this way, the speakers did not perceive a large degree of symmetrical learning with the audience.

Visitors

The interviewed visitors defined themselves as regular visitors of the science café. Most of them did not have any expectations of the Nanokaravaan in particular: "*Usually, I arrived open minded*" (visitor C). The visitors expected a regular meeting that would teach them something about the discussed topic: "*when you don't know much of something, the expectation is that you will be informed*" (visitor A2). The visitors characterized the Nanokaravaan as a way to make nanotechnology and its application more widely known: "*The mission should be of course to show something of the newest development to a big audience*" (visitor B1). This showed that the contribution of the Nanokaravaan to the public debate on nanotechnology was especially interpreted as a way to inform people and raise awareness for nanotechnology and its applications. So, the visitors all identified a major educational aspect in the Nanokaravaan.

Besides visiting other science café meetings, none of the visitors had any experience with other dialogue or engagement projects with science. Both visitors of science café B mentioned the space for debate during the meeting. However, most visitors revealed their preference for the first part of the event, which is mainly used for the lecture of the speaker. The discussion part was perceived more as an extension to this first part. The visitors explained that the discussion part is often used by the visitors for more explanation. The discussion part was denoted as question-answer game between the researcher and the visitors. Consequently, the visitors conceived the event mainly as an informing dialogue: "*I want to go home more wisely than I arrived [at the meeting]*" (visitor B2) Only one visitor, of science café B, proposed the possibility that the Nanokaravaan could function as a kick start for a more broad societal debate on nanotechnology.

In conclusion, the Nanokaravaan meetings were mainly perceived as a regular meeting of the science café. A regular meeting is normally characterized by an interaction in lecture style. The visitors mainly expected to be informed about the topic of discussion. Also the Nanokaravaan was not perceived as an opportunity for engaging with the speakers on a

symmetrical level. Although the dialogue was mainly conceived as one-way communication, the openness and the interactive elements of the format were nourished by the visitors. The visitors perceived the Nanokaravaan as a way of interactive informing. So, the construction of public engagement was not perceived by the visitors as a need nor as a responsibility of themselves. They did not seem to strive for a more symmetrical relation with the speakers to transcend the one-way flow of knowledge about nanotechnology from the speakers.

6.3 Sub-conclusion: The constructed meaning of the Nanokaravaan

The new ways of interaction between science and public, which are proposed by the PES tradition, need to be socially shaped and shared to become institutionalized. This chapter analyzed this process by examining the meaning that the relevant social actor groups attributed to the Nanokaravaan as an engagement activity. The first paragraph showed that the relevant social actors can be divided into three main groups: organizers, speakers and visitors. These actor groups have a shared relation with the Nanokaravaan, but form heterogeneous populations. The second paragraph examined per actor group what meanings they attributed to the Nanokaravaan. Although the groups are rather heterogeneous, the groups did share a big part of the meanings about the Nanokaravaan with each other. Also, among the actor groups the perceptions of the Nanokaravaan did correspond with each other. There was closure on the interpretation of the Nanokaravaan as an informing dialogue. This showed that the science-public relationship during the meetings was mainly defined by the PUS approach. Although the event was perceived as accessible and interactive, during the event there was much focus on the public understanding of nanotechnology. Both the speakers and the visitors conceptualized the dialogue activity as a way to foster learning by facts from the speaker, instead of a process of symmetrical learning.

As a result of these attributed meanings, the actors do not put much focus on the possibility of using a dialogue or discussion for other types of learning or opinion forming. The speakers do note that the project triggers them to think about communicating science to the public and making it relevant for a broad audience. However, the aim of the project is mainly perceived to be on the understanding of nanotechnology. The discussion on nanotechnology is conceived by the actors to be interactive, but the dialogue between the visitors and speakers on nanotechnology is rather limited. The discussion during the meetings is rather seen as fostering understanding among the visitors. This can be explained by the open character of organization of the Nanokaravaan, which led to a degree of 'ambiguity of informality'. The informal character of the meetings made the format of the Nanokaravaan

ambivalent for the actors. On the one hand, the informality and accessibility of the Nanokaravaan helped the project to facilitate an open dialogue. This provided the visitors openings for engagement and the constitution of a symmetrical interaction. On the other hand, due to the informal character of the Nanokaravaan, there was no structure for public engagement. As a result, the speakers tend to stick to their own expertise and the visitors mainly approached the meeting as a lecture. The informality of the meetings seemed to let the participants fall back in the stabilized forms of interaction that is found in the PUS approach.

To conclude, the Nanokaravaan showed openings for symmetrical interaction and learning. The speakers were enthusiastic about presenting their research about nanotechnology and discussing it with the visitors. However, public engagement does not only mean symmetry in interaction, but also needs the intention of a symmetrical relationship. The input of the audience on the discussion of nanotechnology was rather limited. The openings for engagement on nanotechnology needed effort from the actors. While the Nanokaravaan meetings were conceived as interactive, the dialogue between the actors was rather limited. The dialogue was not framed as a co-construct of the input of the visitors and the speakers. As a result, the Nanokaravaan was mainly perceived to be able to empower people for further involvement with nanotechnology by informing them in an interactive manner during the meetings. How this construction of the Nanokaravaan is influenced by the perceptions of actors' own roles and those of others is discussed in the next chapter.

7. The attributed engagement scenarios of the Nanokaravaan

This chapter examines the social construction of the Nanokaravaan as the outcome of actors' perceptions of the engagement scenario and the involved roles. The next sections elaborate on the way the prearranged roles are adopted and negotiated by the actors during the Nanokaravaan. This is examined by focusing on the way the actors perceived their roles and those of others in setting up a dialogue on nanotechnology. The analysis is done in three steps and the first paragraph focuses on the attributed meanings of the actors to their own role. This examines actors' perceptions of their own role in and contribution to the shaping of the Nanokaravaan project. The second paragraph investigates actors' perceptions of the roles of the other actors. Finally, the last paragraph reflects in what way a final scenario of engagement was constructed and which roles were involved.

7.1 Actors' perceptions of their own role

This subsection focuses on the meanings that the actor groups attributed to their own role in shaping the Nanokaravaan meetings. These attributed meanings are discussed per actor group. The first part of analysis discusses the preparations of the actors for the event. These preparations show what the actors expected from their contribution to the dialogue and if they had any guidelines in mind. The second part of analysis deals with the perceptions of the actors of their role during the event. These perceptions will show what meaning the actors attributed to their contribution to the dialogue on nanotechnology. And lastly, the reflections of the actors on their roles are described and analysed. This last part discusses if the actors were pleased with their role and whether they wanted to change their contributions for a next time.

Organizers of Nanokaravaan

During the interviews, the organizers highlighted their preparatory role in setting up science café meetings. They divided their preparatory contributions in two parts. On the one hand, they need to maintain the science café as an association. On the other hand, they organize events. For the Nanokaravaan project, the collaborating science cafés had the extra task to apply for funding from the Nanopodium. Organizer A and B were the main forces behind the proposal for the Nanokaravaan project. They took both the responsibility to work on the application of the project. During the periodical meetings with the science café platform they kept the organizers updated about the development of the proposal. Speaker A and B did not

perceive this as a major effort, because the actual Nanokaravaan meetings were organized by the separate science cafés. The separate science cafés had the responsibility for organizing a meeting that fitted the conditions of the proposal. This meant that, like for a regular meeting, they had to pick a theme, invite a speaker and take care of the promotion of the event. So, although the Nanokaravaan is a collaborative project and had some specific additions, like the web-streaming of the meeting and the scientific evaluation, all the organizers had the idea they could maintain their regular roles.

The organizers defined their role for the Nanokaravaan as facilitator. After the preparations, they did not aim to influence the interaction between the speaker and the visitors: "*As a science café we do not want to spread a certain message [..] we want to provide a stage for scientists [..] who want to present their story*" (organizer C). However, the organizers did realize that picking a theme in combination with a particular speaker influences the way a certain issue is discussed. For the visitors, the organizers wanted to contribute to an open and informal setting: "*our aim is to give the visitors the freedom to ask their questions and points for discussion*" (organizer B). Despite the open character, the science cafés did have a moderator during the evening. These moderators are especially instructed to introduce the speaker and to guide the discussion. The different organizers walked around with microphones, so people in the audience could ask questions. Organizer B admitted that when somebody is really off topic, the moderator considers interfering. But in general this was not needed during the Nanokaravaan. Finally, all organizers were happy with the meeting they organized and did not come up with points for change.

In this way, the organizers presented a clear view on their role for the constitution of the Nanokaravaan. Their perceived task is to contact the right speaker for their chosen theme and keep the event accessible and informal. After these preparations, they do not want to influence the meeting anymore. During the meetings, they perceived their role to be neutral. The organizers explained that they did not make attempts to structure the interaction between the visitors and speakers. They aimed to take care of an informal setting, which means that this left the option open for visitors to interact with the speaker. They did not explicitly aim to stimulate symmetrical learning between the participants. Although, the organizers did not want to construct the interaction between the speakers and visitors, you can question if their role is really that neutral. First of all, the organizers acknowledged that they influenced the dialogue by picking a certain theme and speaker. They explained that the choice for a certain speaker can have a large influence on the way the interaction will take place. If a theme is controversial or the speaker is more interactive, this will influence the participation of visitors.

Secondly, organizer C explained that he wanted to provide a stage for the speaker. This 'stage' metaphor seemed to be an important framing for the Nanokaravaan meetings. During the meetings in science café A and C, the speakers were positioned in front of the audience and made use of slides during their talk. This positioning can be an important framing for the one-way interaction during the meetings. A stage could be a major influence for preserving the gap between the speakers and the visitors.

In science café B, this stage metaphor was less prominent and organizer B explained that their format really tried to keep up the café-setting. She explained that they tried to stick to the initial concept of a 'café scientifique´, which is set up in France. "*the initial set up of these cafés was to provide a sort of stand-up science. You're just sitting in a bar [..] and suddenly someone will stand up on an orange crate and will tell you something [about science] [..] we try to arrange that by not allowing powerpoint slides [..] Ideally we want to place the speaker among the visitors. Ultimately this was not the best solution [due to technicalities]"* (organizer B). This café metaphor could attribute rather different roles to the participants. However, she revealed that their setting is not really set up for discussion. The organizer explained that if she wanted more discussion, she would have organized more discussion by inviting several experts. Because organizer B has the possibility to use multiple communication channels from their university to the public, she uses other formats for more discussion: "*With our science café we emphasize more on information, amassing knowledge*" (organizer B).

To sum up, the organizers perceived their role mainly to be preparatory, and wanted to leave the actual interaction up to the other participants. The organizers did not attribute any roles to the other participants, but the role of the organizers cannot totally be defined as neutral. Like they explained, the choice of theme and the setting of the meeting can have large influence on the construction of the interaction and the roles the participants take up.

Invited speakers

The speakers contributed to the Nanokaravaan by spending time to prepare their talk and doing the talk. The way of preparation was related to the different experiences the speakers had with presenting their work to a broad audience. For speaker B it was the first time she presented her research to a lay-audience. Speaker A was a bit more experienced, but never presented for a big audience, like the Nanokaravaan. Speaker C was the most experienced among the speakers. He already had done other talks on the same topic besides his specific field of research. Also, he had attended discussions and consultations about nanotechnology at

other platforms. Despite these differences in experience, all three experts believed that their main purpose was to inform the visitors about nanotechnology.

Both speaker A and B stressed the importance of their role to present objective information about nanotechnology to the audience. They argued that they did not expect that the visitors would have much knowledge about nanotechnology. Speaker A explained that this brings a certain degree of responsibility to him: "*I get the point that your story can become the truth. And that brings a sort of responsibility to present a story as good as possible and to keep it as close to the real data [..] because you have the responsibility for telling something new where they don't really have a broad base for*" (speaker A). Speaker B explained that she thinks it is her duty as a scientist to present facts in a way that people can understand and use them. "*What I say is that my role is to present people, as a scientist really I think it is a scientist communicating with the public, you want to present facts in a way people can understand them and then can use them themselves, I hope.*" (speaker B). Speaker C presented his research from a more interactive point of view. He explained that besides informing the audience, he also tried to make people enthusiastic about nanotechnology and to let them feel safer. During his talk he was open for the more critical aspects of nanotechnology, like the involved risks and ethical implications. "*I am enthusiastic [about nanotechnology], but I'm open for discussion*" (visitor C). As a result, during the event he presented nanotechnology and its applications with a positive but critical attitude.

All three experts reflected that they had a large influence on setting the stage for discussion: "*so that [the talk] was presented first and I had much more time to stand there and do whatever what I was going to do.*" (speaker B). In the discussion part, speaker A tried to keep up his nuanced view on nanotechnology as his central message: "*Yes, such a debate is of course a bit dependent on the type of questions that are asked. Those [questions] are really steering [..] So I think it is hard to keep a debate balanced. The only thing I try is to keep my central message in it.*" (speaker A). For speaker B, the discussion part felt more like a question and answer game and kept it close to her expertise: "*well it was not so much a debate, as a sort of questions and answers, so I was providing the answers, or at least my viewpoint on these things.*" (speaker B). Speaker C sensed that the audience picked up his critical but broad view and also identified it during the discussion part. "*[I inform the visitors] and try to keep their minds at ease. I listen and if there is critique that will give me new insights, I will take that along. And on the other side I try to answer the critiques or questions as good as possible*" (speaker C).

In conclusion, the speakers perceived a central role for themselves during the meetings. They perceived a responsibility for the forming of visitors' opinions on nanotechnology. As a reaction, the speakers mostly wanted to stick to their expertise and factual argumentation about nanotechnology. This showed that the speakers positioned themselves as experts and mainly advocated one-way interaction between them and the visitors. They constructed the role of the visitors as a lay-audience because of their lack of knowledge. Speaker A and B explained, that because of this lack of knowledge, the speakers did not think it is their role to form the opinions of the visitors. These speakers focused on learning by facts and providing public understanding. They did not intend to set up a symmetrical interaction with the visitors that could have lead to other types of learning. Speaker C was a bit more open for other types of learning. He also wanted to inform the audience, but more from a positive but critical perspective. He showed that he has attention for the diverse implications of nanotechnology that are beyond his specific research domain, but also wanted the people to feel safer about nanotechnology. This difference between the speakers, could be explained by the fact that speaker A and B were new to the setting and they work on more fundamental research on nanotechnology. Because the speakers did not perceive any guidelines, they seemed to fall back in the framing of PUS. So, the speakers mainly focused on informing and therefore experienced a huge knowledge gap with the visitors. As a result, they picked up a central role and did not set the stage for other types of learning between them and the visitors. In this way, the speakers maintained the knowledge gap between them and the visitors.

Visitors

The interviewed visitors explained that they do not prepare themselves for science café meetings. This was also the case for the Nanokaravaan meetings. Most of the visitors arrived with an open mind and were likely to get surprised by the topic and the invited speaker. When it comes to their contribution as visitor to the event, they did not really impute themselves to have any. Most of them had a preference for the lecture part of the meeting. They all acknowledged the space for discussion. However, the respondents did not really feel the urge to participate. The visitors of science café B, explained that this is the case because of the specific academic topics that are discussed: "*I have a preference for the informative part, because I do not have the pretending to be an expert*" (visitor B2). A part of the visitors were denoted as experts because they are linked to the university or were old academics. As a result, in science café B, the discussion often turned into an in-crowd discussion and the

visitors did not really like asking questions. The visitors of science café A did not mention an in-crowd discussion during their meeting. However, they also visited to become informed and did not really feel the urge to engage or take initiative to participate. One visitor explained that he tried to leave after the break to avoid the discussion part, which he does not appreciate in general: "*After a day of work I'm not really waiting for a discussion anymore*" (visitor A2). The visitor of science café C noted that he did not feel expert enough to contribute to the discussion during the meeting: "*I have the impression that the expertise of the speaker always towers far above the audience*". He preferred to get informed by the speaker and thought that other visitors could ask better questions: "*Sometimes there are a lot of clever clogs in the room who know a lot about the topic [..] Those people can of course ask really clever questions [..]For most of the topics I have two left feet*".

To conclude, the interviewed visitors explained to experience a significant knowledge gap with the speakers. The visitors are interested in science and for the biggest part they were positive about the meetings. The visitors do perceive the room for input from the visitors as a group. But it was mainly a subset of the audience that they thought were better informed and really attributed something to the discussion. Individually, they did not have the feeling that they could really contribute to the talk of the speaker. So, the visitors conceived and valued the Nanokaravaan event mainly as an interesting and informing lecture, but not as an engagement activity. They preferred to be educated and did not strive for two-way interaction, although they did recognize the potential for engagement. As a result, the visitors did not seem to take an effort to set up a symmetrical interaction with the speakers and increase their participation during the meetings.

7.2 Actors' perceptions of the roles of the other actors

The process of positioning shows that the way an actor constructs its own role, also influences what meanings the other actors attribute to their own roles. The former paragraph analyzed the way the actors interpreted their own role. The second part of the analysis of the Nanokaravaan focuses on the meaning the actors attributed to the roles of others in shaping the Nanokaravaan. In the following subsections, these attributed roles are discussed per actor group.

Organizers of Nanokaravaan

The organizers argued that the invited speakers contributed the most to the meeting: "*I think of course that the speaker is very determining [for the meeting]. That's the reason why you*

invite him" (organizer C). The organizers believed that the speakers had the most influence on the course of the meetings. They positioned the role of the speakers as the most central and influential. The organizers explained that the speakers really had the time to explain their research and pose their insights and opinions regarding nanotechnology. Both organizer B and C emphasized that the course of the discussion part was also largely depended on the way the theme was discussed by the speaker. They believed that if a speaker is rather positive on the developments of nanotechnology, this will also make the discussion more positive: "*Because of the emphasis she [speaker] chooses, she chooses how to talk about their topic. Look, if you come to talk about a very controversial topic, then you can put much emphasis on the fact that it is controversial, but you can also just tell your story*." (organizer B). Organizer A added that their speaker was aware that the second part of the evening was meant for questions and discussion. Therefore, in the first part the speaker could take the space to share his view on the topic. The organizer explained that in this way, he could influence and pre-structure parts of the discussion.

The organizers perceived the visitors as a heterogeneous group of people. But they did not expect a much different group of visitors than for regular activities. In general, the visitors were portrayed as higher educated people that were a bit older than the average population. Because of the heterogeneous audience, the organizers could divide the visitors up in different groups. A first distinction was made between the visitors who are experienced with visiting science cafés and visitors who are less experienced. A second distinction was made between the visitors that are generally interested in science and visitors that come for a specific topic. A third distinction was made between the people that like to interact and people that only come to listen to the speaker. Organizer A added that there are also visitors at their science café that sometimes leave the room when the discussion part starts. So, the organizers perceived the visitors as an educated and interested group of people. However, they did attribute a passive role to the visitors. The organizers emphasized the space for the visitors to influence the meeting. However, all three organizers explained that the discussion parts of the Nanokaravaan meetings were mainly used by the visitors to ask questions about the discussed content: "*[The fact that there was not that much discussion] could also be the result of the fact that the topic apparently is not yet widely known as a risk*" (organizer C). Although the visitors were perceived to be educated, the organizers had the idea that nanotechnology was a fairly unknown topic for them. In science café B there was a larger group of people that were academic workers or professors. It happened that these visitors started an in-crowd discussion

with the speaker. However, this was seen by the organizers as a threat for the open dialogue for the other visitors.

To sum up, the organizers did not perceive the roles of the speakers and visitors during the Nanokaravaan much differently than for other meetings. The organizers attributed a central role to the speakers. In opposite to the visitors, the organizers positioned the speakers in the role of expert. Not only did the speaker have the most influence on the content of his talk during the first part of the meeting. The organizers also believed that the first part influenced the direction of the discussion to a large extent. The visitors were also perceived to be able to influence the course of the evening. However, on the specific topics that were discussed during the meetings, the organizers did not attribute an active role to the visitors to constitute a symmetrical interaction. The organizers did not aim to constitute an active role for the visitors by structuring the meeting. Because of this lack of structure, the organizers left the constitution for symmetrical interaction largely up to the choice of the speaker.

Invited speakers

In general, the speakers perceived the organizers as helpful. The three speakers noted that they did not receive many guidelines from the organizer: "*The contact with the organisation was pretty informal and not really prescriptive*" (speaker A). Before the start of the event, the speakers got familiarized by the organizers about the concept of the science cafés and its open character. The speakers did not interpret this as an infringement of their own role during the meeting. Also the moderators were perceived as a helpful addition to the meeting. The speakers were aware that this was a way to channel the evening instead of a way to influence the content of the talk or the discussion. This showed that the organizers were mainly perceived as neutral facilitators of the meeting by the speakers. However, not everything from the hand of the organizers was perceived to be neutral. Speaker B was a bit surprised by the introduction film that was part of the Nanokaravaan meeting. She did not preview it and was surprised by the content. She did not really like the way nanotechnology and its risks were framed in the video: "*It seemed to be biased towards Nano as dangerous. Science was portrayed as strange people walking around in white coats doing mysterious stuff. Which is the societal stereotype that is rather not useful shall we say*" (visitor B). In her opinion it was pretty hard with her specific expertise to anticipate on the presented statements about nanotechnology. The next time, she will try to prevent such a situation by previewing the video. In this way she can prepare how to react to certain statements. This showed that not everything from the part of the organizers was perceived as neutral. Although the organizers

may not be aware of this, for speaker B the video was perceived as a way to influence the discussed content to a certain direction.

The speakers perceived the visitors as a broad and interested audience. Besides these interested people, both speaker B and C also sensed some visitors who had more expertise on the topic. All speakers acknowledged the room for the visitors to influence the event. They argued that the questions from the visitors helped them to be aware of what the visitors think is important: "*I don't know which of them people think are important and what sticks with them and then you learn by what they ask*" (speaker B). Speaker B explained that a large group of retired people were asking detailed questions, while the other visitors asked more general questions. Speaker C also tried to inform the public and also sensed their enthusiasm during the event. However, he added that he is open for critical discussion points and input of people. If these points are relevant then he likes to take that along, because he emphasized that there are still some uncertainties and ethical points to discuss. Finally, speaker A and C explained they were open for some new insights from the visitors, but from their view nothing really popped up: "*There were no fundamental things that I picked out, of which I thought I got something wrong or something should be added*". So, the speakers perceived a lot of room for the visitors to take up in the discussion. However, they noticed that the visitors used this room mainly to ask for more explanation. Speaker A explained that the main group of visitors just wanted to be informed. Therefore, the role of the visitors in the process of learning by facts was not perceived to be substantial. They argued that the visitors had not addressed any fundamental things about nanotechnology that could have influence the content of their talk or their opinions on nanotechnology. The role of the visitors in the discussion of the content on the topic seemed to be largely neglected.

To conclude, the speakers did not perceive a major contribution of the organizers or visitors in setting up a symmetrical interaction with the visitors. The role of the organizers was mainly perceived to be neutral and facilitating. The speakers did appreciate the open character of the science café, but the format was not seen as a structure for a dialogue with the visitors. Speaker B seemed to be aware of the openness that was provided by the organizers: "*I guess the event wasn't set up to be a debate [..] I think if you want to set it up as a debate, then there has to be more structure to the questions or the discussion period. It was pretty much left up open*". The speakers perceived their interaction with the visitors to be based on factual learning. The speakers aimed to share their expertise with the visitors. The visitors were seen as an interested group of people that liked to get informed but they were seen as a lay-audience. The interaction with the visitors was not viewed as a potential for symmetrical

learning. The speakers agreed that the visitors are an important element for knowing what is important to discuss during the meeting. However, the speakers did not attribute a substantial role to the visitors regarding the content of the meeting. This was mainly because the intended interaction of the speakers involved factual argumentation. As a result, the discussion that was constructed during the meeting was mainly based on the expertise of the speaker and this maintained the knowledge gap with the visitors.

Visitors

The visitors explained that the contributions of the organizers mainly included the preparation of the science café meetings. They did not believe that the organizers influenced the content of the meetings. However, they noted that the organizers could guide the meeting to a certain degree: *"[for the organizers] the steering lays within the preparation"* (visitor B2). A part of steering is the type of speaker that is invited and this can influence a certain type of interaction. Visitor B1 explained that the organizers could also have influenced the interaction by structuring the debate. He suggested that if the organizers really wanted to have a debate, they should have prepared it differently by inviting different experts at the same meeting. So, this showed that the visitors mainly perceived the role of the organizers as neutral and without an agenda. Although the actors were satisfied with the existing dialogue, they believed that more dialogue could have been stimulated by the organizers. This showed that the visitors attributed the role of structuring the meeting, which could have led to more engagement, partially to the organizers.

The visitors perceived the speakers as the largest contributors to the meetings. The visitors attributed an educational role to the speaker. They mainly perceived the speakers as a supply of information on their field of expertise. The visitors expected an interesting and clear talk on the presented topic. On the one hand, the visitors denoted the interaction during the meeting with the speakers as open: *"The speakers are always open for a question"* (visitor B1). The visitors thought that this interaction made the talk better and more interesting. On the other hand, the visitors also sensed that the speaker can really set the stage for discussion. One visitor explained that the speaker not only influenced the start of a discussion, also the discussion itself is influenced by the speaker: *"[the discussion] is really determined by the way he builds up his talk"* (visitor A2). So, the visitors positioned the speakers as experts in their field. First of all, the visitors perceived a gap of knowledge between them and the speakers. This provided the speaker the room for a one-way supply of information. Secondly,

because of the knowledge gap, they also gave room to the speakers to set the stage for the discussion. In this way, the option for symmetrical learning was left up to the speakers.

In conclusion, the interviewed visitors attributed the role for setting up public engagement both to the organizers and the speakers. They believed that the organizers could steer the meeting with the preparations they make. However, the speakers were seen as the biggest steering element of the meetings. They perceived the speakers as experts on the discussed topics. The speakers were believed to be in charge of the knowledge that was discussed during the meeting. Also in the discussion, the visitors attributed the role of expert to the speakers. In this way, the visitors let the speakers mainly be in charge of the supply of information and discussion. As a result, the speakers had much space to influence the degree of public engagement.

7.3 Sub-conclusion: The constructed engagement scenario of the Nanokaravaan

This chapter investigated this social construction of the Nanokaravaan as the outcome of the positioning of the different actors. Therefore this chapter not only focused on the roles the actors attributed to their own roles, but also to the other roles. The analysis showed that the initial engagement scenario for regular science café meeting was largely maintained during the Nanokaravaan. This initial scenario of engagement was described as an open dialogue. It sketches the distribution of different responsibilities. The organizers were in charge of preparing the event and inviting a speaker. Additionally, the invited speakers were expected to give an interesting talk with room for interaction with the visitors. Lastly, the visitors were welcomed to join in and ask questions when they liked and make an open dialogue possible. The former chapter already showed the ambiguity of the open interaction during the Nanokaravaan. Because the science café meetings were all initially organized as open and informal meetings, this made the meetings suffer from an ambiguity of informality. On the one hand this informality offered openings for more public engagement. On the other hand, because this informality led to a lack of structure in interaction between the speakers and the visitors, the project had difficulties to transcend the frame of the PUS approach.

This chapter showed that the ambiguity of informality during the meetings was mainly constructed by the organizers. The organizers mainly aimed to shape the environment for an open dialogue. They did not aim to structure the interaction between the visitors and the actors. The actual structuring of the STS engagement was subject to the other actors. The organizers expected the most contributions from the speakers. The speakers were attributed

the most influencing role, despite the fact that they formed the most inexperienced actor group on public dialogues in comparison with the other participants. Besides their talks they also were in charge of facilitating the discussion between them and the visitors. Also the visitors attributed the role of expert to the speakers. Due to the perceived gap of knowledge with the speakers, the visitors let their own role depend on the contributions of the speakers. As a reaction on this attributed responsibility, the speakers were a bit careful with the content of their talk. They did not want to form opinions of the visitors. As a result, the speakers tended to stick to their field of expertise. This seemed to preserve the gap of knowledge between the visitors and the experts. Because the visitors did not have much expertise to share in this setting, a symmetrical interaction was not self-evident.

To conclude, the process of positioning during the Nanokaravaan meetings showed that there are several explanations why the constructed scenario of engagement did not transcend the PUS approach of the science-public relationship. A first explanation can be the choice for the setting of the event. The setting of the meeting does attribute symbolic roles to the participants. In science café A and C the ´stage setting´ was hanging around. Because the speaker was on a stage and presented with slides, the setting underlined the knowledge gap between the visitors and the expert. In literature there are examples of other types of settings, like citizens juries, that are likely to stimulate more symmetrical interaction between the participants. A second explanation is already mentioned by the participants. The meetings needed more structure to enable more public engagement. The organizers could play an important role in structuring a dialogue. Especially during the discussion part more structuring was needed to keep the dialogue approachable for visitors. The organizers could transcend the discussion from a question and answer game, by bringing in points of discussion that all visitors can participate on. Or they could have invited another expert to make the discussion more inviting. A third explanation is related to the topic of discussion. It seemed that nanotechnology is not yet a field of science that is well known in society. Because the technology is new, many visitors were not yet familiar with it. This increased the gap between the speaker and the visitors. It can take time before this gap will decrease. Another option is to organize meetings that aim to discuss nanotechnology more in general terms or organize a series of meetings on the same topic. Finally, there appeared to be a lack of explicit social problems relating to nanotechnology. When problems with nanotechnology get more pressing or controversial, visitors can become more willing to engage. They will become more eager to participate and will have come up with issues they want to discuss.

8. Conclusion and discussion

The conducted study on the Nanokaravaan focused on the outcomes of public engagement projects with science. Although the PES is often seen as the new way to deal with emerging technologies, empirical analyses have shown that the approaches of PUS and PES are hardly mutually exclusive. Public engagement can be implemented in different formats and these formats can constitute different degrees of engagement. The conducted study aimed to contribute to the lack of empirical research on PES projects by focusing on the way the intended format of a public engagement is adopted by the participants. The analytical framework for this thesis was based on a social constructivist perspective. The analytical framework was developed by a theoretical detour and conceputalized PES as a tool for structuring social interactions. This instrumental perspective on PES provided the analogy with a specific type of technology; a governance technology. This enabled the framework to use the analytical insights from the SCOT approach. SCOT provided the tools to study the social construction of a PES project, such as the Nanokaravaan, by the meanings that are attributed by the involved participants. By studying both the intended format of the Nanokaravaan and its social construction by the participants, this thesis aimed to get a better understanding of the tension between these two for the outcome of a PES project.

By studying the intended format of the Nanokaravaan project, the first part of analysis could explore what type of PES project the Nanokaravaan is. This showed that the Nanokaravaan meetings did not really have a structured scenario of engagement. During the Nanokaravaan, the organizers applied their regular formats to the meetings and approached the project as an open dialogue. With this format the organizers wanted to preserve the most important condition for the Nanokarvaan: its informality and accessibility for a wide audience. The organizers did not structure much of the interaction between the speakers and the visitors, but focused more on creating an informal environment where science and the public can meet. The meetings were divided in two sections. The first section provided the speaker a stage to do his talk and was mainly intended as a lecture. The second section provided the visitors the possibility to set up a discussion with the scientist, but this discussion was not really structured. As a result, the study on the intended format of the Nanokaravaan showed that the outcomes of the Nanokaravaan were flexible and the degree of public engagement was not really structured by its format. Because of this flexibility and informality, this called for the need to study the social construction of the Nanokaravaan by all involved actors.

The second part of analysis focused on the social construction of the Nanokaravaan as the outcome of actors' perceptions of the project as an engagement activity. This analysis identified three different relevant social actor groups and identified their attributed meanings. The interviews showed that the actors acknowledged the interactive elements of the meetings, but they also put much focus on the educational component of the meetings. In general, the meetings were perceived as informing dialogues. This showed that meetings did transcend a lecture approach, but the dialogue was not framed as a co-construct between the input of the visitors and of the speakers. The perceptions of actors did not put much attention on transcending the PUS tradition. The visitors had the possibility to influence the meetings by interacting with the speaker and in return the speakers learned more about communicating science to a broad audience. However, a higher degree of public engagement, such as a symmetrical interaction between the participants was not perceived. This showed that the potential openings for public engagement were not used. The main reason for this passive scenario of engagement was explained by the 'ambiguity of informality' that the Nanokaravaan deals with. On the one hand, the informality and openness of the meetings created openings to raise public engagement and to transcend the educational characteristics of the PUS approach. On the other hand, due to the informal character the format did not provide a structure to stimulate symmetrical interactions between the speakers and the visitors.

The third part of the analysis investigated the social construction of the Nanokaravaan by the meanings that the actors attributed to their own roles and those of others in setting up public engagement. This analysis showed that the organizers were mainly positioned as the facilitators of the project. The organizers had taken the initiative to constitute a public dialogue on nanotechnology, but their role in constructing actual engagement was rather neutral and passive. As a result of a lack of structuring of the event, the organizers left the responsibility for setting up public engagement to the other participants. However, the visitors of the Nanokaravaan did not position themselves as initiators of public engagement. The visitors did not try to use the interactive elements of the Nanokaravaan to construct symmetrical interaction with the speakers. As a result of the passive positioning of the visitors and the organizers, the position of the speaker turned into a reference point for the engagement scenario during the meetings. In this way, the speakers did not only have the responsibility to inform, but also to initiate public participation. Therefore, the speakers that were not really experienced with engagement activities did not feel the urge to take up this responsibility. Most of the speakers kept the informing dialogue close to their own expertise.

These mechanisms maintained or even increased the gap of knowledge between the speakers and the visitors. Only speaker C had enough experience with public debate and introduced more social relevant themes during his meeting. So, in the case of the Nanokaravaan the construction of public engagement was much dependent on the speakers. Because both visitors and speakers did not actively look for more public engagement, this made it hard for the Nanokaravaan to transcend the old framing of the PUS tradition and construct a more active scenario of engagement.

The social constructivist approach of this thesis showed that for a project like the Nanokaravaan the attributed meanings of the actors on the initial format are a major influence on the constructed scenario of engagement. The Nanokaravaan did provide openings for public engagement; however there was much ambivalence about the public engagement on different levels. You could denote different factors that resulted in a passive scenario of engagement. First of all, the 'stage' setting of the speaker in front of the visitors framed the meeting as one-way interaction. Secondly, the organizers did not structure the scenario of engagement. This was seen as the responsibility of the other actors. Thirdly, the public debate on nanotechnology was not prominent enough. When the state and context of nanotechnology changes, the visitors can become more willing to let their voice hear. Lastly, it appeared that it is rather important to pick an approachable theme. The topics of the Nanokaravaan meetings were pretty specific and this empowered the expert role of the speakers. More general themes during the meeting could have helped to decrease the gap between the speaker and the visitors.

To answer the last research question, it is important to explain what the findings of the Nanokaravaan mean for future public engagement projects on nanotechnology. First of all, the Nanokaravaan is a project that is stimulated by the government, but is executed by collaborative science cafés. The concept science café is a growing phenomenon. On the one hand, this growth in itself is already an increase of public engagement, because many of the science cafés are public initiatives. On the other hand, most of the science café do already have a certain format. Therefore it will be pretty hard to change a format that is already institutionalized. When the government really wants to set up public engagement with nanotechnology in the future, they should be aware of this or they should come up with their own format for setting up PES.

The factors that influenced the engagement scenario of the Nanokaravaan are also relevant for PES projects in the future. These factors can be divided by factors that are the result of the chosen format or the result of the attributed meanings of the actors. The first

factor, the 'stage' setting of a PES project, is largely influenced by the intended. For emerging PES projects it is important to be aware that certain 'stage' settings of the speaker can result in symbolic role-taking by the participants and influence the attributed gap between the experts and the visitors. The café-setting of science café B is a nice example of a setting that tries to bridge this gap. The second factor, structuring interaction between speaker and visitors, is also largely influenced by the choice of the organizers for a certain format. In the case of the Nanokaravaan, there was a lack of structure and this influenced the adoption of the scenario of engagement. For future PES projects, the organizers need to make a deliberate choice about the degree they want to structure their project because this will influence the degree of symmetrical interaction. The third factor, the need for debate on nanotechnology, is a factor that results from the meanings the actors attribute to a certain technology. The influence of this factor is hard to predict for organizers of future PES project. When a technology becomes more controversial, this can mean that visitors will take more initiative to discuss (the implications of) a certain technology and make the scenario of engagement more active. The last factor that is discussed, the topic of the meeting, is a factor that is influenced by both the chosen format of the organizers and the meanings the actor attribute to a certain technology. On the one hand, when organizers decide to pick a more general theme, this can help to increase the input of citizens and stimulate symmetrical interaction. On the other hand, the discussed topic during a PES project is mostly influenced by the speaker and the visitors. However, for organizers of future public engagement projects it is important to be aware that the topic of the project and the state of knowledge of the visitors do influence the engagement of other participants.

Points for discussion

As a case-study, the Nanokaravaan provided extensive empirical data and enabled the qualitative analysis of the outcomes of a specific public engagement project. Although this case-study provided rich data, the research site is rather small and limited. It is important to be aware that the Nanokaravaan is one of the many types of engagement activities that are nowadays available. The Nanokaravaan is an indirect public engagement project and has an existing infrastructure. This means that for most of the participants science café meetings are already institutionalized and attract a certain type of format and a certain type of audience. For these reasons it is hard to compare the data from the Nanokaravaan with other PES projects, because they are not yet institutionalized or have a different format. Therefore, the empirical inquiry of the Nanokaravaan could only make a small contribution to the empirical

gap of public engagement scenarios in science cafés. Good news is that the amount of science cafés is a growing. This growth will make science cafés more interesting for (external) PES projects and could in the future provide more comparison between science cafés.

The analytical framework that is used in this thesis is derived from another academic discipline. Although, SCOT is based on the rather broad framework of social constructivism, one need to reflect what the use of SCOT means for the analysis of the gathered data. SCOT is useful as an analytical framework on PES, because it focuses on the first phase of the social construction of an innovation: externalization. The concept interpretive flexibility shows that it can take some time before something will be institutionalized. Also, public engagement can be conceptualized as an innovation in the science-public relationship. This makes the use of SCOT applicable for further empirical research on PES. However, the use of SCOT makes the interpretation of the data pretty narrow, because it only focuses on the externalization of PES and you neglect other social dynamics. Furthermore, you always need qualitative data to investigate this complex social context of attributed meanings, which will not be available at all time.

To conclude, the conceptualization of PES as a governance technology provides a useful framework for investigating the tension between the intended formats of PES projects and the attributed meanings of the participants. This framework is able to connect both the normative discussion on PES and the empirical analyses. This makes the framework applicable to examine the development or the introduction of a new PES project. One could argue that when PES projects become more institutionalized or you want to investigate a PES project that is institutionalized, analytical framework of this thesis is less useful. However, technology studies argue that interpretative flexibility can always reoccur, even when the use of technology has been institutionalized. This means that the social construction of PES is a continuous process even when PES has turned into a dominant framing of the science-public relationship.

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Appendix A – Interview schemes

I. Organizers
Introduction
- What is your role in the science café?
- What is your relation with the Nanokaravaan? (background)

A.) Perception/meaning of Nanokaravaan
Questions for organizers of Nanokaravaan:
- How did the initiative for the Nanokaravaan come up?
- What was the contribution of the NDM for the accomplishment of the Nanokaravaan?
- In what way did the directions of the NDM influence the design of the Nanokaravaan?

- How were you introduced with the Nanokaravaan?
- Why did you decide to organize the Nanokaravaan?
- Did you have any former experience with public participation?
- What did you expect of the Nanokaravaan? Did this change during the evening?
- To what extent did the separate science cafés have influence on the design of the event?
- How does the Nanokaravaan relate to other science café meetings?
- What is in your opinion the aim of the Nanokaravaan? Does it succeed in this aim?

B.) Own role and influence
- How did you prepare for the meeting?
- What do you think is your (personal) contribution to the Nanokaravaan?
- In what degree do you think you/the organisation directed the process? What was possible?
- In what degree do you think you/the organisation directed the process during the meeting?
- Were you satisfied with your contributions or influence on the process?
- What will you do differently the next time?

C.) Roles of others
- In what groups would you divide the different participants?
- What did you expect of the other attendees (preconception) on beforehand?
- How did the other attendees influence the program before the meeting?
- How did the other attendees influence the program during the meeting?
- What did you think of their contributions?

- Would you organize a meeting like the Nanokaravaan again? How would you change the set-up?
- How do you think science and society could interact in the best way? What is the role of science cafés in this interaction?

II. Scientists
Introduction
- What is your relation with the Nanokaravaan? (background)

A.) Perception of process

- How were you introduced with the Nanokaravaan?
- Why did you decide to participate with the Nanokaravaan?
- What did you expect of the Nanokaravaan?
- Did your expectations correspond with your impression of the Nanokaravaan (describe the meeting)?
- What's in your opinion the aim of the Nanokaravaan?
- Did it succeed in its goals?
- What does the Nanokaravaan mean for you as a scientist? Any former experiences with public participation?

B.) Perception of own role in process

- How did you prepare yourself for the meeting? Did you get any guidelines?
- What do you think is your (personal) contribution to the Nanokaravaan and the debate during the event?
- Were you satisfied with your contributions or influence on the process? In what degree did you have the feeling you could influence the event?
- What will you do differently the next time?

C.) Perception of roles of other in process

- In what groups would you divide the different participants?
- What did you expect of the other attendees (preconception)?
- How did you experience the interaction with the other attendees during the meeting?
- How do you think the other attendees influenced the process during the meeting?
- What did you think of their contributions?
- How do you think you influenced the event for the other attendees?
- Would you participate with a meeting like the Nanokaravaan again? How would you prepare yourself the next time?

- How do you think science and society could interact in the best way? What is role of science cafés in it?

III. Visitors
Introduction
-    What is your relation with the Nanokaravaan? (background)

A.) Perception of process

- How were you involved with the Nanokaravaan?
- Why did you attend the Nanokaravaan?
- Did you have any experience with public participation or science cafe?
- What did you expect of the Nanokaravaan?
- Did your expectations correspond with your impression of the Nanokaravaan (describe the meeting)?
- What's in your opinion the aim of the Nanokaravaan?
- Did it succeed in its goals?

B.) Perception of own role in process
- Did you prepare yourself for the event?
- How did you expect to be involved during the meeting?
- What do you think is your (personal) contribution to the Nanokaravaan and the debate during the event?
- Were you satisfied with your contributions or influence on the process? In what degree did you have the feeling you could influence the event?
- What do you think was the contribution of the other visitors?
- Did you leave the meeting with a satisfied feeling? What will you do differently the next time?

C.) Perception of roles of other in process
- What did you expect of the other attendees (preconception) on beforehand?
- How did you experience the interaction with the other attendees during the meeting?
- How do you think the other attendees influenced process during the meeting?
- What did you think of their contributions?
- How do you think you influenced the event for the other attendees?
- Would you participate with a meeting like the Nanokaravaan again? How would you prepare yourself the next time?

- How should science and society interact in your opinion with each other in the best way?