The Making of Citizen Science

Network Alliances between Science Shops and CSOs Engaging in Science and Air Pollution

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Picture: The CCAEJ's A-team and SALTA members (Photo: Søsser Brodersen)

PREFACE

This dissertation is the result of a PhD project carried out at Department of Management Engineering, Section for Innovation and Sustainability, at the Technical University of Denmark. The PhD project has been co-financed by Section of Innovation and Sustainability, DTU and the ACCENT Network of Excellence through Risø DTU, at the Risø National Laboratory for Sustainable Energy, Division of Biosystems. The research began in February 2006 and ended in April 2010. Supervisors have been Associate Professor Michael Søgaard Jørgensen and Associate Professor Torben Elgaard Jensen, both from the Department of Management Engineering.

The idea for my research project was inspired by a request from the ACCENT[1] Network of Excellence to explore how Science Shops could contribute to promoting a dialogue between the ACCENT research community and the civil society and at the same time provide an arena for dialogue with CSOs about their interests related to air pollution. Since 2002, I have been employed at the Science Shop at DTU, and it fell within my research interest when the leader of the ACCENT *Workpackage 17: Public and Policy* approached one of my supervisors (Michael Søgaard Jørgensen) in 2002 to learn more about Science Shops and how Science Shops in their interaction with CSOs can contribute to strengthening the relation between the ACCENT research community and civil society. The overall goal for the ACCENT network, which is funded by the European Commission, is to promote a common European strategy for research on atmospheric composition change. However since atmospheric composition research deals with important societal problems, the ACCENT network is also obliged to optimize two-way interactions with policymakers and the general public. And as part of 'optimizing two-way communication with the general public', Science Shops are seen as one approach.

My motivation for carrying out this research project has been a wish to understand how Civil Society Organizations (CSOs), through alliance building and network constructions with Science Shops, engage with scientists in order to impact the air pollution agenda.

I hope the reader will find this dissertation as interesting as I have found carrying out the research.

Søsser Brodersen
June 2010

[1] ACCENT is the abbreviation of Atmospheric Composition Change European Network of Excellence.

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This dissertation would never have been possible if it had not been for my supervisor, Associate Professor Michael Søgaard Jørgensen, both in the initial phase of fundraising and framing the research focus, and throughout the whole research process. His comments, ideas and suggestions have been very valuable, and I owe him huge thanks. Also my co-supervisor, Associate Professor Torben Elgaard Jensen, deserves credit and my deepest thanks; his in-depth knowledge of Actor-Network Theory has helped me overcome some of my frustrations concerning 'theory'. My discussions with Michael and Torben have been decisive for my work with this dissertation. I cannot thank them both enough.

I also wish to thank all my colleagues in the Section for Innovation and Sustainability at the Department of Management Engineering, Technical University of Denmark. They have all inspired me throughout my research process. I also wish to thank the Head of the Section for Innovation and Sustainability, Christian Clausen (although on sabbatical leave) for putting the pieces together to make sure I had the time available for finalizing this dissertation. Also Kim Pilegaard at Risø National Laboratory for Sustainable Energy, Biosystems Division at DTU Risø, deserves acknowledgement for his efforts in bringing me and the ACCENT community together. I appreciate this very much.

Frank Raes from the European Commission's Joint Research Centre and Workpackage leader of the ACCENT WP 17 contributed to making my dissertation possible by providing half of the funding through the ACCENT Network of Excellence. In addition to the funding, Frank has also contributed with comments to the project proposal and the progress of the research, for which I thank him.

I also wish to send a huge thanks to all my interviewees – the Science Shop representatives, the CSO representatives and the scientists. Without their willingness and interest in my project and in sharing their experiences, this dissertation would never have become a reality. I really appreciate that all these very busy people gave me their time. Also the members of CCAEJ (Center for Community Action and Environmental Justice) deserve credit for taking their time to share their experiences, show me the neighborhood where they are addressing environmental issues and making me feel welcome and at home when I visited them in Riverside, Los Angeles in the summer 2007. In this relation, I must also thank Professor Richard Worthington (Rick) from the B.A. University of

California for his great efforts in planning my stay at CCAEJ, planning the interviews and just making me feel at home.

I also owe much thanks to my family and friends; I know I have been almost absent the last couple of years due to the finalization of this dissertation. I hope I will be able to make this up to all of them very soon. I especially wish to thank my boyfriend, Hadi Hassan, to whom I am deeply grateful for his continuous encouragement, tolerance and patience with me during these last 4 ½ years. Without his drive and motivation, I would never have had the peace or energy to finalize this dissertation. He has put aside many holidays and vacations, especially these last couple of years to help fulfil my wish to succeed with this dissertation. Words cannot express how valuable his support has been.

Last but not at least, I wish to direct my deepest acknowledgement to Marie Bille. Her contribution in the form of correcting grammar and suggesting formulations has been very valuable to me.

ABSTRACT

This dissertation is the result of a PhD project entitled *The Making of Citizen Science – Network Alliances between Science Shops and CSOs Engaging in Science and Air Pollution*. The PhD project was carried out at Department of Management Engineering, Section for Innovation and Sustainability, at the Technical University of Denmark.

The project's aim is to understand how Civil Society Organizations (CSOs), through alliance building and network constructions with Science Shops and similar community-based research units, engage with scientists in order to impact air pollution problems. The PhD project's agenda is inspired by the institutionalization of more democratic and participatory approaches to knowledge making, which is reflected in several EU-funded research projects, including one of the sponsors of this project, the EU-funded ACCENT Network of Excellence. The ACCENT Network wished to meet the EU requirement of communication with the general public by investigating how Science Shops interact with CSOs.

The analytical approach of this PhD project is inspired by Science and Technology Studies (STS) in general, more specifically by Irwin & Michael's (2003) concept of Ethno-Epistemic Assemblages, and by the Actor-Network Theory and Callon's (1986a) sociology of translations. A version of these approaches is used to study nine cases of network alliances between Science Shops and similar organizations and CSOs. The application of Callon's sociology of translation to the case studies contributes to understanding why and how the actors sought to stabilize controversies, as well as the mechanisms contributing to the networks' success in affecting the problems experienced by the CSOs.

It is concluded that network alliances between CSOs, Science Shops and scientists can cause two types of effects: effects on the CSOs' original problems, and/or other forms of effects. It is interesting to note that these other forms of effects can result in both cases that affected the CSOs' original problems as well as cases that failed to do so. It can be concluded that CSOs can influence such actors as industry and local authorities and their practices through alliances with Science Shops and scientists. It is further concluded that the Science Shops' role can have decisive impact on whether networks succeed in influencing the problems experienced by the CSOs. When the Science Shops apply an impact-seeking approach, the networks are more likely to succeed in affecting the CSOs' original problems than when the Science Shops apply the mediation approach. It is also

concluded that scientific documentation in itself is not sufficient to solve a problem but can be used to open discussions related to the problem. What is important is that the scientists in the Science Shop, or at a university department co-operating with a Science Shop, are willing to assume other roles than just being producers of knowledge without any obligation to bring the produced knowledge into a context, and without being willing to discuss the premises for the produced knowledge.

The case studies indicate that in order to understand the effects of networks like these, we need to broaden ANT's analytical term 'stabilization'. It should be understood as something that strengthens rather than merely something that is taken-for-granted or black-boxed. It is also argued that the project's Callon-inspired analysis of network alliances can be seen as an elaboration of one of the concepts in Sociological studies of Science-Public relations, namely Irwin & Michael's (2003) concept of Ethno-Epistemic Assemblages (EEAs). The project elaborates the EEA concept through a more detailed empirical understanding of 1) *how knowledge is comprised of a mixture of both 'lay and expert' knowledge*; 2) *how this blurring of knowledge may take place*; and 3) *how CSOs and scientists, through this mixture of knowledge, try to cause effects like political influence and/or new research interests*.

Finally, it is concluded that despite the gloomy prospects for the 'old' Science Shops, there may be openings in relation to establishing new Science Shops in other countries. Such possibilities can be seen in both the recently finished EU-financed TRAMS project (Training and Mentoring of Science Shops) and in the coming EU-financed project PERARES (Public Engagement with Research and Research Engagement with Society).

DANSK RESUME

Denne afhandling er resultatet af Ph.d. projektet med titlen *The Making of Citizen Science – Network Alliances between Science Shops and CSOs, engaging in Science and Air Pollution*. Ph.d. projektet blev udført på Institut for Planlægning, Innovation og Ledelse, Sektion for Innovation og Bæredygtighed ved Danmarks Tekniske Universitet.

Projektets formål er at forstå hvordan civil samfunds organisationer (CSOer) via skabelsen af netværks alliancer med Videnskabsbutikker, involverer sig med forskere for at opnå indflydelse på luftforureningsproblematikker. Udgangspunktet for Ph.d. projektet er inspireret af den stigende institutionalisering af en mere demokratisk og brugerdeltagelsesorienteret tilgang til hvordan videnskab og viden skabes, som bl.a. kan ses reflekteret i flere EU finansierede forskningsprojekter, inklusiv sponsoren bag dette projekt, nemlig det EU finansierede ACCENT Network of Excellence. ACCENT netværkets tilgang til EU's krav om tovejs kommunikation var et ønske om at tilegne sig viden om hvordan Videnskabsbutikker samarbejder med CSOer.

Den analytiske tilgang i dette Ph.d. projekt er inspireret af Science and Technology Studies, herunder Irwin & Michael's (2003) koncept omkring Ethno-Epistemic Assemblages, men især af Aktør-netværks-teorien og Callon's (1986a) translations-sociologi. En version af disse tilgange benyttes til at studere 9 netværks alliancer mellem Videnskabsbutikker eller lignende organisationer og CSOer. Anvendelsen af Callon's translations-sociologi på case studierne bidrager til en forståelse af hvorfor og hvordan kontroverser blev forsøgt stabiliseret samt en forståelse af hvilke mekanismer der bidrager til netværkenes succes i at opnå indflydelse på de problematikker som CSOerne rejser.

Det konkluderes at netværks alliancer mellem CSOer, Videnskabsbutikker og forskere kan afstedkomme to typer af indflydelse: indflydelse på det problem som CSOerne oplever og/eller andre former for indflydelse. Hvad er der interessant at bemærke her er, at disse andre former for indflydelse både kan ske i de cases som opnår indflydelse på CSOernes problemer, men også i de cases som ikke lykkedes at skabe indflydelse på CSOernes problem. Det konkluderes ydermere at CSOer gennem disse netværks alliancer med Videnskabsbutikker og forskere kan lykkedes i med at ændre praksissen hos aktører såsom industri og lokale myndigheder. Det konkluderes således også at den rolle som Videnskabsbutikker antager, kan have en afgørende betydning for om netværk alliancerne

lykkedes i at opnå indflydelse på de problematikker som CSOerne forsøger at rejse. Når Videnskabsbutikkerne vælger en *'impact-seeking'* strategi, tyder det på at netværks alliancerne er mere succesfulde i at opnå indflydelse på de problematikker som CSOerne rejser, end når Videnskabsbutikkerne vælger en *'mediation'* strategi. Det konkluderes at videnskabelig dokumentation i sig selv ikke er nok til at løse et problem, men at det kan medvirke til at åbne for diskussioner omkring problematikken. Det vigtige er at forskerne i Videnskabsbutikkerne eller på de forskellige institutter accepterer at spille eller agere inden for andre roller end blot at være producenter af viden uden nogle former for ansvar for at bringe den producerede viden i anvendelse eller uden at ville diskutere præmisserne for den producerede viden.

I konklusionen er det foreslået – når vi søger at forstå effekter af netværk som disse – at vi bredere ANT's analytiske begreb 'stabilisering' ud, således at det forstås som noget der bliver styrket og ikke kun som noget der tages-for-givet eller black-boxes. Der argumenteres også for at projektets Callon-inspirerede analyse af netværks alliancer kan tolkes som en uddybning af et koncept inden for sociologiske studier af Science-Public relationer, nemlig Irwin & Michael's (2003) begreb om "Ethno-Epistemic Assemblages" (EEAs). Projektet uddyber EEA begrebet via en mere detaljeret empirisk forståelse af: 1) *hvordan viden etableres som et miks af både 'læ' og 'ekspert' viden*; 2) *hvordan organiseringen af denne blandede eller kombinerede viden i praksis sker*; 3) *hvordan CSOer og forskere gennem dette miks af viden forsøger at opnå indflydelse i og på politiske dagsordner eller på forskningsdagsordner.*

Endelig konkluderes det at skønt de lidt dystre udsigter for specielt de 'gamle' Videnskabsbutikker, så ses nye muligheder for etablering af nye Videnskabsbutikker i andre lande. Det er en af konklusionerne i det for nylig afsluttede EU-finansierede TRAMS projekt (Training and Mentoring of Science Shops). Men disse muligheder ses også afspejlet i det fremtidige EU- finansierede projekt PERARES (Public Engagement with Research and Research Engagement with Society).

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CHAPTER 1: INTRODUCTION

"Change will not come from the top, I would say.
Change will come from a mobilized grassroots."
(Barack Obama)[1]

"Public opinion alone can keep a society pure and healthy."
(Gandhi 1920)[2]

"I claim that human mind or human society
is not divided into watertight compartments
called social, political and religious.
All act and react upon one another".
(Gandhi 1922)[3]

1.1 Unpredictable Results

The journey I began when I started on this dissertation in 2006 was motivated by a curiosity awakened in me, after having carried out several projects in co-operation with the same CSO (Civil Society Organization). Two things were striking in these projects. First, their outcomes were dramatically different - from obvious successes to complete failures. Second, I was almost entirely unable to predict or explain the fate of the projects in which I was involved. The aim of this dissertation is to add to the explanatory resources I lacked at that time. But before elaborating the aim and structure of this dissertation further, I wish to explain my experiences with the CSO in a little more detail.

Let me start by explaining the success story. Back in 2003, in my function as Science Shop researcher, I initiated several student projects in co-operation with a local CSO (A local resident's board in Raadvad). The CSO wanted to address sustainability in their community, and had initiated several local activities such as recycling etc. As part of the CSO's strategy to make their local community more sustainable, they needed help to explore whether it would be possible to produce energy from an old water mill and how to rehabilitate the water stream surrounding their community, as well as to investigate to which extent the stoves used in all houses in the community were a source of pollution

[1] The Choice 2008. Frontline, PBS. (www.pbs.ord/frontline/choice2008). 4. November 2008.
[2] The quotation is from the book: *Quotes of Gandhi*. Exclusive Distributors. 2004. Page 15.
[3] The quotation is from the book: *Quotes of Gandhi*. Exclusive Distributors. 2004. Page 40.

affecting the health of the residents. One of the first projects we initiated through the Science Shop was the project to explore how to rehabilitate the water stream. The findings of the project pointed towards several possibilities for rehabilitation, but none of the possibilities would be possible without co-operation from the local municipality. Since the area in question is highly valued as a recreation area by both the municipality and the Danish government authority, we realized that it was necessary to bring the discussions further than just articles in the local newspaper. We therefore approached the local municipality and persuaded them to finance a citizens' meeting in order to discuss the future of the recreation area. Over 200 citizens and other stakeholders participated in the meeting, where both scientists, politicians and CSOs presented their ideas and hopes for the area. The ideas were afterwards summarized by the director of technical affairs in the municipality, the CSO and me, and sent to the Danish Ministry of Environment as a contribution to the ongoing planning and strategy development for the area. Some months later, the CSO was approached by the Danish Forest and Nature Agency (an agency under the Ministry of Environment). The agency was in charge of a large rehabilitation project aiming to improve the water quality in the water environment, and wanted to discuss and incorporate the CSO's ideas in their rehabilitation project. Through this agency, we succeeded in impacting the political strategy for the area.

With this successful co-operation fresh in mind, I felt the CSO and I were riding on a wave of success, and we initiated a new project though the Science Shop. This project aimed at exploring whether the community was being exposed to air pollution from their stove use.[4] As illustrated later in this dissertation (see chapter 4, case G), this particular project ended as a failure, because we did not succeed in involving the community or the local politicians. At the immediate level, one explanation of this could be that the CSO did not accept the legitimacy of scientific findings. At the final meeting between the CSO, the student, the supervisor and me, the CSO argued that the findings, which indicated that the residents need not fear being exposed to air pollution from their stove use, did not reflect the actual situation, since the investigation was based on a literature study and a questionnaire study, rather than on actual measurements and direct observations. The CSO thereby contested the research's legitimacy, perhaps due to the fact that the research did not seem to back up their claims about exposure to health risks. Thus, what started as a successful co-operation ended as a failure, with no effects on the use of stoves in the community or the political agenda.

Reflecting on the two projects afterwards, I realized that seeking a solution to a problem can lead in several directions and cause unpredictable results. This particular co-operation gave rise to such questions as: *Why did one of the projects end as a success and the other as a*

[4] This particular project is one of my cases (case G) and is explored in more details in chapter 4.

failure? Did I as Science Shop representative play different roles in the two networks? To which extent did the research design and research activities play a role for the outcome of the two projects? And finally what motivated and demotivated the CSO representative?

These experiences added to a curiosity that first arose when as a new Master of Science candidate in 2002, I worked on a research project exploring the interaction between Science Shops, CSOs and research institutions (the INTERACT research project). It became clear that as Science Shop researchers, we lacked in-depth understanding of why some Science Shop co-operations with CSOs and scientists ended as successes, in the sense that through the co-operations CSOs succeed in gaining impact on the issues being dealt with; and why some co-operations end as failures, unusable for the CSOs' activities. The question that then arises is what possibilities do we have to explore this relationship in detail? We received the answer to this question when my colleague (also one of my supervisors) was approached by the ACCENT network (Atmospheric Composition Change the European Network of Excellence). As part of network activities, they wished to strengthen their relations (i.e. the air pollution scientists' relations) with civil society, and they saw Science Shops as one means to achieve this. We accepted this challenge and decided to conduct the research as a PhD research project, striving towards an explorative study of why and how CSOs approach Science Shops concerning air pollution issues, and whether and how co-operation is established. It was further agreed that the research should include considerations about how these experiences from the Science Shops could contribute to strengthen the ACCENT scientists' relations with CSOs.

1.2 Science Shops - from Protest Organizations to Formalized Organizations

Before continuing to a discussion of my research focus and the theories that have inspired me, I introduce the concept of Science Shops, since it can contribute to an understanding of why, for example, the ACCENT Network saw Science Shops as a means to strengthen their relations to civil society. The concept of Science Shops was developed in the 1970s at Dutch universities as one out of several means to democratize science and technology. By responding to a growing demand from both citizens and CSOs, as well as left-wing student activists and university scientists, to give citizens and CSOs a voice as well as access to and impact on scientific and technological knowledge, the Science Shop model challenged the traditional orientation of science and toward how knowledge is developed (Wachelder, 2003; Dickson, 1984; Farkas, 2002). Since the 1970s, Science Shops have been developed in several European and non-European countries, all aiming at democratizing science by providing a forum for interactive dialogue between citizens and/or CSOs and scientific communities.

The political climate reflected in the early years when Science Shops developed throughout Europe has changed, however, during recent years; the left-wing movement of students and scientists has grown weaker and at the same time a more conservative political orientation has developed. As a consequence, the Dutch government reoriented university structures, assigning the control of budgets to the individual universities, while also confronting them with cut backs in governmental financial support. As a survival strategy, the universities had to find additional funding. Research became a commodity for sale, and since Science Shop clients, i.e. the CSOs, have no independent financial means, many universities have decided to close the Science Shops and place more emphasis on the priorities of business interests. Contributing to weakening the Science Shops' position at the universities during periods with budget cuts has been a tendency to fail in turning the requests of the CSOs into research projects (Wachelder, 2003). Despite the challenges faced, especially by the Dutch Science Shops, the recently finished TRAMS (Training and Mentoring of Science Shops) (de Bok, 2008) project illustrates that new Science Shops are being initiated and established in other countries. The current pressure on Science Shops in some countries, as well as tendencies in some political parties to emphasize two-way communication between scientists and civil society, seems to reflect a complex situation, since Science Shops could be one means to promote such two-way dialogue. This complexity indicates the importance of understanding how Science Shops contribute to bridging the gap between scientists and CSOs, as well as which effects such co-operation can lead to. By studying how CSOs seek to gain impact on the issues they deal with through alliances with Science Shops and scientists, my hope and motive is to investigate how Science Shops can play a role in knowledge production as well as which effects alliances between CSOs, Science Shops and scientists may lead to.

1.3 Research Focus

Having introduced what kicked off my curiosity and motivated me to start the journey behind this dissertation, as well as the motives and concept of Science Shops, time has come to delve into my research focus and sources of inspiration.

My scientific position and research approach lies within Science and Technology Studies (STS). Characteristic for studies within the field of STS is that they are concerned with in-depth studies of science and technology in practice. Another characteristic of STS studies is a particular interest in materiality and how it contributes to discussions about the

actions and relationships between human and non-human actants[5] (Jensen et al., 2007). STS's focus and interest in materiality and the relationship between human and non-human actants seems to provide an adequate platform to explore my research interest, which is to **understand how CSOs, through alliance building and network constructions with Science Shops, engage with scientists in order to impact the air pollution agenda as well as which effects these network alliances can cause.**[6] This means that I am interested in understanding how knowledge is produced and how this knowledge contributes to stabilizing network alliances. It also means that I am interested in understanding whether and how this stabilization contributes to the network alliances' success in gaining impact.

As my research interest illustrates, I seek to understand the networks between CSOs and scientists, and how knowledge is produced in these networks. A platform for this understanding is provided by Irwin & Michael's (2003) concept of Ethno-Epistemic Assemblages (EEAs). EEA is a heuristic that can help to understand *"[...] how such 'odd' mixtures come together, cohere and 'work' as, perhaps, unitary or singular actors"* (Irwin & Michael, 2003; p. 113). Irwin & Michael (2003; p. 112-113) illustrate this heuristic by explaining one such situation: At a conference in Helsinki, several actors were gathered to discuss transgenic animals in medicine. These actors included scientists, activists, politicians, regulators and medicine companies, thus representing a range of different perspectives. At a plenary session, arguments against transgenic medicine evolved based on several discourses (ethical, scientific, regulatory and experimental). Irwin & Michael (2003) describe this as a 'discursive mosaic which took form'. This mosaic consisted of many different types of knowledge constructed by both the 'nature' and the 'socials', where arguments from what can be termed 'lay' knowledge became blurred with 'scientific' knowledge, making the distinction between these two types of knowledge meaningless. Irwin & Michael (2003) therefore suggest abandoning the distinction between lay people's knowledge and expert knowledge. Instead, they suggest understanding these networks and the knowledge production which takes places within them as groupings where the individual actors knowledge contribution is blurred and mixed into relevant coherent assemblages. Thus, the dividing line in the debate over transgenic animals is not between experts and lay people, but between one expert-lay-assemblage, which is in favour, and another expert-lay-assemblage, which is against.

[5] ANT operates with the word 'actants' rather than 'actors' to avoid associations related to the word 'actors' that often only includes human actors. In this dissertation I use the term 'actors' when I refer to human entities and when I refer to human as well as non-human entities I use the term 'actants'.

[6] Due to my co-operation with air pollution scientists in the ACCENT network, my empirical focus is on air pollution and CSOs addressing air pollution issues.

Thus, inspiration from Irwin & Michael's (2003) EEA concept contributes with an understanding of that knowledge is produced in heterogeneous networks. Added to this, I have an interest in understanding how and why this blurring occurs and what this blurring means. To help me analyse this, I combine the concept of EEA with Callon's (1986a) sociology of translation analysis, which is part of the Actor-Network Theory (ANT). Or rather, I am inspired by his sociology of translation analysis, meaning that I do not claim that in this dissertation I conduct ANT analyses to their full extent. Translations, in Callon's (1986a) sense, are to be understood as mechanisms to which resemblance is made between different actants or networks. By combining the concept of EEA with Callon's (1986a) sociology of translation analysis, I gain analytical resources to explore how networks are created. By following their genesis, I have the opportunity to explain why some networks become stable and cause effects, while others fail.

Based on inspiration from Irwin & Michael's (2003) ideas of EEAs and Callon's (1986a) sociology of translation, my analysis and discussions of the network alliances between Science Shops, CSOs and scientists are guided by the following research questions:

- How and why are network constellations between CSOs, Science Shops and scientists created around air pollution controversies?

- Which effects are caused by network alliances between CSOs, Science Shops and scientists, which are created around air pollution controversies?

As discussed in chapter 2, section 2.3, in ANT, stabilization of networks equals effects; however, situations can be imagined where networks becomes stable but fail to cause any effect. The opposite situation could also be imagined, i.e. a network that does not become stable but nevertheless succeeds in creating some kind of effects. Due to these considerations, I do not limit my analysis of effects of the network alliances to be a question of whether or not the networks become stable.

With the theoretical considerations in place, I end this section with some considerations regarding my empirical material. Since my research project was initiated, due to the wish of ACCENT WP17 to learn about how Science Shops engage and co-operate with CSOs about air pollution issues, my objective has been to contact as many Science Shops as possible to learn about their experiences with network alliances around air pollution issues. This means that I have not limited my empirical field to only include the experiences of one or two Science Shops or network alliances; rather, I have chosen an open and explorative approach, striving to learn about as many experiences as possible. As a consequence of applying this explorative approach towards generating the empirical material for the case studies, I have obtained uneven empirical material that differs in

scope and depth and covers different time periods. Despite this uneven access to the empirical material, I believe I have succeeded in drawing a picture of the chronology, results and effects of the co-operations that serve as my case studies, and thus found in each case the best possible explanation as to how access to scientific expertise and knowledge production can change the CSO's possibilities to impact political decisions and scientific agendas.

1.4 The Structure of the Dissertation

This dissertation is structured as follows:

Chapter 2 outlines the theoretical framework that forms the basis of my analyses. First, I go into more detail, describing the progress from Public Understanding of Science - where ordinary citizens (either individually or organized) were perceived by many scientists and policy makers as illiterate on science subjects and with no capabilities to contribute to either scientific progress or policy decisions - to Public Engagement in Science – where citizens' participation in scientific and technological decisions are acknowledged for their contributions. Then, I outline which roles CSOs can play when they become engaged with scientists. Next, I introduce the concept of Science Shops as one initiative reflecting the engagement perspective and summarize the discussions of the roles of CSOs by pointing out that CSOs' alliances with Science Shops can be viewed as what Irwin & Michael (2003) call Ethno-Epistemic Assemblages (EEAs). Next, I introduce the Actor Network Theory (ANT) and the perspectives in Callon's (1986a) sociology of translation, since this is where I find my inspiration to analyse network alliances between CSOs, Science Shops and scientists. The chapter ends with a discussion of the nature and state of explanations in ANT, since this has been one of the main points of criticism put forward by its opponents.

Chapter 3 describes how I designed my research, specifying my research questions, how the empirical material were identified and gathered, as well as my considerations about how to achieve validity and reliability in the material. I also describe in detail how the project was initiated, my intentions from the beginning, and why some of these intended activities failed. The chapter also contains considerations related to how, by using a multiple case study approach, I have analysed the case studies as a cross-case synthesis and by pattern matching. Rounding off the chapter, I reflect on how I designed the research, both with regard to the analytical framework and collection of the empirical material to be studied. These reflections comprise my considerations at this given moment, now when the research is completed and the dissertation is in its final phase.

Chapter 4 contains the translation analysis of the network alliances between CSOs, Science Shops and scientists. In this chapter, nine cases are analysed individually, emphasizing translations and roles of the actants. Each case concludes with discussions of the effects caused by the networks and reflections combining the cases.

In **chapter 5,** the case studies are cross-analysed in relation to the effects caused by the networks. This analysis is guided by my wish to understand the mechanisms contributing to the networks' successes in affecting the CSOs' problems. Therefore, I start by discussing the cases that succeeded in affecting the CSOs' original problems. This discussion includes reflections concerning when the network alliances caused effects, how effects were caused and which kind of effect. Then I move on to discuss the networks that failed to cause effects, to explore the mechanisms contributing to the failure. At the end of the chapter, I discuss the other effects - than direct effects on the CSOs' problems - caused by the networks.

In **chapter 6,** I first reflect on my theoretical and methodological approaches. Then, I reflect on the possibilities for influence by networks between CSOs, Science Shops and scientists in relation to the political discourses facing both Science Shops and scientists. I discuss the lessons learnt from the case studies (based on both the individual translations analysis of the cases and the cross analysis of the case studies), and conclude the chapter with reflections on the future perspectives for the Science Shop.

CHAPTER 2: PUBLIC ENGAGEMENT - ISSUES, ARRANGEMENTS AND THEORETICAL PERSPECTIVES

Why talk at all about the relationship between citizens and science and public engagement? Many scholars within this field, including me, will argue that since science and technology shape both our working lives and our private lives, we of course need to understand and analyse the relationship between citizens[7], science and technology and how citizens seek to impact or participate in scientific and technological decisions and changes.

In this chapter I outline the theoretical framework that forms the basis of my analyses and thereby contributing to an **understanding how CSOs (organized citizens), through network alliances with Science Shops and scientists, seek and maybe achieve impact on scientific and technological changes**. First, the chapter contains a short introduction of the field of 'citizens and science', since the opportunities and rights of citizens and CSOs to participate in and impact scientific, technological and political decisions have only recently been partially recognized in European countries. Previously, ordinary citizens (either individually or organized) were perceived by many scientists and policy makers as illiterate on these subjects, with no capabilities to contribute to either scientific progress or policy decisions. Followed is a discussion of which roles CSOs can play when they become engaged with scientists as well as an introduction to the concept of Science Shops as one initiative reflecting the engagement perspective. The chapter continues with an introduction and discussion of heuristic tool of Ethno-Epistemic Assemblages (EEAs). Then I introduce the Actor Network Theory (ANT) and the perspectives in Callon's (1986a) sociology of translation, since this is has served as my inspiration to analyse network alliances between CSOs, Science Shops and scientists. The chapter ends with a discussion of the nature and state of explanations in ANT, since this has been one of the main points of criticism put forward by its opponents.

[7] The term 'citizens' is used here to include both citizens and organized citizens (CSOs). Later in this chapter, I distinguish between citizens as individuals and organized citizens.

2.1 Setting the Scene: Citizens and Science

The shift, from a perception of citizens as not capable of participating in scientific, technological and political decisions to acknowledgement of their contributions with emphasis on 'public engagement', is outlined in this section. First, I present a brief historical outline of the progress from Public Understanding of Science (PUS) to Public Engagement in Science (PES), then I discuss the different roles citizens and CSOs can assume or be assigned. Finally I introduce the concept of Science Shops and discuss how the concept of Science Shops seems to meet the requirements for 'engagement'.

2.1.1 Historical Outline of the Progress from PUS to PES

The empirical sub-field 'Pubic Understanding of Science' has existed for the past 40 years, with changing perspectives among scientists and politicians on how knowledgeable citizens are, and how they can contribute to science and knowledge production.

Before the World War II, there were a tendency among many European scientists, politicians and people in industry to assume that any impact on scientific and technological decisions were to be restricted to the elite. This was based on the assumption that ordinary citizens were illiterate and ignorant about scientific progress, and therefore not capable of participating in science and policy decisions. This is often characterized as the *deficit model*. However, during the period after the World War II with its industrialization of the European countries various protest organizations were established that agitated for women's rights, democracy and equality. The introduction of such technologies as nuclear power and automation, and the increase in cars, which caused an increase in highways etc., gave rise to protests and resistance among citizen groups in several countries. Due to these protests and this resistance, politicians in several of the European countries realised[8] that they had to establish a link between science and society, with the aim of increasing 'public understanding of science'. The first attempts towards establishing a relation between science and society focused on science education (Bauer et al., 2006; Felt, 2000; Hagendijk & Irwin, 2006).

However, increased science education did not cause citizens to be as positive about progress in science and technology as politicians had hoped. Although citizens had been taught about science, they kept questioning scientific and technological developments such as biotechnology, IT, nuclear power etc. And such accidents as the nuclear leakage in

[8] This shift in the relation between science and society was seen in Denmark and the Netherlands already in the 1970s, whereas the shift in how to perceive science and society was first seen in countries such as UK in the 1990s (Irwin, 2006; Baark, 1997).

Chernobyl and the risks of spreading genetic material from genetically modified plants and animals caused distrust among citizens with regard to scientific and technological progress. This distrust became even more extensive due to lack of consensus among different groups of scientists and different political parties concerning possible risks and which risks would be acceptable. The lack of a positive attitude towards scientific and technological progress caused politicians and scientists to reconsider their approach to the public. The politicians and scientists recognized that what was needed was a more democratic approach, if public trust in science and technology were to be restored. Now the rationale became to achieve deliberation and participation within science and technology decision making (Bauer et al., 2006; Irwin & Michael, 2003; Hagendijk & Irwin, 2006). Politicians and scientists had realized that risks and accidents could not be suppressed, but had to be discussed openly, and also that new technologies could not and should not be implemented without dialogue with citizens and citizen groups.

By turning towards a more democratic approach to scientific progress based on co-operation and dialogue between scientists, policy makers and citizens, politicians hoped to achieve: 1) development of mechanisms for handling risks through exchange of information, 2) decision making based on common agreements, and 3) development of capacity within institutions, organizations and/or communities (Wondolleck and Yaffee, 2000 in Bellamy, 2006).

Different underlying rationales lie behind politicians and scientists' approach towards democratizing science and technology. Foster (1999: p. 317-323) argues, for instance, that there are three different rationales behind politicians' and scientists' motives for democratizing science and participation of citizens in public policy assessment or assessment of technology:

1. Participation of citizens is a democratic goal in itself. The rationale here is that in a democracy every citizen has the democratic right to influence both science and policy decisions.
2. Participation of citizens can help improve the efficiency of public services.
3. Participation of citizens can contribute to producing better science. The rationale here is that citizens have knowledge about their local environments and may view their local environment differently than scientists. This knowledge can contribute or lead to new understandings of local problems. For example, according to Entwistle et al. (1998) (in Foster, 1999: p. 8): " […] *although communities may know that something is a problem to them, such as nuisance, dust or air pollution incidents at particular times, the scientific experts may not have previously perceived these as particular problems. This area could also concern fields where knowledge is uncertain. Here the public can be involved in legitimating new knowledge in controversial areas*".

Bailey et al. (1999: p. 300-302) agree to some degree with Foster (1999: p. 317-323) about the rationales behind the motives for citizen participation in assessment of environmental issues. But they also argue that participation is necessary because 1) it gives scientists access to local knowledge; 2) it ensures quality; and 3) it reveals values and agendas. The point I want to make in this dissertation relates to both Foster (1999: p. 317-323) and Bailey et al. (1999: p. 300-302): In a democratic society, citizen participation is sometimes encouraged as a means to improve scientific choices; while in other situations, it is motivated by a wish for citizens to impact scientific and political decisions.

Even though there seems to be a shift from the deficit model towards a more democratic basis for thinking about the relation between citizens and science, Irwin & Michael (2003: p. x) argue that within the PES ear, there is still a need to create new forms of dialogue between citizens and scientists, which considers citizens' values and attitudes as well as needs for more transparent approaches to science and technology decision making. The question is, however: How do we create these new forms of dialogue between citizens and scientists? And which roles are citizens allowed to play or take upon themselves when entering into dialogue with scientists?

2.1.2 Roles of Citizens when Interacting with Scientists

In this sub-section I discuss the question that emerged from the brief introduction to the historical progress from PUS to PES above: the question of *which roles citizens are allowed to play or assume when entering dialogue with scientists*. My reason for taking up this discussion here is related to the point made previously, that sometimes citizen participation is encouraged as a means to improve scientific choices, while in other situations it is based on a wish for citizens to impact scientific and political decisions. Depending on the motives for involving citizens in scientific and political decision making, different roles are appointed them. Therefore, the aim in this sub-section is to outline the different roles[9] played by citizens and CSOs when they strive to impact both political and academic structures.

[9] The roles of citizens and CSOs are presented according to level of political acknowledgement. The characterization is also my way of trying to systematize the different roles CSOs can play, and it is based on both theoretical readings and empirical experiences.

2.1.2.1 Citizens as Democratic Subjects

In every democratic society, citizens have the right to seek influence through democratic structures, whether it is through the official election system by voting or by drawing attention to problems or issues through actions in society. When citizens acts as democratic subjects, it is often due to a problem experienced in their local settings, such as too heavy traffic in their neighbourhood, as one of my case studies illustrates. Citizens can address this issue through the democratic channels, through dialogue with local politicians or by raising the issue for public debate.

2.1.2.2 Citizens as Policy Decision Makers

Engaging citizens in policy decision-making processes is one form of strengthening the dialogue between citizens, experts and policy makers. Citizens can be assigned the role of lay people in this form for dialogue, where politicians and 'experts' acknowledge that citizens and CSOs can contribute to decision-making processes involving scientific and technological decisions. Especially two approaches to engaging citizens in policy decision making seem to dominate: 1) the post-normal science model, and 2) consensus conferences.

The Post-Normal Science Model

Funtowicz and Ravetz (1991) have developed a framework for involving lay people in the scientific analysis and modelling of environmental issues. They argue for what they call the post-normal science period. According to them, the requirements for science have changed; previously, science focused mainly on discovery and application of facts, whereas now science needs more than facts. It has to meet the challenges of global environmental changes. Funtowicz and Ravetz (1991: p. 138-141) argue that in contrast to previously, scientists now have to deal with policy-related issues and manage uncertainties. The model is framed on the assumption that science, in relation to policy questions need only address: 1) the amount of system uncertainty, and 2) the scale of the decisions at stake.

Due to the growing need for quality assurance in this period of post-normal science, Funtowicz and Ravetz (1991: p. 148-150) suggest what they call *extended peer communities*. The idea is that by involving peers with different backgrounds and knowledge, high-quality, policy-relevant knowledge will be produced. One issue at question in this model, however, is who are the peers? Funtowicz and Ravetz (1993) themselves are weak on this issue. The closest they come to a definition: *"[…] persons directly affected by an environmental problem will have a keener awareness of its symptoms, and a more pressing concern with the quality of official reassurances, than those in any other role"* (p. 752). Yearley et al. (2001: p.

356) argue that the model does not provide an answer to whom the extended peers should include, nor do they set up criteria for what the peers are assumed to assess.

The model does however recognize that scientific expertise is not enough when science is applied to policy issues, and that contributions from other actors are needed in such situations. Yearley et al. (2001: p. 364-366) agree with Funtowicz and Ravetz that the idea of extended peer reviews could function as a means for citizen participation in improvement of their local environment, not just by leading local communities to change behaviour, but by having them contribute with their knowledge.

The role assigned to citizens in this post-normal science model is to assess science before political decisions are taken. It could seem that citizens here are being used to legitimize the findings of the scientists.

Consensus Conferences

Consensus conferences are another approach to strengthening the dialogue between citizens, experts and policy-makers. This approach was developed by the Danish Board of Technology, and as in the post-normal science model, citizens are given the role as lay decision makers. The concept is to invite randomly selected citizens to participate in a lay panel. Preliminary sessions are arranged by a facilitator who provides the lay panel with different kinds of information about a given issue or technology. After a period of time, usually some weeks after the preliminary sessions, a conference is held. At the conference, the lay panel confronts invited experts with their questions and concerns in relation to the issue or technology in question. After the conference, the lay panel is asked to send their written conclusions and recommendation to the policy makers. What makes this approach unique is that the lay panel needs to reach consensus among all the members before they can draft their conclusions and recommendations (Danielsen, 1998 and Callon et al., 2009). One weakness in this approach is that even though the lay panel is able to send their recommendations to the policy makers, there is no guarantee that the policy makers will take them into consideration in the political decision-making process. However, experience in Denmark shows that recommendations from lay panels do impact the policy decision-making process. Another point of criticism to this approach is the selection of the lay people (Danielsen, 1998). The citizens are randomly selected from the whole country, with no regard to their background. This means that the panel does not necessarily consist of citizens who have interest or knowledge regarding the issue or technology in question. The consensus strategy has also been criticized by Hagendijk and Irwin (2006), who argue that applying consensus strategies as a democratic means to make a decision reflects to some extent the deficit model: *"Once the public understands the 'real' issues, then it will trust institutions, a 'reasonable' consensus will arise, and policy-making can proceed"* (Hagendijk & Irwin, 2006: p. 175). Callon et al. (2009: p. 176) argue further that although consensus

conferences provide a forum where lay people and experts can meet, this does not ensure or contribute to further co-operation between lay people and experts after the end of the consensus conferences.

2.1.2.3 Citizens as Members of Organized CSOs

Instead of acting as individuals, the citizens can organize themselves in CSOs, and in some situations, this will give them a stronger position locally. Citizens in these CSOs can assume and act within different roles[10].

Since the emergence of the environmental movement in the 1960s, the role of the environmental CSOs has been to react to particular cases of environmental destruction by mobilizing knowledge and expertise related to the strain on the environment and by developing alternative initiatives for environmental improvement. Through such efforts, the environmental CSOs have been able to impact policies and exert pressure on policy-making processes (Jamison, 2001; Rootes, 1999).

Both scientists and policy makers recognize that CSOs play a role in representing the public with regard to the environmental problems experienced in society, but how do these CSOs impact scientific and technological changes? Jamison (2001: p. 149-151) argues that the first step toward understanding the role of environmental CSOs in science and society is to understand the types of organizations and their strategic approach towards problems and solutions. Jamison (2001: p. 151-168)[11] states that the environmental CSOs can be grouped into three different types that practise different types of environmentalism:

1. Community environmentalism – equal to community-based CSOs
2. Professional environmentalism – equal to professional CSOs
3. Militant environmentalism – equal to CSOs as soldiers

Community-Based CSOs

For the community-based CSOs, the emphasis is on results, understood as successfully impacting policies and political decisions. These CSOs tend to favour factual or scientific-

[10] I want to emphasize that in the following discussion, I focus entirely on environmental CSOs and the roles citizens can play in these organizations, since all the CSOs in my cases can be regarded as environmental organizations. It is possible that citizens in organizations aiming at health, social services etc. can play other roles.

[11] It should be noted that with this division Jamison (2001: p. 151-168) problematizes categorizing CSOs in these three groupings. I operate with this division here, since it provides a picture of how CSOs seem to organize themselves.

technical knowledge over more normative or moral-philosophical knowledge, i.e. factual empirical details about particular environmental problems and information about solutions to problems that are already known. Their main work consists in mobilizing 'local' knowledge and experiences, initiating local research and promoting their findings. These groups do not have economic resources to hire scientific staff when they need scientific knowledge or expertise.

Rootes (1999: p. 17-24) further argues that the tendency for community-based CSOs is to address local problems, and sometimes they educate those involved to see environmental problems in a more global context.

Professional CSOs

For professional CSOs, the emphasis is also on results through attempts to impact policies and political decisions. These activists also tend to favour factual or scientific-technical knowledge over the more normative or moral-philosophical knowledge. Organizations like Greenpeace, WWF and the Nature Conservation Foundations are perceived as professional CSOs. These activists have in many cases become the agenda-setters, formulating the strategies for the culture as a whole and taking responsibility for representing the broader interests in the environment. These CSOs are characterized by their formalized and professional work, which gives priority to expertise. They are permanent entities, which mean that organizational growth and survival are important factors in their choice of topics and methods. These organizations have some resources to hire scientific staff to meet their knowledge needs (Jamison, 2001).

Rootes (1999: p. 17-24) further argues that the role assumed by the professional CSOs is to obtain representation in formal bodies: participate in hearings and ministerial committees etc. They increasingly provide institutions with expert advice, either through formal or informal channels.

CSOs as Soldiers

The main concern of CSOs that act as soldiers is of moral character. In some cases, activists who assume roles within community-based CSOs or professional CSOs also engage in this form of environmentalism. Greenpeace can also be considered to be this type of CSO when they organize such events as occupying ships that are polluting the ocean or transporting nuclear radioactive products in order to gain the attention of the public and media.

Mouffe (2000: p. 103) and Young (2001: p. 673) in Elam & Bertilsson (2003: p. 245) argue for what they call radical citizens. Radical citizens (organized citizens) oppose scientists or policy makers if they feel decisions are made with no regard to their opinions or views. To indicate their opposition against the authorities in power, they organize demonstrations,

campaigns etc. In some cases these 'soldiers' may appear very radical, almost acting as partisans; however, they do play an important role in ensuring democratic criticism.

Summing up these discussions indicates that CSOs and thereby citizens can play an important and valuable role in:

- Expressing the needs of society, at local, national and global levels
- Lobbying with both industry and governmental institutions
- Mobilizing the public
- Defining problems and/or solutions
- Setting agendas based on the needs of society
- Contributing to knowledge production

2.1.2.4 Citizens and CSOs as Research Assistants

Citizens and CSOs can also be assigned the role of research assistants, e.g. where they are asked to participate in exercises where they for instance map or identify problems, issues of concern, or how local knowledge is experienced in 'reality'. One approach that can be applied when citizens act as research assistants is 'citizens' mapping'. Based on research carried out within the field of air pollution quality and modelling, Yearley (2006) argues that citizens' mapping can contribute as a quality check of the predictions of air quality models.

The focus-group model for citizen involvement in assessing air pollution
The example illustrates how mapping exercises were used as a model to enable local citizens to express their knowledge of air pollution. The mapping exercises were conducted in three urban cities, Bristol, Sheffield and York in UK. As part of mapping their knowledge about air pollution sources and air pollution hot spots, citizens participated in group discussions. The researcher's underlying assumption was that local citizen's knowledge with regard to air pollution could identify other sources or problems than those identified by the authorities, such as dust, noise or odour.

Mapping exercises were conducted with community members in each of the three cities, and consultations were held with representatives from a local organization carrying out a cycle campaign.

The outcome was that citizens' mappings in most cases were very similar to the officials' mappings of air pollution problems. In one case, however, citizens mapping differed tremendously from the officials' mapping. The explanation was that the model used by the officials predicted misleading data about how emissions from roads spread.

In the city of York, the authorities found the model of citizens' mapping very interesting, and they supported additional exercises. The authorities further used the citizens' mappings to identify new monitoring locations, and the exercise became part of the authorities' outreach activities with the public.

Example 1: The focus-group model for citizen involvement in assessing air pollution (Yearley, 2006)

The role assigned to citizens and /or CSOs when they participate in focus groups is to provide knowledge and new perspectives to issues that are often defined by scientists or politicians beforehand. Callon et al. (2009: p. 166) argues that such forms of citizen

participation can be acknowledged for their contribution to establishing dialogue between scientists and citizens and/or CSOs; however, the information and knowledge gained through these exercises are controlled by the scientists, since they define the topics for discussion.

CSOs can also act as research assistants when CSOs participate in research projects by conducting interviews in the community they represent, or by conducting measurements to be used by scientists.

2.1.2.5 Citizens and CSOs as Empirical Objects

Another role I want to emphasize is citizens and CSOs as the empirical object. This role is often assigned to citizens and/or CSOs when researchers want to gain an understanding of how citizens and CSOs perceive or understand a specific issue or what knowledge they have of their local settings. As in the case of Bailey et al. (1999), the motivation for assigning citizens and CSOs the role of empirical objects can also be that researchers want to explore how citizens' knowledge can contribute to knowledge production. Citizens and CSOs often play the role of empirical object through different forms of interviews or focus-group exercises, or as objects for observation.

Bailey et al. (1999: p. 300-302) argue, on the basis of research applying the focus-group model in order to involve citizens and CSOs in assessing air pollution, that by assigning this role to citizens and CSOs, they can contribute to revealing new types of knowledge – local knowledge, which differs from what experts usually consider important knowledge. Through the focus-group exercise, citizens and CSOs contribute with knowledge and comments with regard to validation of assumptions; need for communicating air pollution data and results; and ways to disseminate the results.

Applying the focus-group model for citizen and CSO involvement in assessing air pollution
The aim of this example is to illustrate how the focus-group model was used by Bailey et al. (1999) to involve citizens and CSOs in environmental assessment of local air pollution, i.e. by assigning them the role of research objects. Their aim was to give local citizens an opportunity to describe their knowledge about local air pollution and quality. The local council was also interested in citizens' views for their future policy work.

The focus-group approach was used in a research project carried out in Sheffield, UK in 1997. The city experienced severe air pollution problems, and in order to meet some of these problems, the council had invested in an air quality management system, Six different groups participated in the focus-group discussions: 1) environmentalists who were all members of the city's environmental forum; 2) citizen representatives from housing co-operatives near the city centre; 3) community groups situated near major causes of air pollution; 4) representatives from local environmental organizations campaigning against traffic-related air pollution; 5) representatives from public workers within the health sector; and 6) representatives from the business community.

The outcome of the focus-group discussions was related to three issues: 1) participation in local governance and environmental assessment; 2) quality assurance in environmental assessment; and 3) public understanding and receptivity to scientific and environmental assessment. With regard to *participation in local governance and environmental assessment*, the participants concluded that using modelling in order to obtain scientific evidence for air pollution was not necessary since the air pollution was clear to all citizens in the city. They recommended that resources be used for activities to prevent air pollution instead of on models. For example, the participants recommended investing in more environmentally sustainable engines for public busses. The participants further concluded that investing in the modelling system could be interpreted as the council's way of avoiding taking 'real' actions against air pollution.

With regard to the issue of *quality assurance in environmental assessment*, some of the participants mentioned that having only two to five monitoring sites was insufficient to give a correct picture of air pollution in the whole city. Also, lack of monitoring sites was interpreted by some of the participants as a reflection of the council's lack of interest and concern for the citizens. The participants were also interested in baseline assumptions and data from the monitoring, and they raised such questions as the frequency of traffic monitoring updates and the variation of emissions over time. By raising such questions the participants showed the researchers that they were aware that scientists often make generalizations on the basis of a limited data foundation and that limited data can have implications for the output.

With regard to the last issue, *public understanding and uptake of scientific and environmental assessment*, the participants raised questions related to who decides on the assumptions made in the modelling, and which procedures are behind the extrapolation made in the model. Also, the participants did not perceive the model as being an adequate tool for assessing local pollution. The participants finally made it clear that they lacked communication with the council about the results of the modelling.

The researchers behind the focus-group research project concluded that involving the citizens in assessing air pollution does reveal a new type of knowledge, local knowledge, which differs from what experts consider important knowledge. The citizens contributed with knowledge and comments with regard to the validation of assumptions; need for communicating air pollution data; and results; and ways to disseminate the results.

Example 2: Applying the focus-group model for citizen involvement in assessing air pollution (Bailey et al., 1999)

2.1.2.6 Citizens and CSO as Consumers

The most common role citizens and CSOs are assigned or take upon themselves is the role of consumer. Through their consumer behaviour, citizens and CSOs can impact both technological development and political decisions regarding different products (Hamstra,

1995). If citizens and CSOs refuse to accept a certain product or technology, the politicians and developers can be forced to withdraw the product or technology from the market, or they can be pressured to set up regulations and restrictions that ensure that the technology or product lives up to consumer standards or claims.

After discussed the different roles CSOs can play when interacting with scientists I now introduce the concept of Science Shops, and argue that Science Shops - a forum which already exists - may provide one possible platform for dialogue between CSOs and scientists, which Irwin & Michael (2003: p. 111-137) argue and advertises. This discussion also includes reflections on the role of citizens and CSOs when interacting with Science Shops.

2.1.3 The Role of Science Shops as Intermediaries between CSOs and Science

The Science Shops can be understood as one possible forum for interactive dialogue between citizens[12] and/or CSOs and scientists. As mentioned in the introduction (chapter 1, section 2), the concept was developed in the 1970s at Dutch universities as one means to democratize science and technology by responding to the growing need of citizens and CSOs as well as student activists and university scientists to have a voice in and gain access to scientific and technological knowledge (Wachelder, 2003; Dickson, 1984; Farkas, 2002). The principle behind the concept is to offer free or low-cost access to scientific and technological knowledge and research resources to citizens or CSOs in order to develop capacity within their organizations to tackle social and environmental challenges or other types of problems experienced by CSOs (Jørgensen et al., 2004).

2.1.3.1 Organization of Science Shops

Originally, Science Shops were initiated by left-wing student activists and scientists as more or less formalized structures with weak affiliation to the formal structures at Dutch universities. As the years passed, the tendency became that Science Shops became more and more formalized and part of the official university structure (the term used for this kind of Science Shop is university-based Science Shops), which implied scientific staff members, offices and development and strategy plans (Wachelder, 2003). In contrast, we also find Science Shops with weak or no affiliation to universities, such as the Austrian Science Shop FBI (Institut für gesellschaftswissenschaftliche Forschung, Bildung & Information) and the German Science Shop VilaBonn (Wissenschaftsladen) (both termed non-university-based Science Shops). This type of Science Shop is organized as a non-

[12] Citizens as individuals can be clients of Science Shops, if their concerns or interests are of societal concern.

profit organization and may in some cases require a fee for their services (Jørgensen et al., 2004).

The way Science Shops are organized depends on the context and the funding opportunities at the time the Science Shops were established. This is one conclusion in the SCIPAS (Study and Conference on Improving Public Access to Science through Science Shops) project, which is a research project funded by EU and carried out by the Science Shop community during the period 1998- 2002. Another outcome of the SCIPAS project was an overview of the different ways Science Shops organize their activities, which showed there is no dominant way of organizing Science Shops (Gnaiger & Martin, 2001). These different ways are summarized in the figure below:

	University-based Science Shops			**Non-university-based Science Shops**			**Mixed university-based and independent**
	Central office	Faculty office	CBR centres	NGOs (university -related)	NGOs (Non-university -related)	NGOs as incubator	CURA (Community-University Research Alliance)
Countries	Netherland Denmark Austria Germany UK USA Canada Australia South Korea Malaysia	Netherland Denmark Rumania South Africa USA Canada	USA DK Canada	Germany Austria USA	Germany Austria USA	Israel	Canada
Approach	Mediation	Research mediation	Participatory Actions Research	Mediation research	Research	Mediation	Participatory Actions Research

Figure 1: Overview of the clustering of Science Shops (Mulder et al., 2001: p. 18)

Explanation: The approach of mediation means that the Science Shops mediate the research process, whereas Participatory Action Research means that the clients participate actively in conducting the research. It should be noted that this overview is based on the status from the Science Shops in the period of 1998-2001 and thus does not represent the status and organization of the Science Shops at the present time.

Science Shop clients can be of various types, from local citizen groups to larger NGOs. Some Science Shops even accept requests from SMEs (Small and Medium-sized Enterprises) and local authorities – although this differs from the original idea behind Science Shops when they were developed in the 1970s in the Netherlands. In the SCIPAS project (which was one of the first research projects conducted by the Science Shop community, in which they investigated their own activities), one of the aspects investigated was client types. It was concluded that Science Shop clients fall within the following groups (Gnaiger and Martin, 2001):

- Community/Voluntary groups (including environmental groups and religious groups)
- Trade Unions
- Political Parties
- Individuals
- Public Institutions
- SMEs

To understand the role of Science Shops as mediators between CSOs and scientists requires an understanding how the Science Shops have tried to approach democratization of science, as well as an understanding of the knowledge needs of the CSOs that approach the Science Shops. In the following paragraphs I outline and discuss different models of university-based Science Shops, and how they have approached the challenges facing them during recent years. This discussion is based on the development of the Dutch and Danish Science Shops, as my empirical material[13] mainly covers Science Shop co-operations in these two countries. Next, I discuss the knowledge needs of the CSOs when they approach Science Shops, as the research interest in this dissertation involves *how* the CSOs can make impact on their issues of concern.

2.1.3.2 Models of University-based Science Shop Organization

In the article *Democratizing Science,* Wachelder (2003) argues that the Dutch university-based Science Shops have adopted four different models in their struggle to democratize science. These four models can be categorized as: 1) a non-profit service provided by students; 2) a specialized, market-oriented research centre and consultancy; 3) a university public relation tool; and 4) a professional broker mediating between science and society (p. 250-261). The motives for the Science Shops organized as non-profit services (the first type) provided by students have been and still are: to maintain independence from the

[13] My empirical material covers cases from the Netherlands, Denmark and United States (US). In US, they do not have the same Science Shop tradition; however, they have what is called 'community-based research', which resembles to a large extent the way Science Shops work, even though the research units are not termed Science Shops.

universities, even though they are part of the universities. This form of Science Shop is not found in Denmark.

The second type of Science Shop organization is what Wachelder (2003) terms *a specialized, market-orientated research centre and consultancy*. The example he presents is the transformation of the chemistry Science Shop at University of Amsterdam, which during the late 1990s turned the Science Shop into a market-orientated organization, because the need developed to deal with more complex problems, not suitable for smaller student projects. The head of the centre also argues (in Wachelder, 2003) that problems involved in environment and health issues are no longer only the concern of CSOs, but also the concern of private companies. This change in cliental is also observed in Denmark, where the Science Shops at Copenhagen University, Roskilde University and Aalborg University have all chosen to expand their client group to also include private companies. At these Science Shops, however, it is still students who conduct the research and not staff members, as in the Dutch Science Shop model 2, and their focus is not only on environmental issues, but also includes issues such as social welfare, economy, legislation etc. Moving towards a more market-oriented approach has caused these Science Shops to focus more on the markets needs for science and technology rather than democratizing science and technology.

Another strategy applied by some Dutch Science Shops is to use Science Shops as the university's instrument to establish and maintain a strong link to the regions in which they are located. The research in these Science Shops (at Nijmegen University, Tilburg University and Maastricht University) is carried out by students and supervised by faculty members. In this model, the Science Shops still maintain their original goals of democratizing science; however, the broader cliental and demands for payment for some research requests raise some doubts about this. This type of Science Shop organization is not found in Denmark.

The last model of Science Shop organization is termed *a professional broker mediating between science and society*. The motives behind this model were to become independent of university structures, both in regard to obligations and financially. The previously mentioned Chemistry Science Shop at University of Amsterdam chose this approach and is now run as a private consultancy. Even though the Science Shop succeeded in transforming into an independent unit, it experienced economic shortcomings, causing the Science Shop staff to seek new job opportunities outside the university. Science Shops organized as professional brokers mediating between science and society are not found in Denmark.

Wachelder's (2003) conclusion that only four types of Science Shops models exist seems rather problematic to me, since other Dutch Science Shops are organized according to different models that cannot be captured in these four models. For instance, the Chemistry Science Shop at Groningen University[14] may not have been captured by any of these four models[15]. The Science Shop at Groningen seems to reflect a model that lies close to the original ideas behind Science Shops. In this model, Science Shops are affiliated to either a specific department or the university in general and have scientific staff which both functions as supervisors for students carrying out the research needs of CSOs, but also as researchers involved themselves in carrying out the research. The aim of these types Science Shops was and still is to democratize science by giving a voice to CSOs. The Science Shop at DTU also falls outside Wachelder's (2003) four models, since its organization closely resembles the organization and operation of the Science Shop at Groningen University. Affiliated with the Department of Management Engineering, Science Shop DTU stands out, however, by reaching out to all areas of specialization within the engineering field.

The reorganization of the Science Shops at Utrecht and Groningen Universities reflects the challenges facing the Science Shops in the Netherlands, challenges also faced by the Danish Science Shops. For instance, Science Shop DTU does not currently exist, although negotiations are being carried out with DTU's match-making unit about how to handle requests from CSOs in the future.

This whole redefinition and reorganization of Science Shops due to new political priorities appears problematic, since investigations and studies (i.e. the INTERACTS and the SCIPAS projects) on the impact of Science Shops all indicate that they make valuable contribution towards the democratization of science.

2.1.3.3 The Knowledge Needs of CSOs when Approaching Science Shops

In the transnational study *INTERACTS*[16], the Science Shop community explored how the interaction between CSOs, universities and Science Shops could be improved. The study was based on the experiences and expectations of seven Science Shops in Austria,

[14] The Science Shops at Groningen University have gone through a restructuring to reorganize Department Science Shops into larger Faculty units. The former Chemistry Science Shop is now reorganized into Science Shop Mathematics and Natural Sciences.
[15] Despite the fact that the Science Shop has undergone recent changes (in 2008), I still believe it belonged to another type of organizational model, which until December 2009 still existed in the DTU Science Shop.
[16] The INTERACTS (Improving Interaction between NGOs, Universities and Science Shops: Experiences and Expectations) study was financed by the European Commission and was conducted during the period January 2002 to December 2003.

Denmark, Germany, the Netherlands, Romania, Spain and United Kingdom. One of the conclusions from this study, based on case studies of a number of projects concerned with technology, was that the knowledge needs experienced by the CSOs approaching the Science Shops could be characterized as follows:

- A need for problem documentation. The CSOs experience a problem, usually in their local environment, which they need documented in order to enter into dialogue with authorities, companies etc.
- A need for knowledge enhancement. The CSOs need knowledge about technological changes and assessments of policy decisions, in order to be able to participate in dialogues about future scenarios.
- A need for alternative solutions and change of perspective. The CSOs want to assist and want assistance in developing alternative technologies and solutions to improve the social and/or environmental situation.

(Jørgensen et al., 2004).

2.1.3.4 The Mediating Role of Science Shops

The Science Shops can have different functions in their interaction with CSOs, such as 1) providing easy access to the resources at universities; 2) acting as mediator between the knowledge needs of the CSO and the researcher/student; 3) carrying out research; 4) acting as antenna for new societal topics that are not yet addressed by either CSOs or the authorities; and 5) acting as incubator for new research and teaching areas (Farkas, 2002; Jørgensen et al., 2004; Mulder et. al, 2006).

The knowledge production that takes place in Science Shop co-operations is shaped by the conditions of the involved actors and their understanding of research. In some situations, existing knowledge is transferred to the CSOs by the Science Shops; in other situations, it can be characterized as knowledge supply, i.e. scientists and/or students produce new knowledge, which is then transferred to the CSOs. Knowledge production can also take place as participatory knowledge production, i.e. knowledge is produced through a mutual process between the CSO, scientists and/or students and Science Shops. This form of knowledge production implies that lay people's knowledge is considered just as important as scientific knowledge (Jørgensen et al., 2004).

According to Irwin (1995: p. 155-166) and Bellamy (2006: p. 258), Science Shops make a valuable contribution to CSOs by 1) providing technical assistance or knowledge to CSOs; 2) providing mediation between CSOs and scientific structures; and 3) facilitating 'self-help networks', i.e. establishing contact between CSOs experiencing the same problems; 4) raising societal problems among students and scientists at the universities; 5) impacting research agendas to meet societal needs; and 6) empowering CSOs to 'put science into

perspective'. The CSOs themselves argue that co-operation with Science Shops contributes to their efforts to impact and effect policy making, because they become able to bring scientific knowledge and alternative solutions to the attention of politicians and initiate public debates. The CSOs further argue that through co-operation with Science Shops they become aware of research possibilities and limitations. In some cases, the CSOs also acquire the capacity to use scientifically grounded methods when carrying out investigations themselves (Jørgensen et al., 2004; Jørgensen, 2008).

Science Shops can therefore be regarded as a platform for bringing together scientific analytical principles on the one hand, and the lay persons' (with or without scientific background) knowledge about the issue on the other, thus contributing theoretically based systemization of lay knowledge or problem conception and lay insights on perceived problems to science.

According to the CSOs, the possibility of using students as researchers in Science Shop projects is one of the main barriers for developing this kind of co-operation, because there are some uncertainties related to whether or not the project will be carried out and when.[17] This has led some CSOs to approach Science Shops only with less urgent problems/issues; thus, their requests may involve more strategic issues or long-term problems. Another barrier mentioned by CSOs is concern about whether students are capable of meeting the CSOs' needs within the time frame students have due to their study obligations. The scientists, who in most cases act as supervisors, also experience some barriers for strengthening their interaction with Science Shops and CSOs. Since university scientists must fulfil publication requirements, they tend only to engage in interactions which offer publication possibilities; in most cases, Science Shop projects do not offer such possibilities. Scientists also tend to give priority larger to projects with large-scale funding opportunities (Jørgensen et al., 2004).

2.1.3.5 The Role of Citizens and CSOs when Interacting with Science Shops

After discussed the concept of Science Shops, I conclude this sub-section by summarizing the different roles citizens and/or CSOs can and may play when entering into dialogue with Science Shops. Often when CSOs approach Science Shops, they are acting or reacting in relation to a problem they experience in their local settings – for example due to assumed health risks from local or global pollutants, or lack of action by local authorities to ensure sustainable development etc. When networks are established based on these perspectives, the roles assumed by citizens and/or CSOs can be characterized as *democratic*

[17] Students at most universities have various opportunities to conduct research as part of their studies, Science Shop projects being just one among many. This means that Science Shops are not in a position to guarantee when the students can carry out the project.

subjects, as *soldiers,* and as *members of organized CSOs*. Alliance building between citizens and/or CSOs and Science Shops can also be created because the citizens and/or CSOs have a wish to implement or introduce new and more sustainable technologies in their local settings – for example car-sharing in order to minimize their communities' CO_2 emissions. In such situations, the role of citizens and/or CSOs can also, in addition to those mentioned above, be characterized as *research assistants* and *research objects*. This shows that the roles of citizens and CSOs, when they enter into network constructions with Science Shops, vary depending on the motives of the citizens and CSOs when they decide to act.

The role assigned to citizens in the post-normal science model and in consensus conferences are not roles citizens can assume or be assigned when they enter into dialogue with Science Shops. In the post-normal model the citizens' role is to assess science before political decisions are taken. It could seem that citizens here are being used to legitimize the findings of the scientists, which is in direct contrast to the role of citizens when interacting with Science Shops. Alliances between Science Shops and (organized) citizens can almost be seen as the opposite, because it is often a question of legitimizing the problems of (organized) citizens and thereby 'forcing' politicians and scientists to acknowledge their problems. In the consensus conference model, citizens are assigned a role involving them in scientific and technological decision making; however, the concept and the role assigned to citizens are very different in this approach than in Science Shop alliances. Consensus conferences seek consensus and thereby neglect controversies, and citizens are involved as individuals with no prior interest in the subject being discussed. In contrast, Science Shop alliances with (organized) citizens are motivated by their interest and their experiences of conflict, which cannot necessarily be solved through consensus.

2.2 Ethno-Epistemic Assemblages

In most of the roles in which citizens or CSOs seek to impact scientific and/or political decisions, they act mainly as lay people, i.e. as consumers, soldiers, empirical objects, and partly in the role of policy makers, as a group separate from scientists or government officials. When seeking to understand the knowledge produced in networks between CSOs and scientists, it may be more appropriate, however, to view citizens and CSOs as participants in assemblages of lay people and experts. This is the subject of the discussion in this section, which introduces the heuristic tool of Ethno-Epistemic Assemblages (EEAs).

The concept is put forward by Irwin & Michael (2003: p. 111), who argue that since in many situations, the differences between expert and lay knowledge are blurred, citizens or

CSOs should not be seen exclusively as lay people. Especially in three situations, they argue, this blurring of expert and lay knowledge is distinctive:

1) In situations when citizens and CSOs contribute to risk assessment, Irwin & Michael (2003: p. 111) argue, citizens and CSOs are highly knowledgeable.
2) In situations where citizens and CSOs are enrolled in different networks or alliances with other CSOs, the media, scientists, and industries. In these situations, it is not possible to distinguish between citizen and CSO knowledge and expert knowledge (Irwin & Michael, 2003: p. 111).
3) In situations where citizens and CSOs are able to draw on global issues (such as CO_2 discussions) to strengthen their local issue (such as local air pollution), Irwin & Michael (2003: p. 111) argue, there is a blurring between local and global that causes a blurring of the boundary between lay knowledge and expert knowledge.

Since it is not always possible to distinguish between lay knowledge and expert knowledge, Irwin & Michael (2003: p. 111) argue for abolishing the traditional way of analysing citizens' and CSOs' understanding of and interaction with science. This tradition presumes a distinction between society and science. Instead, they point towards the need to study *"[…] contrasts between actors or constituencies each comprised of mixtures of both science and society"* (p. 111). To study these contrasts, they suggest a concept or a heuristic they call *Ethno-Epistemic Assemblage* (EEA), which stresses that scientific citizenship relies on both heterogeneity and relationality. In principle, an EEA consists of mixed groups of lay people, i.e. CSOs and experts (i.e. scientists).

Irwin & Michael argue they provide a more adequate frame for understanding interaction between science and society and the knowledge produced as part of this interaction with their concept of EEAs than Gibbons et al.'s (1994) considerations of how knowledge production takes place. Gibbons et al. argue for what they call 'Mode 2', the new trend where knowledge is produced in networks where different actors, and not only scientists, contribute with their knowledge and expertise. They also argue that in contrast to what they call 'Mode 1' (i.e. knowledge produced only by scientists), Mode 2 knowledge production, besides being interdisciplinary, is driven by context, perception of problems and solutions. Irwin & Michael's (2003: p. 113) concept of EEA takes up some of these considerations but argues that by studying the relations between science and society as a question in relation to EEAs, what is added to the analysis is an understanding of 1) the heterogeneity of the groupings, and 2) the role of non-human elements (be they technical or natural artifacts); as well as 3) how scientific controversies are shaped, by whom and by what; and finally, 4) how shared beliefs and the validity of science and policy are achieved in these mixed groups.

By suggesting an analysis of the relationship between science and society as EEAs, Irwin & Michael (2003) thereby set focus on scientific citizenship, and start the exploration of ways in which discourses and practices participate in ensuring accountability and transparency in scientific policy making and how this is shaped by complex social dynamics. Irwin & Michael (2003) argue that the heuristic 'EEA' can help the researcher *"sensitize us to ways that, in making knowledge claims, many disparate techniques (both discursive and practical) can be utilized"* (page 113). They further argue "*that ethno-epistemic assemblages can serve to highlight concerns of the role of non-humans (whether 'technological' or 'natural') in the process of knowledge-making and -claiming. To the extent that our 'humanity' cannot be separated from these non-humans, ethno-epistemic assemblage (together with cognate approaches) enable us to raise questions about who or what contributes to a scientific controversy"* (page 113).

In the above quotation, Irwin & Michael (2003) introduce the notion of 'non-humans', with inspiration from the Actor-Network Theory. In their discussions concerning the concept of EEAs, Irwin & Michael argue that they have been inspired by four different perspectives within science and technology studies: epistemic communities (Haas, 1992); discourse coalition (Hajer, 1997); Actor-Network Theory (Callon, 1986b); and Deleuze and Guattari's (1988) ideas of 'rhizome'. Irwin & Michael (2003) present counter-arguments for why these four perspectives each fail in helping us gain an understanding of the blurring of knowledge-making and -claiming. According to Irwin & Michael, epistemic communities fail because this perspective is only concerned with professionals and their beliefs, whereas the aspects of non-professionals' contribution to knowledge-making and knowledge-claiming is neglected. Discourse coalition emphasizes narratives or storylines, but fails to include practices and the influence of technologies and other natures as important elements in co-ordination of actors. Actor-Network Theory provides an understanding of the heterogeneity in the actors involved, but Irwin & Michael argue that the tendency within ANT studies is that techno-science becomes the main driver for the networks: *"Science proceeds through a process of enrolling its public, redefining their interests and allotting them new roles"* (Irwin & Michael, 2003: p. 116). Furthermore, *"What this approach offers is an account of how to make the public 'understand' [...]. This is a managerialist view of (techno)scientists and knowledge production"* (p. 117).

Irwin & Michael then proceed to the perspectives in Deleuze and Guattari's notion of 'rhizome', arguing that this perspective advocates a more fluid and complex relationship between science and public. However, before continuing the discussion of the heuristic EEAs, it is necessary to comment on Irwin & Michael's statement of ANT as managerialist. The studies Irwin & Michael refer to are made by Callon and Latour in the early days of ANT. These studies focussed on historical technological and scientific developments, such as the electric vehicle around 1973 (Callon, 1986b) and 'Laboratory Life' in the late 1960s (Latour & Woolgar, 1979). During this period, the deficit model's idea of technological

development was dominating: science and the scientists were the main drivers of innovation and development. And this may very well be reflected in the studies referred to by Irwin & Michael. Had they however chosen to refer to more recent ANT studies, such as Shiga (2007) and Shostak (2007) it would appear that this managerialist view no longer characterizes all ANT studies. I continue this discussion in section 2.4: The Nature and State of Explanation in ANT in this chapter.

Summing up this discussion leaves us with a heuristic that can help us understand how knowledge is produced in networks between CSOs and scientists, as well as how different actors seek impact. By introducing the concept of EEAs, Irwin & Michael (2003) reverse the agenda of PUS and introduce us to PES. The authors thereby break with an earlier dominant tradition within Science and Technology Studies that scientists are the main source and producer of knowledge. Instead, the Irwin & Michael (2003) emphasize that citizens and thereby also CSOs, in their interaction with scientists, play an important role in contributing to the production of knowledge.

My understanding of Irwin & Michael's concept of EEAs is that it is both descriptive and normative – descriptive, because it contributes to an understanding of the relations between science and society; and normative, because EEAs can be viewed as the trend for how interaction between different human and non-human actors, as well as knowledge production, ought to take place in the future. Given this understanding of Irwin & Michael's (2003) concept of EEAs, I deduce that Science Shop co-operations can be understood as EEAs. The challenge, however, as I see it, with regard to their ideas about studying network alliances as Ethno-Epistemic Assemblages (EEAs), is two- fold. It seems that Irwin & Michael (2003) do not provide methods or guidelines for studying these network alliances, nor do they reflect on how the produced knowledge is sought used and by whom. Thus, I suggest that one way to study and gain understanding of how this interaction takes place, how knowledge is produced, and how the EEAs seek to use the produced knowledge in order to cause effects, is to study these processes as translation processes, which I have done with the inspiration of Callon's sociology of translations.

By viewing these network constructions as EEAs, I am thus able to gain an understanding of how stabilization within these networks is reached and how impact on the issues the networks address is achieved or not achieved. Analysing the network alliances as EEAs through the means of Callon's sociology of translation may contribute to a further elaboration of Irwin & Michael's concept of EEAs in relation to understand the interaction in such EEAs, how these EEAs are created and maintained as well as how the produced knowledge is sought used to impact the problems of the CSOs.

2.3 ANT as Inspiration for Studying Science-Society Relations – as Network Constructions

As already stated, my research interest is to understand how CSOs, through alliance building and network constructions with Science Shops, engage with scientists in order to impact the air pollution agenda. Thus, I am interested in open controversies around socio-technical complexities. Approaches such as ANT and SCOT seem to capture these complexities more comprehensively than for instance the Sociology of Scientific Knowledge (SSK), which seems to focus only on human actors and scientific knowledge, leaving out socio-technical complexities. I could have chosen another approach, and instead studied these network alliances as social processes constructed around the Science Shops, or as a question of understanding the practices of the human actors and the methods they apply in their daily practices as ethnomethodology suggests. But since I am interested in understanding the relations between human and non-human actants – for example, CSOs' use of physical artifacts to help them legitimize their concerns – I have chosen to be inspired by the Actor-Network approach, since through this approach I can examine and unfold relations between humans and non-humans in order to find the patterns and effects of the network alliances.

My analysis of the case studies is inspired by Callon's (1986a) sociology of translation, because analysing translations within the networks enables me to gain an understanding of how and why network constellations (EEAs) between CSOs, Science Shops and scientists are created around air pollution controversies, as well an understanding of which effects these network alliances cause. In this way, I will be able point out how power is achieved and stabilized within these EEAs, which consist of both human actors, such as CSOs, Science Shops, scientists, and local authority members, and non-human actants, such as air pollution particles, scientific reports, measurements etc. Callon (1991: p. 142) also argues that making ANT studies allows the researcher to gain understanding of:

- *How different actor-networks which have no a priori reason to be compatible with one another manage to reach agreement*. This means that I will be able to understand why, for example, authorities or industries that may have other interests than CSOs focus on environmental issues and manage to reach agreements they all accept.

- *What happens if one actant does not accept another actant's definition. Or if two actants disagree about the nature of a third.* Stabilization within networks is not always achieved, even though various persuasive measures (i.e. interessement devices) are used by the actants interested in or persuaded into the network. This failure to reach stability may be due to some actants' rejection of other actants' definitions

and arguments. My case study *the pesticide case* illustrates this problem and the consequences it has had for the community and the CSO.

- *How is it that sometimes agreements are reached*. Agreements are often reached based on a variety of negotiations and translations that cannot be generalized, as my case studies illustrate. Some agreements are reached due to threats of legal action and others due to scientific evidence of health risks, as my case studies *the Scania case* and *the Mira Loma case* illustrate.

- *The role played by science and technology in structuring power relations*. Agreement and network stabilizations are not reached based on human negotiations alone, as my case studies illustrate. All my case studies point to the fact that effects and power are achieved through a mixture of personally motivated arguments, scientific arguments, and non-human entities' being enrolled in the networks. For example, in the case study: *The Scania case*, Scania would not have been persuaded to enter the network, if the particles were not able to be measured, and the measuring techniques were not capable to perform the measurements.

I have set out on a journey aiming at studying how CSOs, through alliance building and network constructions with Science Shops, engage with scientists in order to impact the air pollution agenda. This means that I am interested in exploring how these networks reach or not reach a stable state and which affects the network alliances cause. The question is, though, how am I to determine what has been stabilized and what has not reached stabilization? Callon (1986a: p. 223) argues that to understand whether a network has reached stabilization, the researcher's starting point is to examine the situation prior to the initiation of the network, and then move to the final situation examining what the network achieved. What lies between these two situations can be explained by analysing translation processes. Emerging from this, however, are questions such as: Does stabilization within a network also imply effects on the issue in question? And how does one actant succeed in obtaining a position where it can speak on behalf of the whole network? I start the discussion with the second question, since this can contribute to a discussion of the first.

2.3.1 Knowledge as Power and Power as Knowledge

2.3.1.1 The Ontological Position of ANT

The ontological position of ANT is that entities or actants in themselves do not possess specific essences, but that the essences are effects of heterogeneous network relations between human and non-human actants. Fundamental for ANT is that it rejects that an *a priori* distinction exists between the natural and the social or the technical and the political, but that these distinctions are effects from the controversies between the actants (Latour, 1987). This means that ANT would argue that what some would call a technical solution are actually the effects of negotiations and battles between social, political, natural etc. elements. A fundamental analytical principle in ANT is its generalized symmetry (Callon, 1986a: p. 200), which means that dualisms such as true and false, human and nonhuman etc. do not exist. Callon (1986a) argues that these distinctions cannot be made until stabilization is achieved. For example, a scientific result is not true unless the actants have negotiated it to be the truth. The interesting aspect for me as researcher is therefore to study how the actants construct the world they live in by enrolling themselves in different controversies.

Central in ANT is the application of the term *network*. Network in ANT terms means transformation, i.e. translations and transductions. Each individual actant is perceived and can be described as an actor-network in itself. Furthermore, each individual actant represents specific interests and wishes for the specific development in question; however, these interests and wishes are not determined in advance; they are not ascribed *a priori*. This means that each individual actant is defined through its relations to other actants in the network and each actant through the network relations might practice their influence and thereby affect and occasionally control the technological development (Law, 1992; Lindegaard et al., 2004; Elgaard Jensen, 2003; Latour, 2005). When a network has reached a certain degree of stability, it is termed *black box*, which means that it is a closed unit that reacts predictably to specific input (Elgaard Jensen, 2005).

2.3.1.2 Knowledge as the Effect of Heterogeneous Network Relations

Central for Irwin & Michael's (2003) thoughts behind the heuristic of EEAs is that the knowledge produced in heterogeneous networks can be interpreted as a blurring of the different actants' contribution in producing the knowledge. This means that 'knowledge' becomes a focal element to understand when examining how CSOs construct and maintain alliances with other actants in order to impact the issues they are concerned with. As I mentioned in the introduction to this section, ANT perceives 'knowledge' as a controversy, an effect of network negotiations and battles. Law (1992: p. 381) argues that 'knowledge' simply cannot be generated by applying a scientific method; it has to be

understood as a social production and is the effect of a network of heterogeneous materials. He argues that knowledge and science is:

> "[…] *a process of 'heterogeneous engineering' in which bits and pieces from the social, the technical, the conceptual and the textual are fitted together, and so converted (or 'translated') into a set of equally heterogeneous scientific products"* (Law, 1992: p. 381).

According to Law (1992) it is clear that 'knowledge' cannot be black-boxed but needs to be unfolded; the question thus becomes how? Law (1991) and Callon (1986a) argue that 'knowledge' is the negotiated results of power relations. The two authors draw here on the Foucaultian concept of power: *"[…] that power and knowledge are indisociable from one another […]"* (Fox, 2000: p. 857). Foucault (1984) is concerned with the 'concrete practice' of power; i.e. that 'power to' and 'power over' need to be distinguished from each other, and that neither situations are stable, but are negotiated effects. Foucault's (1984) concept of power further emphasizes that power relations provide the only explanation for why anything is achieved. Law (1991) and ANT have adopted this notion of power, arguing that power is the actions of all actants in the network and should be understood as *"[...] an effect, a product of a set of more or less precariously structured relations"* (Law, 1991: p. 170).

The emphasis in ANT that *all actants act* is inspired from the Foucaultian concept of power. Since power is action (whether it may be resistance, acceptance etc.), Callon (1986), Law (1991), Latour (1986b) and Fox (2000) suggest that these actions, be they negotiations, battles, manipulation etc. are to be understood as translations; thus, the authors set an equal sign between power relations and translations, arguing that what needs to be examined is how the networks grow into acting as one and thereby obtain a position that can be termed black box. To examine this, Callon (1986a), (1986b) and Fox (2000) suggest using what has been known as Callon's (1986a) sociology of translations.

2.3.2 Translations

ANT has adopted the term translation based on Michael Serres' definition of translation. Serres (as quoted in Elgaard Jensen, 2003: p. 8) defines translation as a kind of mediation – something is replaced and shaped. Callon (1986a: p. 224) writes about translation as follows: *"Translation is the mechanism by which social and natural worlds progressively take form. The result is a situation in which certain entities control others. Understanding what sociologists generally call power relationships means describing the way actors are defined, associated and simultaneously obliged to remain faithful to their alliances. The repertoire of translation is not only designed to give a symmetrical and tolerant description of a complex process which constantly mixes together a variety of social and natural entities. It also permits an*

explanation of how a few obtain the right to express and to represent the many silent actors[18] *of the social and natural worlds they have mobilized"*. This means that through translations processes resemblance is made between two different actants or networks (Elgaard Jensen, 2005). The translation processes visualize the 'struggles' which take place within the networks, battles of enrolment and mobilization of other actants. When one actant succeeds in translating another actant, it positions itself in the network and becomes stronger (Elgaard Jensen, 2003). The question is, though, how are we to explain these battles of enrolment and mobilization? Latour (1987: p. 108-144) argues that the fact builder or the spokesperson (the actant(s) seeking to enrol or mobilize other actants) may apply one or several strategies in order to interest, persuade or force actants into the network. These strategies are described in more detail in the following.

2.3.2.1 Translations Strategies

Latour (1987) argues that when translating claims into facts, the fact builder or the translator may apply different strategies to interest actants in the claim. The *first strategy*, Latour (1987: p. 110) terms 'I want what you want': *"[...] the easiest means to enrol people in the construction of facts is to let oneself be enrolled by them. By pushing their explicit interests, you will also further yours".* When this translation strategy is applied, the actants become interested in the claim without the translator having to use force or persuasive means. However, this situation may also be a bit dangerous for the translators, since control over the claim is given to the interested actants. Rather than giving control over the claim to the interested actants, the translator may in some situations apply *another strategy:* 'I want it, why don't you want'. The disadvantage of this strategy, however, is: *"[...] why should people go out of their way and follow yours instead"* (Latour 1987: p. 111). Latour argues, that an actant will only accept this translation in situations where the road is blocked.

Since strategy 1 leaves the control over the claim to the other interested actants rather than the translator, and strategy 2 is only applicable in rare situations, Latour (1987: p. 111) argues for another and more powerful strategy: 'If you just take a short detour'. Here, the argument making the actant interested in the claim is: *"You cannot reach your goal straight away, but if you come my way, you would reach it faster, it would be a shortcut".* This strategy may be applied successfully in situations where *"the main road is clearly cut off; the new detour is well signposted; the detour appears short"* (Latour, 1987; p. 11-112). However, if such situations do not exist, this strategy 3 will fail and another strategy is needed. Latour (1987: p. 113-119) calls this strategy: 'Reshuffling interests and goals'. The argument here is that in some situations the translator persuades the enrolled actants to replace their original goal by inventing new goals that unite the whole network.

[18] When Callon (1986a) here uses the term actors, it is meant in the broad sense as actants.

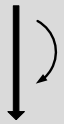
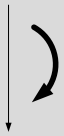
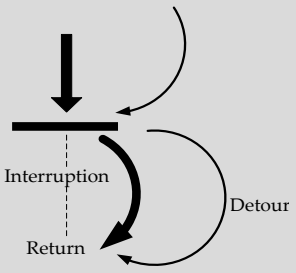
Strategy 1:	I want what you want	
Strategy 2:	I want it, why don't you want it	
Strategy 3:	If you just take a short detour	
Strategy 4:	Reshuffling interests and goals	

Figure 2: Translation strategies to interest actants to join the network (Latour, 1987: p. 108-121)

Interesting actants in the claim may not be enough for the claim to become fact, since actants can lose interest or be persuaded to join other networks that contest the claim. The challenge for the network and the translators is therefore to keep the actants interested in the network and have them work for the network. To keep actants interested in the network, Latour (1987) argues for three conditions which can help ensure that all actants accept a translation and contribute to the process of making the actants' behaviour predictable:

Condition 1:	A chain is only as strong as its weakest link
Condition 2:	Tying up with new unexpected alliances
Condition 3:	Machinations of forces

Figure 3: Conditions contributing to keeping actants interested in the network (Latour, 1987: p. 121-132)

For a network to translate its claim into facts, it needs to link all actants to the network. If one actant resists, the chain risks breaking and stabilization will not be possible. Therefore, Latour (1987: p. 121-124) argues that the network translator needs to be aware of what I call condition 1. Latour (1987: p. 124-128) also argues that *tying up with unexpected alliances* can contribute to keeping actants interested in the network. These unexpected alliances can consist of human and non-human actants, and serve the purpose of keeping

persuaded actants enrolled in the network. The third condition, which Latour (1987: p. 128-132) calls *machinations of forces*, can contribute to linking up the allies into one whole, by constructing or developing a machine, which he defines as follows:

> *"A machine, as its name implies, is first of all, a machination, a stratagem, a kind of cunning, where borrowed forces keep one another in check so that none can fly apart from the group"* (Latour, 1987: p. 129).

By introducing the four strategies, Latour (1987) provides an overall frame or means to understand knowledge claims and how they are translated into facts through network translations. However, what is lacking is a framework that can help explain how the actual translation strategies are applied. One such framework is provided by Callon's (1986a+b) sociology of translations.

2.3.2.2 Sociology of Translations

The sociology of translations was suggested by Callon on the basis of his study of scallops (Callon, 1986a). In this study, Callon analysed how specific technological and scientific solutions can participate in solving societal problems. A more recent study done by Shiga (2007) concludes that even though scholars within ANT have turned away from Callon's sociology of translations over the years when exploring the role of artifacts in everyday life, and have moved towards what has become known as Post-ANT, it might be beneficial to return to the original thoughts of Callon because: *"The linguistic metaphor of translation emphasizes the manner in which entities' interests, goals, or desires are represented, simplified, and transformed in the production and mobilization of artifacts"* (Shiga, 2007: p. 41).

In his sociology of translations, Callon (1986a: p. 203-221) argues that translations, and thereby power relations, can be analysed by focussing on four moments of translations:

1. Problematization: Obligatory Passage Point (OPP)
2. Interessement
3. Enrolment
4. Mobilization

Problematization moment of translations

For Callon (1986a: p. 203-206; 1986b: p. 26-27), the first moment of translation involves facts all actants want to know about, no matter what their interests and motives are. An example of this could be that air pollution problems are experienced in a community. Some actants assumes the pollution is due to pesticides used by agricultural activities surrounding the community, and thus needs fact investigating this. Their motive is to force authorities to take actions towards the polluters. Other actants are also interested in facts related to the air pollution levels and the use of pesticides, however, their motives

may be to gain more insight about the scientific relationships or it may be to be able to claim that the pollution is caused by other means. One actant (the spokesman or translator) defines a problem and suggests negotiations with other actants. These negotiations end with an obligatory passage point (OPP), which states the problem they all want facts about. The actants may in most cases have very different motives to join the negotiations, but they alone are not able to obtain the facts without making alliances with other actants. If the actant proposing the problem succeeds in negotiating or persuading other actants to accept the obligatory passage point, and succeeds in making it accepted as the only way to overcome the obstacle problems, the actant becomes indispensable for the network. Continuing the example from above, one could imagine that the CSO's obstacle problem is to put an end to the farmers' use of pesticides, and the only way they can achieve facts supporting their problem is to accept an investigation where the focus is on how far pesticides travel in air. Thus, in this situation, the CSO may not achieve exactly the facts they need to overcome their obstacle problem, but it may provide – if the facts support the CSO's claim – the CSO with initial support to their claim.

This first moment of translation, the problematization and obligatory passage point is illustrated below:

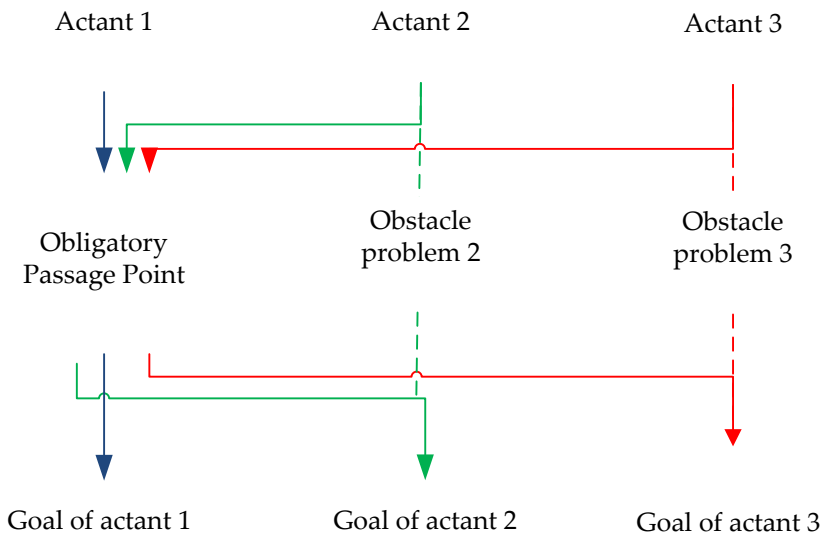


Figure 4: The first moment of translation: the problematization and obligatory passage point (Inspired by Callon, 1986a)

Interessement moment of translation

The interessement moment of translation includes the processes where one actant seeks through alliances to persuade other actants to play a specific role to benefit the network. This could be that the CSO assumes a role of being invisible or that scientists assumes are

role of not only producing the facts but also engaging in the process of striving to enrol other actants into the network. If one or more actants disagree with the obligatory passage point or are enrolled by another actant into another network, they can reject the translation by defining their interests or motivations differently than those defined in the problematization moment of translation.

To interest actants, the translator, Callon (1986a: p. 206-211) argues, needs to build interessement devices, which serve to block the way for other entities wanting to identify other roles and interests for the actants in the alliance. Interessement devices can be technical devices, strategies etc. Callon (1986a: p. 208) describes the process of interessement like this:

> *"A interests B by cutting or weakening all links between B and other invisible (or at times quite visible) group of other entities C, D, E etc. who may want to link themselves to B".*

B thereby becomes a result of the alliance with actant A, and this link disconnects actant B with the other actants C, D, E etc.

Stabilizing the network and seeking to lock the actants into a specific role can be done through the use of inscriptions (reports, documents etc.), specific movements of people (events, meeting etc.), treats and force etc. (Callon, 1986b).

Enrolment moment of translation

This moment of translation involves defining and co-ordinating roles. To understand how the actants are enrolled, the researcher needs to analyse how the actants are convinced to assume the role allocated to them (Callon, 1986a). Callon (1986a: p. 211-214) argues that the moment of interessement does not necessarily lead to enrolment. Enrolment requires the question (the problem) to be translated into statements. Enrolment can also be obtained through physical violence, persuasion, or seduction (Elgaard Jensen, 2003).

Mobilization moment of translation

This last moment of translation focuses on the mobilization of allies. Up to now, it is only the individual actants that have been enrolled, but are they representatives? Mobilization concerns ensuring that the individual actants can speak or act on behalf of the others and how others will maintain their roles (Elgaard Jensen, 2003; Callon, 1986a).

Callon (1986a: p. 214-219) suggests that the researcher ask herself/himself the following questions in order to analyse the mobilization moment of translation:

- Are the translators representatives?
- Who speaks in the name of whom?
- Who represents whom?

Even though stability has been reached, betrayals and controversies can occur in all four moments of translation, and when analysing this, the researcher should ask questions such as:

1) Why do controversies occur?
2) How are they handled?
3) How do they end and who tries to end them? (Callon, 1986a)

By introducing the sociology of translations, Callon (1986a+b) provides a framework that allows us to understand how one actant succeeds in obtaining a position where it can act on behalf of the whole network. Thus, I have found an answer to one of the questions posed in the introduction to this section (see page 376), i.e. *how one actant succeed in obtaining a position where it can speak on behalf of the whole network*. I return now to the other question: Does stabilization within a network also imply effects on the issue in question?

2.3.3 Stabilization and Effects

For Callon, Latour and other scholars in ANT, network constructions and alliances serve one purpose, to reach stabilization within the network. But how is stabilization to be understood? In ANT, stabilization is an effect and result of translations. A network's stability is never a fixed state, and it will continuously be challenged by other networks. However, "*a network can continue to build upon and align strongly with new elements, further stabilising its network configuration [...]; alternatively, the network can unravel at any point in the preceding process of translation and be (albeit partially, or wholly) destabilised. [...] In an ANT framework, stabilisation is not an expression of a 'static' state of the network, but points to the network's ability to seemingly remain stable and robust [...], despite of [...] its ability to continually draw on new resources and adaptations, which renders it 'stable'*" (Yoshinaka, 2009: p. 8-9). Latour (1987) seems to provide another suggestion to how stabilization is to be understood than Yoshinaka (2009). Latour (1987) suggest that only network that produces a black-box reaches a stable state; meaning that the network reaches a state where it is taken-for-granted. Having this characterization of stabilization in mind leads me to conclude that stabilization of the network does not necessarily equal the effects caused by the network. Stabilization may occur within a certain network that is striving to uphold its obligatory passage point; however, the attempt to enrol other actants from other networks into the network and make the knowledge claim true could still fail, and the network could fail in causing any effects, as some of my case studies show. The opposite situation can also be imagined, i.e. that the network fails in becoming stable but nevertheless succeeds in causing effects. Due to these considerations, I follow Callon's (1986a) interest in effects, i.e. that something is strengthened and becomes stable. However, I maintain an open mind in the situations where stabilization of the networks fails, and explore whether effects are to be observed in these situations as well.

Choosing an ANT perspective is a methodological choice that others may oppose or be critical towards. But I find the ANT perspective challenging and a very useful methodology for exploring the relations between human and non-humans in order to find patterns and effects of the network alliances between CSOs, scientists and Science Shops, which is my research interest. I do not ignore, however, some of the main points of criticism put forward by, among others, Star (1991) and Collins and Yearley (1992), but comment on this in the next section.

2.4 The Nature and State of Explanation in ANT

In this section, I discuss in detail the nature and state of explanation in ANT. This is necessary because ANT is often criticized by, among others, Collins and Yearley (1992) for lacking the ability to explain the studied phenomena. It could be argued that every methodological approach can be criticized, so why engage in this discussion? I do so because I want make clear which type of explanation I am able to present through my case studies. Callon's (1986a) sociology of translation analysis, which is the analytical approach I have chosen, has also been criticised, primarily as argued by Star (1991: p. 33), because it has a tendency to favour the strong and powerful actors and oppress small and marginalized actors. The question is, however, how do these two points of criticism impact my research?

In relation to the criticism of Star (1991: p. 33), one very important principle in ANT is that to start with no actors are more powerful or marginalized than others. These positions develop through the translation processes. The analytical challenge for the researcher is to study these translations and discover how some actants are able to mobilize others. This means that it is the found empirical material that reveals whether or not some actors become marginalized or oppressed, and not something that the researcher should predetermine from the beginning (Olsen & Kroustrup, 2007). In relation to my studies of CSOs and Science Shops, Star's criticism would be that the stories are told from the translator's perspective – meaning from the Science Shop's perspective. However, I do not see Star's points of criticism as relevant, since neither the Science Shops nor the CSOs are the winners or losers from the beginning; if they succeed in gaining power and thus impact the issue in question, this happens through the translation processes.

ANT is often criticized for lacking possibilities for the researcher to explain the shape of the actants in the network constellations, and why they act as they do (Collins and Yearley, 1992: p. 322). This criticism is however, based on a wish by sociologists such as Collins and Yearley to be able to give sociological explanations that can help them predict sociological tendencies in society (Latour, 1996). This is in direct contrast to the idea of

ANT, because ANT does not presume that the actants have special interests from the beginning, before the network is created about the issue in which forms the basis of the network. The idea is rather to put forward a method which allows the researcher to understand and describe how actants construct the world they live in by enrolling themselves in different networks. An ANT characteristic is that the actants are not predefined but defined later through their actions. The nature of explanation in ANT terms then becomes to explain how actants develop networks and not to give sociological explanations of tendencies in society (Latour, 1996b).

Latour (1996b: p. 57) puts this very clearly when he argues:

> *"No explanation is stronger or more powerful than providing connections among unrelated elements, or showing how one element holds many others. This is not a property that is distinct from networks but one of their essentials properties. They become more or less explainable as they go and depending on what they do to one another".*

The type of explanations that ANT suggests can help me explain how different types of network alliances between CSOs, Science Shops and scientists are created around air pollution controversies, how they contribute to success or failure in gaining impact on the air pollution issue in question, and whether the networks succeed in gaining impact on other issues than the issue in question.

CHAPTER 3: RESEARCH DESIGN

The aim in this chapter is to describe and discuss how I designed my research, given the conditions and boundaries set up from the beginning; how I conducted the research; and which kind of empirical material lies behind my analytical discussions later in this dissertation.

3.1 Research Questions

When I designed my research four years back, my intentions were to conduct an explorative study of why and how CSOs approach Science Shops around air pollution issues, and whether and how co-operation is established. Based on this, I planned to explore how these experiences from the Science Shops could contribute to strengthen the ACCENT scientists' relations with CSOs. My research interest was therefore to **understand how CSOs, through alliance building and network constructions with Science Shops, engage with scientists in order to impact the air pollution agenda.**[19] This means that I am interested in understanding how knowledge is produced and how this knowledge contributes to stabilizing network alliances. It also means that I am interested in understanding whether and how this stabilization contributes to the network alliances' success in gaining impact. As argued in the previous chapter, I draw inspiration from Irwin & Michael's (2003) concept of EEAs as well as Callon's (1986a) sociology of translation, as the guiding analytical resources in my explorative journey.

More precisely, my research questions are formulated as follows:

- **How and why are network constellations between CSOs, Science Shops and scientists created around air pollution controversies?**

- **Which effects are caused by network alliances between CSOs, Science Shops and scientists, which are created around air pollution controversies?**

To explain how network constellations between CSOs, Science Shops and scientists are created, and how agreement is reached (or not) through translations, I examine the stability and the effects of the networks. *Stabilization* and *effects* are therefore my focal

[19] Due to my co-operation with air pollution scientists in the ACCENT network, my empirical focus is on air pollution and CSOs addressing air pollution issues.

analytical interests. Explaining network stability means explaining translations, and to which extent the translations are returned to the original problem, meaning correlates with the original problem of the CSO. The analytical questions that guide my discussions of how, if and why stabilization and effects were achieved in my case studies are:

- **How are obligatory passage points created and how are networks created around these obligatory passage points?**

- **What are the nature and scope of translations and the relations back to the original problem?**

- **Which actants are made interested and enrolled in the networks, and which roles do these actants play?**

My hope with this research is that my analyses can contribute to such discussions as those by Irwin & Michael (2003) regarding their ideas of EEAs. I hope to take their ideas one step further, however, and add to their discussion an understanding of how stabilization is reached within these EEAs and which effects the networks cause.

3.2 The Background of the Research Project

The idea for my research project originated back in 2004, when one of my supervisors, Michael Søgaard Jørgensen, attended and gave a speech at the conference *Workshop on Interfacing Science with Public and Policy*, held in Gothenburg as part of the Swedish ASTA[20] programme. At this conference, my supervisor was approached by the leader of the WP17 (Public and Policy) in the ACCENT Network of Excellence, who was interested in learning more about Science Shops and how they interact with CSOs. The overall goal of the ACCENT network is to promote a common European strategy for research on atmospheric composition change. Other goals of the network are to develop and maintain durable means of communication and collaboration within the European scientific community, to facilitate this research, and to optimize two-way interactions with policy makers and the general public (ACCENT, 2009). The ACCENT network is funded by the European Commission, which requires the ACCENT community to promote a two-way interaction with the public (ACCENT, 2009).

[20] ASTA is the abbreviation for 'International and National Abatement Strategies for Transboundary Air Pollution'.

During the next year, my supervisor and I had discussions with the ACCENT WP17 leader, and in mid-2005 we agreed on a research project conducting an explorative study of how Science Shops enter networks with CSOs around air pollution issues, as well as which air pollution controversies CSOs seem to engage in. It was further agreed that the research should include considerations about how experiences from the Science Shops could contribute to strengthening the ACCENT scientists' relations with CSOs. Besides learning about Science Shops and how they engage with CSOs around air pollution issues, the ACCENT WP17 leader also required a sort of state-of-the-art survey specifying ACCENT scientists' relationships with CSOs. To combine this requirement with my interests, I intended to follow some of the scientists in their interactions with CSOs from the beginning, in order to understand how the interaction took place, which problems were being raised, and which roles the scientists and the CSOs played in these interactions. I also planned to develop and organize a different form of Science Café, which I called Participatory Science Cafés. Later in the research process I realized however that this action research part of the project was not possible (in Appendix I and II, I elaborate on why these activities failed).

The state-of-the-art survey of the ACCENT scientists' relations with CSOs has been left out of this dissertation, since this survey has no relevance for my research's focus on how CSOs enter network alliances with Science Shops to impact air pollution issues.

Since my research project was initiated on the basis of the ACCENT WP17 leader's wish to learn about how Science Shops engage and co-operate with CSOs around air pollution issues, my objective was to reach out to as many Science Shops as possible in order to learn about their experiences with network alliances. Thus, I did not limit the empirical field to only include the experiences of one or two Science Shops or network alliances, but chose to be open and explorative to learn about as many experiences as possible.

In the next section, I describe how the experiences were identified and how the empirical material was collected.

3.3 Designing the Research

I have approached my empirical field in an explorative manner, since I wanted to be open towards gathering as much empirical material as possible about Science Shops' relations with CSOs addressing air pollution issues. As a result, the diversity in amount and shape of the empirical material I had to deal with has posed an analytical challenge. Although I believe that my explorative approach to my empirical field has contributed to an understanding of shapes and effects of CSOs' network alliances with Science Shops, I cannot ignore the fact of this analytical challenge, and I discuss and elaborate this aspect in section 3.5: *Opportunities and Impossibilities with the Empirical Material* in this chapter.

I have chosen to apply what Yin (2003: p. 47) calls multiple case studies in order to analyse network constructions between CSOs, Science Shops and scientists. Multiple case studies allow the analysis of parallel situations with the same phenomena, i.e. EEA constructions. Each Science Shop alliance is the subject of an individual case study, but the study as a whole covers several cases of Science Shops or Science-Shop-like alliances.

Which cases are included in my research as case studies, and how I have analysed them, both individually and together, follows in the next sub-section.

3.3.1 Identification of the Studied Science Shop Cases

Since the focal issues *air pollution* and *experiences with co-operation between CSOs, Science Shops and air pollution scientists* were defined from the beginning, the next step was to identify the experiences with air pollution issues which existed within the Science Shop network *Living Knowledge*.[21] One of my supervisors and I explored this by writing a message to the whole network (through the Living Knowledge email server) asking if they would be willing to share their experiences with co-operation around air pollution issues with me. Based on the responses from the Science Shops and similar groups affiliated with Living Knowledge Network, nine co-operations were identified between CSOs, Science Shops and scientists that originated in the Netherlands, USA and Denmark, and they all addressed air pollution issues. When selecting cases for multiple case studies, Yin (2003: p. 47) argues that it is important to ensure that each case serves a specific purpose within the overall aim of the research. For my cases, the nine identified cases represent my explorative journey into the study of how stabilization is reached and the effects of the networks. Yin (2003: p. 47) further argues that case selection should be made due to either

[21] Living Knowledge is an international network for Science Shops and similar groups (organizations that do not call themselves Science Shops, but whose work is similar to Science Shops). The aim of the Living Knowledge Network is to provide a platform for exchanging ideas, experiences etc. among Science Shops across national borders.

a wish to obtain similar results among the cases or a wish to obtain contrasting results. This correlates nicely with my research interest, which is to understand how CSOs, through alliance building and network constructions with Science Shops, engage with scientists in order to impact the air pollution agenda, and gaining such an understanding requires discovering similarities and differences across the case studies. My argument for including all nine case studies is that they each present a different perspective on how such EEAs are created and how they succeed or fail in affecting the problems experienced by the CSOs. For example, the roles assumed by the Science Shops involved in the Dutch cases differ – in the cases from the Science Shop for Chemistry at Groningen University, the Science Shop scientist himself carried out the research, whereas in the cases from the Science Shop for Biology at Utrecht University and the one case from the Science Shop for Economics at Groningen University, the Science Shop scientists assumed the role of mediator between the CSOs and the scientists affiliated with the departments. Before going into further discussion about the different perspectives each case brings to my understanding of how CSOs engage with Science Shops and scientists in order to impact air pollution issues, it is necessary to present the cases. The nine cases analysed are listed below.[22]

[22] Each case is named by both a case letter and a title. To ease reading, I refer sometimes to the case by its specific letter and in other contexts by its title.

Case studies	Requesting organization	Science Shop affiliated	University department affiliated
Case A: The parent group case	A parent group	Science Shop for Biology, Faculty of Science, Utrecht University, the Netherlands	A research group at the Department of Environmental Epidemiology, Utrecht University
Case B: The pesticide case	A local citizen group in the city of Zijpe	Science Shop for Biology, Faculty of Science, Utrecht University, the Netherlands	A research group at the Department of Biology, Utrecht University
Case C: The Scania case	A citizen group in Meppel and Bureau for Legal Aid	Science Shop for Chemistry, University of Groningen, the Netherlands	
Case D: The carpet factory case	A local citizen group in the city of Steenwijk	Science Shop for Chemistry, University of Groningen, the Netherlands	
Case E: The board game case	Friends of the Earth – Netherlands (Milieudefensie) in Amsterdam	Science Shop for Economics, Groningen University, the Netherlands	The Faculty of Economics, Department of Marketing, Groningen University
Case F: The bicycle apparatus case	The Dutch Cyclist Union, Fietsersbond	Science Shop for Biology, Faculty of Science, Utrecht University, the Netherlands	A research group at the Department of Environmental Epidemiology, Utrecht University
Case G: The stove case	A local resident's board in the village of Raadvad	Science Shop DTU, Technical University of Denmark, Denmark	Department of Environmental Engineering, Technical University of Denmark
Case H: The Mira Loma case	CCAEJ – A local environmental CSO	The Community Outreach Unit, The School of Medicine, University of Southern California, USA	The School of Medicine, University of Southern California
Case I: The guideline case	CCAEJ – A local environmental CSO	No Science Shop involved	No scientific institution directly involved

Figure 5: Overview of my cases and the involved CSOs, Science Shops and research institutions

My explorative journey to study stabilization and the effects of network alliances between CSOs, Science Shops and scientists started with the Dutch cases, then led to the one case from Denmark, and ended with the two cases from USA. The majority of the case studies originated in the Netherlands (six of the nine cases), and only one case originated in

Denmark. This may appear surprising, since I am Danish, but although we carefully examined all requests addressed to Science Shop DTU since it was established in 1985, neither my supervisor nor I were able to identify other projects that addressed air pollution issues than the one identified.

As argued above, the role of the Science Shops differs among the Dutch cases (from scientists carrying out the research to mediating between the CSOs and department affiliated scientists), but an additional argument for including several cases from the same Science Shops is that the Dutch cases also address different types of air pollution. For example, cases A and B from the Science Shop for Biology at Utrecht University illustrate two different types of air pollution problems; one connected with urban infrastructure and the other related to rural agricultural activities. Furthermore, one case succeeds in affecting the problem of the CSO (case A), whereas in case B, the network failed to affect the problem of the CSO. Thus, the argument for including these two cases is that they each bring different perspectives to my understanding of how such network alliances are created and which effects they cause. The third case from Science Shop for Biology at Utrecht University, case F, illustrates another type of problem such network alliances can be based upon, i.e. a CSO's need for assistance from Science Shops and scientists to develop physical artifacts. In this case, the CSO's concern was not with a problem that needed to be documented scientifically as in the other two cases from the Science Shop for Biology at Utrecht University. The two cases from the Science Shop for Chemistry at Groningen University represent a different Science Shop approach than the other Dutch cases, since the Science Shop in these two cases assumed the role of a scientist carrying out the research. But these cases also illustrate different project strategies despite the fact that they both were related to odour pollution from industrial activities. In one of the cases, the network succeeded in scientifically documenting the problem, whereas in the other case, it failed. Nevertheless, in both cases, the networks succeeded in affecting the problem experienced by the CSOs, but through different project strategies. Thus, my argument for including these two cases in the multiple case studies is that they each contribute to an understanding of how such networks succeed in causing effects to the problems of the CSOs. The case from the Science Shop for Economics from Groningen University brings forward yet another illustration of how such networks may be created as well the fatal consequences translations can have, if they do not respect the CSO's problem. In this case, the CSO needed a scientific investigation of the possibilities for transition within the aviation sector; the network ended up however with a board game that the CSO could not use. The Danish case differs from the other cases by illustrating a situation where the air pollution problem was caused by the residents themselves through their behaviour of using stoves as their single heat source. Finally, one of the cases from USA, case H, presents another type of Science Shop, i.e. a community outreach unit, that at first only intended to disseminate results to the CSO; however, as the co-operation progressed, the scientists became more and more involved with the CSO, and ended up forming a formal

partnership with the CSO. Case G is an effect of case H, and it differs from all the other cases by not involving Science Shops or scientists.

My multiple case studies further include examples of local citizens' battles to improve their local environment as well as their own health conditions (cases A-D and G-I in Figure 5). Furthermore, the case studies also include larger CSOs' battles for improving the environment by trying to impact national and international environmental agendas (cases E-F in Figure 5).

3.3.2 Preparing and Collecting the Empirical Material

Latour (2005) recommends that when identifying the actants in specific controversies the researcher has to follow the actants and trace their activities. Through this process, it is possible to obtain information about: 1) the types of actants that form and impact the development process; 2) the active and passive elements in the networks; and 3) how mobilization is achieved and which interessement devices[23] can be mobilized. I started my explorative search by being guided by the Science Shop representatives. Since all nine case studies occurred several years back, I encountered the restraint not being able to make direct observations in the field regarding the networks' battles, negotiations and agreements. Observations are however not the only method that can be used when exploring and seeking to understand, through the actants themselves, how alliances are built in order to tackle air pollution controversies. Latour (1996a) argues that it is possible to make ANT studies without conducting observations, since both literature (written material) and interviews can reveal such network relations as how actants were sought and enrolled or excluded from the network in order for it to reach stabilization and cause effects. The explorative approach I have chosen thus uses qualitative interviews as its empirical method. Qualitative interviews can be either fully open, allowing the interviewee to frame the interview themselves, or guided by the interviewer. I chose a semi-structured interview approach, since I wanted to be open to whatever the interviewees could tell me about their experiences with network relations, while I still wished to guide the interviews according to my focus on the network relations.

[23] Interessement devices can be strategies, technical devices etc. that aim to persuade actants into the network and at the same time block them from joining other networks.

3.3.2.1 Conducting the Interviews

Having decided on the empirical method of semi-structured interviews, the next decision involved how to conduct the interviews. Since all the Science Shop cases except Science Shop DTU were from the Netherlands and the United States, I had two choices: I could either conduct the interviews as telephone interviews, or I could make field trips to both the Netherlands and the United States. I chose a combination. All the interviews related to the Dutch cases were conducted through telephone interviews, while the interviews related to the two CCAEJ cases were carried out face to face on a field trip. Ideally, I should have conducted the Dutch cases as face-to-face interviews as well, but due to financial and time limitations, I had to settle on telephone interviews. The weakness of this approach is that I was not able to conduct interviews with all the requesting CSOs in the Netherlands. Although I made several attempts to contact them and even had the Science Shop representative from the Science Shop for Biology, Faculty of Science at Utrecht University try to contact the requesting CSOs, I did not succeed. It is impossible to say whether it would have been possible to conduct these interviews had I visited the communities, but my impression from discussions with the Dutch Science Shop representative is that these CSOs may not have responded due to language barriers, i.e. they did not feel comfortable enough with English to accept being interviewed.

With regard to the CCAEJ cases, I took a 14-day field trip to Los Angeles, USA to conduct all the interviews in person. The interviews with involved actors in the Science Shop DTU project were conducted by a colleague, since I had taken part in this project as Science Shop representative and as co-supervisor. Therefore, I found it more legitimate for someone else to make the interviews, since some of the involved parties could have been inhibited in their explanations about what happened in the co-operation, if I had been the interviewer.

3.3.2.2 Identification of Interviewees for the Science Shop Case Studies

I identified all my interviewees for the Science Shop case studies through the 'snowball' approach (Bijker, 1995), meaning that in the Science Shop cases, I started by interviewing the Science Shop representatives. At the end of these interviews, I asked which organizations or persons they would recommend me to talk to in order to gain further enlightenment about how the controversies were negotiated and stabilized, and which effects were caused by the networks. I continued to ask this question until no new actors were identified. Some of the interviewees also recommended that I talk to the involved company representatives or municipality representatives. This was not possible, however, since they either did not reply to my requests or could not be tracked down.

In one of the Dutch cases, the Science Shop representative specifically asked me not to contact any of the actors involved in the networks (case D), since they had been

interviewed and studied several times as part of other research projects. I accepted this restraint, since it was important to me to explore the field, given the empirical material available, rather than doing a specific in-depth study of this particular case. And in this case several analytical reports were available to support my understanding of this specific case.

In the CCAEJ cases, I identified most of the interviewees through reading project documents, scientific articles and governmental documents related to the cases. During the interviews, I also asked if the interviewee could recommend other interviewees

3.3.2.3 The Interview Guide

I designed an interview guide to suit my research questions in such a way that it could guide me in the interview situation and not restrain me. My aim in the interviews was to have the interviewees explain to me how they remembered the co-operation process. The general topics about which I was interested in gaining understanding were:

- Which organizations or persons had been involved in the co-operation
- How, why and by whom was project initiated
- The aim of the co-operation
- A description of the co-operation process
- The results and outcome of the project
- The impact and influence of the co-operation at the local, national and global level

The interview guide I developed and used when interviewing the Science Shop representatives, CSO representatives, and scientist and/or student representatives can be found in appendix III.

3.3.2.4 Empirical Material

All the interviews I conducted were recorded. The figure below presents the interviewees and the hours of interviews related to the empirical material for case studies.

Case studies	Interviewees	Hours of interviews
Case A: The parent group case	The Science Shop representative and the student + written material	2 hours
Case B: The pesticide case	The Science Shop representatives and the student + written material	3 hours
Case C: The Scania case	The Science Shop representative; the CSO representative and the representative from Bureau for Legal Aid + written material	4 hours
Case D: The carpet factory case	The Science Shop representative + written material	1 hour
Case E: The board game case	The Science Shop representative; the CSO representative; the scientist (supervisor) and the student + written material	5 hours
Case F: The bicycle apparatus case	The Science Shop representative and the student + written material	2 hours and 30 minutes
Case E: The stove case	The Science Shop representative; the CSO representative; the scientist (supervisor) and the student + written material	4 hours
Case H: The Mira Loma case and Case I: The guideline case	Representatives from CCAEJ; all relevant governmental institutions; USC researchers – in total 19 interviews were conducted + written material	29 hours

Figure 6: Overview of empirical material for my Science Shop case studies

Summing up, the nine cases represent both local and national air pollution issues; while the local issues primarily concerned locally experienced problems, the national were related more to capacity building within larger CSOs. Eight of the cases represent issues dealt with in the Netherlands and USA, and one case represents an issue dealt with in Denmark, where I myself was involved as Science Shop representative and co-supervisor for the student carrying out the project.

3.3.2.5 Transcription of Interviews

Transcriptions have been made of all the interviews conducted. During the first interviews I agreed with the interviewees that they would receive the transcription for approval, in order to give them the possibility to erase any comments they regretted having said. After the first six interviews, I decided to change this practice, because I experienced that the

interviewees started to correct grammar instead of relating to the content. Instead, I asked each of them if they could accept not seeing the transcription for approval, and they all agreed to this.

3.3.2.6 Other Information Sources

The semi-structured interviews have been my main source of information, but I have supplemented the information gathered through the semi-structured interviews with other sources, such as documents (reports, scientific and popular articles, folders etc.) and maps (showing the area in question or the air pollution density).

3.3.3 Validity and Reliability in the Collected Material

Collecting supplementary material in addition to the semi-structured interviews also had the purpose of establishing the validity and reliability of the information gathered through the interviews. Besides triangulation between the information gained through the interviews and the information obtained through written documents, I have tried to triangulate the information gained through one interviewee with the information gained through another interviewee involved in the same project. If views have differed on certain perspectives, my approach has been to take into account all perspectives, since I could not be the judge of what happened or did not happen (Yin, 2003).

Yin (2003: p. 35-39) also recommends creating a data study base and/or making a chain of evidence in order to obtain validity and reliability in the case study information. I have done this by discussing all information gathered with my two supervisors, and had one of them read some of the interview transcriptions.

3.4 Case Study Analysis

3.4.1 Analysis of the Individual Science Shop Case Studies

Yin (2003: p. 111-112) points out that when conducting multiple case studies, the research has to rely on theoretical propositions to lead the analysis. My theoretical proposition is as already mentioned, inspired by Callon's (1986a) sociology of translation analysis and Irwin & Michael's (2003) concept of EEAs. Thus, each of the stories that the cases present are described through moments of translations. The stories are based on the initial problem defined by one actor, how it was translated and which actions that were taken in order to construct and stabilize the network.

One of the points of criticism of ANT and Callon's translation analysis have been and are exposed to is that there is a tendency to favour the strong actors and oppress the marginalized actors. As discussed in chapter 2, section 2.4: *The Nature and State of Explanation in ANT*, this is a misunderstanding, since it is not up to the researcher to predefine the actant's role, but to explain how the actants themselves define their own and other actants roles. Having had this in mind when doing the case analysis, I believe that I have not fallen into the trap of only explaining the stories from the perspective of one strong actor.

3.4.2 Dimensions of Comparison in Multiple Case Studies

When doing multiple case studies, the researcher needs to identify an analytical technique to cross analyse the cases. Yin (2003: p. 116-118 & p. 133-137) points out several techniques from which the researcher can choose, depending on the purpose of the multiple case studies. The analytical technique I have chosen is cross-case synthesis, which implies that the researcher treats each case study as a separate study and then compares the cases in relation to different characteristics. My approach is that cases are cross analysed with respect to stability and effects in order to understand if, how and why the network alliances reached stabilization and caused effects. The dimensions for comparison are:

- The CSO's problem
- CSO type
- The CSO's agenda
- Science Shop approach

3.5 Opportunities and Impossibilities with the Empirical Material

I now turn to some reflections concerning my empirical material to discuss the opportunities and impossibilities facing me in the analytical phase. Having an explorative approach to my empirical field left me with a huge amount of inhomogeneous empirical material covering information on nine different network alliances of Science Shops or similar groups, involving five different Science Shops or Science-Shop-like organizations. In each of these cases, the Science Shops play different roles, such as mediators, scientists, supervisors etc. The empirical material also covers different air pollution issues, such as airborne pesticides, air pollution from traffic, air pollution from industry etc., and the different levels (local or national) at which the air pollution problem is addressed.

Since my interest in the empirical field has been to seek patterns and formations that indicate how stabilization is reached or is not reached when CSOs enter network alliances with Science Shops and scientists around air pollution issues, and which effects these

networks cause, I have allowed diversity in the material collected. To allow such diversity is intrinsic to the approaches I have used in order to engage with the empirical field.

Searching for empirical material has been an explorative journey right from the beginning, a journey I began by interviewing the Dutch Science Shop representatives in order to explore the network they were involved in. This first exploration was accomplished through telephone interviews. The choice of initiating my search through telephone interviews with the three Science Shop representatives was to give me an idea of their experiences with network alliances and discuss with them how to explore the network alliances further. These initial interviews opened up the field to me; however, in some of the cases, allowing the Science Shop representative to recommend which other actors I should approach also served as a restraint. In one case, the Science Shop representative specifically asked me not to approach the involved actors, since they had been involved in several research projects over the years. Instead, the Science Shop representative provided me with several research reports and articles that described and discussed the case. In the other Dutch cases, the Science Shop representatives recommended me to approach the involved actors by email and ask for a telephone interview. Since all the network alliances had been carried out several years previously, I realized that exploring these network alliances would require putting bits and pieces together, like a puzzle, and that field observations were not a possibility. So following the advices of the three Science Shop representatives, I approached the involved CSOs, scientists, students and local authorities by email, asking for a telephone interview. At this point in time, I had also begun the initial exploration of the experiences of CCAEJ, which opened up new possibilities for me to understand and search for stabilization patterns and formations. The initial talks with the chairperson from CCAEJ made me realize that if I wanted to explore their activities and how they entered into network alliances with scientists in their battles for cleaner air in their local communities, I had go to the field. Most of the local community members as well as some of the involved staff members spoke poor English, because they spoke as mother tongue Spanish, and I would therefore require an interpreter. Due to time limitations because of my teaching obligations and financial restrictions, I could only make field trips during summer vacation in 2007. With the recommendations of the Dutch Science Shop representatives in mind, I felt that I could gather more empirical material by doing a field study of the CCAEJ's activities and conducting the interviews with the involved Dutch actors by telephone.

Despite my reflections of how to conduct the interviews, I later found that I might have gained more insight about the Dutch network alliances if I had planned a field trip covering some of the Dutch cases as well. It turned out that in some of the cases (cases A, B and F) I did not manage to make contact with the involved CSOs, and in another case (case C), I did not manage to establish contact to the involved local authority or the industry. The failure in establishing contact to the later mentioned actors might not have been due

to the language barrier but due to the actors were no longer working in the company and as local authority officers. The failure to establish contact to the involved CSOs in cases A, B and F, however, could very well be ascribed to the language barrier. I discussed this with the involved Science Shop representative, and she tried to approach them herself without receiving any response. The fact that neither I nor the involved Science Shop representative succeeded in establishing contact to the CSOs indicates that even though I had been able to arrange for another field trip to study the Dutch cases, using an interpreter, this would most likely not have brought me closer to the CSOs.

All the case studies took place in the past, and it is impossible to observe past activities; however, through my work with the empirical material, I realized that the fact that I experienced the air pollution problems in Mira Loma myself and observed the huge amount of warehouses and trucks in that small community, I was able to relate more to the problems than those dealt with in the Dutch cases. Observing the problems with my own eyes, however, has not caused me to be less critical towards my empirical material, since I have strived to relate to the translations made by the actants in the network alliances.

Despite the huge diversity in the empirical material collected across the nine case studies from the interviews, interviewees and written material, I argue that the empirical material nevertheless allows me to seek patterns and formations of stabilization within the networks as well as the effects of the networks. This despite the fact that in some cases it has not been possible for the CSOs to speak for themselves. I believe that I have succeeded, however, in giving them a voice and traced their tracks through the literature and through other actors' descriptions. Regardless of the amount of empirical material for each case, I believe I have succeeded in drawing a picture of the chronology, results and effects of the network alliances.

CHAPTER 4: TRANSLATION ANALYSIS OF NETWORK ALLIANCES

This chapter presents individual analyses of the nine Science Shop or Science-Shop-like network alliances, EEAs, involving CSOs. Each of the stories that the cases represent reflects my explorative search for patterns and formations of stabilization and effects of these networks. The stories are described through moment of translations and are based on the initial problem as defined by the CSOs, how it was translated, and the actions taken in order to construct and stabilize the network.

My explorative search into the field of studying stabilization and effects of the networks starts with the Dutch cases and ends with two cases from USA. The case studies represent both stories of local citizens' battles to improve their local environment and their own health conditions (case A-D and G-I) as well as stories about larger CSOs' battles to improve the environment by trying to influence national and international environmental agendas (case E-F). In Chapter 5: *Cross Analysis of the Case Studies*, I discuss across the cases the issues addressed in the case studies together with the effects at the local or national levels.

The cases analysed in this chapter are:[24]

Case A: **The parent group case** (Science Shop for Biology, Utrecht University, NL – a local CSO) aiming at scientifically documenting that construction of a new school building would expose schoolchildren to air pollution from a nearby motorway. This documentation was to be used by a parent group to avoid construction of the school building close to a motorway.

Case B: **The pesticide case** (Science Shop for Biology, Utrecht University, NL – a local CSO) aiming at scientifically documenting that airborne pesticides used in bulb farming caused health risks to humans. This documentation was to be used by a local CSO to force the authorities to make regulations for the use of pesticides close to residential areas.

[24] **A note to the reader:** When there after a quotation is written for example [Science Shop representative], then it refers to what this person said in the interview. When refereeing to written material in the individual case studies I mark it as (Author, year).

Case C: **The Scania case** (Science Shop Chemistry, University of Groningen, NL- a local CSO) aiming at scientifically documenting that a local community would be exposed to odour pollution from a proposed factory. This documentation was to be used by a local citizen group to force authorities and Scania to set up mechanisms to avoid odour pollution.

Case D: **The carpet factory case** (Science Shop Chemistry, University of Groningen, NL – a local CSO) aiming at scientifically documenting that a local community was being exposed to odour pollution from two carpet factories. Originally the CSO were worried about not only odour but also toxicity from the carpet factories and exposure to water pollution, but these concerns were translated by the Science Shop into being a concern of odour pollution. This documentation was to be used by a local citizen group to force the authorities and carpet factories to set up mechanisms to avoid odour pollution.

Case E: **The board game** (Science Shop for Economics, University of Groningen, NL – a larger CSO) aiming to explore whether transition is possible in the aviation industry. This documentation was to be used by a nationwide CSO in a campaign to reduce the environmental impact from the aviation industry. The request of the CSO were translated by the Science Shop into being a question of developing a board game that should serve as a communication tool between the different actors involved in decisions concerning the aviation industry.

Case D: **The bicycle apparatus case** (Science Shop for Biology, Utrecht University, NL – a larger CSO) aiming to develop an apparatus a bicycle to measure both road quality and air pollution. Developing this apparatus was part of a nationwide CSO campaign to improve conditions cyclists.

Case F: **The stove case** (Science Shop DTU, Technical University of Denmark – a local CSO) aiming at scientifically documenting that particles from local stove use caused health risks to the local community. This documentation was to be used by a local resident's board to create awareness regarding the community's own stove use.

Case H: **The Mira Loma case** (The Community Outreach Unit, The School of Medicine, University of Southern California, USA – a local CSO) aiming at scientifically documenting that traffic- related pollution from truck driving and warehouse development caused health risks to a local community. This documentation was to be used by a local CSO to force the authorities to make regulations ensuring the community a healthy environment.

Case I: **The guideline case** (County and State authorities in Riverside and California, USA- a local CSO) aiming to develop guidelines for future warehouse development. The guidelines were to ensure healthy living conditions for residents living close to warehouses.

In the following, each of the nine cases are described and analysed individually through moment of translations (each analysis is between 10-15 pages, with the exception of case H, which is around 25 pages). The structure of the individual case studies follows Callon's (1986a) four moments of translations; i.e. problematization, interessement, enrolment and mobilization. The case descriptions also follow my wish to analyse how the initial problem was defined by the CSO, how the problem was translated by the Science Shop or scientists, and the actions taken in order to construct and stabilize the network. Each case concludes with discussions of the effects caused by the networks and reflections about relationships between the cases.

4.1 Case A: The Parent Group Case

- The story about stopping plans to locate a new school building close to a motorway

This is the story of an EEA created to support a local parent group's fight against the local authorities' and school board's plan to locate a new school building close to a motorway. By entering into an alliance with a Science Shop and succeeding in enrolling air pollution scientists, the CSO managed to create and stay enrolled in an EEA, which may have contributed to preventing the authorities and the local school board from constructing a new school building within 50 metres of a motorway.

An interesting aspect of this case is that even though the network succeeded in producing new data indicating a relation between children's health and exposure to emissions from motorways (which was the network's objective), the actors enrolled in the network felt the network had failed to cause any effects; it was not able to persuade the local authorities and members of the school board that there was a relationship between children's health and exposure to emissions from motorways. Nevertheless, the decision was made to reject constructing the new building close to the motorway. Another interesting aspect of this EEA and its effects is that it illustrates very clearly that network alliances can have effect and impact other network alliances, even when the network is not aware of its effect.

Problematization: Is children's health damaged due to particle exposure from motorway traffic?

According to the Science Shop representative involved in this case, which took place in 2005, there had been a rising concern among Dutch scientists and some politicians about the possible risks to human health from traffic emissions. A growing concern rose among parents about whether their children would be exposed to health risks if they were to attend a school only 50 metres from a motorway. Despite this concern, the city council and school board in Leiderdorp planned to construct an extension to an existing school in such a location.

The school

The motorway

Figure 7: The location of the existing school 'Brede School Oude Dorp' in Leiderdorp, little more than 100 metres from the A4 motorway (Picture: Google Earth)

A local parent group called 'Vereniging Weg van de Snelweg' (in English: Association 'Away from the motorway'), feared that their children would be exposed to health risks from emissions caused by traffic on the motorway, if the proposed new school building was constructed. The parent group found support for their concerns in findings from a project carried out by a research group at Department of Environmental Epidemiology at Utrecht University 8 years earlier (Brunekreef et al., 1997), which explored health risks to children living and going to school near motorways. Since the research results dated back to 1997, however, the parent group felt they needed new scientific evidence with which to confront the city council, which was reluctant to accept arguments about health risks to children if the school should expand to buildings so close to the motorway.[25]

The question for the parent group was now, how to gain new and updated scientific results that would support their concern about their children's potential exposure to air pollution emissions if the extension of the school building were to be constructed within 50 metres from the motorway. The parent group decided to approach the research group at Department of Environmental Epidemiology at Utrecht University, where the research

[25] This story is based on interviews with the Science Shop representative and one of the master students conducting the research and several written reports and articles. It has not been possible to establish contact with the representative from the parent group, even though both I, the Science Shop representative and the student interviewed tried several times. According to the student, this representative was very active and engaged, and she did not understand why none of us received answers to our mails and phone calls. Nor did I succeed in establishing contact to the student's supervisor. According to the student, this could be because he had just become a professor when I approached him, and therefore may not have had time to reply to my requests.

had been conducted 8 years earlier. The research group first rejected the parent group's idea of a new survey, but they recommended that the parent group approach the Science Shop for Biology at Utrecht University:

> *"Go to the Science Shop and they will consider your question and is it something that's worth research, we will carry it out, but only through intermediate action of the Science Shop"* [Science Shop representative].[26]

The research group thus introduced a new and unknown actor, which also can be seen as an obligatory passage point (OPP), since the parent group was obliged to engage the Science Shop's interest so that it could be enrolled in their network, in order to gain the support of the research group. The research group's emphasis on the Science Shop's involvement in the network was due to the role it plays in interaction and network alliances with CSOs and scientists; the Science Shop is responsible for making the research proposal and all communication and co-ordination with the involved CSO throughout the whole project period. Thus, for the scientists, involving the Science Shop meant that they could assume the role of scientists carrying out the research, without having to negotiate or explain the research to the CSO, since the Science Shop would assume this role.

This meant that the road toward creating a network with this research group was blocked, unless the parent group succeeded in persuading the Science Shop to assume the role of spokesman for the network. When the parent group approached the Science Shop for Biology with their need for more scientific evidence about the relationship between emissions from motorways and the risks to their children's health, the Science Shop for Biology had already received several requests from different CSOs concerning this issue. Therefore, due to this increasing concern in society, they decided to meet all the requests through one comprehensive research project with the obligatory passage point framed as *new research data on relationship between motorway emissions and children's health*. By framing the obligatory passage point around the health impact on children living or attending school close to motorways in general terms, the Science Shop representative translated the parent group's request from the specific school in Leiderdorp to a more general research theme. The parent group accepted this, because the Science Shop representative was able to make a correlation of the translation that made it clear that this would be the only way the parent group could solve their obstacle problem: *lack of scientific evidence showing that children would be exposed to health risks if school building is built 50 metres from the motorway*. Through this framing, the Science Shop representative also made herself indispensable to the parent group and to continuation of the network alliance.

[26] When using quotations from interviewees, I use their own words; however, in some instances I have corrected grammatical errors in order to make the meaning clear and understandable for the reader. When such brackets [….] are used, the reference refers to specific interviewees.

Figure 8: Housing close to motorways[27] (Picture: my own)

The Science Shop representative understood, however, that she needed to persuade the research group from the Department of Environmental Epidemiology to accept the obligatory passage point, if she were to succeed in creating this network, since the Science Shop for Biology do not carry out research themselves. Since the research group had conducted a similar project 8 years earlier, they saw this alliance as a means to obtain new data that they could compare to their earlier study. Therefore, the Science Shop representative was easily able to persuade the research group to participate in the network and accept the obligatory passage point. Since the research group was interested in the network in order to obtain new and updated data, the study would have to be comparable to their previous study; therefore, the focus was broadened to also include children living close to motorways. Despite this translation, which expands the focus to include children both attending school and living close to motorways, the obligatory passage point was not re-framed; it remained: *new research data on relationship between motorway emissions and children's health.*

By framing the obligatory passage point in this way, the network assumed that the health risks the children would be exposed to would be caused by particles from cars and trucks driving on the motorway. Also, the network assumed that the particles, cars and trucks would behave in a certain manner that would make it possible to capture, observe and register their behaviour; and that it would be possible through the data thus collected to determine whether or not there was any impact on human lung functions (in the previous research carried out, impact on human lung functions had been in focus). If the particles,

[27] This picture was taken close to the village of Mira Loma in the outskirts of Los Angeles, and therefore does not illustrate the specific area of the case; I include this picture here, however, to illustrate housing close to motorways.

cars and/or trucks behaved differently than assumed, the network would face severe difficulties in upholding the obligatory passage point. This assumption meant that the network black-boxed the behaviour of particles, cars and trucks without considering whether or not it would be possible to capture or register the particles, cars and trucks.

At this moment of translation, the Science Shop representative intentionally chose not to interest either the city council or the municipality's school board in the network. At this point in time, these two actors were not seen as necessary for the network to succeed in upholding the obligatory passage point.

This first alliance can be visualized as illustrated below. Since the behaviour of the particles, cars and trucks was black-boxed by the network, and the city council and the school board were not made interested in the network, the alliance consisted of only the Science Shop representative, the parent group, and the research group. The figure illustrates the obligatory passage point; i.e. facts that the three actors wanted to uphold in order to overcome each of their obstacle problems and finally achieve their goal.

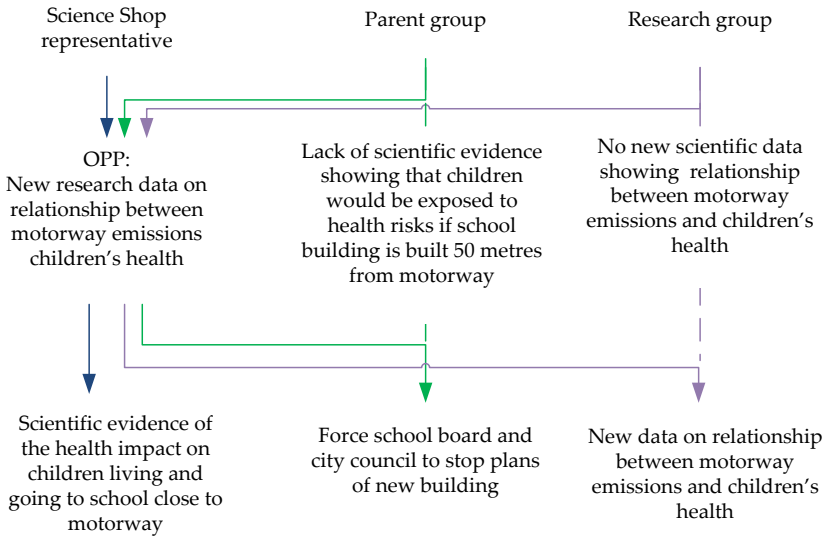


Figure 9: First alliances made – framing the obligatory passage point

As illustrated in the figure above, the goal of the Science Shop and the scientists is different from the goal of the CSO – for the scientists and the Science Shop it is a question of upholding new scientific data, whereas for the CSO this new scientific data serves as the means to force the school board and the city council to stop the plans for constructing the new school building. The question that arises from this is whether the actors' different goals and motives for being persuaded to join the network contributed to or jeopardized stabilization of the network, and at the end, which consequences this may have had for the effects caused by the network.

Requests made through the Science Shop of Biology are not researched by the Science Shop staff but by students. So the next step for the Science Shop representative was to persuade students to join the network for the purpose of conducting the research.

Interessement: Persuading other actants to accept the obligatory passage point
The Science Shop representative launched the project framed around the obligatory point in the local university paper and on the Science Shop website, which was standard procedure for new Science Shop projects. Both the local university paper and the website were used as what Callon (1986a) terms 'interessement devices' to interest students. Two master students responded; they were interested in doing the research as their master thesis. The two students became interested in the network through the interessement device because the project provided the opportunity to do research for the benefit of society. Since this was important to the students, they were relatively easily persuaded to join the network and accept the role of conducting research framed around the obligatory passage point.

> *"We decided to do such research. Yeah, finding out if there are clear effects of the air pollution on children who are living near to the main roads"* [One of the student researchers].

Once the students had accepted the obligatory passage point, the research design and data collection could begin. The research was designed through negotiations between the research group and the students. The research group wanted to ensure that the results of the research would be comparable with the results from their earlier research project. Therefore, the research was designed to:

> *"[…] test the hypothesis that exposure to exhaust from traffic related to childhood respiratory health"* (Graveland & Rensen, 2005a: Report Abstract).

Yet another translation emerges here, a translation which re-frames the obligatory passage point to be *the relationship between traffic related air pollution and respiratory health in Dutch schoolchildren*. The intention of re-framing the obligatory passage point was to make the research comparable with the research results from the research conducted 8 years earlier, where focus had been on children's respiratory health and not health in general. All interested actants up to this moment accepted this translation, because the research group was able to correlate the translation with the original problem of the parent group. Furthermore, it was the research conducted 8 years earlier that had motivated the parent group to establish contact with the research group and the Science Shop representative. Despite this re-framing of the obligatory passage point, and the fact that it took place before the research started, some sort of stabilization within the network and among the actants interested up to this moment was reached; all interested actants agreed on the actions to be taken.

To test the hypothesis, the network needed to interest three new actants into joining the network: the schools where sampling was to take place, parents, and schoolchildren. The two students contacted nine schools. Some had already participated in the earlier research project and others were new. All nine schools accepted voluntarily to take part in the sampling. The schools were not informed that the research was being carried out due to the needs of the parent group but only that the research project was being carried out in co-operation between the Department of Environmental Epidemiology and the Science Shop of Biology at Utrecht University. The Science Shop representative explained the motive for this:

> *"To act as independently as possible, the parent group was not involved further in the research; we just carried it out through our own, well, scientific standards"* [Science Shop representative].

The Science Shop representative, the research group and the two students persuaded the schools to join the network by using the interessement device of independent research, and they succeeded. The intention was not to enrol the schools in the network or have them work for the stabilization of the network; rather, it was they should allow the students to take samples, both at the schools and from the children, since this was essential for the process of successfully upholding the obligatory passage point.

The parents and schoolchildren were informed about the research through the schools. As was the case with the particles, cars and trucks, it seems that the network black-boxed the behaviour of the parents and the schoolchildren. It was assumed that the schools had control over the parents and schoolchildren and that they would accept and behave as the school asked them to (i.e. allow samples to be taken both at the school and from the children through lung samples). Due to this assumption, no initial contact was taken to the parents or schoolchildren. Had the parents or schoolchildren refused to participate in the network, it would have had fatal consequences for the students' success in upholding the obligatory passage point. However, the parents and schoolchildren behaved in accordance with the role attributed to them by the network.

The framing of the obligatory passage point included another assumption made by the network: the assumption that it would be possible to measure the existence of the particles in the children's lungs. This behaviour of the children's lungs was also black-boxed by the network, since the network and especially the scientists did not consider whether it would be possible or not to capture and measure particles in the lungs of the schoolchildren. The network simply assumed that this could be measured, meaning it was taken-for-granted.

Once the schools had accepted their role, the students could begin taking samples at the nine elementary schools, all situated close to motorways (within 400 metres) in the provinces of North Holland, South Holland and Brabant (Graveland & Rensen, 2005b).

Over 100 children participated with breathing samples, and air particle samples were taken in the school area. The samples were analysed to find any indications of lung infection. Data related to respiratory symptoms were collected through questionnaires filled out by parents of children living within 1000 metres of a motorway. The students also analysed exhaled nitric oxide, and indoor air samples were analysed for air pollutants. Lastly, exposure to traffic-related air pollution was assessed by using specific traffic-related characteristics (individual car and truck traffic counts, and distance from homes and schools to motorway). These data were compared with data on intensity and type of traffic on the motorway situated close to the schools and houses in order to find any relationship between traffic density and lung effects (Graveland & Resen, 2005b; Graveland et al., 2007).

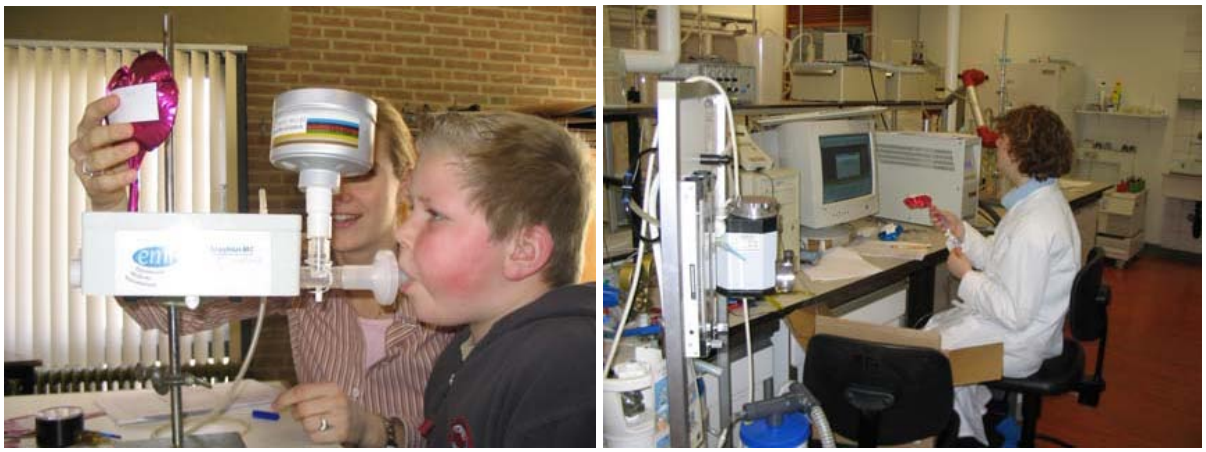


Figure 10: NO measurement of exhaled air (picture to the left) and analysis of NO (picture to the right) (Graveland & Rensen, 2005b: p. 18)

While the research was taking place, the parent group (the CSO) acted as an invisible partner in the network – which did not mean that they were not enrolled in the network. Almost the opposite was true. The parent group understood that the research had to be independent of their involvement; otherwise, they would not be able to claim that the results were independent when presenting them to politicians and the school board. Since the city council had launched their plans for constructing the new school building, the parent group had been involved in heavy discussions with the school board and the city council; therefore, the parent group realized that to strengthen their fight against the municipality's school board and the city council, the research results needed to be legitimate and without their influence. Since their involvement would give the city council an opportunity to say that the research was not objective, the parent group accepted their invisible role until the results of the research were published. Furthermore, the parent group feared that the specific school ('School Oude Dorp' in Leiderdorp) in question would refuse to participate if they learned that the parent group was involved in the

research, because the municipality's school board was very eager to get started on the construction of the new building.

The actants interested in the network up to this moment, before the results of the research were published, can be visualized as illustrated below. Note that the particles, cars, trucks, and the children's and parents' behaviour is still being black-boxed. These actants have not resisted behaving according to the network's assumptions about their behaviour. Therefore, the network has only been extended with one actant, i.e. the schools at this moment of translation.

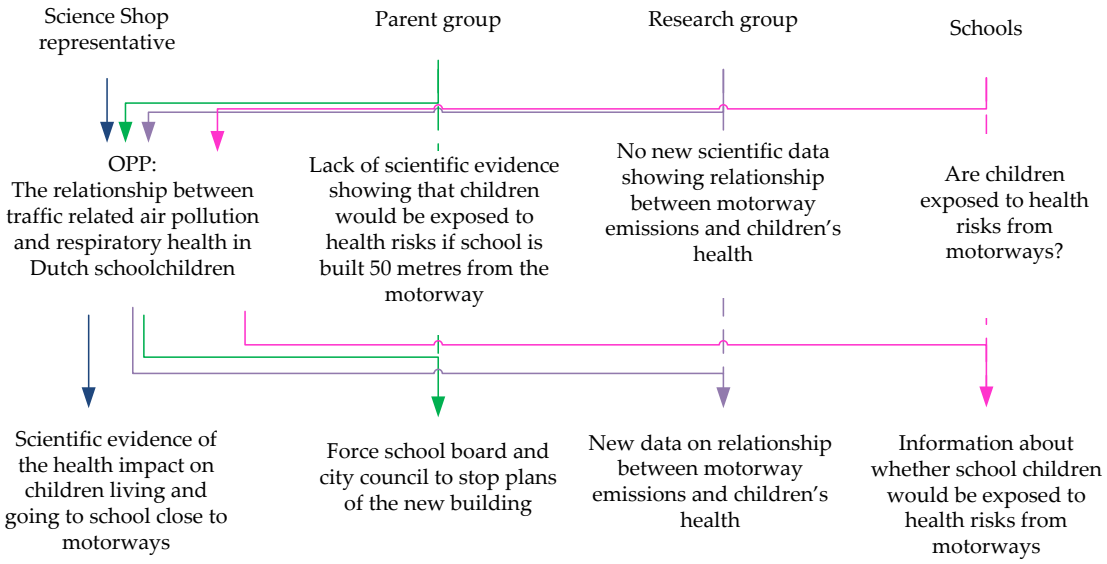


Figure 11: Illustration of problematization and obligatory passage point at the interessement moment of translation

The results of the research confirmed the hypothesis tested by the network, as the students explained in their report:

> *"Respiratory symptoms were increased in children that live near motorways with high truck traffic counts; especially when mean weighted Odds Ratios were calculated by combining data from other similar Dutch studies. Nitric oxide values were higher in children with respiratory symptoms as compared to children without respiratory symptoms. Near motorways with high car and truck counts, exhaled nitric oxide levels were higher. The results of this study demonstrate that high truck traffic counts, in particular, are related to children's respiratory health. Children attending schools near motorways with high traffic counts experienced more respiratory health problems and showed higher exhaled nitric oxide values than children attending schools near motorways with low traffic counts"* (Graveland & Rensen, 2005: Report abstract).

With these new results, it was confirmed that children living and attending school close to motorways with much heavy traffic were exposed to health risks; thus, the research supported the parent group's concerns and contributed to stabilization within the network. This also meant that the particles, cars, trucks, and the parents and schoolchildren, and their lungs, behaved as the network had assumed.

Enrolment: Did the actants accept and play the roles they were assigned?
As the story has shown until now, many actants were persuaded to be interested in the attributed behaviours favouring the network, but this does not enlighten us about how actants were enrolled in the network and how they were kept in the network. Once the results of the research indicated that the obligatory passage point was successfully upheld, the next step for the network was to seek to persuade the local authorities and the school board not to construct the new school building at the planned location.

When the results of the research became available, the students made a brief summary of the results and, together with the research group and the Science Shop representative, and they invited the parent group to a meeting to explain the findings of the research and impact in relation to their children. In this way, the students wanted to ensure that the parent group understood the results; they used this meeting as an interessement device to try to keep the parent group enrolled in the network. The parent group was happy with the results, because they confirmed their concerns, and publication of the results in a scientific report provided the opportunity to substantiate these concerns. The parent group wished to organize a meeting with the school board and the city council to discuss the results, but they feared that the school board and the city council would reject their invitation or the results if the parents group presented them. To support the parent group, the Science Shop representative and the research group decided to issue a press release presenting the results of the research. The press release worked as an interessement device in relation to the school board and the city council, with the aim of having them accept the results and agree that the results indicated that children would be exposed to health risks if the school board continued their plans to build close to the motorway. The Science Shop representative explained their motives for the press release:

> *"Although we knew that it was not quite new scientific information, it was of such an importance because of all the discussions going on"* [Science Shop representative].

The parent group also persuaded the local newspaper to print an article presenting the results of the research, as well as pictures of some of the children blowing air into a measuring device.

As soon as the press release from the Science Shop and the research group were published, the city council in Leiderdorp reacted defensively towards the results, arguing that they did not believe that the results were objective. The city council did not have the expertise

to make judgements about the research methodology and results, however, so they hired a consultant to evaluate the results and method of the research project. The consultant answered that it was only students that carried out the research, that the methods applied were not applied appropriately, and that the conclusion could not be made on the basis of the samples taken. With this argument, the consultant tried to open what up to this moment had been black-boxed, the methodology of the research. The consultant recommended that the city council forgot about the research and its conclusions. This argumentation persuaded the professor in the research group to enter the debate. This professor, a well-known expert in air pollution in the Netherlands, had carefully examined the conclusions in the students' report, because he knew the results would create debate. After the consultant's response to the city council, he wrote a letter explaining the method and stating that it was scientifically sound and used in USA as well.

Despite the professor's attempt to persuade the city council to enrol in the network, the city council refused and chose to believe the consultant, thereby challenging the stabilization of the network.

The professor's reaction to the consultant's insinuations about the research's lack of scientific credibility showed that the professor and the research group were enrolled in the network. They had sound scientific evidence of the relationship between children's health and the exposure from motorways, and they were willing to fight for it in public. The parent group and the Science Shop representative were also fully enrolled in the network and were trying to persuade both the city council and the school board to enrol in the network by arguing for the research results.

Mobilization: Speaking on behalf of others?

Upholding the obligatory passage point does indicate that stabilization within the network was achieved. This did not however at first help the parent group persuade the school board or the city council to change the plans to build next to the motorway. Now a dilemma raised concerning the actors different goals, since changing the city council and school board plans for the location of the proposed school building was not a criterion for success for the network as a whole but the goal for the parent group, whereas the research group's goal was solved by upholding the obligatory passage point and thereby gaining more scientific facts about *the relationship between traffic related air pollution and respiratory health in Dutch schoolchildren*. The research group's intention in entering the network was a scientific interest in the issue and not a wish to enter discussions about the locality of the new school building. Due to this translation made by both the research group and the Science Shop representative, who guaranteed objectivity, the network did not strive to mobilize the decision makers further than what was sought through the press release.

The parent group did succeed, however, in bringing the local media into the controversy to explain the story from their side. This indicates that the media accepted that the parent group was speaking on behalf of all children living and attending school near motorways and that the results were of local relevance.

According to the Science Shop representative and Leiderdorp (2008), the school building was not constructed. Whether the decision not to construct the school building at the proposed location was due to the activities of the network or other circumstances was unknown to the interviewed actors. However, by following the discussions the Leiderdorp municipality website (Leiderdorp, 2008), it becomes clear that there is an ongoing discussion (however with no reference to this specific research) concerning the whole school system, its strategy and location in the municipality.

Epilogue: Effects of the network alliance

This story is an example of an EEA in which the actants enrolled into the EEA succeeded in upholding the obligatory passage point and thereby obtained scientific evidence of the health risks children are exposed to if they live or attend school close to motorways. The success in upholding the obligatory passage point and the actions taken by the professor when the city council's consultant claimed that the results could not be trusted are indications that the network achieved some sort of stabilization. This story also illustrates how difficult it is to trace effects back to specific network alliances. The fact that the school building was never constructed (Leiderdorp, 2008) may be due to the network's activities, even though the network did not succeed in enrolling either the school board or the city council in the network.

Returning to the discussion I started in chapter 2, *section 3: ANT as Inspiration for Studying Science-Society Relations – as Network Constructions*, about whether stabilization of networks equals effects, this case illustrates that stabilization of networks does not necessarily equal effects on the original problem of the CSO. The case illustrates further that stabilization is never a fixed state; on the contrary, stabilization is continuously being challenged by other networks. Publication of the research results contributed to stabilizing the actants within the network, since the obligatory passage point was successfully upheld. However, the results were contested by another network that tried to persuade the actants that these results did not reflect the truth and thereby could not be claimed as scientific facts.

The subject of stabilization in EEAs, such as those created between CSOs, Science Shops and scientists, brings up another issue that needs to be discussed: the background and motives for actors to be enrolled in networks. In this case, the parent group was fighting for their children's health, while the research group and the Science Shop representative had a scientific interest in exploring the relationship between emissions from traffic and children's health. When this scientific interest had been explored and the research group

had obtained the scientific evidence they sought and defended their scientific credibility, they no longer had any motive to remain in the network, whereas the parent group remained to continue the fight with the city council. This complex situation reflects a situation where building network alliances is based on obtaining scientific evidence concerning a specific issue and not on a wish to cause direct effects to the issue as it is experienced in a local setting. It also indicates that it is maybe only relevant to discuss stabilization within such EEAs in relation to knowledge production processes. As soon as the networks have obtained knowledge about a scientific claim, some actors seem to perceive their role to be finished, and other actors are needed to bring the scientific claim into local political discussions.

In concluding this case, I return to the discussion about effects. In this case, the city council finally decided not to construct the school at the proposed location. It is not possible to conclude whether this decision was impacted by the activities of the network or not. On the other hand, it cannot be concluded that the network did not have an impact on the school board and city council decision. The network alliance did however affect the scientific community, since the research group achieved new and updated data about the relationship between emissions from traffic and children's health, data that has been published in several articles and reports, such as Graveland & Rensen (2005b), Graveland & Brunekreef (2006) and Graveland et al. (2007).

The next case (case B) is from the same Science Shop (Science Shop for Biology at Utrecht University), and this case illustrates another type of problem, i.e. air pollution from using pesticides in agricultural production. Case A illustrates a local CSO's battle against local authorities; however, in case B, the battle involves local farmers. Another difference between the two cases is also that in case A the problem experienced by the CSO can be connected to a specific decision made by the city council, whereas in case B the problem experienced by the CSO is related to pollution from daily farming activities.

4.2 Case B: The Pesticide Case

- The story about uncertainties concerning whether the Dutch brand, bulbs, affects human health

This story is about an EEA created around a local citizen group in the city of Zijpe fighting against local bulb farmers and the local authorities – a battle about whether or not pesticides used in blub farming travel into the lungs of citizens through the air. The citizen group succeeded in persuading several actors, such as a group of scientists and a Science Shop representative, into a network striving to obtain knowledge about the transportation of airborne pesticides. Despite the network's attempts to achieve and produce solid claims concerning airborne pesticides, they failed; the pesticides simply did not show up where they were expected to.

Of particular interest with regard to this EEA is that the local citizen group's concern made scientists aware of a research field that had not previously been thoroughly researched. Some initial research had been carried out in USA, but in the Netherlands, scientists had not explored the relationship between airborne pesticides and human health. This seems even more remarkable when we realize that the network did not succeed in raising funds to allow more research into the issue. The absence of the pesticides in the samples taken and arguments about other pollution sources destabilized the network and caused it to remain unstable.

Problematization: Are airborne pesticides a health risk to humans?
A local citizen group from the city of Zijpe, a rural city situated in the northern region of the Netherlands, had since 1998 tried to debate environmental issues, such as pesticide use in bulb farming and traffic pollution in their local community, with their local politicians and the community at large (Hogenkamp, 2002). Prior to 2002, when the network alliance was initiated, bulb farming had increased considerably in the area and as a consequence, farmers had intensified use of pesticides. The citizen group feared that this intensification of pesticide use caused a health risk to the community, since the bulb fields were located close to residential homes (Hogenkamp et al., 2004).

Figure 12: The city of Zijpe surrounded by fields (Picture: Google Earth)

In 2000, prior to the initiation of this network, the citizen group had tried to raise concerns about the health risks from airborne pesticides by entering a network alliance with the Science Shop for Biology, with the aim of conducting a literature study. Through the literature study, this network alliance found that more information was needed to explore the relationship between airborne pesticides and health risk to humans (Wietse, 2000). Given this recommendation, the citizen group had sought to address the issue with local politicians, but they refused to enter into dialogue, since the citizen group could present no scientific evidence indicating that the community's health was in danger due to airborne pesticides. Therefore, the local citizen group needed scientific evidence to support their suspicions that airborne pesticides indeed caused health risks to the community.[28]

To obtain the scientific evidence they needed, the local citizen group approached the Science Shop for Biology at Utrecht University once more. Back in 2000 the citizen group spokesman had become acquainted with the Science Shop through the internet, while he was searching for information about pesticide risk for humans. Since the literature study conducted prior to this, had left the scientists with many uncertainties with regard to

[28] This analysis is based on interviews with the Science Shop representative and the student conducting the research for the local citizen group, as well as written material such as scientific reports and articles. It has not been possible to establish contact with either the local citizen group spokesman or the student's supervisor, although many attempts have been made.

understanding the relationship between airborne pesticides and effects on human health, both the Science Shop representative and the scientists had become interested in exploring this in more detail. So when the citizen group approached the Science Shop representative again, she was easily persuaded to accept the request.

The knowledge the Science Shop representative and the citizen group spokesperson wanted to obtain comprised the obligatory passage point, which was to collect *evidence showing whether airborne pesticides cause health risks to humans in the vicinity*. By framing the obligatory passage point in this way and making it possible for the citizen group to receive an answer to their obstacle problem, the Science Shop representative became somehow indispensable to the citizen group. Without successfully passing through the Science Shop, the citizen group could not solve their obstacle problem of obtaining evidence of the health risk to which their community was exposed. The interests and motives of the two actors were different; the Science Shop representative wanted to gain more scientific evidence about the impact on humans from airborne pesticides, while the spokesman from the citizen group wanted to obtain scientific evidence of the threat to which he was convinced his community was exposed, due to the bulb farms located close to the city of Zijpe. By framing the obligatory passage point in this way, the network assumed that pesticides would behave in a certain way, i.e. that they were airborne – they were to be found in the air and they would settle on the ground – and this behaviour would make it possible for the network to capture and measure the pesticides. This assumption indicates that the network assumed the pesticides' behaviour to be predictable and unproblematic for the network, which in Callon and ANT terms means that pesticide behaviour was black-boxed by the network. Several elements would influence the behaviour of the pesticides, however: the wind could blow them far from where they were used; people and plants could carry them with them when leaving the field; and gravitation would tend to draw them to the ground. If this black-boxing of pesticide behaviour should prove to be mistaken, this would cause destabilization of the network.

This alliance can be visualized as illustrated below. It is worth noting that by black-boxing the pesticide behaviour, the only actors interested in this moment of translation are the Science Shop representative and the citizen group spokesman. The figure illustrates the obligatory passage point; i.e. the facts the two actors wanted to uphold in order to overcome each of their obstacle problems and finally achieve their goal.

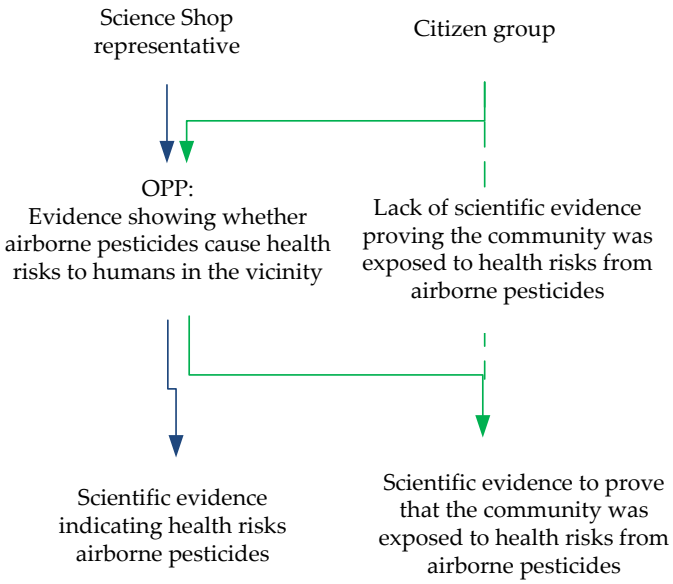


Figure 13: First alliances made – framing the obligatory passage point

As shown in the figure above and described earlier, the Science Shop representative framed the obligatory passage point in such a way that it complied completely with the citizen group's obstacle problem. In this way, the Science Shop representative succeeded in interesting the citizen group to enter the network without having to persuade them or motivate them further.

Requests to the Science Shop are not researched by the Science Shop staff themselves, but by students and interested scientists at the university. So the next step for the Science Shop representative was to draw on the alliance she already had with the research group that supervised the literature study on health risks of airborne pesticides. Through the literature study, the research group supervising the research had learned that this specific scientific area was not well researched and therefore very little data existed. So when the Science Shop representative approached the research group with this request and the framed problem, the research group was very keen to be involved.

Interessement: Persuading other actants to accept the obligatory passage point
In order to obtain more scientific knowledge about health risks from airborne pesticides, the research group was willing to do a small pilot project, taking a few samples in households in and near the city. A larger project would not be possible because it would be very costly. Also, the research group argued, they could only become involved in a larger project, if they found evidence of a connection between airborne pesticides and health risks.

After making an alliance with the research group, the Science Shop representative launched the project in the local university paper and on their website. The research group

was persuaded by the argument for the obligatory passage point framed by the Science Shop representative, but they did require that a student be found to conduct the research, because they had no researcher available.

A master student responded on the request from the Science Shop. She needed an internship for her Master in Biology, since it was mandatory to do practical work for one year. She had already worked for one-half year with the Department of Biology, and wanted to study something completely different the last half-year. What appealed to her in the request from the Science Shop was that the research was framed in a way that would give her freedom to design the project according to her interests. This openness in the research question, which showed to be an interessement device, affected the student's decision to choose to be involved in the network around the obligatory passage point. Contact between the student and the research group was established by the Science Shop representative. This alliance between the student, the research group and the Science Shop representative was the last step that was initially necessary before the network could start its activities. Other networks and alliances would be needed later, when the research gave results, but at this point in time, the citizen group spokesman acted within the interests of the network, and since the sampling had not be initiated the pesticides could not contest the role assigned to them.

The student had only half a year to conduct the research, which meant that the actors in the network had to narrow the focus of the project. Instead of focusing on the potential risks to the community of being exposed to pesticides from bulb farming, she and the research group decided that she should focus on whether pesticides were to be found in the homes of some people living in the community. This choice meant that the perspective of the research was narrower than the citizen group had hoped, but they accepted the research design. Although it would not state the specific health risk, it would still provide scientific evidence about how far the pesticides were borne by the air. The student described the controversies like this:

> *"Well, we had some discussions as to how the research would be set up and well, ok, the spokesman for this group, he was very, how do you say that […] outgoing , I think the word is. Ok, if you would ask that man a question, he would probably give you an answer over 10 minutes in a very load voice. So we [the Science Shop representative, the student and the research group, ed.] explained to him what we were going to do and well sometimes he would be focused on getting the answers he wanted so much, that it would take some time to explain to him, that if you would do this in a scientific way, so objectively as possible, then certain things were just not going to happen, because you can't just sample at one site and then decide well there is another pesticide here, so that must mean you have samples from many sites - there is a difference [...]. But eventually he agreed that we were taking the right direction"* [Student researcher].

The alliances and the network can now be illustrated like this:

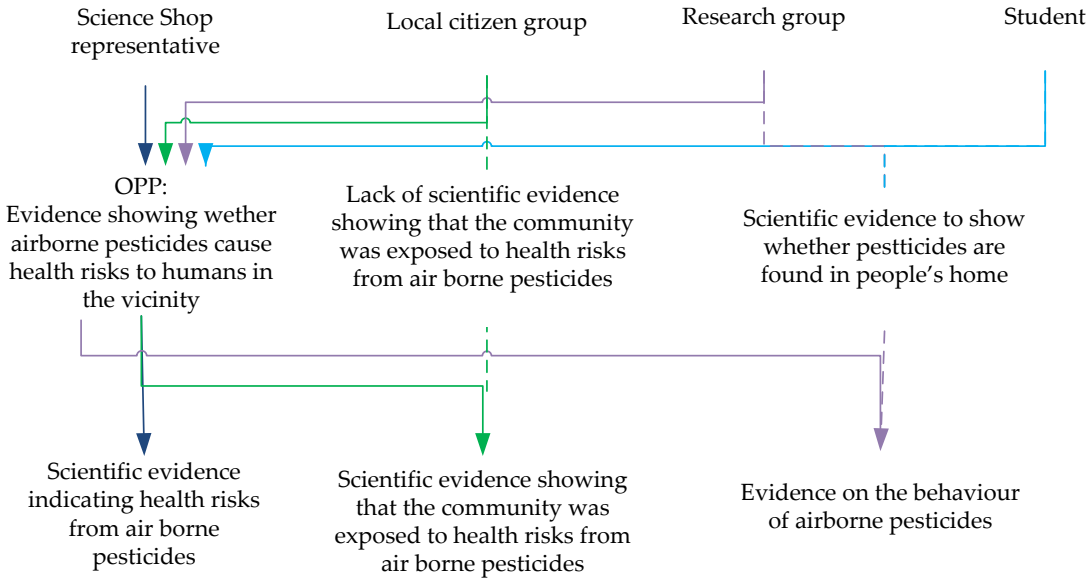


Figure 14: Illustration of problematization and obligatory passage point at the interessement moment of translation

The obligatory passage point was not changed, even though the obstacle problem of the student and the research group had another focus than the framed and agreed obligatory passage point. It could then be asked: how can this lead to the achievement of their different goals? The research group still wanted to commit to the network and uphold the obligatory passage point, because this framing still comprised what they wanted knowledge about, but a student project could not answer this in depth. They hoped that through the student project they would be able to analyse and arrive at conclusions about whether airborne pesticides did cause health risks to humans.

During this moment of translation, the research group and the student managed to translate the wished outcome of both the Science Shop representative and the citizen group spokesman. The translation was made by moving the focus from whether or not the community was exposed to health risks from airborne pesticides, to a focus on whether pesticides were to be found in homes in the vicinity of the bulb farms. The citizen group spokesman accepted this translation, because the research group and the student were able to persuade him that scientific evidence about how far the pesticides were borne by the air would be the first step in determining if they caused health risks to the community.

Enrolment: Did the actants accept and play the roles they were assigned?
Up to this moment in time, the Science Shop representative had created an alliance between the citizen group, a research group, a student – and partly the pesticides, since their behaviour had been black-boxed. This meant that the network around the obligatory

passage point had started to take form. The Science Shop representative did realize however that it would not be possible for the student to take samples in the community unless the community and the bulb farmers were somehow involved and accepted the research.

Due to the local citizen group's commitment and eagerness to prove that the bulb farmers' use of pesticides was unhealthy for the community, the community was divided; some supported the citizen group, and others sided with the bulb farmers, saying that the use of pesticides did not cause any problems for the community. The two standpoints were often discussed in the local newspaper, so the Science Shop representative understood that when announcing the research to the community, it would be important to point out that this was scientific, objective research, taking no sides with any group in the community. Again 'science' and 'objectivity' were used as an interessement device to persuade other actors to accept the role the network had assigned them.

The student and the Science Shop representative approached the farmers and citizens in the community by writing a letter to them (see Figure 15) to explain the objectives of the research and specifying that this was university research. The Science Shop representative explained it as follows:

> *"In the letter to the farmers and inhabitants, it was mentioned that the research was performed by the university and we didn't mention the citizen group because that would raise so much anger in some people whom we wanted to have involved in our research project […]. Well, it was not quite clear unless they asked for it, that it was on the behalf of that citizen group, because we wanted to have it all as independent as possible"* [Science Shop representative].

Geachte mevrouw, meneer, In het kader van mijn studie Biologie voer ik een onderzoek uit naar de blootstelling aan bestrijdingsmiddelen van mensen die in een bollenteeltgebied wonen. Voor dit onderzoek wil ik metingen in huis en buitenshuis uitvoeren en daarvoor heb ik de medewerking van een aantal bewoners van de gemeente Zijpe nodig. Uw adres is aan de hand van de kaart van de gemeente Zijpe geselecteerd. Ik zou het zeer op prijs stellen als u aan het onderzoek mee wilt werken. Dit onderzoek wordt verricht in opdracht van de etenschapswinkel Biologie, en de inhoudelijke begeleiding is in handen van het IRAS (Institute of Risk Assessment Sciences), beiden van de Universiteit Utrecht. De plaatselijke GGD is ook op de hoogte gebracht. Aanleiding voor dit onderzoek is de groeiende ongerustheid van bewoners van de gemeente Zijpe over de mate waarin zij worden blootgesteld aan bestrijdingsmiddelen en het mogelijke verband met gezondheidsklachten. […]. In mijn onderzoek wil ik gaan kijken of de waarden die in het rapport van de GGD werden berekend overeenkomen met de werkelijke situatie in uw omgeving en bij u thuis. Tijdens dit onderzoek ga ik in de maand maart metingen doen aan de concentratie van bestrijdingsmiddelen in de lucht en in stof, binnen- en buitenshuis. Op deze manier wil ik tot een nauwkeuriger beeld van de blootstelling komen. Dit houdt in dat ik bij mensen die meewerken aan het onderzoek thuis langs zal komen om wat huisstof te verzamelen en indien mogelijk wat van de lucht binnenshuis. De monstername duurt ongeveer 30 minuten en zal twee keer plaatsvinden in een periode van twee weken, uiteraard op afspraak. Ik hoop van harte dat u bereid bent om aan dit onderzoek deel te nemen. Met vriendelijke groet, Astrid Hogenkamp, studente Biologie Universiteit Utrecht	Dear Madam, Sir, In the context of my study of biology, I am conducting research on exposure to pesticides of people living in a bulb cultivation area. For this study, I make measurements in homes and outdoors, and therefore it is necessary that I have the co-operation of a number of inhabitants of the town of Zijpe. Your address is selected from the map of the town of Zijpe. I would be grateful if you would work with the investigation. This research is conducted on behalf of the Science of Biology, and the substantive guidance is in the hands of the IRAS (Institute of Risk Assessment Sciences), both of the University of Utrecht. The local health authorities are also informed. The reason for this research is the growing concerns of residents of the town of Zijpe regarding the extent to which they are exposed to pesticides and possible association with health problems. […]. In my research I would like to investigate if the values in the report of the Municipal Health Service were calculated corresponding to the actual situation in your environment and at home. In this research, which I am carrying out in March, measurements will reflect the concentration of pesticides in the air and dust, indoors and outdoors. In this way, I will be able to achieve a more accurate picture of exposure. This means that, along with people involved in the investigation, I will visit you at home and if possible collect some samples of the air indoors. Sampling takes about 30 minutes and will take place twice in a period of two weeks, of course by appointment. I sincerely hope that you are willing to help make this investigation. Best regards, Astrid Hogenkamp, Biology student University of Utrecht

Figure 15: Extracts from the letter the student researcher wrote to the farmer and residents in Zijpe (Hogenkamp, 2002; 39: appendix 1). The English translation is made through google-translate which is why some errors in the grammar appear

The letter, used by the network as an interessement device to persuade the bulb farmers and citizens, contained information about the research and asked the citizens and bulb

farmers if they would be willing to participate in the research by inviting the student to take samples in their homes. The student received 50 letters in response from both citizens and farmers accepting that she could take samples in their homes. By announcing the research as initiated by the university with the objective of investigating whether traces of airborne pesticides were to be found in the homes of the community, the student and the Science Shop representative managed to create a new alliance and thereby partly enrol the community and the farmers in the network without having to change the obligatory passage point or create new controversies between the already enrolled actants.

Figure 16: The use of pesticides – not the actual bulb fields (Picture: Colourbox)

The student could now start her research. She took samples of airborne dust inside and outside the houses of the 27 households living in the community and from families working in the bulb fields.

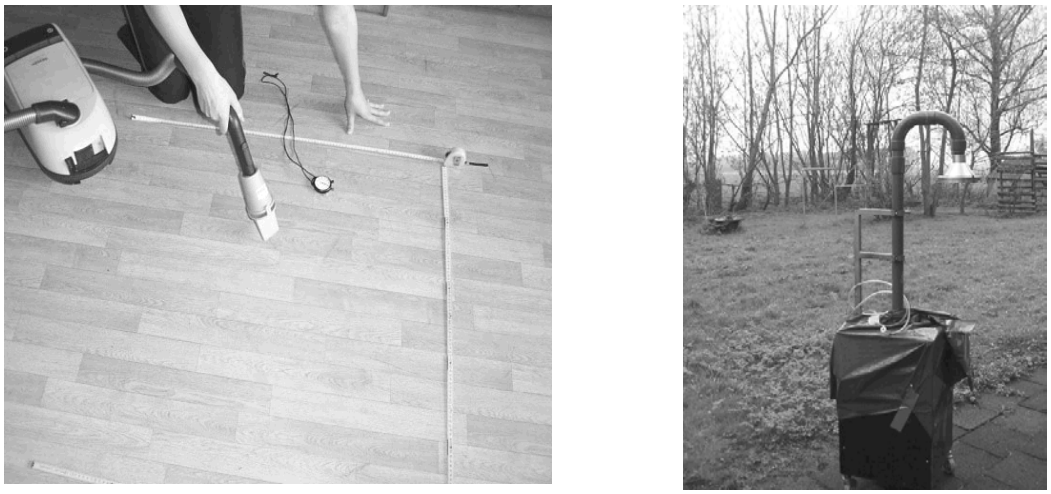


Figure 17: Pesticide particles sampled inside and outside residents' homes (Hogenkamp, 2002)

While the student was collecting the samples, and the alliance built around the network was collecting *evidence showing whether airborne pesticides cause health risks to humans in the vicinity*, the citizen group continued to actively debate the issues in the community. The group wrote articles in the local newspaper and gathered all the citizens to discuss their concerns. Because they raised the issue so determinedly, the farmers grew quite angry. The local authorities and the Health Department were also involved in the discussions in the community, arguing that the citizens had no reason to be concerned. The Science Shop representative tried to persuade the citizen group to stay in the alliance and await the research results, but the group sought to assign themselves another role in the network – for example by trying to find information on their own on the Internet and interpret it so that it supported their claims. The Science Shop representative had to pull them back into the role the network had assigned them by explaining that if the group wanted to use scientific evidence to support their concerns, they would have to interpret the data without bias. Although the citizen group's attempts to interpret information found on the Internet to support their concerns actually worked against the network to some extent, the network did not fall apart, since the Science Shop representative succeeded in persuading the citizen group to play the role assigned to it by the network.

Back in the laboratory, the student analysed the samples for seven substances: chlorpropham, chloridazon, flutolanil, metamitron, procymidone, tolclofos-methyl and vinclozolin (Hogenkamp, 2002). The results of the analysis showed that three of the pesticides were found in very small amounts in the dust from households not involved in bulb farming, whereas six pesticides were found in the farmers' households. The most significant discovery, however, was that many more pesticides were found in the bulb farmers' home than in the rest of the community. The results did not indicate any differences in the amount of pesticides in the dust from people living near the bulb farms and people living far from the bulb farms. The fact that the pesticides were not mobile over a longer distance and the fact that the sampling sites and techniques had failed to capture the pesticides challenged the network's black-boxing of pesticide behaviour. As it turned out, pesticide behaviour could not be black-boxed as had been done in the project. The student and the research group concluded that it was not possible, based on this small pilot project, to make a good and adequate risk assessment; there were too many uncertainties that were not accounted for in the research. On the other hand, it could not be concluded that the community was not exposed to health risks from airborne pesticides. These conclusions made it clear to the network that their assumptions about pesticide behaviour were wrong, and that something new would be required to capture and measure this behaviour. If the network was to uphold the obligatory passage point, more research would be needed, research that would acknowledge that pesticide behaviour was unpredictable. In addition to these conclusions, the report did specify that pesticides were measured inside the houses.

The citizen group spokesman and the citizen group were disappointed about the results of the research – not the research itself; they were satisfied with the fact that the research had been carried out objectively. But they were disappointed that the research did not clearly specify the health risk they were convinced they were being exposed to. If the pesticides had behaved as assumed, manifested themselves, and thereby contributed to stabilizing the network, the citizen group spokesman would have been able to substantiate that they were exposed to health risks. The Science Shop representative also felt a bit disappointed that the research did not support the argument of the citizen group more than it did, because

> *"[…] that's also to do with how they [the citizen group, ed.] are treated by the city council and the health service, because […] they are not really supportive of listening well to what their worry means to them, so they are not […] considering the problem [very much, ed.]"* [Science Shop representative].

Mobilization: Speaking on behalf of others?

When the research was finished, the citizen group organized a meeting in the community where the student and the research group presented the results. The citizen group understood that it was important for them and their position in the community to invite the bulb farmers, the community members and members of the city council. That the citizen group understood that this form of alliance was needed indicates that they knew it was important for them to represent the whole or at least a large part of the community in order to be able to speak on its behalf. By inviting the bulb farmers and the city council to the meeting, the citizen group was trying to persuade these actors to enter the network recognizing that airborne pesticides might be a health risk to the community. However, the community meeting did not lead to agreement or alliances between the network and the city council or bulb farmers but almost the opposite. Since the results of the research could be interpreted as supporting both parties, the citizen group realized they had to persuade other actors (than the city council and the bulb farmers) to join the network, if they were to succeed in making a more stable network that recognized the health risks of airborne pesticides.

Although the network did not succeed in upholding the obligatory passage point, the research findings did not indicate that the exact opposite was true either. Thus, it might still be possible for the network to uphold the obligatory passage point if other steps could be taken. The network realized that other actants had to be enrolled into the network that would support the network by funding more research – indicating that the network had reached some sort of stabilized situation.

After the community meeting, the roles in the network changed. The citizen group spokesman now became the spokesman for the whole network. The Science Shop representative and the research group were interested in obtaining funds to extend the

research in order to tackle the uncertainties that the recently completed research project had not accounted for. It was however the citizen group spokesman who took the lead in the process of obtaining funds for further research.

The citizen group was very determined to find funding in order to extend the research project. They contacted the city council and the province council, but they declined. The citizen group then contacted a Dutch parliament member and tried to persuade him to join the network. The parliament member invited the citizen group, the Science Shop representative, the research group and the farmers (who were represented by their agriculture organization) to several meetings to discuss the possibilities of funding the research project. The discussions made the parliament member realize that some uncertainties existed as to whether or not airborne pesticides caused health risks to the community, but he finally concluded that the health risk from airborne pesticides was small compared to other pollutants. He therefore decided that he could not help make funds available for more research, even though the Science Shop representative and the research group had argued that more research was needed in the field of airborne pesticides. They added that this had been recognized in the United States, and much funding had been allocated to research focusing on risk assessment studies of airborne pesticides. Concern in the United States was particularly focused on children's exposure, since their outdoor activities heavily exposed them to airborne pesticides. But the arguments of the Science Shop representative and the research group did not convince the parliament member to fund the study. Thus, the network was still not more stable, and the actors within the network had to reconsider what could be done next.

After failing to persuade the parliament member to join the network, the Science Shop representative again assumed the role as spokesman for the whole network and again made herself indispensible by proposing to apply for research funding through the EU. In 2005, the EU called for research projects mediated and facilitated through Science Shops. The Science Shop representative thus tried to mobilize a new actor – the EU research evaluators – by framing an experimental research project to investigate the uncertainties connected with health risks from airborne pesticides. Due to experiences with the co-operation with the citizen group, the Science Shop representative and the research group also included the aspect of risk communication in the research proposal, but this new attempt to enrol a new actor in the network also failed. The research proposal received a good evaluation by the EU but not good enough, and funding was rejected.

Epilogue: Effects of the network alliance

This story is about an EEA in which the actors in the network struggled to find scientific evidence about whether or not airborne pesticides cause health risks to humans. Despite attempts by the network to scientifically document the existence of pesticides in residents' homes, the network failed to enrol other networks involving the farmers, the local

authorities and the parliament member. The failure to uphold the obligatory passage point can be interpreted to indicate that the network never succeeded in becoming stable. However, according to the student researcher, the citizen group did not give up the fight, even though the network did not achieve funding from the EU, and it is her impression that the citizen group is still seeking funding opportunities. Nevertheless, it cannot be concluded that the network became stable to its full extent, since the network's status at this point in time is that the student has graduated and is no longer part of the network, and the Science Shop representative is no longer working in the Science Shop. The story does show, however, that mobilization was not achieved, since the network did not succeed in persuading the local authorities, the parliament member, or the EU evaluators to join the network.

To follow up on the discussion begun in chapter 2, *section 3: ANT as Inspiration for Studying Science-Society Relations – as Network Constructions*, about whether stabilization of networks equals effects – and continued in the final discussion of case A – it is not possible to determine through this case whether stabilization of networks necessarily equals effects. The network never reached a fully stable state since it failed in upholding the scientific documentation needed to persuade the farmers and the local authorities that airborne pesticides did cause a health risks to the community. Thus the network did it have any direct effect on the CSO's claim. In spite of the fact that the network did not succeed in clearly documenting a relationship between airborne pesticides and human health, the story does illustrate other effects. The citizen group's request made the research group aware of a scientific field that had been underexposed – risk assessment of airborne pesticides – and thus had an impact on the research agenda. The influence on the research agenda is illustrated by the fact that in 2006 the research group initiated a PhD project entitled: "*Microbial components with immunoregulatory properties in dust from the home and work environment: identification, characterization and exposure assessment*".[29] The network also succeeded in bringing their concerns to the political agenda. As though no funding was provided, a politician was made aware of the issues.

The story also illustrates that stabilization is never a fixed state; on the contrary, stabilization is continuously challenged by other networks. The network seemed stable when the student began collecting her samples, but the pesticides did not behave as assumed. They did not make their presence known and thus contributed to making the network unstable. The network seemed to be made stable again when it succeeded in arranging a meeting with the parliament member, but only until this actor refused to accept the network's findings and rejected funding. During the whole process, the actors enrolled – the Science Shop representative, the citizen group spokesman, the student and

[29] The PhD project description can be found at: http://www.iras.uu.nl/research/eepi/Project-eepi-Noss.php

the research group – remained committed to the network, even though other networks tried to pull them out. This indicates some degree of stabilization, even though there were no direct effects and the obligatory passage point failed to be clearly and successfully upheld.

In the last part of case A, I discussed the actors' background and motives for becoming involved and enrolled in the EEA. This case differs from case A, since the obligatory passage point was not upheld. In case A, we saw that the research group withdrew from the network when they had upheld the obligatory passage point and obtained the data they needed. In case B, the failure to uphold the obligatory passage point may have contributed to keeping the research group in the network, because they found it of scientific interest to explore the relationship between airborne pesticides and human health in more detail. This observation supports my conclusion in case A, that it is mainly in relation to knowledge production processes that it is possible or relevant to discuss stabilization within such EEAs.

The next case (case C) is different from this case both in relation to the type of problem, but also in relation the role of the Science Shop. In cases A and B, the Science Shop assumed the role of mediator between the CSOs and the scientists, whereas in case C, the Science Shop assumed the role of scientist carrying out the research. The type of problem also differs. In case B, the CSO's concern was related to pollution and health risk from daily agricultural activities, a conflict that could have caused the farmers to become aware that they were possibly exposing themselves to health risks due to their use of pesticides. In case C, on the other hand, the CSO is concerned with possible future exposure to odour pollution from industrial activities planned in the future. In principle, this planned activity created an opening for participation, even though the local authorities were not interested in meeting the concerns of the citizens.

4.3 Case C: The Scania Case

- The story about a legal claim based on findings from a Science Shop project

This story is about an EEA created around a local citizen group in the city of Meppel fighting against the international corporation, Scania – a battle about whether the company's painting processes caused odour pollution and health risks to the community. The citizen group succeeded in persuading several actors, such as a scientist and lawyers, to join a network striving to obtain facts about the levels of the odour pollution. Through this work, the network managed to claim their legal rights for a healthy environment.

Of particular interest in this EEA is that the controversy seems to be more about how to interpret the odour levels than whether the odour particles are to be found in the painting process. The story also illustrates an important dilemma for many small cities and villages: Should communities accept health risks from pollutants, when the pollutant creates employment opportunities in the region?

Finally, this EEA is an example of a network that became stable due to the different roles the actants were either assigned or assumed. Scientific arguments and legal rights were combined and played out to support the network's claim that residents were potentially being exposed to odour pollution.

Problematization: Odour pollution caused by Scania
In 1994, the Dutch government decided to abolish the national laws on odour pollution and instead leave such legislation to the local authorities. The philosophy behind this political decision was that odour pollution is a local problem and should be solved in the settings in which it occurs. This political decision was made with the intention of creating more local participation, but according to the Science Shop representative involved in this case, it has caused many problems due to the complexity of calculating odour pollution. Since 1994, local authorities have had a tendency to judge odour pollution as an annoyance, whereas interest organizations, such as CSOs, some university scientists, and the public in general, judge odour to be a health issue. If odour is considered a health issue, local authorities are obliged to handle it as a legal matter.

According to the Science Shop representative involved in this case, local authorities typically do not know how to handle odour pollution, so they use private consultant firms to make sensitivity analyses. Such analyses, however, are often of very short duration and do not cover all aspects of the odour pollution, as this case exemplifies. According to the Science Shop representative involved in this case, the consultant firms' inadequate handling of sensitivity analyses has led to a need for counter-expertise to ensure proper handling of odour pollution. As a response to the need for counter-expertise to the reports

made by consultants, Science Shop Chemistry used its expertise to counter the reports developed by companies or consultant firms when applying for permits to open new factories. When performing the counter-expertise regarding report information, the Science Shop is restricted in their analysis by having to rely on the information provided by the companies, since the Science Shop is not allowed by law to take samples from the plant. The Science Shop representative can however make calculations on the dispersion of air pollution, i. e. sensitivity analyses, through a dispersion model, which means that he can check whether the company's calculations of pollution levels are correct.

In the Dutch city of Meppel, in north-eastern Netherlands, Scania[30] planned in 1996 to reopen a factory it had closed three years earlier. Previously, Scania had produced trucks at the factory; now, they planned to use the facility and its equipment for painting trucks.

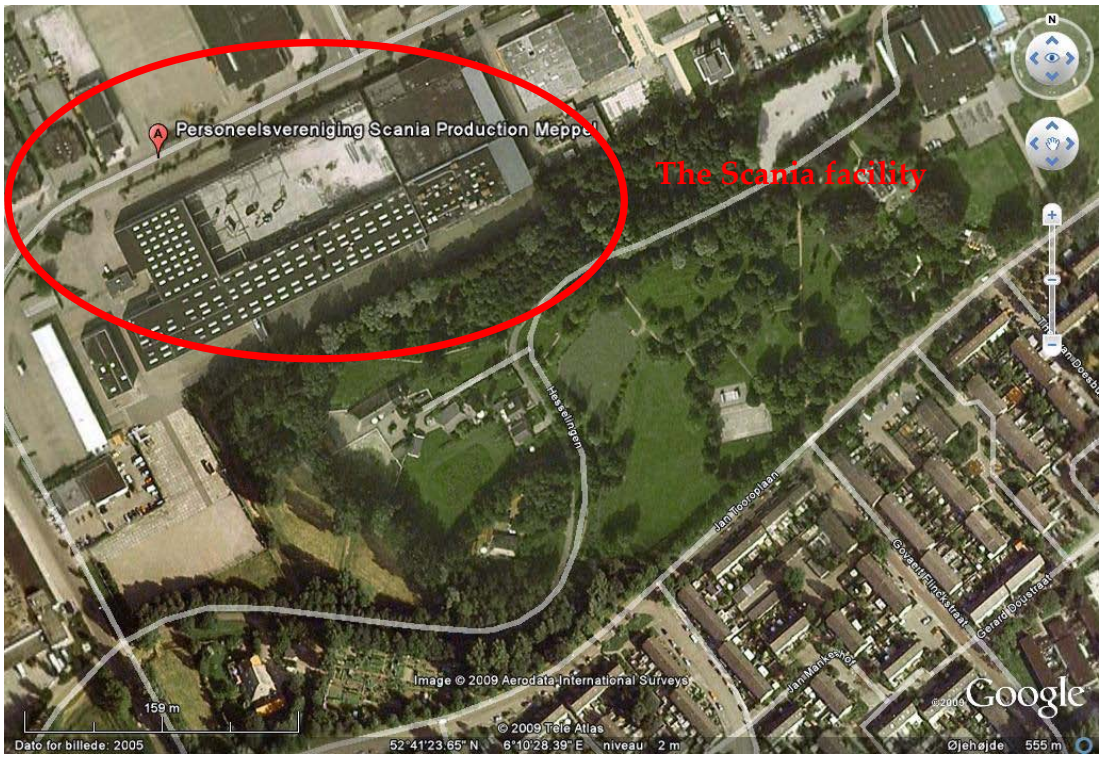


Figure 18: The location of the Scania factory close to residential areas (Picture: Google Earth)

Citizens (around 5,000) living near - within a distance of 80 metres to 300 metres of - the Scania property (see Figure 18. The citizens live both within the green area as well as outside the green area) were afraid that the painting process would cause odour nuisance, but at the same time they understood the importance for employment in the region if Scania were to reopen the factory. After having heard about Scania's plans, a seven-member citizen group representing the residents living near the factory approached the

[30] Scania is a Swedish truck enterprise.

factory management to discuss their concerns. The management refused to discuss their plans with the citizen group, however, nor did they acknowledge that their future plans could cause odour pollution to the community. They argued that they were just following the official process of application for a production permit through the structures of the local city authority.[31]

The standard application procedure for a production permit is that the local authority publishes the company's request in the local newspaper to inform the residents living in the direct vicinity of the plant. According to the Science Shop representative, this standard procedure is based on the local authority's wish for dialogue with the residents so they have the opportunity to discuss their ideas or concerns. When the residents in the vicinity of the Scania facility were informed officially about the plans, they became concerned about the impact the painting process could have on their living conditions; they were especially concerned about the smell. The citizen group recognized the importance of the 125 new jobs that reopening the factory would create, but they also felt that the factory was required to comply with the regulations, thus ensuring the residents' living conditions. Neither the local authorities nor Scania would listen to the citizen group's concern:

> *"We had several discussions with the local authorities and also with Scania, and they rejected our items. They said, well you are afraid for nothing and they [Scania, ed.] are not going to produce a lot of noise and all the things, like smell. […] The local authority, they rejected it, and they made a provisional permission for this plant"* [Citizen group representative].

This was despite the fact that the company philosophy is to be *"…an environmental friendly organization. And this is not right. They are just, like every big multinational, in it for the money"* [Citizen group representative].

Figure 19: The logo of Scania at Scania's garage in Greve, Denmark (Picture: my own)

[31] This story is based on written material as well as interviews with the involved representatives from the citizen group, the Science Shop, and the Bureau for Legal Aid. No interviews were made with the representatives of the local authority or Scania, since it has not been possible to establish contact with them. One of the representatives has retired, and the other has a new job outside the Netherlands.

The permit granted Scania by the local authority was based on an odour report produced by a consultant firm hired by Scania. The technical report contained 350-400 pages of technical data. The citizen group did not trust this technical data, since reports produced by consultants had a reputation for being based on wrong assumptions and favouring their clients, but the citizen group did not have the expertises to challenge the data in the report. They realized that they needed the expertise of scientists and lawyers if they were to be heard by the local authorities and Scania. The citizen group therefore decided to approach the Bureau for Legal Aid.[32]

According to Dutch law, citizens have the right to launch legal proceedings against a company or a local authority, if they feel that the information provided by these parties is not trustworthy, or if they do not believe that the local authorities have made a proper and in-depth investigation of the impact of the planned factory. The citizen group questioned the technical data from Scania concerning the noise levels and pollutants from the painting process; they *"…didn't believe that the government did a proper investigation and the proper legal norms, the proper legality of pollution in it"* [Representative from the Bureau for Legal Aid].

The Bureau for Legal Aid representative was persuaded by the citizen group's arguments for distrusting of the information provided by Scania and the local authorities and agreed to accept their case, but they needed scientific expertise to evaluate the technical data specified in the report. In previous cases when scientific expertise was needed, the Bureau for Legal Aid had co-operated with Science Shop Chemistry at Groningen University, so the Bureau for Legal Aid representative recommended that the citizen group contacted the Science Shop Chemistry.

Until this moment, the citizen group had not been able to create a network around their concerns about odour and noise from the planned Scania factory, but they had taken the first step by approaching the Bureau for Legal Aid, which then introduced them to another actor that had to become interested, if the network were to be established.

The citizen group approached Science Shop Chemistry with their concerns, hoping to persuade the Science Shop representative to enter a network around odour and noise

[32] Bureau for Legal Aid is an independent organization within the governmental structure of the Netherlands, aiming to represent the public in matters of environmental injustice. The organization was established in the 1980s because the governmental structures understood that laws concerning environmental issues were too complex for the public to understand and navigate within. Bureau for Legal Aid should function as the entrance to law procedures for the public by providing legal advice and going to court when necessary, on behalf of individual citizens and/or environmental CSOs in the Netherlands. Advice from the Bureau for Legal Aid is free of charge; however, if citizens or CSOs choose to go to court, they have to pay an entrance fee to the court of around 150 Euros.

pollution from the planned Scania factory. The Science Shop representative was a specialist in odour pollution, which is a special type of air pollution, and he had worked with odour pollution since the abolishment of the national odour laws in the Netherlands. According to the Science Shop representative, local authorities often perceived odour pollution to be a psychological problem. He explained the argument of the local authorities like this: *"It is between the ears as they say, like just a little bit of annoyance, and people often overreact to odours"* [Science Shop representative].

If the local authorities succeed in persuading citizens that odour is just an annoyance, then they are not obliged to make regulations for the factory causing the odour problem. Odour is however more than annoyance, the Science Shop representative explained; it is a question of health, and therefore the involved local authorities are obliged by law to set up regulations and standards with which the factory must comply.

Since the citizen group's concerns lay within the Science Shop representative's areas of interest, he offered to make a scientific evaluation of the technical report Scania had delivered to the local authorities, and which the citizen group distrusted.

The network now began to take form; the Science Shop representative offered to make a scientific evaluation of the technical report, and framed the obligatory passage point as such. The citizen group fully agreed to the obligatory passage point, since they needed the scientific expertise the Science Shop representative could provide, and which they could not achieve without the Science Shop. The Bureau for Legal Aid representative also accepted the obligatory passage point, since he could not bring the case to court unless he had an external scientific evaluation of the technical information provided by Scania. By persuading both the citizen group and the Bureau for Legal Aid representative that the obligatory passage point was the only way to approach the problem, the Science Shop representative made himself indispensable to the network; without him the road was blocked for the two other actors' obstacle problems. By framing the obligatory passage point as *'scientific evaluation of the technical report'* the network assumed that it would be possible to calculate the expected number of odour particles on the basis of the figures and numbers provided in the technical report. However, if the expected number of odour particles could not be calculated, it would have the fatal consequence for the network that the obligatory passage point could not be upheld and a lawsuit would not be possible.

The network around the obligatory passage point at this moment of translation can be illustrated like the figure below. The figure illustrates the obligatory passage point; i.e. the facts the three actors wanted to uphold in order to overcome each of their obstacle problems and finally achieve their goal.

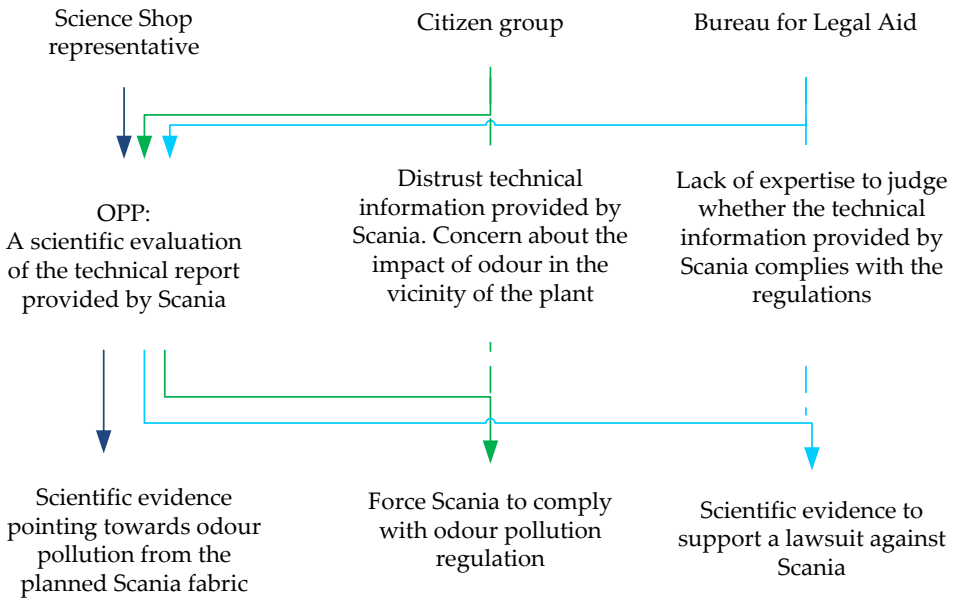


Figure 20: First alliances made – framing the obligatory passage point

As illustrated in the figure above, the goal of the Science Shop is different from the goal of the CSO and the Bureau for Legal Aid. For the Science Shop, it is a question of upholding scientific data that indicates odour pollution, whereas for the CSO and the Bureau for Legal Aid, this scientific data provides the means to force Scania to comply with odour pollution regulations.

Once the obligatory passage point was framed, the next step for the network was to assess the technical report provided by Scania.

Interessement: Persuading other actants to accept the obligatory passage point
According to the Science Shop representative, already at first glance, the technical report that the local authorities had accepted looked incorrect; therefore, the Science Shop representative requested all files on the planned factory from the local authorities, the Bureau for Legal Aid, and the citizen group. The main issue of the report surprised the Science Shop representative, since it was argued that a limit of four Dutch odour units per m^3 was reasonable. The Science Shop representative expressed his surprise thus:

> *"Normally you have a norm of one Dutch odour unit. So their limit was four times as much as normal for small car painting units, and I knew that this one odour unit limit was also applicable to ship painting, because we had been working on a case like that, and I knew it was reasonable for small car paint facilities like the small garages that you have in the villages, they always take the norm of one"* [Science Shop representative].

After this discovery, the Science Shop representative delved deeper into the technical report to analyse how the norms of four Dutch odour units were identified. He realized that the consultant firm that had developed the sensitivity analysis for Scania had based their assumption on a report from a conference about odour. The Science Shop representative explained the findings in this conference report:

> *"In this conference all participants were handed out one A4 page with 20 odours typed on it, and you had to order these odours from 1 to 20, from bad to nice; it was like coffee and paint etc. What happened in the final order of all participants was the odour of car painting was right next to the odour from the food industries, and it was like 15 and 16 place or something. So what they [the consultant firm, ed.] said, well, the odours are comparable, so we take the level which is used for the food industry. So, this is not scientific at all. […]. And as luck has it, I had been at that conference myself, so I knew firsthand how these results were obtained. Normally, you can compare odour only in the laboratory, by additional testing, like, they call it the "hedonic" value of odour, which is a measurement for tastefulness and distastefulness, but it is very complicated as well and it's not really standardized yet"* [Science Shop representative].

Besides basing their assumptions on a non-scientific methodology, the consultant firm had also made wrong references to scientific journals in the technical report.

After having made the evaluation, the Science Shop representative informed the citizen group about the main errors in the technical report, which were all related to odour and noise. The level of four Dutch odour units was unacceptable, and the Science Shop representative recommended that the citizen group confront the local authorities and Scania with a demand of reducing the level to only one odour unit.

By succeeding in making a scientific evaluation of the technical report, the Science Shop representative succeeded in upholding the obligatory passage point; odour problems were found in the technical report. The network was now somewhat stabilized, and the three enrolled actors had complied with the roles they had been assigned by the network, but the network was not satisfied. The network also wanted to force the local authorities into the network and finally also Scania, since their enrolment would be required if the network were to succeed in avoiding that the community be exposed to odour pollution. The network wanted to accomplish this through the findings of the evaluation of the technical report, as well as by using the limit of one odour unit as interessement device.

With the new information provided by the Science Shop representative, the citizen group approached the local authorities again, and once again they rejected the demands of the citizen group and thereby refused to accept the interessement device:

> *"Well we [the local authority, ed.] think it's a good thing what happens there, and it does not harm in any way the direct surroundings around this plant"* [Citizen group representative].

Furthermore, the local authorities tried to persuade the citizen group to give up their resistance, through the interessement device of employment possibilities for the region. Even though the citizen group recognized the importance of employment possibilities they were not persuaded by the local authorities' argument; instead, they were convinced by the arguments of the Science Shop representative.

The network realized that even though they had successfully upheld the obligatory passage point framed by the Science Shop representative, it could not persuade the local authorities or Scania to enrol in the network. Other means had to be used. The three actors – the Science Shop representative, the Bureau for Legal Aid representative, and the citizen group – therefore translated the first obligatory passage into *a lawsuit at the Hague High Court*. To successfully uphold this new obligatory passage point, the three actors had to interest a new actant, the Hague High Court.

The Hague High Court is a court institution that performs a pre-judgement of the case, before it can go to the actual court. The citizen group and the Bureau for Legal Aid representative approached the Hague High Court, and the institution used 6-7 months to study all the material, including the technical report developed by Scania and the evaluation made by the Science Shop representative. During those months, representatives from the Hague High Court visited the city and the factory location. The Hague High Court representatives also met with both the local authorities and Scania to discuss the reports and the potential health impact the odour would cause the community. At the end of the Hague High Court proceedings, they concluded that the local authorities and Scania would most probably lose their case, if the citizen group decided to bring their concerns to court.

A lawsuit against the local authorities and Scania was seen by the citizen group as the only way to persuade these two actors to join the network, and by choosing to approach the Hague High Court they succeeded in enrolling the Hague High Court in the network.

The network around the new obligatory passage point can be illustrated like this:

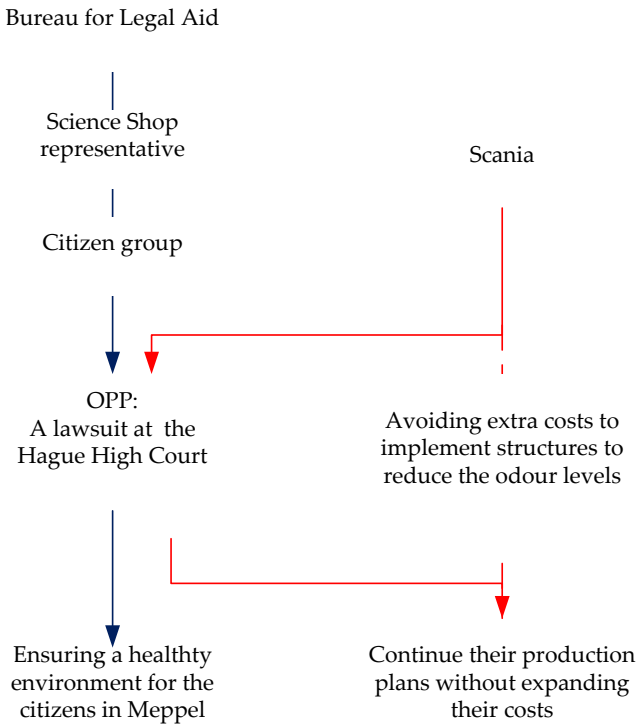


Figure 21: Illustration of problematization and obligatory passage point at the interessement moment of translation

The threat of a lawsuit now became the network's interessement device for forcing the local authorities and Scania into the network.

During the period when the Hague High Court was making its investigation, Scania had threatened the citizen group with the prospect of unemployment, threatening to move the whole operation to Poland. Even the Mayor of Meppel threatened the citizen group, saying:

> *"If you going on by saying no, we will take care of the fact that probably 5000 people are against you"* [Citizen group representative].

The mayor also made physical threats against the CSO's members. The CSO representative explained the mayor's treat:

> *So the houses here for example, the roofs are straw, one match, a little bit fire, and your houses are on fire. And of course this did not happen, but the threat was always in the discussions there"* [Citizen group representative].

The representative from the citizen group explained further:

> *"If we did not know we had a very strong position, and we did know this through the Science Shop, probably we would have said yes ok, for the good sake. And the result of this would be that we had a plant, with a very very high output of dangerous stuff, with very bad smell output, a lot of noise in our direct neighbourhood. And it is not us, the seven people who protested, the group of people, but there was another 5000 people"* [Citizen group representative].

The local authorities also tried to place the citizen group in a bad light in relation to the whole community by having the local newspaper bring articles stating the economic consequences for the region, if Scania were not allowed to reopen their factory.

Enrolment: Did the actants accept and play the role they were assigned?
As the story has shown until this point, the network upheld the first obligatory passage point, but despite this, the network did not succeed in persuading the local authorities and Scania to join the network. Therefore, the three actors translated the first obligatory passage point into a new. With the interessement of the Hague High Court, the network was further strengthened. The question is, however: Are these actors enrolled in the network and willing to keep working for the network's interests?

After the Hague High Court's announcement that the local authorities and Scania would have a very weak case, if the citizen group should bring its concerns to court, Scania became much more friendly towards the citizen group. They realized that they might lose the case and would then be forced to go through the whole process of applying for the permit again, which would cost them years of work. So Scania was suddenly willing to listen to the citizen group; they wanted to reach a settlement with them to avoid the lawsuit.

During this whole period, the network remained stabled. The Science Shop and Bureau for Legal Aid representatives supported and provided the citizen group with advice when needed, which showed that both actors were enrolled in the network. The fact that the Hague High Court became interested in the network, forced Scania into the network; they either had to accept the obligatory passage point and thereby the citizen group's demand, or they would be dragged to court and probably lose their case.

Although Scania showed interest in creating dialogue with the citizen group, the citizen group decided not to cancel their lawsuit. They wanted to be sure of an agreement between themselves and Scania. Only four days before the citizen group's procedure was to come before the Hague High Court, Scania and the local authorities approached the citizen group, asking them about their demands to Scania and to withdraw from the lawsuit. The citizen group then sought advice from the Science Shop representative,

asking him what would be reasonable demands to ensure that odour would not be a problem for the community. The Science Shop representative recommended the citizen group to demand that Scania install a burning unit to ensure that the air from the plant would be transported to the unit to cleanse the air and remove the odour and thus the threat to humans. The installation of such a burning unit would cost around 800,000 Euro, and the gas needed for burning the odour would cost around 1 million Euro per year. The Science Shop representative thereby introduced a new actant: the burning unit. For successful stabilization of the network, Scania had to accept installing the burning unit. The role the burning unit was assigned by the Science Shop representative was to ensure that the smelly air was transformed into clean air.

The citizen group announced this demand to Scania, which was at first reluctant, since it would exceed their budget; but after some thought, they agreed to the citizen group's terms. Scania further suggested making a voluntary agreement with the citizen group and the local authorities, stating that within one year they would comply the regulation of one odour unit. If they did not comply with this agreement within one year, they would have to pay 10,000 Euro to the citizen group.

When the Science Shop representative heard about Scania's proposal, he asked to see the text of the voluntary agreement, because he was a bit worried that the citizen group was being duped by Scania. The Science Shop representative explained to the citizen group that 10,000 Euro was a very little amount, especially compared to the costs of the necessary investments. He was apprehensive that Scania would proceed as usual, without investing in the technologies necessary to prevent odour, and then after the first year, just pay the fine of 10,000 Euro to the citizen group. If this should happen, the citizen group would not be able to take any legal action against Scania, since they had signed the voluntary agreement.

The citizen group confronted Scania and the local authorities with these considerations, as well as a demand that the fine was to be paid to all residents in the community and not only the citizen group. Scania was at this point very desperate to reach an agreement with the citizen group in order to avoid the lawsuit and offered to raise the amount to 50,000 Euro. Scania would also add to the agreement that if they had not complied with the agreement after the first year, they would also have to pay the community the avoided costs for the installation of the burning unit, an amount exceeding 1 million Euro.

The citizen group went back to the Science Shop and Bureau for Legal Aid representatives, and both actors agreed with the citizen group that this suggestion sounded acceptable. Thus ends the story of the controversy between the citizen group in Meppel and Scania. Status is that Scania received the permit to reopen the factory, and in the spring of 2007, Scania opened their new facility, including the burning unit (Business Wire, 2007).

The network's translation of the first obligatory passage point to the second obligatory passage point – *a lawsuit at the Hague High Court* – contributed to enrolling the three actors, the citizen group, the Science Shop and Bureau for Legal Aid representatives, to remain in the network. All actants in the network around the first obligatory passage point were interested and enrolled in the network. This was however not enough to persuade Scania or the local authorities to enrol in the network. After upholding the first obligatory passage point, the three actors realized that although the scientific evaluation of the technical report revealed errors and incorrect measurements, Scania could not be persuaded by this, which meant that a new obstacle problem occurred: to make Scania comply with the regulations. The introduction of a new actant, the Hague High Court, into the network, contributed to extending the enrolment of the three actors; now, they had the courts to support their obstacle problem. When the local authorities and Scania realized this, they accepted being enrolled in the network, and finally agreed to comply with the regulations. The network thereby became stable.

Mobilization: Speaking on behalf of others?
The citizen group, even though starting as a group of just seven concerned citizens, succeeded in representing the whole community. At first, Scania and the local authorities thought they could turn the community against the citizen group, but due to their ability to create alliances with both legal and scientific institutions, they persuaded the community, Scania and the local authorities that they were speaking and acting on the behalf of the whole community. The voluntary agreement signed by Scania and the citizen group contributed to this mobilization, since the citizen group insisted that possible fines were to be paid to the whole community and not only the citizen group.

The expertise developed through the Science Shop in relation to sensitivity analyses of odour placed the Science Shop in a position where it could become the voice of the community against the local authorities in such matters. Although the Science Shop representative has assumed this role of representing communities since 1994, and although he is also a member of a national odour platform, he has not succeeded in translating odour into a research area at the university. Another university has done so, however; at Utrecht University, a research group has just been formed to study how odour impacts people's behaviour.

Epilogue: Effects of the network alliance
This story shows the importance of alliance- and network-building with human and non-human actants, constructed as EEAs. Through a combination of scientific facts, legal claims and persistence, the network succeeded in avoiding that the community in Meppel was exposed to odour pollution from activities at a Scania factory. This EEA also illustrates how difficult it can be for CSOs when facing types of pollution where regulation is minimal or weak. Despite threats such as unemployment and burning down the CSO

members' houses, made by actors outside the network, the network succeeded in standing against the threats, and finally, by introducing a lawsuit and a burning unit, the network managed to persuade the resistant actor, Scania, to join the network.

This story also illustrates the complexity of stabilization. Although the network succeeded in upholding its first obligatory passage point – to make a scientific evaluation of the technical report – it did not manage to stabilize the network, since both the local authorities and Scania refused to be enrolled in the network. So even though the network seemed stable with the enrolled actants, the resistance of the actors not enrolled caused an unstable situation for the network. In relation to this complexity of stabilization we might ask: when is something stable? Is it when the obligatory passage point is upheld or is it when no actants resist the network any longer? Callon and Latour argue that stabilization is never a fixed state but the effect of translation and a state that will be continuously challenged. And I agree with this explanation; however, my case studies thus far indicate that stabilization can be analysed from two angles; from inside and outside the network. By this I mean that the determination of the enrolled actors in this case – to keep fighting against the actors refusing to be enrolled in the network – indicated some sort of stabilization of the network from the inside, even though several actors outside the network resisted enrolment. It does not seem that this angle is covered fully in Latour and Callon's definition of stabilization. I return to this discussion in chapter 5 where I strive to characterize what is meant by stabilization and effects.

This story distinguishes itself from the previous two cases (cases A and B) with regard to reflections on the relationship between stabilization and effects. Based on the previous two cases, I argued that stabilization is not necessarily equal to effects, and that effect on the issue in question or other related issues may be achieved despite the fact that the network does not manage to become stable. In this case (case C), the network managed to cause effects and thereby avoid odour exposure in the community. Whether this would have been possible had the network not achieved a stable state is questionable, since persuading and enrolling Scania in the network was essential for the network in order to secure that the community not be exposed to odour pollution.

It is also interesting to observe how this EEA differs from the two previous cases (cases A and B) when reflecting on the framing of the obligatory passage point. In cases A and B, the obligatory passage points were framed around upholding facts of scientific interest – i.e. 'new research data about the relationship between traffic-related air pollution and respiratory health in Dutch children' (case A), and 'evidence of whether or not airborne pesticides cause health risks to humans in the vicinity' (case B), whereas in this case, the network translated their first obligatory passage point, which focused on a scientific interest, into 'a lawsuit at the Hague High Court', when they realized that Scania and the local authorities did not accept their scientific arguments. This meant that in this case, the

Science Shop was willing to assume another role than merely that of the scientist carrying out the research. He assumed a role in which he was willing to enter into political discussions in order to assist the CSO to avoid exposure to odour pollution.

This case also illustrates that although several actions and actants contributed to the stability of the network, one relationship was essential; the alliance between the Science Shop representative and the representative from the Bureau for Legal Aid. This alliance had been built up through years of co-operation, and they each knew when to draw on the other's expertise. Finally, this EEA shows that Science Shops can play an important role as in assisting CSOs, when legislation in an area is weak and local authorities do not have the expertise or interest to carry out regulation and control in the interests of both industry and local communities.

The next case (case D) originates from the same Science Shop and is also concerned with odour pollution. Case D differs from case C, however, in relation to two aspects: the network in case D failed to provide the necessary scientific documentation for the assumed odour pollution, and the role assigned to the CSO was merely to be a passive partner in the network rather than an active partner involved in negotiations with the local authorities and the company as in case C. Nevertheless, and despite the failure to document the problem scientifically, the network in case D succeeded in enrolling the local authorities and the carpet factories in the network.

4.4 Case D: The Carpet Factory Case

- The story about a complex claim being reduced to a complaint telephone

This story is about an EEA created around a local citizen group in the city of Steenwijk and its fight against the local authorities and two carpet factories – a battle about whether the carpet factories were responsible for toxic emissions causing health risks to the community. Through network alliances with a Science Shop representative and others consensus was reached between several actors, despite the fact that it was not possible to obtain sound and clear scientific evidence of the odour pollution experienced by the citizen group. By defining the problem as a question of assessing scientific data as well as re-establishing communication between the local authorities, the two carpet factories and residents in the community, the Science Shop representative won accept for a proposal to establish a complaint telephone in order to achieve a state in which the network seemed stabilized.

This EEA is an example of a network that became stable due to the different roles assumed by the particular Science Shop representative, both that of a scientific expert and a mediator between the other actors. At the end, an agreement was reached between the fighting actors that satisfied them all.

Problematization: From cancer risks to odour pollution

For seven years, a local citizen group in the city of Steenwijk had fought against the local authorities and two carpet factories, Crilux and Betap, because of their concern that the emissions produced by these two factories caused health risks to the community. Several reports and analyses had been produced by the local authorities evaluating the emissions from the two carpet factories, but the citizen group distrusted these analyses. Their distrust arose because errors had been discovered in one of the analyses. And due to this error, the citizen group had concluded that they could not trust any of the analyses. The citizen group's concerns were related to whether or not the emissions and the sewage from the carpet factories were toxic and could therefore cause cancer and odour related and/or water pollution related diseases. After having fought with the citizen group for seven years, trying to meet its demands for analyses with no success, the local authorities and the two factories were no longer interested in dialogue with the citizen group; the situation had become unsolvable (Neubauer, 2002).[33]

[33] This case study is based entirely on written material: a case study in a PhD dissertation, the scientific report produced by the Science Shop representative, two articles written by the Science Shop representative and newspaper articles. I would have liked to interview the involved actants, but the Science Shop representative asked me not to, because the case took place 10 years ago, and all the involved actants had been interviewed several times. In spite of the fact that I have not been able to interview the involved actants, I believe that the available written material does cover most of the points I wish to make with this case study.

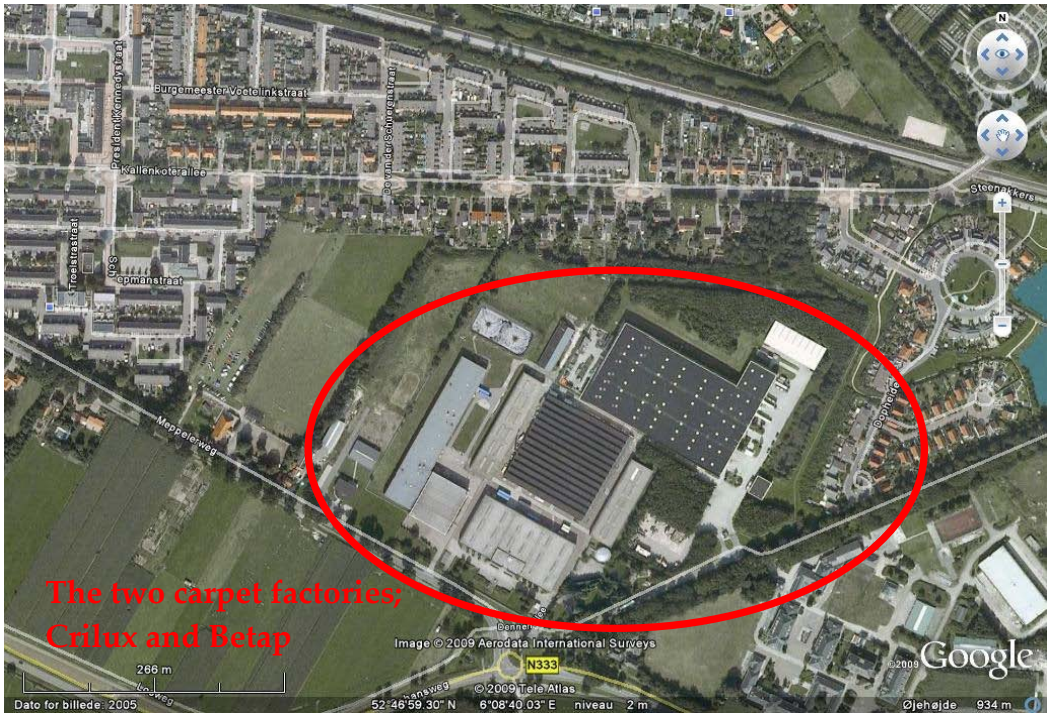


Figure 22: Steenwijk and the location of the two carpet factories, Crilux and Betap (Picture: Google Earth)

The citizen group realized that the situation with the local authorities and the two carpet factories had reached the point where no solutions could be found, unless they obtained support from other actants. The citizen group then initiated contact with the Monitoring Network of Reporting for Health and Environment, which is a nationwide CSO in the Netherlands. This CSO recommended that the citizen group approach the Science Shop for Chemistry at Groningen University, because they knew the Science Shop had been working with odour problems for several years and assisting local communities to address such problems with local authorities (Neubauer, 2002).

Bewoners van Gagels/Gagels 2 willen snel onafhankelijk onderzoek

Onrust over uitstoot fabriek

STEENWIJK — Een grote groep bewoners van de wijken Gagels en Gagels 2 is hevig verontrust. De stankoverlast van twee bedrijven aan de Meppelerweg, Betap en Crilux, is zodanig, dat bewoners zich moeten opsluiten in hun woningen of overwegen elders woonruimte te zoeken. Daarnaast rijst al jaren de vraag wat er uit de schoorsteenpijpen van deze bedrijven komt. Zijn het stoffen die gevaarlijk zijn voor de volksgezondheid? De bewoners willen een onafhankelijk onderzoek.

Naar aanleiding van eerdere berichten in deze krant over klachten van bewoners in de wijk Gagels, zocht Robert Stokkers contact met de wijkvereniging. 'Ook in onze wijk Gagels 2 zijn klachten over stank en kampen bewoners met gezondheidsproblemen', aldus Stokkers. Besloten werd de krachten te bundelen, vervolgens werd bij het meldpuntennetwerk Gezondheid en Milieu in Hengelo advies gevraagd.

Dag in Dag uit

1998

Woensdag 12 augustus:

Figure 23: An illustration of how the citizen group sought to debate their concerns through the media. The heading says: " Residents of Gagels/Gagels 2 want independent research – concern over emissions from plant" (Mulder, 2006; p. 4)

When the citizen group approached the Science Shop representative, one of the spokesmen of the citizen group described the citizen group's motive for doing so:

> *"The situation is that there is a lot of smell and smoke, and we did not know what to do. When we sit in our garden during the weekends, and are exposed to this awful odour, then it is really not a pleasure. Besides, there were rumours about cancer and other health related problems. So we decided we had to do something"* (One of the spokesmen of the citizen group in Neubauer, 2002: p. 72).

At the first meeting with the Science Shop representative, the citizen group expressed their concerns that the emissions from the two factories could be toxic, causing cancer, ugly smell and water pollution (Mulder & De Bok, 2006). The citizen group further explained which analyses and investigations the local authorities and the two factories had made previously. The Science Shop representative, who had worked with odour for several years and become an expert in odour problems, clearly saw a problem; the question was whether the problem was related to lack of scientific evidence of odour pollution or was a problem of lack of communication between the citizen group, on one side, and the local authorities and the two carpet factories on the other. To gain a more in-depth understanding of the problem, the Science Shop representative invited the citizen group to another meeting. At this meeting it became clear for the Science Shop representative that the problem experienced by the citizen group was in fact three different problems: odour, cancer and water pollution. The Science Shop representative explained to the citizen group that due to limited resources in the Science Shop, he would only be able to address one of the issues; he suggested addressing the issue where successful results could be reached

within a short period of time, which in this case was the odour problem. The citizen group's main concern was cancer risks, but the Science Shop representative explained to the citizen group that it would not be possible to obtain results from a research project focusing on cancer risks within a short period; to collect and analyse such data would take about two years. The Science Shop representative further argued that odour pollution would be easier to address, since two reports on this issue already existed. The citizen group accepted the arguments of the Science Shop representative and decided that the focus should be on odour pollution (Neubauer, 2002).

The Science Shop representative thus succeeded in translating the concerns of the citizen group into one single problem that could easily be assessed within a short period of time. The translation from cancer concerns to odour concerns was accomplished due to the Science Shop representative's ability to persuade the citizen group that short-term results were important. Having narrowed the problem down to odour, the next step for the Science Shop representative was to frame an obligatory passage point that he could persuade the citizen group to accept.

After having studied the material provided by the citizen group, the Science Shop representative realized that:

> *"…the fact that the three issues were considered together as one big problem had made it impossible to discuss them individually with the other stakeholders (local authorities and companies). The only communication had been through newspaper interviews (and especially headlines). In fact, the problem, as we saw it, was at least partly a problem of communication. We decided, after discussing it with the citizen group, to try and improve the communication instead of trying to win a legal case. If we would put the issue before a court, we feared it would be 'expert A' versus 'expert B' and nothing but delays would come out of it"* (Mulder, 2006: p. 3-4).

The Science Shop representative succeeded in yet another translation; a translation from a legal court case to improved communication between the actors. The Science Shop representative's idea was to conduct research exploring the odour emissions, and use these results as basis for creating dialogue between the citizen group, the local authorities and the two carpet factories.

The Science Shop representative therefore framed the obligatory passage point as: *Develop an independent assessment of the odour emissions from the two carpet factories to be used for creating dialogue between the citizen group, the local authorities and the two carpet factories*. By framing the obligatory passage point in this way, the Science Shop representative emphasized dialogue and independent research, two aspects that the citizen group itself was not able to achieve. The citizen group was persuaded by the Science Shop representative's arguments (results within a short time, odour easily assessed, and the

other part could win a legal court case), and they accepted the framing of the obligatory passage point. The citizen group meant they had no other choices. If they wanted to open the situation with the local authorities and the two carpet factories for dialogue again, they had to follow the recommendations of the Science Shop representative.

The way in which the Science Shop representative framed the obligatory passage point meant that, in addition to the citizen group, the network later needed to interest and enrol the local authorities, the two carpet factories, and a student to conduct the research. The network's framing of the obligatory passage point also meant that the network assumed that it would be possible to trace the odour emissions and the toxic particles in the reports and analyses made by the local authorities and the two carpet factories. Making this assumption also meant that the network did not question the methodology behind the measurement; the controversy involved how the measurements were calculated and analysed. If it turned out that the odour emissions and the toxic particles could not be traced, the network could face difficulties in upholding the obligatory passage point; however, at this moment of translation, the network can be illustrated like this:

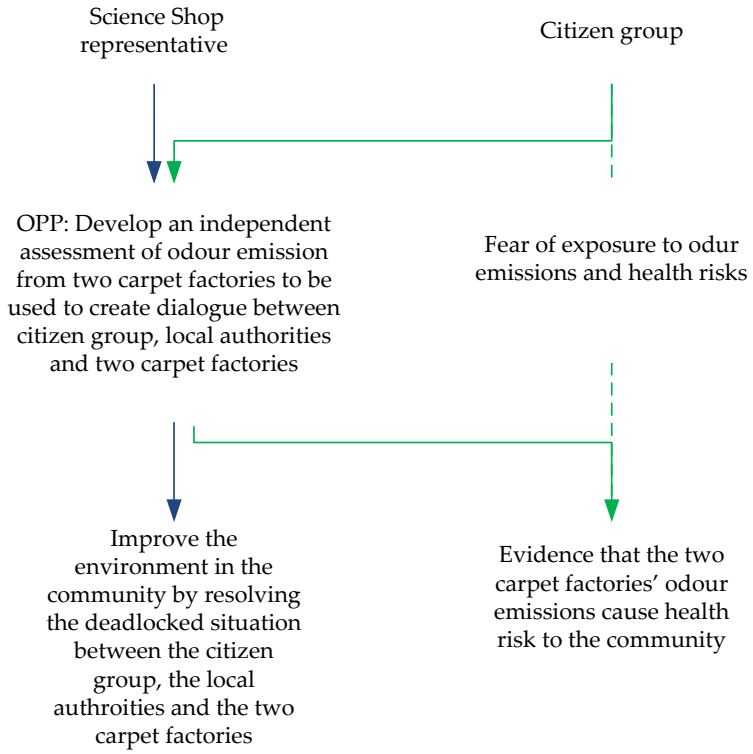


Figure 24: First alliances made – framing the obligatory passage point

As illustrated in the figure above, the goal of the Science Shop is different from the goal of the CSO. For the Science Shop, it is a question of loosening up a deadlocked situation between the CSO on the one side and the local authorities and the two carpet factories on

the other, whereas for the CSO, the assessment of the odour emissions from the two carpet factories is perceived as a means to pressure the local authorities and the two carpet factories to reduce odour emissions. The question arising from this is whether the two actors' different goals and motives for being persuading to enrol in the network contributed to or jeopardized stabilization of the network, and at the end, which consequences this may have had for the effects caused by the network.

Interessement: Persuading other actants to accept the obligatory passage point
Until this moment, the Science Shop representative had not tried to interest other actants than the citizen group. On the basis of the obligatory passage point, the Science Shop representative framed a research proposal and started searching for one or more students who would be interested in joining the network. One way the Science Shop made this search was through a catalogue stating the trainee possibilities offered by the Science Shop. This catalogue can be understood as an interessement device, according to Callon, because the Science Shop seeks to attract students to their projects through this catalogue, and thus draw them away from other projects.

One student responded to the project proposal, because he was looking for an interesting subject for his bachelor thesis. The student studied chemical engineering, found the issues of odour problems interesting, and decided to enter the network to conduct the research over a period of three months (Neubauer, 2002).

After the student had been persuaded to join the network, the research began. As part of the research activities, the student compared and combined the data from the technical reports produced by the local authorities and the two carpet factories in order to calculate a worst-case scenario for odour emissions. By plotting the data into a modelling programme, the student also calculated the amount of odour units and the components of the toxic chemicals emitted from the two carpet factories. The Science Shop representative supervised and trained the student throughout the whole research process, and also double-checked all the results, to make sure that no errors occurred.

The research found that there were no toxic emissions causing a health risks to the community. The level of the toxic emissions was a factor 1000 lower than the limits. It was found, however, that one of the carpet factories exceeded the odour exposure limitations (van der Werf & Mulder, 1999). After the student had arrived at these conclusions, the Science Shop representative invited the citizen group to a meeting to discuss the results and next steps to be taken. The Science Shop representative explained the conclusions of the meeting thus:

> *"Because the Science Shop is independent, and paid only by the university, we were a trustworthy source. We made our explanation very personal, including tales from our own families and friends, thereby showing the citizens that we understood […]. Thus,*

> *they also accepted our explanation that current emissions were a factor of 1000 below the strictest limits"* (Mulder, 2006: p. 5).

Despite the research and network activities, the network did not succeed in tracing the toxic particles – i.e. the particles did not behave as the network had assumed. The odour emissions were traceable, however, and the student's analysis concluded that the levels of odour emissions were higher than the legal limits (van der Werf & Mulder, 1999), and this result persuaded the citizen group to remain in the network, even though they had hoped for evidence of toxic particles as well.

The Science Shop representative and the citizen group agreed to approach the local authorities with the results of the research with the aim of again establishing dialogue between the actors. The local authorities agreed to meet with the Science Shop representative and the citizen group, and in 1999, a couple of weeks after the research had been completed, a meeting took place at the municipality of Steenwijk. The Science Shop representative, the student and the citizen group participated in the meeting together with a representative from the health department at the municipality, a councillor, representatives from the two carpet factories, and a representative from the CSO, Monitoring Network for Reporting for Health and Environment. The local authorities opened the meeting by trying to pressure the citizen group to accept their report, which stated that the two factories caused neither health risks nor odour pollution. The reason the local authorities were so anxious to convince the citizen group that they were not in danger was that the municipality planned to build a refugee camp in the area near the two carpet factories. If environmental problems were identified in that area, it would not be possible for the municipality to establish the camp, and the extra income the camp would bring to the municipality would be lost. The local politicians were also afraid that the Science Shop's research results would support the citizen group's concerns. The citizen group rejected the local authorities' arguments, because they distrusted the report they referred to. Then, the Science Shop representative explained that the research did not indicate toxic emissions and supported the conclusions of the technical report presented by the local authorities, arguing that he found the report scientific and independent. However, the Science Shop representative then said that one of the factories caused an odour problem. The citizen group argued that the odour problem occurred in specific situations, when product changes took place (Neubauer, 2002). The conclusion of the meeting was that the local authorities agreed to set up a steering committee to supervise odour mitigation research. The citizen group as well as representatives from the local authorities, the regional health inspectorate, the regional environment inspectorate, and the two factories became members of this steering committee. The Science Shop representative was also invited to be a member in the committee to assist the citizen group (Mulder & De Bok, 2006).

Through this dialogue, the Science Shop representative succeeded in persuading both the local authorities and the two carpet factories to enter the network by making them aware that odour did cause a health risk to the community. By establishing the steering committee, the local authorities assumed the role as the responsible authority. By persuading these actors to enrol in the network, the Science Shop representative, and thereby the network, succeeded in upholding the obligatory passage point. However, stabilization was not yet achieved, as the rest of the story shows. At this moment of translation, the network can be illustrated like this:

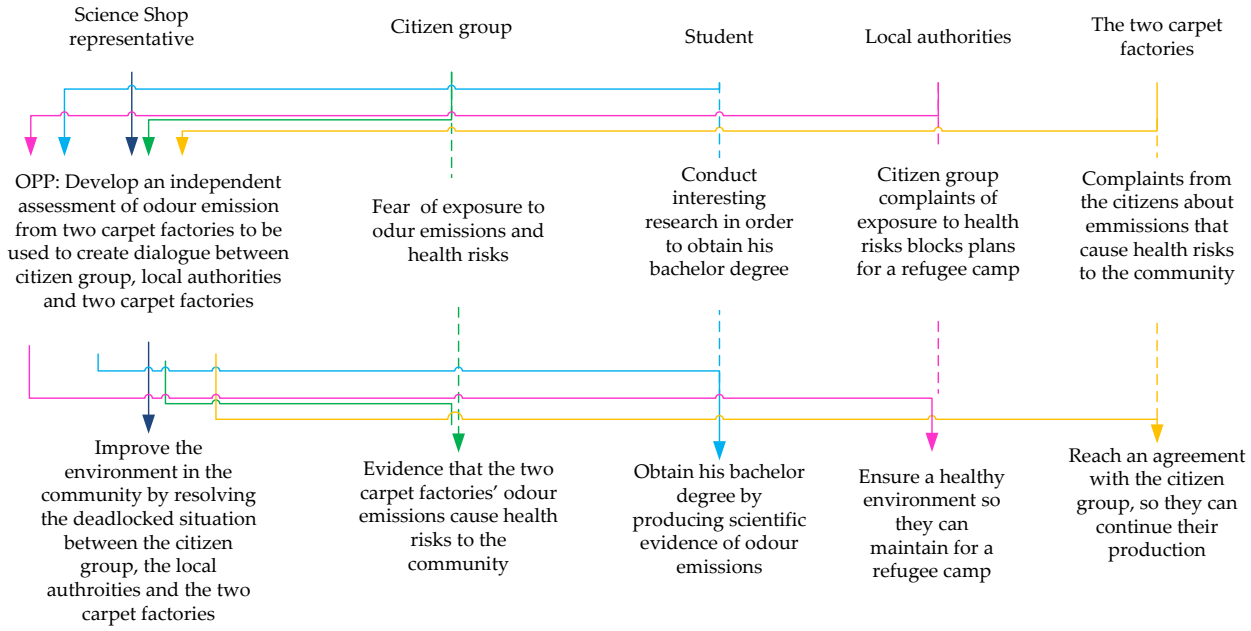


Figure 25: Illustration of problematization and obligatory passage point at the interessement moment of translation

As illustrated in the figure above, the network now consisted of the Science Shop representative, the citizen group, the student, the local authorities and the two carpet factories. It is interesting to note that especially the local authorities' and the two carpet factories' obstacle problems and goals seem very different from the CSO's obstacle problem and goal. All actors were persuaded by the obligatory passage point, however, and they agreed that upholding the obligatory passage point would assist them in reaching their goals.

After the meeting, a representative from the factory causing the odour problems approached the Science Shop representative with a request to establish co-operation with the aim to compare and discuss the Science Shop's results and the factory's results and measurements. The factory representative was convinced by the arguments of the Science Shop representative that they were causing odour problems to the community, and he and the factory wanted to take initiatives to avoid odour pollution (Neubauer, 2002).

During the research project the Science Shop representative had discussions with one of his colleagues from the Medical Science Shop at the Groningen University about the conclusions in the reports made by the local authorities. This colleague was an expert in environmental medicine, and he had pointed out another problem that had not been addressed before: asthma among children, which was especially problematic in situations of odour pollution. Based on discussions with the Science Shop representative, the expert and his research group had decided to carry out a research project aiming to explore the frequency of asthma among the children in the community (Neubauer, 2002).

Enrolment: Did the actants accept and play the role they were assigned?
During the first meeting in the established steering committee, all actors agreed to a common methodology to measure and monitor odour. The methodology was suggested by the Science Shop representative, and the investigations were to be carried out by the consultant company PRA-OdourNET.[34] The purpose of the work of the steering committee was to assess odour pollution from the different companies in the community (Neubauer, 2002).

At the same time, the research aimed at exploring the frequency of asthma among the children in the community had started. This caused disputes with the regional health directorate, which was sceptical about the research, even though it was their legal obligation to provide the information needed and to investigate the risks. The regional health directorate tried to stop the research, by arguing that the questionnaires were not validated or appropriate for investigating the relationship between children with asthma exposure to odour emissions. To overcome this barrier, the scientists produced the questionnaires themselves. Then, the regional health directorate argued that it was not allowed to register postal codes due to privacy legislation. If registration of postal codes were not be allowed, the research would be useless, since one of the most important parameters to measure regarding the correlation between children with asthma and odour pollution was the distance to the factories. The regional health directorate's refusal to allow registration of postal codes caused the citizen group to refuse to participate in the steering committee, even though this committee was not involved in the research project. The citizen group was however persuaded to return to the steering committee by the Science Shop representative, who also explained that other obstacles occurred that caused difficulties for the steering committee. For instance, the local authorities often postponed arranged meetings or proposed meetings which they knew important stakeholders could not attend. At other times, they forgot to invite all stakeholders to the meetings, and they even misplaced notes from one of the meetings – notes containing statements from all the

[34] PRA-OdourNET stands for Project Research Amsterdam – OdourNET.

stakeholders that they would concur with the outcome of the odour mitigation research (Neubauer, 2002).

Although the local authorities had committed themselves to the network and had taken responsibility to organize the steering committee meetings, they actually attempted to withdraw from the network by being unorganized and trying to sabotage the meetings. The local authorities did not succeed in withdrawing from the network, however, since the other actors kept pulling them into the network again, making them live up to their responsibilities as a local authority.

At this moment of translation several translations were made by the Science Shop representative that could have caused the lack of both interessement and enrolment of the citizen group, even though it did not cause this. The citizen group hesitated especially when the results of the Science Shop project showing no toxicity became known to them, because these results did not support them. But as the story will show, the Science Shop succeeded in keeping them enrolled in the network by suggesting communication with the authorities by means of a complaint telephone.

Until this moment, the Science Shop representative also seemed to be enrolled in the network, as indicated by his accept to be a member of the steering committee. The Science Shop representative could have chosen, if he had not been fully enrolled, to refuse to participate in this network, since the role of the Science Shop representative in principle was only to assess the technical reports made by the local authorities. However, in order to uphold the obligatory passage point, the Science Shop representative accepted the role the local authorities assigned him: to support the citizen group in the steering committee.

The factory identified in the Science Shop research as responsible for producing odour pollution, recognized their responsibility and established dialogue with the Science Shop representative. This indicates that the factory was enrolled in the network and wished to comply with the obligatory passage point.

Eventually, the steering committee agreed to the choice of factory for the further investigation, and the consultant company could finally begin its measurements. The findings of the investigation showed that the factory did not exceed the official limitation for odour pollution. This meant that the steering committee could not force the factory to reduce its odour emissions by legal measures. These findings were difficult for the citizen group to accept, because they experienced discomfort from odour from this particular factory (Neubauer, 2002). The Science Shop representative knew that the findings could again cause a critical situation between the local authorities and the citizen group, if the local authorities were to conclude that this meant that there was no problem. So the Science Shop representative suggested that the local authorities should establish a

complaint telephone that was open 24 hours, seven days per week. The local authorities agreed to this solution and implemented the complaint telephone line with the help of the provincial authorities. The Science Shop representative explained his motives for this suggestion thus:

> *"The citizens had complained about peak emissions and felt they weren't taken seriously, so we saw a 24/7 line as a solution to mitigate their stress—which mainly occurs when people can neither escape nor influence the source of stress. The phone line, and the subsequent action and feedback of the regulators, would again give citizens some control over the situation"* (Mulder & De Bok, 1996: p. 6).

By suggesting a complaint telephone, the Science Shop representative succeeded in keeping the citizen group enrolled in the network, because through this interessement device, the citizen group would be able to inform the authorities about peak hours when odour exposure was at its highest. When the Science Shop representative, at the problematization moment of translation, translated their concern from one big problem into three separate problems, and recommended that only one problem should be dealt with, the citizen group accepted this translation, even though they perceived the cancer problem to be more serious than the odour problem. The citizen group's acceptance of this translation and their continuous work for the network throughout both the Science Shop research and work in the steering committee, indicates their enrolment in the network. The interessement devices used by the Science Shop representative to keep them enrolled were: 1) the Science Shop's independent research, 2) communication between all actors was the only way to solve the odour problem, and 3) the complaint telephone line.

Mobilization: Speaking on behalf of others?

It is concluded so far that the actants – maybe with the exception of the local authorities – seemed to be fully enrolled in the network. The question is, however: Did the actants also succeed in mobilizing those who they were expected to represent?

The Science Shop representative was a member of an odour platform, a working group for research and policy advice. He presented the findings of both the Science Shop project and the odour mitigation research at one of the platform's biannual national conferences, and through his presentation he managed to bring the concerns of the citizen group into a network consisting of other scientists and policy makers. As the Science Shop representative explained:

> *"Some of our technical concerns have also been taken up in the long-term planning of this platform, which is an example of communicating science from citizens to research"* (Mulder & De Bok, 1996: p. 6-7).

The director of one of the factories participating in the steering committee suggested continuing the steering committee even after the odour mitigation research was finished. The Science Shop representative explained:

> *"The director of one of the factories even asked if our regular meetings could continue, since he now saw the value of more contacts with the neighbourhood. One of the meetings had been held at the factory, and this took away some of uneasiness as well; if one knows what is behind the fence it may become less threatening"* (Mulder, 2006: p. 6).

The factory director's wish to continue the steering committee meetings indicates that he had become enrolled in the network; he had been persuaded by and accepted the obligatory passage point.

Despite the fact that the network succeeded in making the local authorities implement the complaint telephone, it is not possible to analyse to what extent the actors succeeded in mobilizing the groups or institutions they represented, since in the material available, all actors are discussed only as organized groups. The citizen group is not represented by one specific individual, nor are the local authorities represented as individuals but rather as the institution itself. The same applies to the regional health and environment directorate and the factories. The only sign that could indicate that the citizen group did represent the community was the discussion of the Science Shop representative and the citizen group about the importance of reporting back to the community all the findings and conclusions of the two research projects. It is clear, however, that when the student finished his research, he disappeared from the network, indicating that while he was enrolled in the network during his research, he was not enrolled to such a degree that he stayed in the network after the research was over.

Epilogue: Effects of the network alliance

This story is about an EEA in which the actants in the network succeeded in reaching a stable state, thereby avoiding further odour exposure to residents in the city of Steenwijk. By redefining and translating the concerns of the citizen group into one concern – exposure to odour pollution – the network succeeded in reopening a conflict which in the beginning seemed locked.

Like the previous three cases (cases A-C), this case also reflects the complexity of stabilization, although in another manner than in the previous cases. In this case, the network did not fully succeed in obtaining sound scientific evidence of odour pollution, i.e. in upholding the obligatory passage point. Nevertheless, the network succeeded in persuading some of the actors that had resisted the network (the two carpet factories and the local authorities) to enter the network, through the framing of the obligatory passage point aiming at mediating and seeking consensus. The indication that the network reached

some sort of stabilized state, despite the fact that the obligatory passage point was not upheld, adds yet another aspect to understanding stabilization in the terms of ANT. This case seems to indicate that stabilization of networks may be achieved even when the obligatory passage point is not fully upheld. What seems important is that the network perceives that the problem is solved and not necessarily that that obligatory passage point is upheld.

Returning to the discussion about the relationship between stabilization and effects, this case (like the previous case C) succeeded in affecting the issue in question, even though the network did not fully uphold the obligatory passage point. The two carpet factories and the local authorities accepted that in some situations the factories caused odour pollution, and to meet the concerns and claims of the citizen group, the Science Shop representative, and the scientific report produced by the student, they agreed to establish a steering committee as well as a complaint telephone. The implementation of this complaint phone contributed to keeping the citizen group persuaded to continue in the network, since this interessement device would open up for the possibilities for people in the community to inform the authorities when odour problems peaked. Furthermore, due to the research of the Science Shop, one of the factories also agreed to reduce their odour emissions, and the other factory, which was not obliged by law to reduce their odour emissions, also agreed to take initiatives to reduce their odour emissions.

The framing of the obligatory passage point in this case also deserves some attention, since I have observed some differences that can affect the stabilization of networks. In cases A and B, little impact could be observed as a result of network activities, whereas in this case, as well as case C, the networks succeeded in impacting the issues around which they were created. By reflecting on the framing of the obligatory passage points, we can maybe find an explanation as to why these differences in effects occurred. In cases A and B, the obligatory passage points were framed around upholding facts of scientific interest, whereas in cases C and D, the obligatory passage points were framed around upholding facts of scientific interest *as well as* seeking dialogue or using legislative means to make sure the claims of the citizen groups were addressed and solved. In the cross analysis (chapter 5), I return to this discussion, since it seems that the role assumed by the Science Shop representatives may impact the network's ability to impact the issue in question.

To complete this story, effects not directly linked to the Steenwijk community are also evident in this case. First, the Science Shop representative reported the findings and experiences to the odour platform of which he was member. And the odour platform later discussed the technical concerns of this specific citizen group and how to measure and document odour pollution. Secondly, a research project aiming to explore the relationship between children with asthma and their exposure to odour pollution was initiated, because the Science Shop representative had discussed the citizen group's concerns with a

colleague and expert in children and asthma, and he found the citizen group's concerns relevant for further investigation.[35]

The next case (case E) originates from a third Dutch Science Shop, the Science Shop for Economics at Groningen University. It differs from case D and the other cases by addressing air pollution connected with the aviation industry, and it illustrates as well how translations made by both Science Shop and scientists can end with an outcome that is almost unrecognizable for the CSO. The case also differs in the sense that the CSO in this case is a nationwide CSO, whereas in the cases discussed until now, the CSOs have been locally based CSOs, created around locally experienced problems.

[35] Results from this research were not available, when I gathered material for this case.

4.5 Case E: The Board Game

- The story about the fatal mistake of assuming that a board game can reflect the position of the aviation industry

This story is about an EEA which ended as a fatal mistake, although the network successfully managed to uphold the obligatory passage point by creating an artifact. The EEA was created on the basis of a larger CSO's interest in scientific knowledge exploring whether transition was possible for the aviation industry. This need for knowledge was translated by both the Science Shop representative and the scientists involved into a question of developing a board game. This translation had fatal consequences for the network, since the Science Shop's action resulted in a board game that failed to provide the information needed by the CSO.

The lessons to be learnt from this EEA, compared to the previous four cases, is that it is crucial to frame the problem, i.e. the obligatory passage point, to suit all actors, if the network is to cause effects to the issue of concern. In this case, the Science Shop representative succeeded in persuading both the representative from the CSO, the student and the supervisor to accept the obligatory passage point framed by him, but as the story shows, none of these actors were fully persuaded to work for the network. Furthermore, the two scientists enrolled in the network had their own agenda, which was incompatible with the CSO's focus on the problem of transition in the aviation industry. For these two scientists, the board game was an opportunity to combine scientific areas, such as simulation and sustainability, and not so much to contribute to developing the CSO's knowledge about transition strategies.

Problematization: Is transition in the aviation industry possible?
Prior to the time this story took its beginning in 2004, a debate had been going on for 10 years in the Netherlands about air pollution and emissions from major airports. Friends of the Earth Amsterdam (Milieudefensie) in the Netherlands was working on a project entitled 'Network and Capacity Building: Air Travel and Climate Change', funded by the Dutch Ministry of Housing, Spatial Planning and the Environment. The aim of this project was to gain new information about the aviation sector with regard to emissions, fuel charges etc. in order to discuss whether transition in the aviation industry would be possible. Milieudefensie involved citizens in several events and also thought it would be beneficial to learn more about the position of the aviation companies. Politicians all agreed that something needed to be done, since the impact on the environment from aviation was increasing. The aviation industry, however, claimed that it was impossible to make changes that would reduce their emissions. Therefore, the question for Milieudefensie was: *Is transition possible in the aviation industry?* To be able to answer this question, scientific research on this issue was necessary.

Figure 26: Activists from Milieudefensie campaigning against the Schiphol Airport, claiming the airport causes too high emissions (Picture: Milieudefensie)

Milieudefensie recognized that if they began to claim that transition in the aviation industry was possible, they needed scientific evidence to support their claim, evidence that was based on independent research. The organization did not have resources or capacity to conduct such research, but a representative from Milieudefensie had previously co-operated on other issues with the Science Shop for Economics at Groningen University. He decided to approach the Science Shop to discuss the possibilities for project co-operation focusing on the need for scientific knowledge about transition possibilities within the aviation industry.

Milieudefensie's request to the Science Shop was that they had *"…a need to know more about the position of the aviation sector, and hopefully show how the aviation section can change without going bankrupt"* [CSO representative].

When Milieudefensie approached the representative of the Science Shop for Economics at Groningen University, he had just developed a board game on social responsibility. Through work with this board game, the Science Shop representative realized that when designing board games, the focus should be on a specific market or area, in order for it to be used as a tool by politicians, CSOs, industry etc. Based on his experiences with his recent work with board games, he thought of the idea of developing a new board game with focus specifically on the aviation industry. The Milieudefensie representative accepted this translation by the Science Shop representative, although it was not exactly the kind of research the Milieudefensie representative had been interested in; but he

thought it sounded interesting. The Science Shop representative thus succeeded in persuading the Milieudefensie representative that their need for scientific knowledge could be obtained through the development of a board game. The Science Shop representative's argument was that this was the only way the CSO could satisfy their need for knowledge (i.e. their obstacle problem) within the half-year period that is the amount of time students have for such research projects. Through the translation made by the Science Shop representative, the problem was changed from an interest in scientific information about whether transition within the aviation industry is possible, to a need for a board game in order to highlight through dialogue with the aviation industry the possibilities of transition within the aviation industry. By framing the problem like this and persuading the Milieudefensie representative to accept this framing, the Science Shop representative thereby made himself indispensable for the network; if Milieudefensie were to gain the necessary knowledge, it had to go through him and the Science Shop.

Until this time, neither the Science Shop representative nor the representative of Milieudefensie took any initiatives to establish contact with the aviation industry, in order to include them in the framing of the problem. This indicates that the two actors did not consider the aviation industry to be an important actor in this phase.

The Milieudefensie representative fully accepted giving the representative of the Science Shop the role of translator. Milieudefensie became busy with other issues arising in society and decided not to try to make alliances with other actors in connection with gaining scientific knowledge about the possibilities of transition in the aviation industry.

With the obligatory passage point defined as the development of a board game, the next step for the representatives from the Science Shop and the CSO was to clarify specific research objectives linked to the development of the board game that could interest a student and a supervisor. The procedure in the Science Shop for Economy is to launch a project idea based on a client's needs, and then find a student or students to conduct the research and a supervisor to supervise the project, together with the Science Shop representative. In order to attract a student within the field of economy, the Science Shop representative knew it was important to define the project with a high degree of research freedom while still based on the client's needs. Based on these considerations and negotiations between the Science Shop and Milieudefensie representatives, the research objectives for the project were defined thus:

> *"We wanted to have a game which could involve stakeholders in the airline industry, which could be captains of the airline industry, lobby organizations, politicians. […] We wanted to have, or Milieudefensie wanted to have this active debate about whether or not the policy should change on air pollution"* [Science Shop representative].

More precisely, the aim of the project became to develop a board game around corporate social responsibility and climate change in the airline industry. The network assigned the board game the role of communication instrument for different stakeholders with widely different 'mind frames' in order to facilitate better informed debate among stakeholders around the main policy issues.

At this point in time, the problematization and obligatory passage point can be illustrated like this:

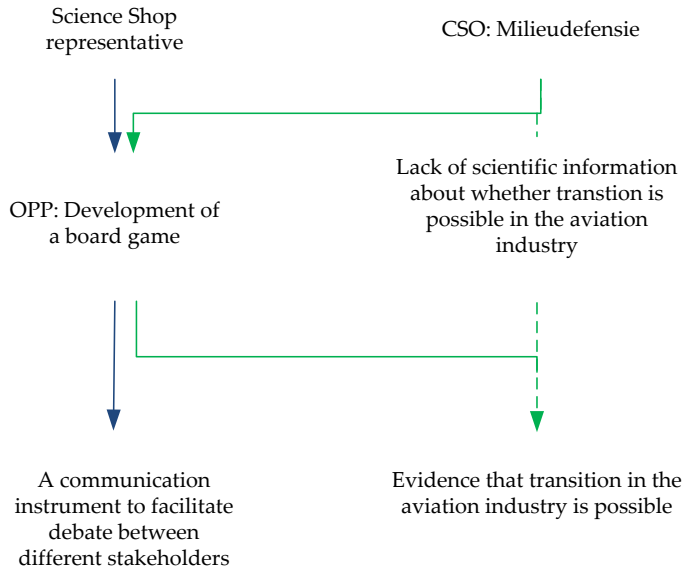


Figure 27: First alliances made – framing the obligatory passage point

As the figure above illustrates, the goals of the Science Shop and the CSO differed; the Science Shop's motive for engaging in the network alliance was to develop a communication instrument, whereas the goal of the CSO was to achieve scientific evidence to support their claim that transition is possible in the aviation industry. The question arising from this is whether the two actors' different goals and motives for being persuaded to enrol in the network contributed to or jeopardized stabilization of the network, and at the end, which consequences this may have had on the effects caused by the network.

Until this moment, the only actors the Science Shop representative sought to interest was the CSO. Other actants were not yet sought interested, since it was important for the Science Shop representative to place himself in the role of translator defining the obligatory passage point.

Interessement: Persuading other actants to accept the obligatory passage point
The next step for the network was to interest one or more students in the project. One means the Science Shop used to interest students was a mailing list consisting of students interested in receiving news from the Science Shop. This list can be understood as an interessement device, since it was used to formulate projects and persuade students to accept the framing of the problem, thus preventing them from being enrolled in other networks. When the Science Shop representative had formulated the project objectives, he sent the project proposal to the students on the list, hoping to interest one or more students to work on the project.

One student responded to the request on the mailing list, because he was looking for a good subject for his master's thesis and had an interest in sustainability issues. He had never before worked with sustainability issues, but he felt that the opportunity to do research within the field would be a good way for him to gain more knowledge about the issue. So although sustainability had not been intended as an interessement device, it served as such in the process of persuading the student to enter the network.

The scientist who became the student's supervisor remembered the story a bit differently than the student. He stated that he knew the student from one of his courses, and that the student was interested in doing his master's as a kind of internship at Marshall electric guitar amplifiers. But when the supervisor happened to meet the Science Shop representative, they discussed the possibilities of the project. The supervisor found the project interesting and asked the student if he might be interested in the topic. The supervisor's background was social simulation complexity studies, and he thought it could be interesting to explore the dynamics of the topic through a board game. Also in relation to the supervisor, the Science Shop representative understood how to use different interessement devices to interest other actants. The Science Shop representative succeeded in interesting the supervisor in the problem to such an extent that he persuaded the student to engage in the project as well. This illustrates how network relations can be used as interessement devices.

With the student and his supervisor persuaded to enter the network, the next step was to frame the research project and get it started.

The student and the supervisor suggested testing the possibilities of simulation models to explore how they can play a role in increasing insight into the problem. As the student expressed it:

> *"This was partly initiated by my supervisor; he is someone who, has quite some experience with simulation models from the consumer perspective, consumer behaviour. I was interested in sustainability consumer behaviour*

and simulations. And I wanted to combine the three factors in my thesis" [Student researcher].

Despite this translation, the Science Shop representative managed to interest the student and the scientist without having to change the project objectives, seeking to uphold the obligatory passage point; however, all the actors involved had different obstacle problems and end goals. Figure 27 can now be extended to also include the student's and supervisor's interests:

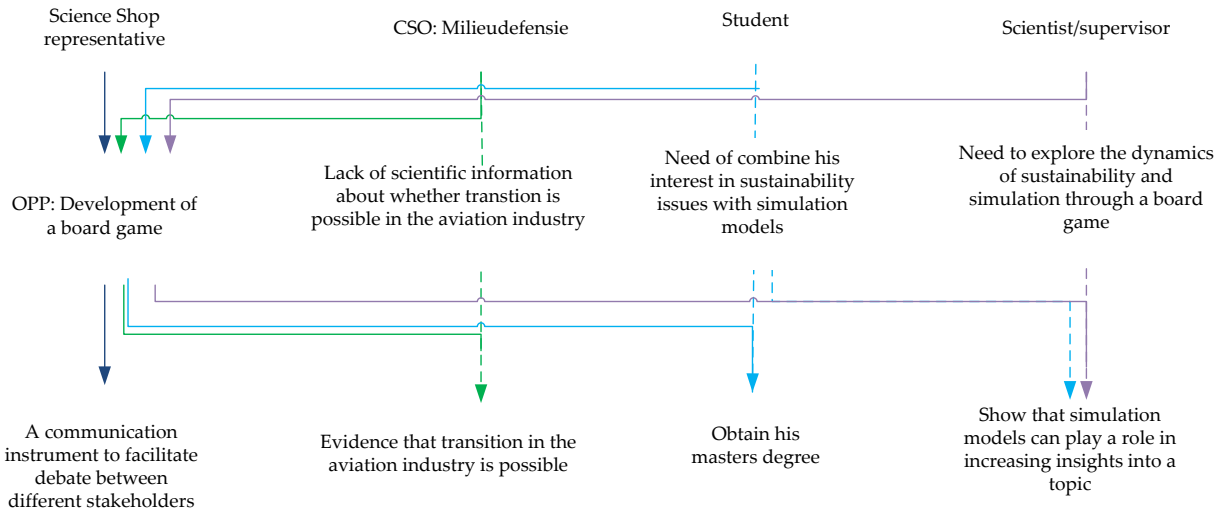


Figure 28: Illustration of problematization and obligatory passage point at the interessement moment of translation

As the figure above illustrates, it is now not only the Science Shop's and the CSO's goals that differ; the scientist's and student's goals also appear very different from especially the CSO's goal. As the story shows, this also proved to be problematic for the network, especially for the CSO.

The Milieudefensie representative accepted the student's and supervisor's ideas for the project, and the project was able to start. As the story later shows, this acceptance may not have meant that the representative was fully persuaded into the network, or at least the framing of the obligatory passage point caused him to lose interest in the network. The translations made by student and the supervisor did not relate to the CSO's initial problem, and this caused the network to fail to keep the CSO representative in the network to the extent that he was willing to work for the network's success.

During the project period of eight month in 2004-2005, there was very limited co-operation between the student and the CSO. The CSO had several other projects related to other issues, so this project was not given the organization's highest priority. Normally, the

representative stated, Milieudefensie is very active in their projects with the Science Shop, but due to a heavy workload they were not able to follow the project as closely as they usually did. The representative did however help the student by finding relevant material and having discussions with him. That the CSO did not follow the project as closely as they had done in other co-operations with Science Shops, indicates that the Milieudefensie representative was not fully persuaded to work for the network and the obligatory passage point (the board game) that the Science Shop representative had defined from the beginning. The CSO representative did not resist or oppose the alliance, but on the other hand, he did not seem interested in the network and its activities to uphold the obligatory passage point (developing the board game).

The student managed to develop a board game, thus framing its role. The game resembled a monopoly game; the player travels around the edge of the board. The game was constructed around political lines, so the player travels from a left-wing political regime to a right-wing political regime, depending on the kind of investments the player makes. The board game included a small booklet, explaining the rules (Wolsink, 2005).

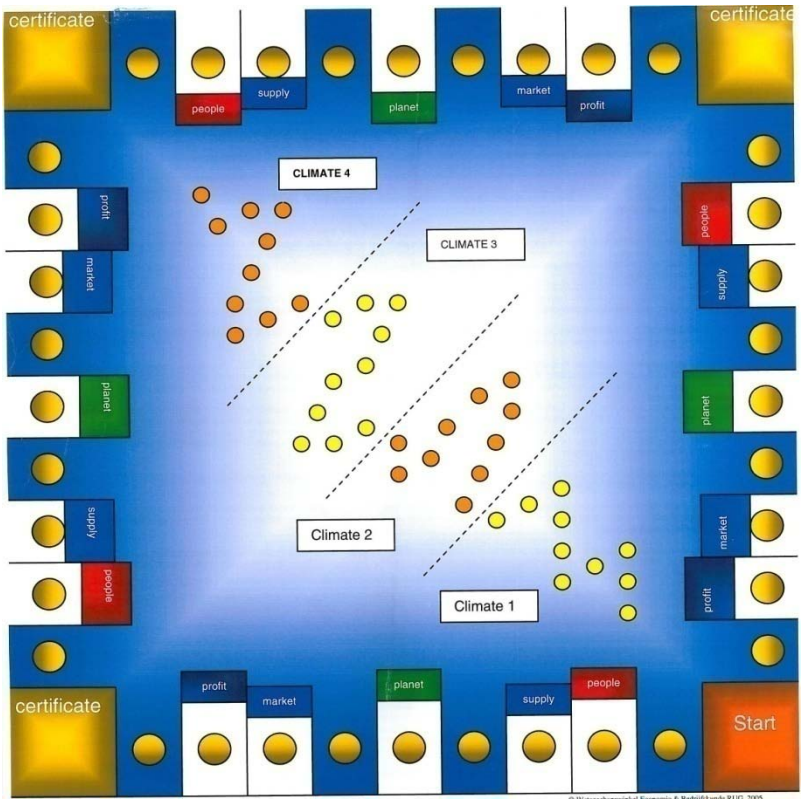


Figure 29: The board game developed and designed by Arnold Wolsink (Picture: Arnold Wolsink)

The CSO's heavy workload also meant that it was not engaged in the process of organizing any kind of event to test the game after the student had developed it. After the Science Shop representative pressed both the CSO representative and the student to test

the board game, the CSO invited the student to a conference for Friends of the Earth's members in Brussels to show colleagues what they were doing. The CSO asked the student to lead and guide the participants in playing the game. The student's impression afterwards was that playing the game was a valuable experience for the players. It gave them an understanding of the different perspectives of the problem, which was one of the basic goals of the game; it could serve as some kind of agenda-setting tool. When playing the game, the player gained experience in other people's tactics. The CSO representative's experience of the test was different than the student's. He said that the game was too time consuming, and that it did not give any new insights to the people playing the game. The CSO representative also mentioned that his initial intention was that when the game was developed, he and his organization would invite stakeholders from the aviation industry to play the game; but after the test, he realized that the game was not interesting enough to try to interest other actors. This meant that he did not try to use any interessement devices to interest the aviation industry. Although the board game was developed, it was not able to perform the role assigned to it by some of the enrolled actors (the Science Shop representative, the student, and the student's supervisor), which was to work as a communication instrument. The board game's failure to assume a role as a communication instrument caused the CSO to refuse to accept it and use it in efforts to debate transition possibilities in the aviation industry.

Enrolment: Did the actants accept and play the role they were assigned?
Until this moment, the network consisted of the Science Shop representative, the Milieudefensie representative, the student, and the supervisor, and to some extent the board game and the booklet. But also the airline industry, the politicians, the lobbyists, and the question of whether it is possible to reduce emissions from the airline industry played a role; they were not direct actors involved in the network, but they were all assumed certain behaviour. The airline industry was assumed to behave as not interested in reducing their emissions; the politicians and the lobbyists were assumed to question whether it was possible without having bankrupting the airline industry. And the question – *is transition in the aviation industry possible* – was a question that the board game failed to answer. The question now became: Did the Science Shop representative succeed in enrolling the actants into the alliance?

The Science Shop representative did not approach politicians or other stakeholders relevant for the game. The Science Shop representative said that this should be the task of Milieudefensie. The Science Shop representative also mentioned that it was not the role of the Science Shop to organize events, since their role was as an independent party and developer of the game. The Science Shop representative would however have participated in such an event had it been organized.

The CSO representative was not persuaded to organize an event for all the stakeholders to test the game; and this indicates that the Science Shop representative did not succeed in enrolling the CSO in the network. The CSO had 30 copies of the game produced, but it has only used the game as a gift when approaching the airline industry and the government. Since the representative felt that playing the game did not give new insights but was very time consuming, he did not want to engage people from the airline industry. The student also wrote a scientific report that was given to both the Science Shop and Milieudefensie, and although the CSO representative thought that it was an interesting report, it could not be of use in policy work.

The student's supervisor was also reluctant to have the board game played by others than members of Milieudefensie, because he did not find the board game sophisticated enough to be presented to the industry or politicians.

Mobilization: Speaking on behalf of others?
The game has not been used as intended – it was not developed to its full extent due to the complexity of developing such a game within the short timeframe. The game was never tested or played by all the stakeholders – the air industry, lobbyists and politicians – which was the initial intention. This indicates that although the network succeeded in upholding the obligatory passage point, it failed to enrol other actors to accept the obligatory passage point, since the CSO did not engaged themselves in the process of enrolling other actors into the network.

The Science Shop representative defined the obligatory passage point as developing a board game, but in the end he did not succeed in interesting the CSO representative, the student or the supervisor to the extent that they succeeded in mobilizing those on whose behalf they should speak.

Epilogue: Effects of the network alliance
This story is an example of an EEA that ended as a fatal mistake, even though the actants enrolled into the EEA succeeded in upholding the obligatory passage point and managed to develop the board game that was the network's goal. According to Latour and Callon, upholding the obligatory passage point should point towards some kind of stabilization of the network, but in this case, this is questionable. It seems that the CSO withdrew and lost interest in the network already at the initial problematization moment of translation. The question is, however, why did the CSO lose interest in the network and why did the board game fail to meet the CSO's needs and thereby contribute to the CSO's process of debating emissions with the aviation industry? Milieudefensie's initial problem when approaching the Science Shop was to gain scientific evidence to show that transition within the aviation industry was possible. This initial problem was translated to such an extent, without the translations being returned to the initial obstacle problem, that when the obligatory

passage point was framed, the CSO could no longer identify it with the problem. An obvious question that then arises is why the CSO did not resist this translation. The answer could be that they did resist; the lack of interest in the development of the board game and lack of initiatives to organize a test event with the aviation industry and politicians were indications of the CSO's resistance. Perhaps the CSO did not actually work against the network, but it clearly did not work for the network's success.

Since the network did not reach a stable state despite the development of the board game, the EEA ended with no impact on the initial problem.

One question which emerges is: why this fatal mistake of developing a board game? One explanation may lie in the motives some of the actors had for entering this alliance. Both the Science Shop representative and the two scientists (the student and the supervisor) had their own agendas, which in principle could have worked but turned out to be incompatible with the CSO's obstacle problem of achieving scientific evidence of the possibilities of transition in the aviation industry. It seems that these three actants did not consider the obstacle problem, and returning the translations to this obstacle problem, to be important. It also seems that they entered the network due to a wish to develop a board game and not necessarily due to a wish to debate emissions from the aviation industry. It is here the fatal mistake occurred: the motives and interests of the actors were not compatible with the obstacle problem of the CSO. In principle, the board game and social simulation could have been compatible with the obstacle problem of the CSO, if the Science Shop representative or the scientist had been able to persuade the CSO about the possibilities of using simulation models, and how they would be able to contribute to creating dialogue between different stakeholders.

The unstable state of the network is reflected in the use or lack of use of the board game. The board game was never used as initially intended by the CSO. It was never played by the aviation industry; it was only sent as a gift to some of the airline companies at Schiphol Airport in Amsterdam. This was a deliberate choice made by the CSO, when the board game had been developed.

Compared to the previous cases (cases A-D), this case really stands out due to the fatal translations made by both the Science Shop representative and the two scientists. In none of the other cases were translations of the CSO's initial problem made that ended up being unrecognizable by the CSO. In cases A and B, the networks also failed to impact the initial problems of the CSOs. In these cases, however, this might have been due to the scientists' and the Science Shop representatives' unwillingness to become involved in discussions not directly linked to the scientific importance of the obligatory passage points. In this case, the failure was due to the Science Shop representative's and scientists' unwillingness and ignorance in relation to the CSO's initial problem.

Despite the fact that the network never succeeded affecting the debate, which was the CSO's initial goal, the development of the board game impacted other arenas, i.e. caused other effects. The model of combining board games with simulation demonstrated to the research community at the university that simulation can lead to greater insight into sustainability issues. This aroused the interest of the university in proceeding along these lines. At the time of my interview, the Science Shop was in the process of applying for a research project to develop a board game for the wood industry in the Netherlands, with the intention of using some of the issues and ideas from the board game developed for the airline industry.

The next case (case F) also involves a nationwide CSO. What makes this next case special, compared to the other cases, is that the CSO needed assistance to develop a physical artifact rather than to document an experienced problem.

4.6 Case F: The Bicycle Apparatus Case

- The story about developing an artifact to measure road and air quality for cyclists

This story is about an EEA that succeeded in upholding the obligatory passage point, which was to develop an artifact, an apparatus for a bicycle to measure air quality on roads and bicycle paths. After having succeeded in upholding the obligatory passage point and succeeded in developing an artifact to meet the needs of the CSO, the network dissolved. The CSO was however able to create new alliances outside this network by being enrolled in a new network with the aim to assess the actual exposure of cyclists to air pollution in four European cities. This story thus illustrates that a CSO's request to a Science Shop can affect regulation agendas.

This case is of interest in illustrating the complexity of stabilization, since it seemed that the network became stable while the artifact was being developed. But as soon as the artifact was developed, some of the actors withdrew from the network, seeing their role as finished.

Problematization: Measuring air quality in connection with traffic

During the period 2000-2008, the nationwide Dutch cyclist union, Fietsersbond, which represents the interests of cyclists in the Netherlands, was working on a nationwide project to monitor the quality of roads and bicycle paths. With funding from the Ministry of Transport, the CSO explored the conditions for cyclists in Dutch municipalities (Fietsersbond.nl, 2009). As part of this monitoring, the CSO wanted to extend the measurements of road quality to also include measurements of air quality on roads and paths. This would give the cyclists the opportunity to choose roads with less air pollution when cycling from one place to another.

Figure 30: Logo for the road planner for cyclists developed by the CSO (Picture: Fietsersbond)

The CSO had already constructed a bicycle with an apparatus to measure the quality of roads and paths as the bicycle passed, but now they needed an apparatus that could help them measure air quality.[36]

The CSO thus needed scientific advice regarding what kind of apparatus could measure air quality, what should be measured, how often and how the data should be interpreted (den Breejen, 2004). Within the CSO, a scientist was already working on the programme to monitor road quality, and this scientist had several ideas about how to extend the monitoring programme to cover air quality as well, but he did not feel he had the specific scientific knowledge or the time required to extend the monitoring programme. According to the Science Shop interviewee, air pollution from traffic was often debated in the media during this time, and one professor from the Department of Environmental Epidemiology at Utrecht University was often interviewed and quoted; he argued that exposure to traffic pollutants could impact human health. Due to the professor's visibility in the public debate, the CSO approached him with their request. The professor found their request and ideas interesting, and recommended that the CSO approached the Science Shop for Biology at Utrecht University. If the Science Shop agreed to take up their request, he and his research group would be interested in being involved in the research. Although the CSO did not succeed in making an alliance with the professor at first, they did manage to interest the professor to the extent that he recommended they established contact with another actor, and held out the possibility of becoming involved subsequently. For the professor, it was important that the Science Shop was part of the network, because this actor would carry out the tasks of framing the research proposal as well as all communication and co-ordination throughout the project period.

The Science Shop concept was known to the CSO; it had previously co-operated with different Dutch Science Shops, most recently with the History Science Shop at Utrecht

[36] This analysis is based on written material (a master's thesis and articles from the CSO's website), as well as an interview with a representative from the Science Shop that mediated the research project. This representative was not directly involved in the project; a colleague no longer working at the Science Shop facilitated the network. It has not been possible to establish contact with either the representative from the organization, the student conducting the research, or the scientist supervising the research, even though I have tried to contact them several times by both email and telephone. At one point I succeeded in contacting one of the scientists supervising the research project, but after interview appointments had been cancelled both by her and by me, the contact was lost; she did not respond to my later requests. It is difficult to say why the contact from the organisation never replied; he may have been too busy to spend time on the interview. The student conducting the research had graduated, and no new contact information was available. Therefore, this story is based partly on written material and partly on second-hand experiences, and not on interviews with the involved actants, which is critical according to the ANT perspective, since the Science Shop interviewee may have interpreted and translated the activities. I have chosen to include this case study, however, because the story shows that this small student project could be used in a EU financed research project. Therefore, the case does contribute to my understanding of whether and how Science Shop alliances can impact the issues they are created around.

University, with the aim of writing the history of the organization as part of its twentieth anniversary activities. The CSO approached the Science Shop for Biology at Utrecht University with the request of extending their monitoring programme to include measurements of air quality. The CSO requested specific assistance with regard to scientific knowledge about which apparatus could help them measure air quality, which measurements to take, the frequency of measurements, and the treatment and interpretation of the resulting data.

The Science Shop found the request very interesting and relevant, since one of their interest areas was health impact on humans from traffic. Since the professor had already shown his interest, the Science Shop accepted the request, framing the project as: *Development of an apparatus for a bicycle to measure air quality on roads and bicycle paths*. This framing of the project came to function as the obligatory passage point, and through this framing, the Science Shop representative succeeded in persuading the CSO to enter the network completely. At the same time, he made himself indispensible for the network, since the professor would only become involved in the network around the obligatory passage point, if the Science Shop framed the network. Without successfully upholding the obligatory passage point, the CSO would not be able to achieve their goal of extending their monitoring programme and obtaining the data they needed.

The Science Shop interviewee[37] explained the CSO's motives and interests regarding the scientific knowledge framed in the obligatory passage point as follows:

> *"What does it mean when you ride your bike and [you are exposed, ed.] to this air pollution, could you better make an alternative choice through another road where there is less air pollution? So they wanted to have more information that they can put into a map in their yearly monitoring study, not only how the road is to cycle, but also how the air pollution is with that specific road"* [Science Shop interviewee].

The apparatus to measure the road quality also became an actant at this moment of translation, since upholding the obligatory passage point required that the apparatus could monitor both road quality and air quality. By articulating the apparatus as the network did with the framing of the obligatory passage point, the network assumed that it would be possible to develop such an apparatus. The network also assumed that the particles would behave in a certain manner, making it possible to capture and measure their behaviour by means of the apparatus; and that it would be possible by means of this capturing and measurement to determine air quality. If the particles behaved differently than assumed, the network would face severe difficulties in upholding the obligatory passage point. Since the actors did not consider whether it would be possible to capture

[37] The Science Shop interviewee refers to the person in the Science Shop that I interviewed. Science Shop representative refers to the person in the Science Shop that was involved in the network.

and measure the particles, it seems that the network black-boxed the behaviour of the particles; and this despite the fact that several elements can contribute to the behaviour of the particles – the wind could blow them far from where the traffic emitted them, and gravitation could draw them to the ground.

This first alliance can be visualized like this:

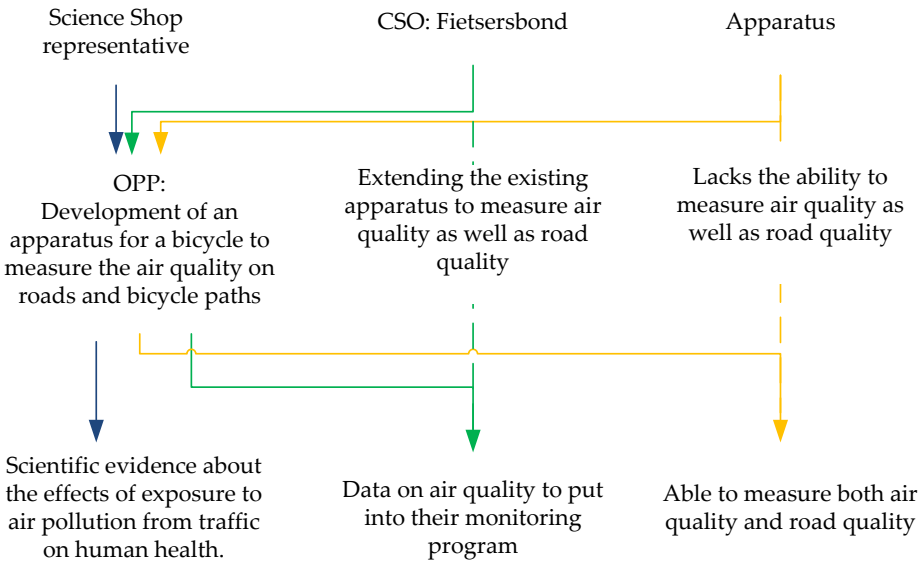


Figure 31: First alliances made – framing the obligatory passage point

As illustrated in the figure above, it is worth noting that the Science Shop representative framed the obligatory passage point in such a way that it complied completely with the CSO's obstacle problem. Thus, the Science Shop representative succeeded in interesting the CSO to enter the network, without having to persuade or motivate it further.

Requests to the Science Shop are not researched by the Science Shop staff but by students and interested scientists at the university. So the next step for the Science Shop representative was to draw on the alliance he already had with the scientists at the Department for Environmental Epidemiology with whom the Science Shop had conducted several projects and where the professor mentioned earlier was chairman.

Interessement: Persuading other actants to accept the obligatory passage point
The scientific interests of the scientists at the Department for Environmental Epidemiology[38] were air pollution and health risks. Due to the perspective of making it possible to measure air quality with an apparatus constructed for bikes, this research group became very interested in co-operating with the Science Shop and CSO to develop this apparatus. Including the Science Shop in the network was a requirement for the research group's participation, because the Science Shop would take charge of communication with the CSO, and when the research was completed, it would also be involved in writing the report and all the public relations. The Science Shop interviewee explained that another reason for the research group to insist on the Science Shop's enrolment in the network was:

> *"[…] maybe also because of our independent position, sometimes they [the research group, ed.] doesn't want to be involved as researchers directly working for such a group, because this group [the CSO, ed.] of course has some things that they fight for and well, as a Science Shop its more like we are an intermediate between the research group and the community group; in fact they are not, although it's mentioned which research group is involved in the project, but its not directly on their behalf"* [Science Shop interviewee].

The Science Shop representative did not have to persuade the research group into the network; they were interested even before the Science Shop representative approached them. After having interested the research group, a student was found[39] to conduct the research as part of his master's thesis. The research activities were related to development of the apparatus for air quality measurements, how to use the apparatus on the bicycle, and how to design the monitoring programme to include outputs on air quality. The following is a more specific description of the student's study (see next page):

[38] In the rest of the story, these scientists are referred to as the research group.
[39] It has not been possible for me to learn how the student was found and how he was persuaded to enter the network, since the Science Shop interviewee was not aware of this. However, in the forword in his master's thesis, he writes that he was interested in air pollution and cycling (den Breejen, 2006).

In dit onderzoek worden vragen beantwoord: [...]: Met betrekking tot het verkrijgen van een goede, betrouwbare meting: 1. Wat zijn de onzekerheden en gevoeligheden van de gebruikte meetapparatuur? 2. Wat voor effect heeft het luchtinlaatsysteem op deze metingen? 3. Wat voor invloed heeft de snelheid van de fietser op de metingen? 4. Wat voor invloed heeft de ventilatiestand in de auto op de metingen? 5. Hoe beïnvloedt het weer de meetresultaten? Met betrekking tot het analyseren van knelpunten: 6. Wat voor verkeerssituaties zorgen voor hoge pieken in blootstelling? 7. Hoe beïnvloeden toevallige verkeerssituaties de gemiddelde blootstelling? Met betrekking tot vergelijking en beoordeling van de gegevens: 8. Hoe kunnen de blootstelling van fietser en automobilist met elkaar worden vergeleken? Met betrekking tot interpretatie van de gegevens: 9. Wat voor gezondheidsschade veroorzaken fijn stof en hieraan gerelateerde stoffen?	In this study, questions are answered with respect to [...]: With regard to obtaining a good, reliable measurement: 1. What are the uncertainties and sensitivities of the measuring equipment? 2. How does the air intake system impact these measurements? 3. How does the speed of the cyclist affect the measurements? 4. How does the ventilation mode in the car impact the measurements? 5. How does the weather affect the results? With regard to the analysis of bottlenecks: 6. What kind of traffic situations ensures high levels of exposure? 7. The influence of random traffic situations, the average exposure? With regard to comparison and evaluation of the data: 8. How can the exposure of cyclist and motorist compare? With regard to interpretation of the data: 9. What kind of health damage from particulate matter and related substances?

Figure 32: The research questions the network set out to explore. The translation from Dutch to English was made with Google Translate (den Breejen, 2006: p. 11)

The alliances and the network as explained by the Science Shop interviewee can now be illustrated like shown in the figure on next page:

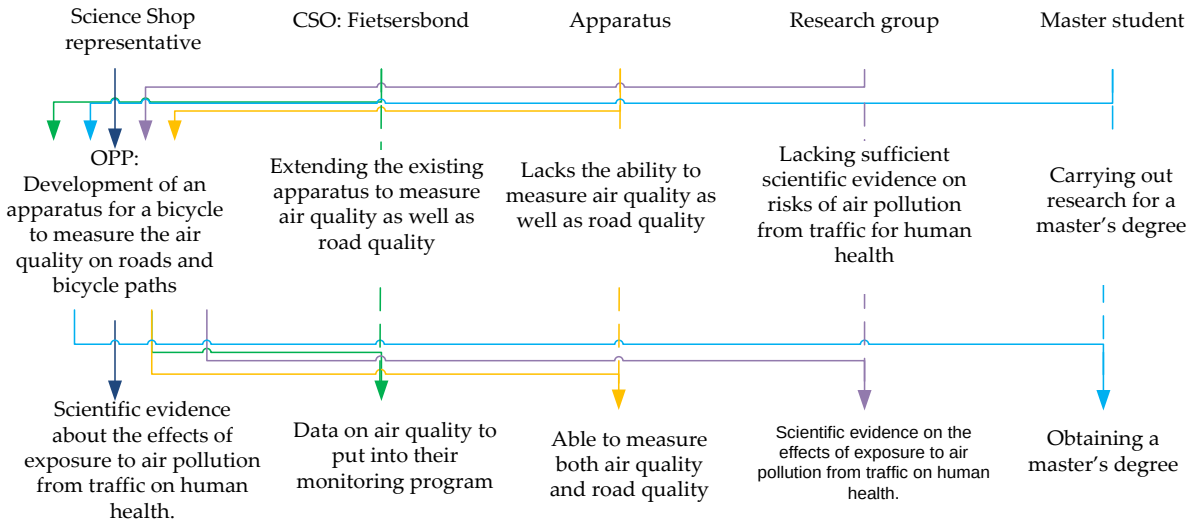


Figure 33: Illustration of problematization and obligatory passage point at the interessement moment of translation

According to the Science Shop interviewee, neither the research group nor the student translated the obligatory passage point into a new obligatory passage point, and the student actually developed a functional apparatus to measure air quality:

> *"Last Friday it was in the national newspapers; there was this project mentioned as one of the monitoring programmes of the Cycle Union, because they started a new monitoring year and also it was mentioned that they also take into consideration the air pollution"* [Science Shop interviewee].

Enrolment: Did the actants accept and play the role they were assigned?

The Science Shop representative managed to create alliances between the CSO, the research group and the master student. The network also succeeded in developing a functional apparatus to measure both road quality and air quality. This meant that the particles behaved as assumed – they could be captured and measured. This also meant that none of the actants withdrew from the network during the project; thus, some form of stabilization was achieved.[40] The student's findings were also published in a scientific report (den Breejen, 2006). The Science Shop representative and the research group did not try to enrol other actants in the network after the student had developed the apparatus for monitoring air quality. For them, the project was over; they had upheld the obligatory passage point. How the apparatus was to be used was now up to the CSO.

[40] It is possible that some of the actants may have tried to withdraw or work against the network, but since the apparatus was developed and the CSO was able to monitor air quality as well as road quality, it can be concluded that no fights within the network caused it to fail in upholding the obligatory passage point, thereby destabilizing the network during the project.

Figure 34: Illustration of the bicycle with the apparatus to measure road and air quality (Picture: Fietersbondl)

It was important for the CSO that the research group was in the network, in order to gain legitimacy for the air quality measurements and thereby be able to enrol both the public and politicians. The CSO was able to argue that external experts could validate their measurements and methodology. The CSO tried to ensure this legitimacy by mentioning the research group and the co-operation in all their publications and the information released to the media.[41] In this way, the research group's legitimacy was used by the CSO as an interessement device in relation to the public and politicians. The CSO also tried to enrol politicians into the network by giving the scientific report, which was published as one of the network's activities, to the Minister of Transportation. By trying to enrol the minister in the network through the interessement device of the scientific report, the CSO hoped to enlist political support, both financial and moral, for the network in their efforts to ensure the city and cyclists better air quality.

The CSO also developed a handbook for their local member groups, which explained how to gather and treat the data to be used in the monitoring programme. Through this handbook – an interessement device – the CSO tried to enrol its local member groups in the network. In addition, cyclists can plan their routes on the CSO's website, so they can ride from one place to another most comfortably – i.e. while being exposed to as little emissions as possible and riding on the most comfortable roads.

[41] See for example www.fietersbond.nl/urlsearchresults.asp?itemnumber=1, where the student's report is mentioned.

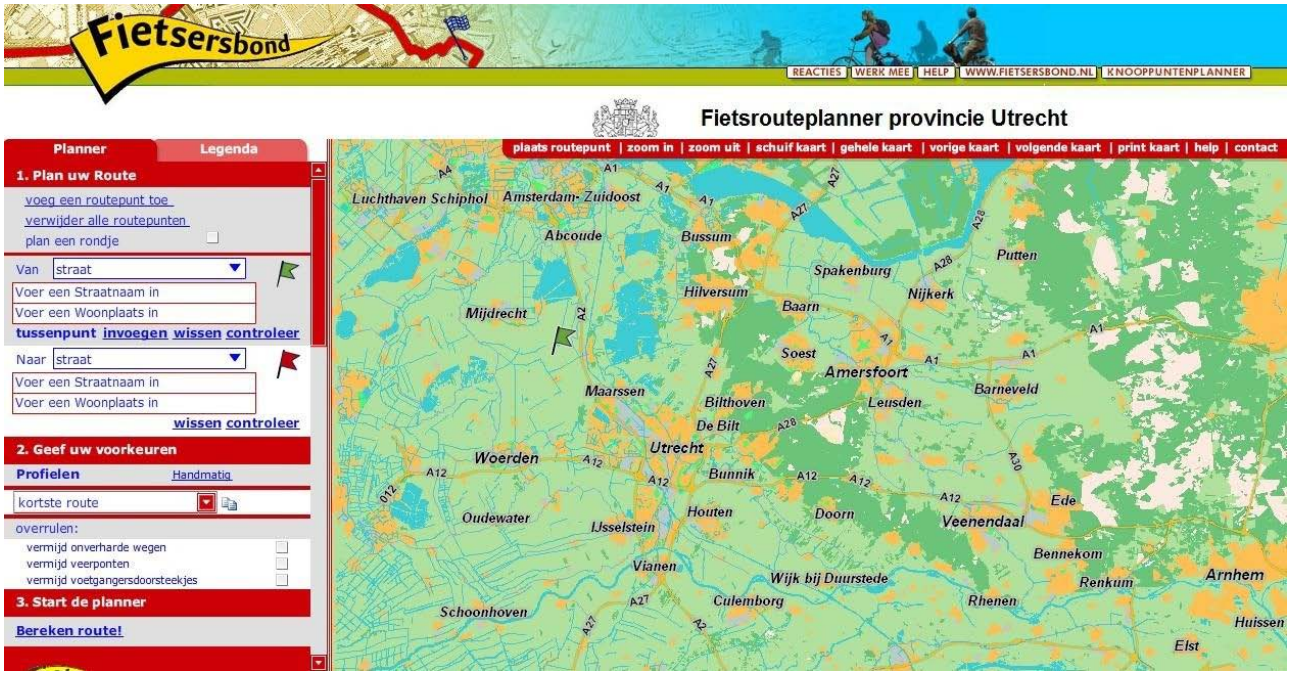


Figure 35: The logo of the road planner for cyclists
(www.fietsersbond.net/fietsrouteplanner/fietsroutes-utrecht)

Although the CSO attempted to enrol politicians in the network, it did not fully succeed; the politicians rejected enrolment in the network by denying further funding or support. The CSO then understood that they needed to take other actions in order to enrol politicians. One such action was for the CSO to become members and thus be enrolled in a new network: a research project called VECTOR[42] (Visualisation of the Exposure of Cyclists in Traffic on Roads). The aim of the project was to assess the actual exposure of cyclists in four European cities (in the Netherlands, Germany, Hungary and Lithuania).

> *"VECTOR will assess the exposure of cyclists by studying the fine particle air-concentration (PMx) at the position of the cyclist on the bicycle. Hereby, so-called 'measurement bike' is used that was specially developed by the Dutch Cyclist Association [Fietsersbond, ed.]"* (LK, February 2007).

Mobilization: Speaking on behalf of others?

When the apparatus for measuring air quality was developed, the Science Shop representative and the research group considered the network's activities to be over. Both actors were highly enrolled in the network during the project, but since their interest in the network was to meet the challenge of developing the apparatus, they were not mobilized,

[42] This project is still being carried out. I choose to end the story here, partly because I have not been able to establish contact with the representative from the Fietsersbond and partly because this research project involves new network constructions.

as the CSO was, to take actions to promote the apparatus or expand the network to deal, for instance, with improving air quality in the cities.

The CSO's role of representing the cyclists in the Netherlands was strengthened due to the network's success in upholding the obligatory passage point. The organization understood how to use the outcome of the network to create publicity in the media. And the media accepted the organization as spokesman for Dutch cyclists.

Epilogue: Effects of the network alliance

This story, although incomplete as told here, shows that this EEA, by combining measurements of air pollution with measurements of road quality, succeeded in upholding the obligatory passage point and meeting the needs of the CSO. This case, like the others, illustrates the complexity of stabilization, since it again leads me to pose questions about when a network is stable. Is it when the obligatory passage point is upheld, or is it when the network has caused effects? As in cases A and B, the network in this case succeeded in upholding the obligatory passage point, indicating some sort of stabilization. However, after the artifact was developed, it seems that some of the actors enrolled in the network perceived the network's purpose as fulfilled. Campaigning for the artifact and for clean air for cyclists was not included in the Science Shop representative's and the research group's perception of their roles and the purpose of the network. As in cases A and B, this indicates that it is mainly in relation to knowledge production processes that it is possible to discuss stabilization within such EEAs. As soon as the networks have achieved knowledge about the scientific claim, it seems that some actors perceive their role to be finished, so that other actors must bring the scientific claim into the local political arena.

Returning to the discussion started in chapter 2, *section 2.3: ANT as Inspiration for Studying Science-Society Relations – as Network Constructions,* about whether stabilization of networks equals impact, this case illustrates that stabilization of networks does not necessarily equal impact. The case also illustrates that stabilization is never a fixed state; on the contrary, stabilization is continuously challenged by other networks. The development of the apparatus contributed to stabilizing the actants within the network, since the obligatory passage point was successfully upheld. However, the fact that some of the actors withdrew from the network when the artifact became functional, indicates an unstable state, if the success criteria is to have politicians acknowledge and support the apparatus. To counteract this instability, the CSO enrolled in new alliances outside this network, with the aim of assessing the actual exposure of cyclists in four European cities. Due to the limited background material in this EEA, it is not possible to discuss how much impact this EEA had; however, the fact that the apparatus was successful developed, and the enrolment of the CSO and the artifact in another network – the VECTOR research project – indicates some sort of effect on research agendas.

The next case (case G) involved a local residents' board in a small village in Denmark that was concerned with exposure to air pollution caused by their fellow residents' use of stoves. Thus, case G differs from the previous cases in that it illustrates a conflict caused by the villagers themselves and not by private companies, urban infrastructure or farmers as illustrated by the prior cases.

4.7 Case G: The Stove Case

- The story about the fatal mistake of translating making measurements into a literature study in order to explore health risks from stove use

This story is about an EEA in which a local residents' board feared they were being exposed to air pollution particles from using their stoves. The network created around this concern succeeded in producing the scientific facts to enable the network to uphold the obligatory passage point. Nevertheless, the road to obtaining the facts included several translations. Especially one of these translations, made by the scientist enrolled in the network, caused the data produced and the outcome to be unusable for the CSO, and thus contributed to destabilizing the network.

This story is interesting because it illustrates how a local residents' board group sought to relate their concerns about being exposed to health risks to a national debate going on in Denmark. Although the network failed to reach a stable state, its story contributes to an understanding of how difficult it can be for CSOs to raise their concerns in the public debate, even when they are already an issue on the national agenda.

Problematization: Is smoke from stoves dangerous to human health?
A local residents' board (in Danish called 'Raadvad Beboerforening') had been working for two years to develop a more environmentally sustainable village. It had taken various initiatives towards minimizing their household waste, minimization of energy and heat consumption, transport through commuter agreements, composting of household waste, and rehabilitation of natural water reservoirs near the village.

Originally (in 1641), the village had been built around a factory facility producing weapons and agricultural implements. These facilities were taken over in 1921 by Raadvad Cutlery, which first owned the facility and the houses surrounding it and then later in 1973 rented the facilities and the houses from the Danish state. In 1980, the factory closed production in the village. Since then, the factory facilities have been rented to various artists, while the housing has been rented to ordinary citizens. The single heat source in all the houses in the villages is stoves, and for years the smoke had been a nuisance to the citizens, since due to the village's location in a valley in the middle of a forest, the smoke often lies like a blanket over the village rather than blowing away.

Figure 36: The location of the village of Raadvad surrounded by forest and recreational areas (Picture: Google Earth)

When new research results were published (Glasius et al., 2005; Palmgren et al., 2005) indicating that the health risks from particles from stove use could be compared with health risks from traffic emissions, the CSO became concerned. These concerns related to whether particles from stove use could injure their health. Historically, citizens in the village had suffered with lung problems, such as coughing and bronchitis, but these problems had always been explained by the high humidity in the houses; now, however, the citizen group feared that it could also be due to particle pollution.

The CSO, in its efforts to achieve a more environmentally sustainable village, had established a co-operation with the Science Shop at the Technical University of Denmark (DTU), which had been involved in several projects on the topics mentioned above.[43] When in 2005 the CSO read about the research results indicating that particles from stove use could cause risks to human health, they decided to approach the Science Shop at DTU again and tried to make an alliance with them so that students could explore this issue in more detail.

The CSO representative called the Science Shop representative[44], and she agreed to look into the issue and examine the research findings. These findings, published by the Danish National Environmental Research Institute (NERI), did indicate a relationship between exposure to particles from stove use and health risks, but did not clearly indicate how big

[43] The reports made as part of the previous co-operations between the citizen group and the Science Shop DTU are: Perret-Gentil (2004); Korsbæk et al. (2004); Cappelen et al. (2005); Anderson et al. (2005); Binici et al. (2005) and Bjørgvinsson et al. (2005).

[44] In this case, I am the Science Shop representative. I refer to myself as the Science Shop representative in this case in order to be consistent in all the case studies.

a health risk these particles caused and how. Therefore, NERI had applied for a new research project to explore this relationship in depth.

The CSO wished to initiate a debate among the citizens in the village, partly about their behaviour when using their stoves – what they burned and how – and partly to create awareness among the citizens about whether they should consider installing stoves with particle filters or implement another heating source. The CSO also wished to obtain scientific documentation showing whether particle emissions from the stove use actually did cause health risks. The Science Shop representative explained that another motive the citizen group representative had for entering into the network was to put pressure on the Danish Forest and Nature Agency, which owned the houses, to install a new heating system in the village.

The Science Shop representative accepted the request from the CSO, as they do with most requests from CSOs. As she further explained:

> *"Well, we thought it was quite interesting to work with an entire community, even though it was a small community, but to address all environmental issues confronting the village, was interesting. Often, we are only involved with communities addressing one single environmental problem, like noise, but this community, they wanted their whole community to be more sustainable. That was quite interesting [translated from Danish, ed.]"* [Science Shop representative].

The Science Shop and CSO representatives together framed the research aim:

> *"Raadvad residents' board want to explore the possible existence of invisible particles from stove use to which the community might be exposed. And as a supplement, suggestions to which initiatives that could be taken to minimize this exposure, should be developed"* (Science Shop project proposal).

The project proposal was framed in such a way that it left room for future students to design the research to suite their interests. This was a deliberate choice made by the Science Shop representative, because openness in project proposals often seems more attractive to students. Framing an open project proposal that allows for student interests can be seen as an interessement device for enrolling students in such an alliance.

Before the project proposal could be sent out to the students, a supervisor from the university had to be found. It was standard procedure in the Science Shop to ensure the interest of a supervisor before launching projects. Only one scientist at the university worked with air pollution, and his focus was mainly on air pollution from industries. This scientist had previously supervised other projects through the Science Shop, so he was familiar with the concept. The Science Shop representative and the scientist also knew each other previously, when the Science Shop representative was still a student at the

university. When first approached, the scientist was a bit reluctant, since it was not his field of expertise; however, dialogue with the Science Shop representative succeeded in persuading him to accept, if and when students became interested in the project proposal.

Having persuaded the scientist to join the network, the Science Shop representative could now frame the obligatory passage point: *Is the Raadvad community exposed to health risks due to their stove use?* By framing the obligatory passage point to be specifically related to the community, the Science Shop representative succeeded in persuading the CSO representative to join the network, indicating that the latter considered this alliance to be the only way to solve the CSO's obstacle problem. The research initiated by NERI referred to above could have been another way for the CSO to obtain the knowledge they needed, but the findings from this research would be more general and not specifically related to the behaviour of the citizens in the village. The Science Shop representative thus became indispensible for the CSO representative, if the obstacle problem were to be overcome. How much the scientist was persuaded into the network by the framing of the obligatory passage point was unclear at this point in time, since he had only accepted to be supervisor, if the Science Shop representative succeeded in interesting any students. In the framing of the obligatory passage point, the network assumed that particles from stove use would behave in a certain way – i.e. they could be captured and measured. This assumption indicates that the network assumed the particles' behaviour to be predictable and unproblematic for the network, which in Callon and ANT terms means that the particles' behaviour was black-boxed by the network. If this black-boxing of the particles' behaviour should prove to be mistaken, it would cause a destabilization of the network.

The network around the obligatory passage point can be illustrated like this:

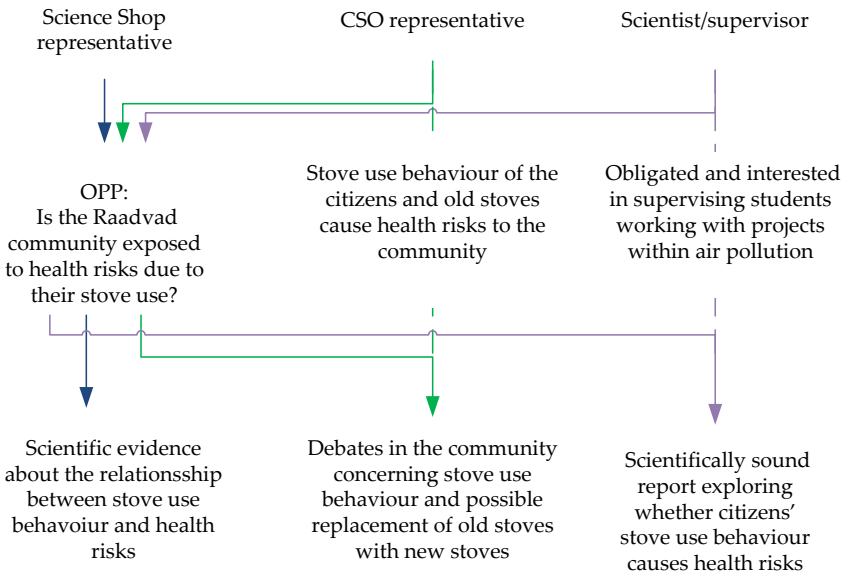


Figure 37: First alliances made – framing the obligatory passage point

As the figure above illustrates, the goal of the Science Shop, the CSO and the scientist seem to differ, since the Science Shop and the scientist appear only to be interested in documenting the problem scientifically, whereas the CSO wants to use documentation as a means to create debate among the residents about their use of stoves. Normal procedure in the Science Shop, however, is to assist the CSO in creating debate, if they still have this as goal after the research has been carried out. Thus, in this case, the Science Shop's goal would be extended to also include the CSO's goals, if this turns out to be relevant later in the process.

With the obligatory passage point framed and the CSO representative and the scientist enrolled in the network, the next step for the Science Shop representative was to find students to conduct the research.

Interessement: Persuading other actants to accept the obligatory passage point
The Science Shop uses several interessement devices to interest students in joining a network. The first initiative the Science Shop representative took was to launch the project on the Science Shop website, where all Science Shop projects are listed and described. Another initiative involved an activity the Science Shop arranges regularly every semester: a presentation of the project proposal to students, this time during the course the Science Shop representative was teaching. A month later, a student approached the Science Shop via the Science Shop's email function on the website and expressed interest in the project. The student studied environmental technology and was required to conduct a smaller project during the early phase of her studies. The student had heard about the project when the Science Shop representative had presented it at the course she was attending, and then she had read the project proposal on the Science Shop website. This showed that the interessement devices used by the Science Shop representative had succeeded in interesting the student.

Figure 38: Illustration of Science Shop DTU's website with project proposals (http://www.vb.dtu.dk/index.php?id=6&sub=2&emneID=2)

Also, the student found the project proposal interesting, as she explained:

> *"This [the findings of the research, ed.] was something that someone actually wanted to use, that could contribute to knowledge building for other people, that inspired me. This was not something that had been investigated before, and where the results are known ahead, but this was something useful for others [translated from Danish, ed.]"* [Student researcher].

After the student had expressed her interest, the Science Shop representative organized a meeting between the CSO representative, the scientist, the student and the Science Shop representative. The purpose of this meeting was to discuss how to design the research. Since the project the student was to conduct was a minor project, and the student was to conduct the research alone, the scientist argued from the start of the meeting that for such a small project, due to time limits and financial limits, it would not be possible to conduct measurements. The research therefore had to be designed according to these limitations. Thus, the scientist defined limitations that could have fatal consequences for upholding the obligatory passage point.

At this point, the CSO was still interested in creating debate in the community about air pollution from stove use and how to use stoves and wood correctly. To investigate this problem when measurements were not possible, the scientist and the Science Shop representative suggested that the student carry out a literature survey and combine it with a questionnaire survey to explore the citizens' behaviour and stove use. More specifically, the research aim became to explore which type of firewood the citizens' used in their stoves, which types of stoves were used in the village, how the stoves were maintained, and if there were specific circumstances that caused the smoke to blanket the village. The research aim thus became focused on the citizens' behaviour rather than the particles' behaviour. This meant that the network changed its assumption about the behaviour of the particles. From assuming that the particles should be captured and measured in the community, the network now assumed that the particles' behaviour could be explored in the literature and through interviewing the citizens. The network also assumed that there was a relationship between wood types, wood humidity, stove types and particle emissions. The CSO representative accepted these translations, because he assumed that some of the citizens used wet firewood, and that this could be one explanation of the heavy smoke covering the village. As the story shows, however, the translation from measurements to literature study became the focal point for the failure of the network to initiate debate in the community. By framing the research aim in this way, the Science Shop representative succeeded in keeping the obligatory passage point as framed from the beginning, since the focus of the research was still to explore whether the community was exposed to health risks due to their stove use behaviour. In spite of the limitation of the research – i.e. measurement was not possible – the CSO representative continued to be

interested in the network, even though he had hoped that it would be possible to conduct measurements.

After the first meeting between the four actors, the Science Shop representative and the student went to the village to see the location and how the houses were situated. Subsequently, another meeting was held between the Science Shop representative, the scientist, and the student. At this meeting, the technical details of the research were discussed, and then the student began the research, supervised throughout the process by the scientist and the Science Shop representative.

Figure 39: Smoke from stove use in Raadvad (Pictures: My own)

During the research period, the Science Shop representative organized three meetings between the student, the CSO representative, the scientist and the Science Shop representative. During these meetings, the findings and the research approaches were discussed in order to ensure that the CSO representative understood the knowledge produced and found it usable. Contact between the four actors was maintained throughout the whole process. The CSO representative was especially very interested in the problem of health risks from stove use, and he kept himself updated about the issue through the media. Whenever new information was released, he sent it to both the student and the Science Shop representative.

The student's research process was divided in two parts; first, she carried out a literature study, studying particle pollution in general and particle pollution from stove use related to wood types. Then, the student conducted a questionnaire survey in the village, asking the citizens about their behaviour and use in relation to their stoves (Holst, 2006). The questionnaire, together with a letter explaining the research, was used by the network as an interessement device to persuade the citizens to join the network. When they were handed out in the village, the student explained her research aim and why she approached the citizens. The student handed out 40 questionnaires and received 23 responses. The

citizens' responses were generally positive; many found it interesting and important to explore whether their behaviour in relation to their stoves had an impact on their health. Only a few citizens found the research and the citizen group's concern exaggerated.

Kære Raadvad beboer. På grund af den senere tids opmærksomhed på partikelforurening fra brændeovne har Raadvad Beboerforening henvendt sig til Videnskabsbutikken på DTU for, at få undersøgt forholdene i Raadvad. Jeg læser Miljøteknologi på DTU på 4. Semester og har gennem Videnskabsbutikken fået et projekt om risikovurdering af partikelforurening fra brændeovne i Raadvad. Formålet med dette projekt er, at vurdere om der er nogen helbredsmæssig risiko forbundet ved at bruge brændeovne til opvarmning i Raadvad. Der findes litteratur om farligheden af røgen fra brændeovne, som jeg vil bruge som baggrundsviden til min risikovurdering, men for at kunne lave den individuelle vurdering for Raadvad som område, må jeg vide lidt om fyringsvaner, helbredstilsande og udsættelse for andre forureningskilder for beboere i området. Jeg håber I vil hjælpe med at udfylde vedlagte spørgeskema, så mit overblik over brugen af brændeovne i området bliver så fyldestgørende som muligt. Spørgeskemaet er delt i fire dele. Den første del omhandler brændeovnen, den anden del omhandler hvilken form for brænde, der bruges og den tredje del omhandler hvordan brændeovnen bruges. Den sidste del af spørgeskemaet omhandler personlige oplysninger og er vedlagt i to eksemplarer. For at kunne vurdere, om der kan være gener forbundet ved brug af brændeovnene, vil jeg bede om at to personer over 18 år udfylder hver sit eksemplar af den fjerde del af spørgeskemaet. I slutningen af hvert afsnit i spørgeskemaet er der plads til andre kommentarer. I er meget velkomne til at benytte denne mulighed for, at fortælle om forhold, I mener ikke er dækket ordentligt med spørgsmålene. Hvis der ikke er plads nok er I velkomne til at bruge bagsiden. Hvis det bliver nødvendigt vil jeg gerne have muligheden for at vende tilbage for at lave et kvalitativt interview. Derfor beder jeg også om jeres navne, adresse og telefonnummer. Når I har udfyldt alle dele af spørgeskemaet bedes I lægge dem i svarkuverten, forsegle den og aflevere det til mig igen når jeg kommer forbi igen onsdag den 19. April. Jeg vil til slut gøre opmærksom på, at svarene på spørgeskemaerne vil blive behandlet fortroligt, det vil sige, at kun jeg og min vejleder vil vide, hvem der har svaret på spørgeskemaerne og hvordan der er blevet svaret, samt at de besvarede spørgeskemaer vil blive destrueret, når projektet er færdigt. Hvis I har spørgsmål kan I kontakte mig på e-mail: SanneHolst@FDF.dk Eller på telefon: 20 92 87 24. På forhånd tak for jeres deltagelse og hjælp til mit projekt. Med venlig hilsen Sanne Holst	Dear Raadvad residents, Given the recent attention on particle pollution from wood stoves Raadvad Residents has contacted the Science Shop at DTU to have the situation in Raadvad examined. I am studying Environmental Engineering at DTU in the 4th semester, and through the Science Shop, I am making a risk assessment of particulate pollution from wood stoves in Raadvad. The purpose of this project is to assess whether any health risk is associated with using wood stoves for heating in Raadvad. To provide background for my assessment, I am studying the literature on the danger of the smoke from wood stoves, but I will also make an individual assessment of Raadvad, which is why I need information about the firing habits, health conditions, and exposure to other sources of pollution for residents in the area. I hope you will help me by completing the attached questionnaire, so my overview of the use of wood stoves in the area will be as complete as possible. The questionnaire is divided into four parts. The first part deals with the stove, the second part deals with the type of wood used, and the third part deals with how the stove is used. The last part of the questionnaire deals with personal information and is enclosed in duplicate. To assess whether, you experience any kind of discomfort in connection with use of the stoves, I ask that two people over 18 years of age each complete the fourth part of the questionnaire. At the end of each section of the questionnaire, there is space for other comments. You are very welcome to take this opportunity to give any facts that are not covered properly by the questions. If there is not enough space, you are welcome to use the back. If it is possible that I would like to have the opportunity to return to make a qualitative interview. Therefore, I am asking for your name, address and telephone number. When you have completed all parts of the questionnaire, please put them in the reply envelope, seal it and hand it to me again when I return on Wednesday, 19 April. I would finally point out that the answers to the questionnaires will be treated confidentially, meaning that only I and my supervisor will know who responded to questionnaires and how they have been answered and that the completed questionnaires will be destroyed when the project is completed. If you have questions you can contact me by email: SanneHolst@FDF.dk Or by phone: 20 92 87 24. Thank you in advance for your participation and help with my project. Sincerely, Sanne Holst

Figure 40: The accompanying letter to the citizens in Raadvad village (Holst, 2005; p. 21)

The information gathered through the questionnaires was used to make statistic calculations of the citizens' behaviour when using their stoves. The results showed that some citizens used wet wood in their stoves, which could cause health risks to the citizens in the community. The method used for the statistical assessment did, however, leave room for discussion. As the CSO representative explained:

> *"We discussed the findings of the interviews and what the statistics indicated. The problem was that the findings were not as clear and simple as the student tried to indicate. In the end, what can numbers be used for? [translated from Danish, ed.]"* [CSO representative].

The student also concluded that the discomfort experienced from the smoke by the citizens was caused by the bad quality of the stoves, wet or inappropriate wood, and meteorological conditions. The CSO representative, the student and the Science Shop representative explained that the conclusion became a minor conflict. The CSO representative read the conclusion of the report as follows:

> *The citizens should not be worried about whether or not they are exposed to more particles than other people living in other housing areas. However, there is room for improvement in order to minimize the exposure to particles, for instance buying a new stove or improving their behaviour towards the stoves and the wood used [translated from Danish, ed.]"* [CSO representative].

The student explained that she felt that the CSO representative tried to persuade her to frame the conclusions so that they more clearly indicated a health risk. Also the Science Shop representative explained that the results were not what the CSO representative had expected. She also explained that it was not possible to make clear and scientifically sound conclusions based on only 30 answers in a questionnaire survey. In contrast, the scientist explained that he was not of the impression that the CSO representative had specific expectations to the findings, nor that there should have been any conflict about the findings.

The CSO representative was not persuaded by the findings, but he was not disputing them. He just wished to point out the following:

> *"Particle pollution requires measurement to document, and she did not have the time to do such measurements, which means that we have to read the conclusion with certain reservations [translated from Danish, ed.]"* [CSO representative].

The introduction of measurements as a requirement for scientific documentation indicates that the CSO representative had not fully accepted the translation made earlier by the scientist to not include measurements in the research. The resulting effect of this was that the CSO representative did not accept the results as scientific, since they were not based on scientific measurements.

After the student had finished her research, the CSO representative presented the findings at a community meeting in the village. Normally, the student would have attended this meeting as part of the Science Shop project, but it was not possible for the CSO representative and the student to find a date that suited everyone. The citizens' response at the presentation of the findings was that they found it hard to understand that they had to improve their stove use behaviour.

The alliance and network around the obligatory passage point can be illustrated like this:

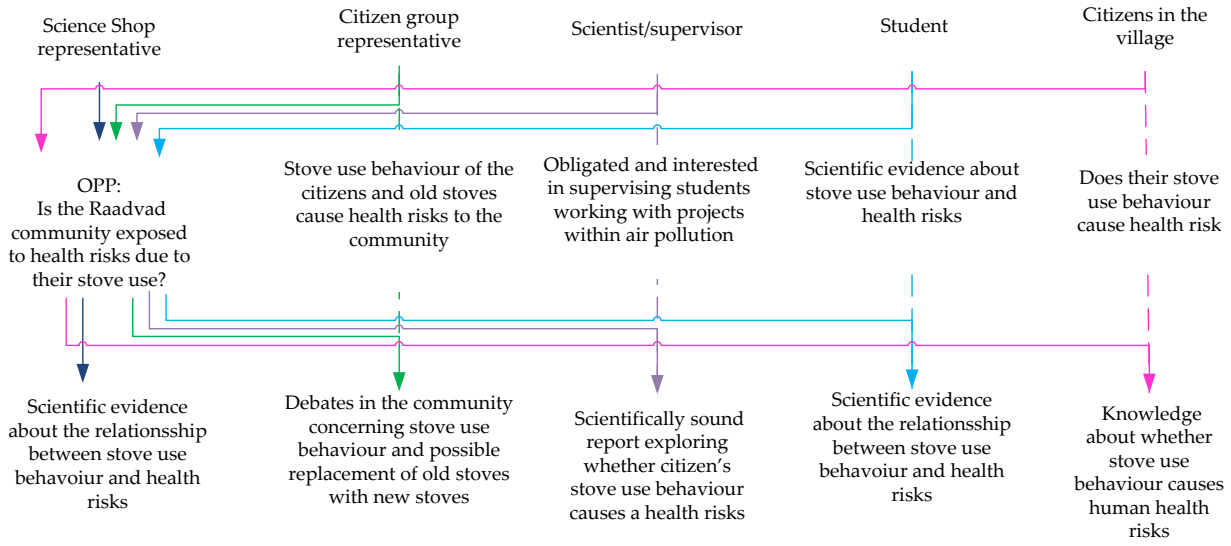


Figure 41: Illustration of problematization and obligatory passage point at the interessement moment of translation

Even though there were contrasting views on what to conclude on the basis of the research, the obligatory passage point did not change and was to some degree upheld. Through the alliance, the network succeeded in gaining some scientific evidence about the relationship between stove use, wood use, and health risks.

During this moment of translation early in the process of establishing the network, the scientist managed to translate the research activity from particle measurements to a literature study and a questionnaire survey regarding the citizens' behaviour. Both the CSO representative and the Science Shop representative accepted this translation, because the scientist persuaded them that measurements were not possible within the framework of such a small student project. Although both the CSO and Science Shop representatives accepted the translation, it had an impact on how and to which extent the conclusions were accepted. The question is whether this also had an impact on the enrolment of the actants and their willingness to work for the network.

Enrolment: Did the actants accept and play the role they were assigned?
The Science Shop representative managed to create alliances between the CSO representative, the student and the scientist, as well as to uphold the obligatory passage point. The student's findings were published in a report, and the student wrote a more popular article for the Science Shop magazine *Applied Knowledge* (In Danish, *Anvendt Viden* No. 2, 2006). Early in establishing the network it was agreed that the student should write a popular article to be published in the Science Shop magazine and the local newspaper, because the Science Shop and CSO representatives both found dissemination to the general public very important. The newspaper article was however never published.[45]

During the research, all actants played the role they were assigned in the work for the network. The student did the research; the Science Shop representative supervised the student and kept the actants working for the network; the scientist supervised the student; the CSO representative followed the research closely and also the more general debate about air pollution from stove use; and citizens in the village were willing to play the role of informants in the student's questionnaire survey. Also the firewood and particles behaved as the network had assumed – the firewood types were observable and the particles from the stove use could be explored to some extent in the literature. All this indicates that the actants were enrolled during the research; however, once the research was over and the findings published, the network dissolved. The conclusions were not stated clearly enough for the CSO representative to bring it much further than local debate during a community meeting. This meant that the interessement device failed, i.e. the report used by the student to persuade the actants to stay in the network. The CSO representative explained the problem with the conclusions as follows:

> *"I think I had expected a report stating some pollution in the village, because it is obvious when there is no wind, then there is a lot of smoke, which may seem cosy, but it also contains a lot of pollution, and that was the weak point in the report. The part of documenting the level of particle pollution, this she should have explored in more detail, if she had had more time. Also the part where she makes conclusions directly based on the information provided by the citizens […]. These conclusions are based on subjective explanations about the health of people; that were also a weakness. I had expected a much tougher report, stating high levels of particle pollution [translated from Danish, ed.]"* [CSO representative].

The CSO representative further explained that if they had to re-do the research again, then measurement of particles would be one condition he would make. Further, the research should be more focused on the actual behaviour of the citizens, e.g. through direct

[45] At the end of the research, the CSO representative was offered a job outside Denmark, which meant that he moved just after the research was completed. The agreement was that the student should write the article, and the CSO representative should approach the local newspaper to try to have it published. But the student was late in delivering the article, and the CSO representative moved, so this initiative was not taken.

observations of their behaviour and habits. This indicates that despite that the translation made by the scientist, of not conducting actual particle measurements, was accepted by the CSO representative, in principle it might have been due to 'force'; some results would be better than no results given what was possible in a small student project.

The CSO representative also explained that due to the weak conclusions, it was difficult for the CSO to start a debate among the citizens in the village, because the conclusions did not persuade the citizens that they needed to replace their old stoves or change their stove use behaviour.

The research did not lead to continuation of the network; however, the Science Shop representative continued working with the issue of particle pollution from stove use as part of her PhD dissertation. And when a possibility arose, she tried to bring the concerns of the Raadvad residents' board into a research project conducted by NERI. Her hope was that Raadvad, as a community, could be used as a case study object in the NERI research project. However, the Science Shop representative's effort to convince the NERI scientists to include the problem in Raadvad community did not succeed[46], but it did show that she was highly enrolled in the network and the controversies around the network.

The student and the scientist were enrolled during the research, but after the research was finished, their interest in the issue and the network stopped.

Mobilization: Speaking on behalf of others?

As mentioned earlier, the CSO organized a community meeting after the research was over to discuss the research findings. But as the CSO representative explained, it was difficult to mobilize the community due to the weak conclusions. The CSO representative also explained that if their success criteria had been to persuade the citizens in the village to replace their stoves with new ones, then they had not succeeded. After the debate at the community meeting, the CSO stopped working actively with the issue of particle pollution from stove use, because as the CSO representative explained:

> *"The Ministry of Environment launched a campaign about correct use of stoves and firewood, right after [the research was finished, ed.], so it was not necessary for us to continue, and then we discovered that we have mould fungus in all houses, which meant that we were all offered to replace our stoves. And the possibility of being able to turn on a radiator has contributed to replacement of stoves [translated from Danish, ed.]"* [CSO representative].

[46] When the Science Shop representative entered the network with the NERI scientists, the research project had already begun and had some preliminary results. This meant that it was not possible within the research's time frame to extend the research objects to include other communities than the two that were already identified.

The CSO consisted of elected representatives who should in principle be able to act as spokesmen for the community. In this case, however, the CSO did not succeed in mobilizing the whole community, but it did succeed in initiating a debate in the community. Some citizens were surprised to learn that on days with heavy smoke over the village, they were exposed to the same amount of particles as people walking on roads in Copenhagen with heavy traffic. Others found it useless to discuss this information, and they did not see it as a problem, even though they had old stoves.

Epilogue: Effects of the network alliance

The story shows that upholding the obligatory passage point not necessarily leads to effects on the issue in question or at least the issue in question for the CSO. According to Latour and Callon, upholding the obligatory passage point would indicate some kind of stabilization of the network; however, this is questionable in this case, since it seems that the CSO lost interest in the network and withdrew, when the translation that was made (to not conduct measurements) failed to be returned to the CSO's obstacle problem. The failure to return the translation to the CSO's obstacle problem caused the effect that in the eyes of the CSO, the knowledge produced by the EEA was not scientific and was therefore unusable. Due to this view of the knowledge produced by the EEA, the CSO were not capacitated to initiate more than a small debate in their community. Without strong scientific evidence, the CSO failed in relating their local concerns to the national debate about air pollution from stoves. This in spite of the fact that it seemed that the network had reached some sort of stable state, while the research was being conducted.

Returning to my earlier discussions of the background and motives of the actors to remain involved and enrolled into the EEA, this case indicates, like cases A and E, that the scientists involved seem to withdraw from the network when the obligatory passage point has been upheld, even though the CSO's obstacle problems have not necessarily been solved or sought solved. This observation supports my conclusion in case A that it is mainly in knowledge production processes that it is possible to discuss stabilization within such EEAs.

This case differs from the other cases in one central aspect. In this case, the results of the research did not seem to support the CSO's claims, and this made the CSO refuse to accept the conclusions by arguing that the findings were not based on scientifically sound evidence, such as measurements.

Finally, attempts by the Science Shop representative to impact the research agenda also failed, since she did not succeed in bringing in the Raadvad community as a research object for a research project conducted by NERI.

The next case (case H) illustrates another type of Science Shop than those represented in the previous cases – what is known in the USA as community outreach units, affiliated with departments at universities. What makes this case different from the prior cases is that what started with scientists aiming to disseminate knowledge to a CSO, ended up with a formal partnership between the scientists and the CSO that involved employment of a liaison officer, training of poor and uneducated Latino women, and the common goal of forcing the county supervisor to enact initiatives to reduce air pollution caused by warehouse activities.

4.8 Case H: The Mira Loma Case

- The story about a fight for clean air

This story and the next (case I) both illustrate how the same CSO has used scientific evidence to advocate for a cleaner air policy in the local communities it represents. I have chosen to analyse the two cases separately, even though they are somehow interrelated. I have made this choice, because it seems to give a clearer picture of how the CSO has constructed and become enrolled in different networks where scientists and scientific evidence have played an important role in winning the CSO's battles against local and provincial authorities. However, it is true the CSO would not perceive the two stories as separate, unrelated activities.

This story thus involves an EEA created around an environmental CSO's battle for the right to clean air in local communities. Through establishing an alliance between the CSO and a group of scientists, the network succeeded in forcing the county supervisor[47] and the local authorities to recognize the health risks their unplanned development of the area caused to the residents, and subsequently to consider health risks in their further area planning. The means the network used to force the local authorities to recognize the relationship between emissions from truck traffic and poor health were scientific evidence as well as campaigns in the media and in local communities. This EEA further illustrates a network that became stable to such an extent that some of the actors continued their alliance afterwards to address other health-related issues.

This story distinguishes itself from the previous stories by involving a different type of CSO-scientist co-operation in that no Science Shop was involved. The co-operation was initiated as a community-based research collaboration, which led to a more formalized network that included employing a community liaison as well as training poor and uneducated community members.

Problematization: Health impact on humans from diesel emissions

The Center for Community Action and Environmental Justice (CCAEJ) was formed in 1973 by a local group when local authorities neglected to do anything about water and sewage pollution from a dump in the city of Glen Avon in Riverside County (in the outskirts of Los Angeles). Through local activities and lawsuits, CCAEJ succeeded in forcing the local authorities to clean up the dump. The group realized, however, that their communities faced other serious problems of pollution that were affecting the health of their residents, i.e. exposure to air pollution (Newman, 2004).

[47] In USA, counties are administrative areas outside metropolitan areas. Each county has a county supervisor, an office that is equivalent to a city mayor.

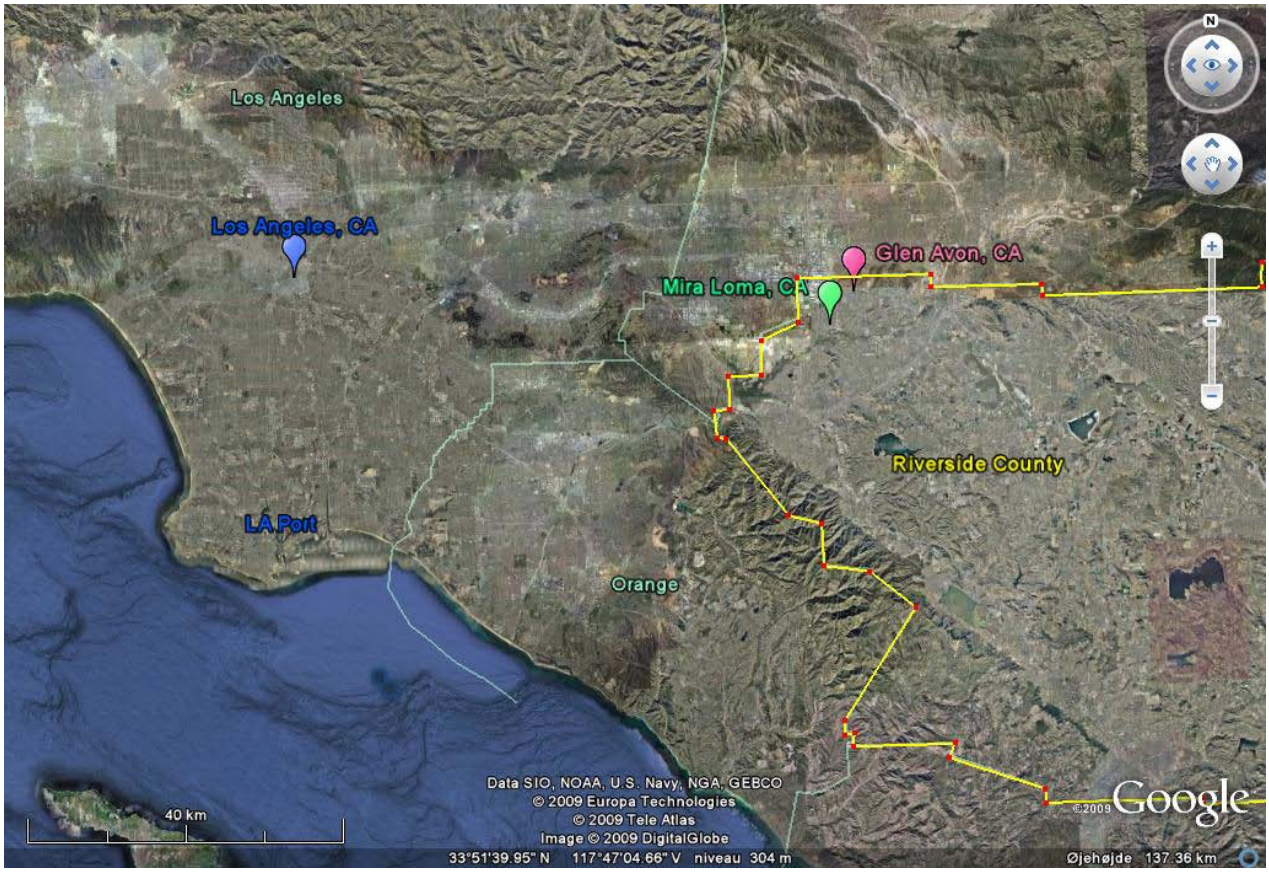


Figure 42: Map showing Mira Loma, Glen Avon and Los Angeles (Picture: Google Earth)

Mira Loma, a community of around 18,000 inhabitants, is the location for this story. This community had in the course of the past 50 years undergone a transition from an agricultural area with dairy farming to an industrial area for warehouse (distribution) development. This change had been encouraged by the county board of supervisors in order to promote economic growth in the area. The warehouse development did however have a negative impact on air quality and public health due to heavy truck traffic. These negative impacts were documented by the South Coast Air Quality Management District in 1987, which warned the county board of supervisors that the city of Mira Loma failed to meet the federal goals for clean air. The county board of supervisors continued to approve warehouse development, however, and during the period 1980-2001, the board approved 71 warehouses in the county.

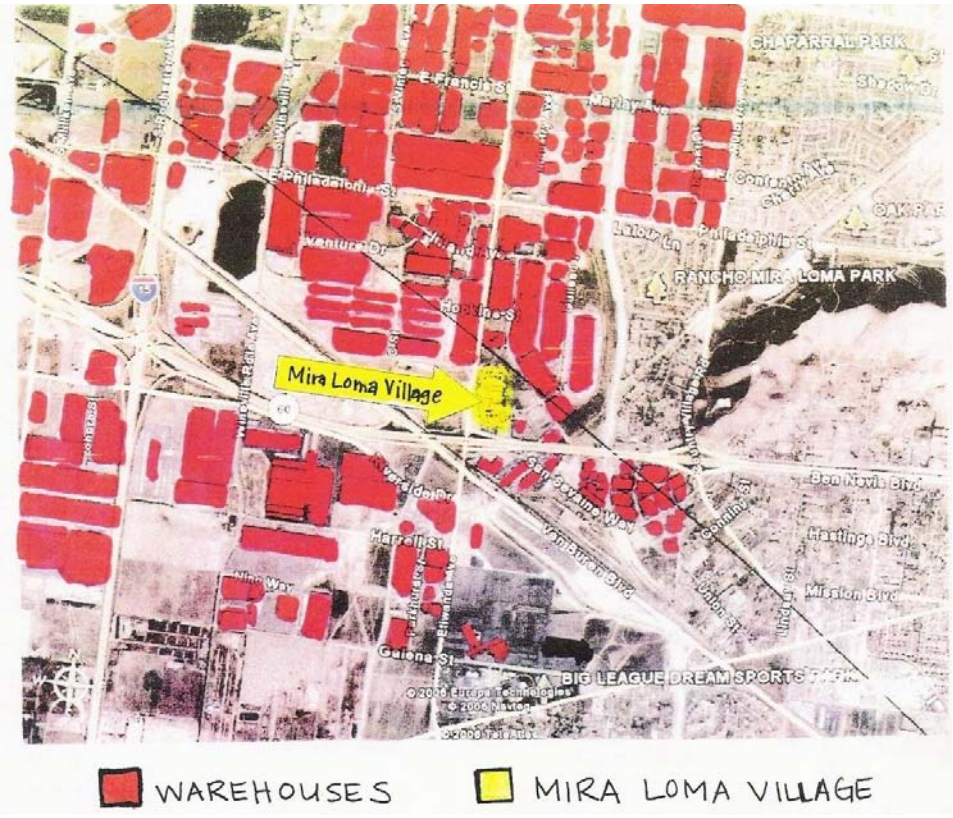


Figure 43: The location of Mira Loma Village surrounded by warehouses (Map provided by CCAEJ)

The county board of supervisors even implemented what was called 'fast track approvals', which meant that warehouse proposals that would produce high incomes for the county could be processed and approved within only 60 days, in contrast to the standard procedure which often took up to six months. In the standard procedure for new industrial development of this kind, the company was obliged by law to produce an Environmental Impact Report containing an in-depth assessment of the environmental and health consequences of the new development. Applications for warehouses through the 'fast track' procedure did not require these Environmental Impact Reports.

CCAEJ's first involvement regarding air pollution and health-related risks from the warehouse development was initiated on the basis of a request from a small grocery owners' union (Unit Food) that ran a campaign to stop the supermarket chain Wal-Mart[48] from being established in the area of Mira Loma. The union was afraid that Wal-Mart would force small grocery store closures, since this tendency had been observed in other areas where Wal-Mart was allowed to operate. The chairperson of CCAEJ explained how they became involved as follows:

[48] The CCAEJ chairperson explained that Wal-Mart is a huge commercial supermarket chain that neglects workers' rights due to the firm's goal to be the cheapest supermarket chain in the US.

> *"I guess it all started with a notice we got about a warehouse going in near Belgrave [an area in Mira Loma, ed.]. And we were trying to figure out, why are we turning a dairy area into an industrial area - does this make any sense. And, so we started looking into, ok, we have this warehouse, what does this mean. We also had - now the warehouses are built on speculation, so the developer builds it and then they lease it out to different companies, so you don't know what's going into those warehouses. And in this particular first one that we got notice of would be a Wal-Mart, and so we were approached by Unit Food"* [CCAEJ Chairperson].

The union asked CCAEJ if they would be willing to help them fight against the establishment of the Wal-Mart chain in Mira Loma. CCAEJ realized that establishing a Wal-Mart would have an environmental impact on the community, so they decided to file a lawsuit against Wal-Mart and the county board of supervisors for violation of the California Environmental Act. The California Environmental Act is a law to help ensure a healthy environment in cities and communities in the state of California. The county board of supervisors had processed the Wal-Mart warehouse through the 'fast track' procedure, which meant that they had not developed an Environmental Impact Report. As the Chairperson explained:

> *"They [Wal-Mart, ed.] had issued a negative declaration, saying that there would be no possibility of any impact from this million square feet building with thousands of trucks coming in. And so we challenged that and the county lost; we won, and they had to go back and do an EIR [Environmental Impact Report, ed.] and they ended up settling and they agreed not to lease to Wal-Mart"* [CCAEJ Chairperson].

Through their fight against establishment of the Wal-Mart warehouse in Mira Loma, CCAEJ became aware of the environmental and health impact caused by the industrialization of their communities. They realized that if they wanted healthy and safe community environments, they needed to start addressing air pollution issues. The lawsuit against Wal-Mart had caused a major conflict with the county supervisor, who neglected the communities' rights and gave first priority to economic growth; therefore, CCAEJ had to find out how to establish networks with other actants than the county supervisor, in order to force him to fulfil his responsibilities in connection with promoting healthy living conditions for the county's residents.

At the same time that CCAEJ decided to start addressing air pollution in their communities, the initial results were published from a research project at University of Southern California, School of Medicine (USC), which investigated the impact of diesel emissions on children. One of the USC scientists conducting the research explained the background for the research project:

> *"Back in the yearly '90s, we already knew a fair amount about air pollution having effects, but most of the literature about this was based on acquit effect of health findings. So we knew a lot, if it was a high pollution day and a kid with asthma went out and exercised, then he might end up in a hospital etc. […]. A lot known from what we call chamber studies, where you bring people in and then you gas them for three-four hours, maybe they are riding a stationary bike and then we measure things like their lung functions or symptoms or things like this, and a lot of documentation shows pollution has short-term effects, but there wasn't much known about longer term health effects at that point. So California Resources Board put out a request for proposals for groups [scientists, ed.] to study the long-term effects of air pollution and we were one of the groups that responded and they ended up funding us to do the work. That was a ten-year investigation because the aim was to look at the long term"* [USC scientist A].

The USC scientists conducting the research had focused on asthma and asthma-related symptoms occurring due to long-term exposure. The group they studied comprised children between the ages of 10 to 18. These children were followed and studied during a period of ten years. The data obtained from monitoring the children's health were combined with data from monitoring air pollution emissions in the area where the children lived and attended school. The USC scientists followed children in ten different areas of southern California, and one location was Mira Loma.

Some of the preliminary results of the research published just about the same time as CCAEJ started to consider how to address air pollution in their communities showed that children who were engaged in three or more sports had a markedly diminished lung capacity. The preliminary findings also indicated that if children moved from the area to an area with less pollution, their lung capacity immediately improved.

The CCAEJ chairperson explained how these preliminary findings of the USC research made them aware of the huge negative impact the warehouse development had on residents:

> *"This is a real health issue here, and if these warehouses come in that close to where people are living, we are going to have a really huge problem. And that kind of led us to looking at the levels of particulate pollution we already had and which we came to realize was really bad. We would run into people from Boston that knew where Mira Loma was, because they had seen the levels of particulate pollution - we had no idea. So, we came to find out that we have the highest levels of particulate pollution in the nation and fourth in the world"* [CCAEJ Chairperson].

After they discovered that Mira Loma had the highest levels of particulate matter in the whole study conducted by the USC scientists, CCAEJ wished to establish contact to the

scientists. They wanted them to come to the community and explain their findings to the residents. The CCAEJ chairperson knew the manager of the USC School of Medicine's community outreach unit[49] from the previous campaign against the dump in Glen Avon, and she contacted her in order to establish contact to the USC research group.

> *"I knew Andrea from our String Fellow activities here [the dump, ed.]. Years before, she worked in TV and news stuff, so we had done some interviews, so she knew who I was, well we worked together. So I think that kind of gave us an inroad into the scientists, where she could say, hey this is somebody who really knows how to use the science and it's good to work, you know, credible staff, so that kind of helped to put down any resistance"* [CCAEJ Chairperson].

The manager of the community outreach unit at USC explained that the unit's function is to communicate and translate science for communities so they understand how they can use the scientific results in their own context. The manager of the community outreach unit further explained that another aim of the unit is:

> *"To have a two-way street and get community input and community concerns, so that the scientists understand what's going on in the community"* [Community outreach unit manager at USC].

Figure 44: The logo of the USC School of Medicine community outreach unit (Picture: SCEHSC)

One of the USC scientists involved in the research project concerning health impact on children, further explained the motives for establishing this unit:

> *"I think the original rational for these projects was that they would, having community participation and getting the community invested in the projects, facilitate the research or better research, better participation and a sort of ongoing collaboration by the community that would make the quality of the data better, and*

[49] The community outreach unit was facilitated by the National Institute for Environmental Health Science. 12 centres exist throughout the US, all promoting community-based participatory research as well as dissemination of results to affected communities. These community outreach units can be understood as a sort of Science Shop.

> *also result in more benefits to the community through the community partners"* [USC scientist B].

The USC community outreach unit manager accepted CCAEJ's invitation for her and the USC scientists to come and present the research group's preliminary findings at a community meeting in Mira Loma. The community outreach unit manager explained that they accepted the invitation because she knew the CSO's chairperson and knew that she was really concerned about the environment in the community. Furthermore, as Mira Loma was the city with the highest level of particulate matter and highest impact on children, the USC scientists felt obliged to share their findings with the affected community.

A network between CCAEJ and the USC scientists had now started to take form around the problem of health impact from emissions from trucks. However, an obligatory passage point had not yet been framed by either the USC scientists or CCAEJ. At this point in time, the two actors had a loose network relationship, and both actors, if they no longer saw any purpose in maintaining contact, could just withdraw from the network. It is however clear that the beginning of the network was based on previous network relations between the CCAEJ chairperson and the USC community outreach unit manager.

Once the USC scientists had agreed to meet with the residents in Mira Loma, CCAEJ organized a community meeting, where the USC scientists presented their preliminary findings for around 500 concerned residents. The county supervisor also attended the community meeting; however, as the CCAEJ chairperson explained, this was the last time the county supervisor attended a meeting organized by the community, because the residents were outraged by the fact that for many years the county supervisor had prioritized economic growth over children's health. The CCAEJ chairperson further explained:

> *"I think we scared the living daylights out of them [the USC scientists, ed.] at that meeting; people [the residents, ed.] were just really angry. But I think they [the USC scientists, ed.] appreciated that. Scientists can in a partnership with communities in a very effective way, you know, they bring to the table the research and the information, but the community really brings the public understanding and development into policy. It's a really good approach and they [the USC scientists, ed.] are very eager to help out"* [CCAEJ Chairperson].

One of the USC scientists in the research group remembered the initial start of the network between them and CCAEJ as follows:

> *"We [the USC scientists, ed.] got some calls from CCAEJ, saying: This is what we are interested in. They [the preliminary results, ed.] fitted right into the kind of policy issues we are interested in and gives us some amo [ammunition, ed.] to go and deal*

> *with the local supervisor board to try fight some new developments to trucking-related industry and things like that. So a couple of us that are involved in the study went out there and gave some talks at town hall meetings and attended some of the supervisor board meetings and things like this, to try and help them get the science part of it right, not CCAEJ but the advisors, the supervisors they don't always understand the science quite as well"* [USC scientist A].

After the USC scientists had published the preliminary findings, they applied for another research grant to extend and elaborate their research further. The National Institute of Environmental Health Science granted them further funding, however with a requirement that the research would include a component of community-based participatory research. Since the USC scientists had already established contact with CCAEJ it was natural for the USC scientists to approach CCAEJ with a request of entering a partnership. One of the USC scientists explained:

> *"So our study is one looking at air pollution and its relationship to asthma and children. And we have two community partners, one in Long Beach and one in Riverside and we have picked those areas partly because those were where we had strong organisations that we could work with"* [USC scientist B].

After the community meeting, CCAEJ kept addressing warehouse development in the communities in Riverside County, working to minimize it. To help fight against the county supervisor, they needed the USC scientists, and they needed sound scientific evidence that the community was exposed to health risks due to emissions from the trucks going to and from the warehouses. Another problem the CSO and the community had started to experience was that trucks were being parked everywhere in Mira Loma, even on small one-way streets. Since the county supervisor ignored their complaints, CCAEJ saw entering a partnership with the USC scientists as the only way to force the county supervisor to listen.

Figure 45: A truck parked on a small street in Mira Loma (Picture: CCAEJ)

Entering the partnership with the USC scientists, then, became the only way for CCAEJ to overcome their obstacle problem, which was to force the county supervisor to recognize the environmental and health problems and improve conditions in the communities they represented. The USC scientists framed the obligatory passage point as *community-based participatory research aiming to gather evidence of the impact from truck-related emissions on children's health*. The CCAEJ chairperson explained that they had several considerations before they agreed to enter the partnership with the USC scientists:

> *"For us to enter into a partnership like that with an academic institution, we have to be pretty clear about who is participating and, you know, because very often it's a very lopsided partnership when you have a big institution. So for me its very important to be able to trust and know who it is we are dealing with, so that our community isn't taken advantage of, being kind of an afterthought, so there is kind of an equal partnership here"* [CCAEJ Chairperson].

CCAEJ was however persuaded to join the network. It accepted the partnership with the USC scientists, because it trusted them and understood that this partnership would help to legitimize their concerns in their fight against the county supervisor.

A representative from CCAEJ explained that besides wanting to promote the concept of community-based participatory research, the USC scientists also realized that in approaching the residents to interest them in participating in the research as research objects, it was important for the USC scientists to appear trustworthy; the partnership with CCAEJ promoted this.

At this moment of translation, the network can be illustrated as shown in Figure 46.

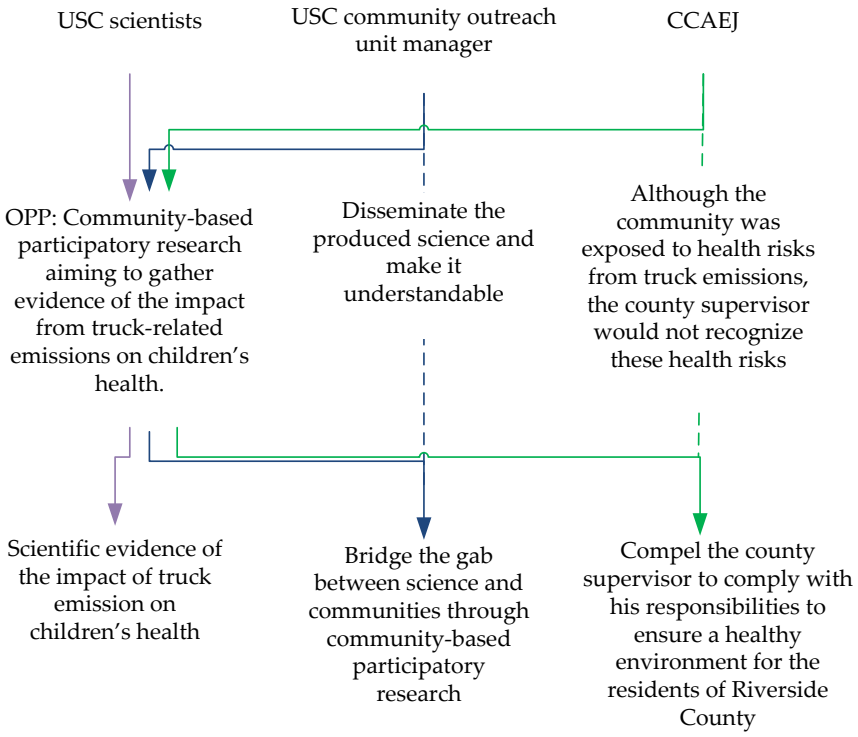


Figure 46: First alliances made – framing the obligatory passage point

As the figure above illustrates, the three actors had three different goals that motivated them to comply with the obligatory passage point. The question arising from this is whether these different goals will contribute to or jeopardize stabilization of the network, and at the end, which consequences this may have for the effects caused by the network.

By framing the obligatory passage point as *community-based participatory research aiming to gather evidence of the impact from truck-related emissions on children's health,* the network assumed that the health risks which the children would be exposed to would be caused by particles emitted by trucks driving to and from the warehouses. In addition, the network assumed that the particles and the trucks would behave in such a manner that it would be possible to capture, observe and register their behaviour; and it would be possible, through this capturing, observing and registering, to determine whether the emissions had an impact on human lung function. If the particles and the trucks behaved differently than assumed, the network would face severe difficulties in upholding the obligatory passage point. These assumptions meant that the network black-boxed the behaviour of the particles and the trucks on the basis of experiences from the previous research on the relationship between emissions from trucks and human health.

Interessement: Persuading other actants to accept the obligatory passage point
When agreement about the partnership between the USC scientists and CCAEJ was reached, the next step for the network was to define the research activities. One research activity was to go to Mira Loma to interview the residents. Since in the US it is not allowed to approach people and ask them questions about their health, CCAEJ's first responsibility was to obtain permission from the Human Subject Research Institute to conduct these interviews. Part of the agreement between the USC scientists and CCAEJ was to hire a community liaison, who would act as mediator between the USC scientists and the community. Since CCAEJ is a non-profit organization, it has no funds for fulltime staff; all staff members are hired on grants to work on specific projects. The community liaison was therefore to be found outside the organization, through CCAEJ's website. By announcing the job opportunity in this way, CCAEJ was using the website as an interessement device to try to attract applicants. A young woman applied for the position, explaining as follows:

> *"After graduating from Santa Cruz undergrad, I wanted to move back to this area to be near my family, because I have plans to move far away for graduate school. So I really wanted to dedicate some time to my family, and I actually had a really really hard time, because I didn't want to settle for a job I wasn't going to love"* [CCAEJ community liaison].

She further explained:

> *I wanted to work at a non-profit, any type of organization, where they were doing actual grassroots organizing and working with communities. […] I really wanted to put my activism into practice, and so I finally found CCAEJ and I was hired on"* [CCAEJ community liaison].

Once the community liaison was persuaded to join the network through the interessement device of working with communities on the grassroots level, the research activities could begin. During the first year, the community liaison conducted interviews with children and their parents and visited their homes, making observations as part of a case control study that included both asthma and non-asthma cases.[50] The USC scientists selected a total of 400 cases, half with asthma. All the data were handed over to the USC scientists to use in their own scientific research, which they conducted simultaneously with the CCAEJ partnership project.

[50] The selection of the study objects, i.e. the children with and without asthma, was done by the USC scientists, without the involvement of the rest of the network. The data gained through the interviews were used in the USC scientists' parallel research. The agreement between USC scientists and CCAEJ when entering the partnership was that the community liaison should carry out these interviews for the USC scientists, but not as part of the community-based research agreement. Since this part of the agreement can be viewed as a separate activity, not directly relevant for the network, I have chosen not to include the study objects as actants in the network.

After the first year, the second part of the research partnership could begin, the part that was related to more community engagement including training a neighbourhood assessment team (A-team). One of the USC scientists explained the idea of the A-team as follows:

> *"To teach them about the health effects of air pollution, to train them to go to community meetings and to make presentations there"* [USC scientist B].

The CCAEJ community liaison explained CCAEJ's motive for creating the A-team:

> *It trained people from our very own community to work with us [CCAEJ, ed.], but not just with us, in communicating with the [figure of] community in demystifying science, exposing the problem - exposing the problem to those who are most affected by it, able to communicate with the community, because fellow members are doing the educating when it comes to the issues, and in all that creating more empowerment for the community […]. These women, you know, started out as housewives; now they feel like they have a role to play in helping these problems"* [CCAEJ community liaison].

The members of the A-team were found among the members of CCAEJ's SALTA class. The SALTA class is a CCAEJ programme aiming to raise awareness regarding environmental and health issues related to the members' communities. The class takes 12 weeks, meeting once a week. During the SALTA class, the members, who primarily are poor unemployed Latino women, learn about harmful substances in household cleaners, pesticides and paint etc., how to read labels etc. The members are also made aware of the political decision-making structures in the communities; they learn about their neighbourhood and their rights as citizens in a democracy.

Figure 47: A SALTA lesson held in the backyard of one of the class members (Picture: My own)

Four members of the SALTA class were asked if they would be interested in forming the A-team, a job that would pay them daily allowances. All four accepted to form the A-team, because they wanted to continue learning about the environment and how they could help their community. The four members thus accepted to be persuaded in the network, together with the USC scientists and CCAEJ, around upholding the obligatory passage point, because they all shared an interest in helping their community to improve the environment and health conditions. To continue work with CCAEJ and the opportunity to help their community were in this situation used as an interessement device to persuade the four women to join the network. Since all four were unemployed, the prospect of daily allowances was also an interessement device used by the USC scientists and CCAEJ to persuade them to join the network.

Once the four women had been persuaded to join the network by forming the basis for the A-team, the USC scientist could start training the A-team so it would be capable to assume the role assigned to it. According to one USC scientist, two seminars were held where the scientists trained the A-team and the community liaison in how to do truck counts and use a monitoring device called P-track to provide data so that the USC scientists could measure the particulate matter (PM) level and the number of trucks passing during the measuring interval.

The checkpoints chosen for monitoring and truck counting were suggested by A-team members, because the USC scientists knew that the A-team members knew their community best and were thereby better able to identify the hot spots for air pollution from trucks.

One A-team member described the truck counting and P-track measuring procedure:

> *"We took the machine and pointed at one point, one community, one school, and one street and went over there and put it on there and it takes about 1 hour, and we measure the air quality, one minute each time"* [A-team member A].

She further explained that sometimes when heavy truck traffic was passing the checkpoints where they took measurements, the PM rate could increase from 150 to 200,000 PM per cm^3. The community liaison elaborated on the procedure:

> *"We do the traffic counting as the reading is being done by the machine and so, every five minutes, we traffic count for one minute, because we want to see how many cars and trucks are passing by in both directions. And then, the next five minutes, you count for a minute, and that's how, and then we kind of collate that to the machine […that] is counting how much particulate matter is in the air that full time, but at certain points you can compare to the traffic count"* [CCAEJ community liaison].

Figure 48: The A-team and the community liaison making P-tracking measurements close to a warehouse in Mira Loma (Pictures: My own)

Through the use of the P-track device, the A-team and the community liaison succeeded in capturing the truck emissions while counting the trucks, meaning that the emissions and the trucks behaved as the network had assumed.

In addition to truck counts and P-tracking, the A-team also made a land assessment of their community, identifying where the children studied in the research lived, attended school and played. The land assessment also identified the placement of warehouses, illegal truck stops, roads with heavy traffic loads etc. One USC scientist explained that this land assessment by the A-team and the community liaison was very beneficial to the scientists:

> *"It was quite eye-opening for us, because they did a nice job in mapping out both new developments and also small-scale sort of mom and pop kind of shops, like automobile repair shops, that somebody had in a residential neighbourhood and it was clear from looking at the maps we used, the publicly available maps we were using to make our estimates, and the overlay that CCAEJ put together, that there were some real undescribed things […]. That area we had defined as agricultural or open space and we were assuming that there was no pollution coming from, in fact now have housing developments on them or they have a big warehouse on them that is a magnet for trucks and other traffic. People are working there, trucks going through. So it was, I mean, it had a lot of importance for the validity of our models and the accuracy of the estimates that we were likely to make at the homes of children"* [USC scientist B].

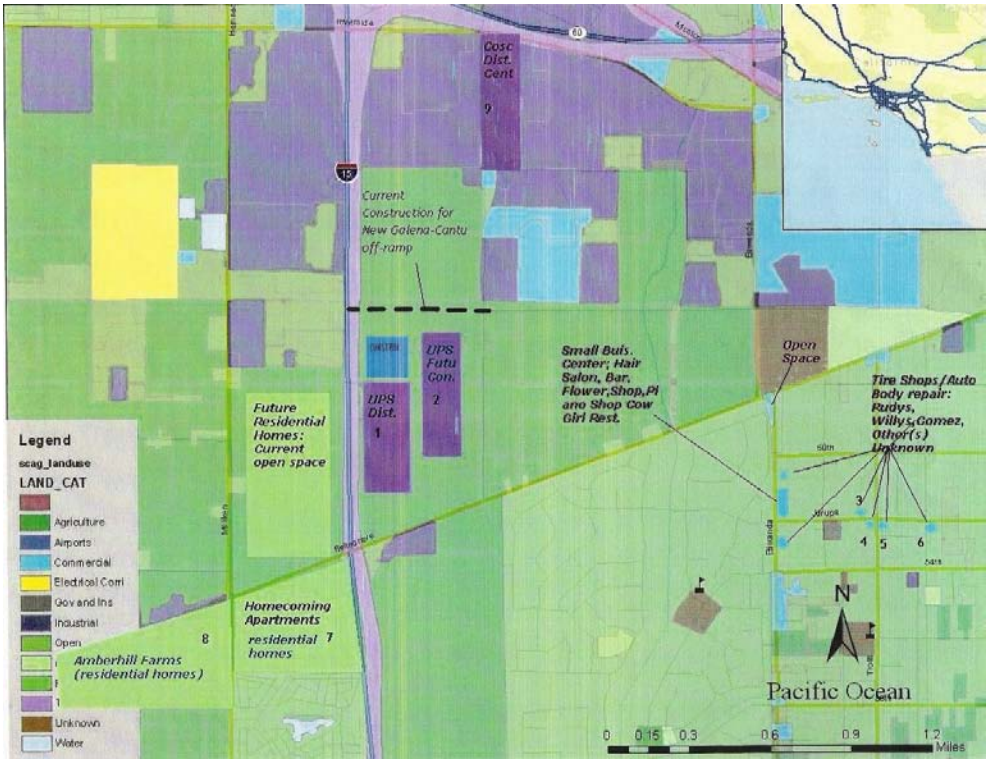


Figure 49: Land assessment map of Mira Loma developed by the A-team and the community liaises in CCAEJ (Map provided by CCAEJ)

The measurements of the PM levels and the counting of the trucks were after each session plotted into a computer programme by the community liaison, enabling them to view the data as graphs, illustrating peak hours etc. The community liaison then discussed these graphs with the A-team, making sure they understood the results and the impact of the results. The monitoring results were also handed over to the USC scientists, for them to use as background information in their own scientific research. One scientist explained that they could not use the monitoring results directly:

> *"It would have been difficult to just take the data they recorded directly, and then use it in our health study, and that's partly because we are studying 12 communities and so we really need comparable data in all 12 to really do the job. Even if we said, well let's do a little sub-study in Mira Loma, the level of training that was provided to the people out there was, you know, probably on the order of a few hours […]; it wasn't of the kind of regular nature that we would need to say well you are going out, you are going to monitor 20 minutes at this location and then go 100 yards and do 20 minutes there, you know, in a real systematic way. So and I think they were […] more, you know, kind of ad hoc spot measurements at this facility and that facility, and feeding into their desire to know where their local hotspots were and not necessarily what we would need"* [USC scientist A].

The other USC scientist, however, explained that the land assessment mapping could be used directly by the USC scientists. He meant that the maps they had access to were two to

four years old, but since the area had developed rapidly, the maps were incorrect. He said further:

> *"I think that's perhaps the most important scientific contribution that the collaboration has made to our study. I think there are some other contributions that they have made as well, for example we had a school district that was quite important to the study. It actually - it's the district with the highest particulate levels of anywhere in Southern California, and one of the highest levels anywhere in the US […]. And the Mira Loma school district dropped out of the study after about 10 years of following children there, so that that was really a source of concern for us, that we were sort of anxious over that, tried to figure out what to do, and I think - I don't know the details of it - but I think it was a large part to do with Penny's intervention that that school district decided that they would come back in. So it has been, I mean there has been, there are a number of examples of that having improved the research"* [USC scientist B].

Through observations in the area, the A-team and the community liaison succeeded in mapping the warehouses in the land assessment and thus strengthened the network's attempts to uphold the obligatory passage point. Before the assessment, the warehouses were invisible on the official maps used by the USC scientists. Now they had been observed and mapped, which meant that the USC scientists now had proof of their existence.

At the same time that the USC scientists and CCAEJ created the network and actants were made interested, another network was established with the county supervisor as the leading actor. The county supervisor and the county board of supervisors had continued to approve development of new warehouses, in spite of the fact that the USC scientists had proven that there was a significantly higher level of PM in Mira Loma than in the rest of the country, and despite the growing resistance in the community. The county supervisor did not trust the scientific results of the USC scientists, so he decided to initiate his own scientific research to investigate the diesel impact from warehouse development in Mira Loma. The county supervisor hired the Center for Environmental Research and Technology (CE-CERT) at Bourns College of Engineering at University of California. A year after CE-CERT had begun their research, they could conclude, as had been the argument of the county board of supervisors from the beginning, that diesel emissions from warehouse development in Mira Loma had a negligible impact on air quality in the community. CE-CERT concluded that 88 percent of the PM measured in Mira Loma was emissions blown into the community from Los Angeles and Orange County and that only 12 percent of the measured PM was caused by local warehouse development and truck traffic.

CE-CERT's results thus differed with the results of the USC scientists, both with regard to the sources of air pollution and levels of PM measured in the community. Through this contrast with the results of the USC scientists, CE-CERT tried to dissolve the network formed by the USC scientists and CCAEJ against the county supervisor. At the same time, they tried to interest the community to join their alliance with the county supervisor by persuading them that the warehouse development was not causing air pollution and health risks to the community.

The CE-CERT scientists did not succeed in dissolving the network of the USC scientists and CCAEJ, because the USC scientists argued that the issue of the amount of air pollution coming from outside the community was based on wrong assumptions.

CCAEJ understood, however, that it was important to persuade the community to join the network and defeat the CE-CERT scientists' and the county supervisor's efforts to persuade them that warehouse development did not cause health risks to the community. Therefore, soon after the announcement of the CE-CERT results, CCAEJ distributed a flyer in the community and on its website to explain that, compared to the results of the USC scientists and the South Coast Air Quality Management District (AQMD), CE-CERT's research results could be questioned. As CCAEJ explained in their flyer:

> "*They [the CE-CERT scientists, ed.] removed the testing equipment from outside at the Jurupa Valley High School, making it impossible to compare their findings with existing information from all the other studies. Since AQMD data shows that the High School is the hot spot due to its location next to Etiwanda (a major truck route) and Hadley's next door, one has to wonder why they didn't measure outdoors as they promised. They said it was due to 'security issues'*" (CCAEJ flyer, August 1, 2002).

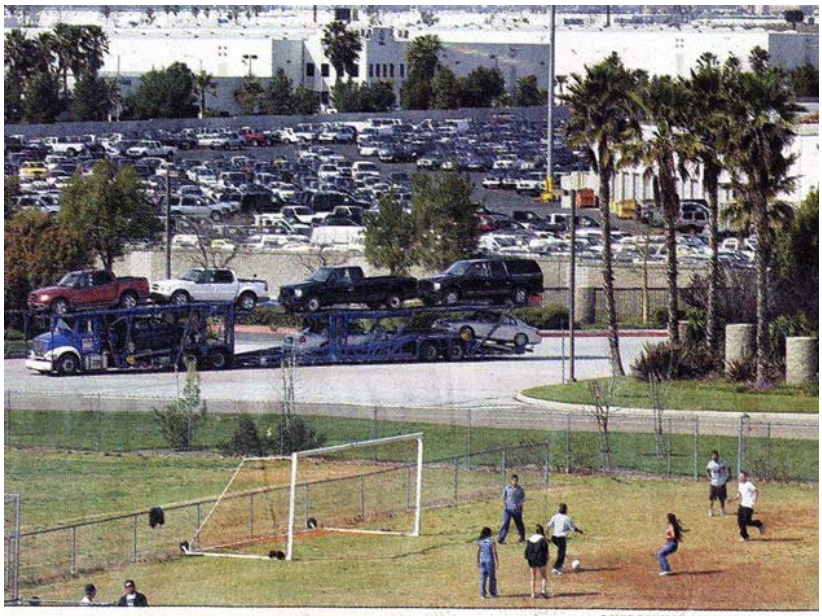


Figure 50: Warehouses and heavy truck routes located just next to the playground of Jurupa Valley High School (Picture: CCAEJ)

CCAEJ further explained in the flyer that the findings of the AQMD study clearly indicated that diesel emissions from warehouse operation in Mira Loma caused increased risks for cancer. CCAEJ ended their flyer with the words:

> *"A vote for warehouses is a vote against the health of our kids and the community"* (CCAEJ flyer, August 1, 2002).

CCAEJ here used the flyer as an interessement device to persuade the community to join the network, and that the USC scientists' results were scientifically correct, whereas the CE-CERT scientists' results could be questioned.

The fight between the two networks was also reported in the media, especially in the Press Enterprise. Throughout the whole period when the battle took place, the Press Enterprise sided with the community, trying to put the county supervisor in a bad light. For instance in an article published August 27, 2002, a journalist revealed that:

> *"…Companies and individuals with financial interests in Mira Loma and warehouse development elsewhere have donated millions of dollars to the UCR environmental engineering center [the CE-CERT center, ed.]"* (Danielski, 2002).

The fight between the network and the county supervisor continued, as the rest of the story illustrates, but the network as it was at the interessement moment of translation can be illustrated like this:

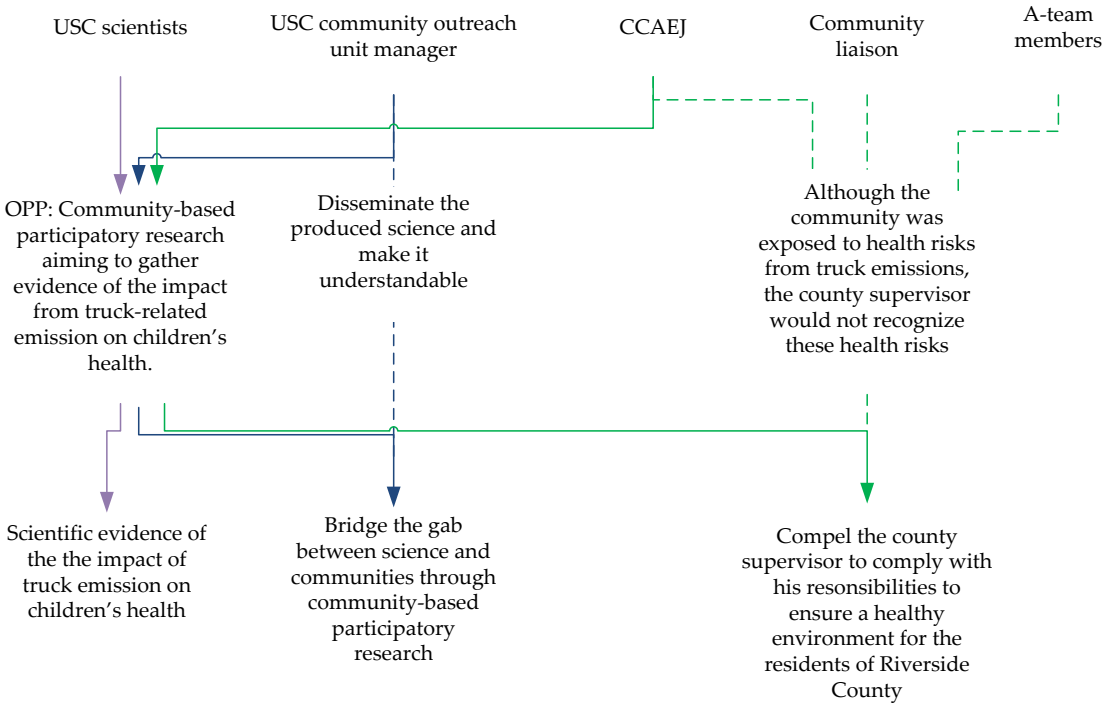


Figure 51: Illustration of problematization and obligatory passage point at the interessement moment of translation

As the figure shows, the network had now been extended to include the community liaison and the A-team, but these new actors had the same obstacle problem and goal as CCAEJ. Thus, the dilemma may still be, as it was in the problematization moment of translation, whether the goals of the scientists and the community outreach unit are compatible with the CSO's goals.

The media (e.g. Press Enterprise) showed interest in the network, but no attempt was made to persuade them to join the network, due to the wish to uphold the obligatory passage point. Rather, they were persuaded to join the alliance by the results produced by the network, and due to the actions of the county supervisor - e.g. his priority of economic growth over the health of the community.

Nor was it attempted to persuade the county supervisor and the CE-CERT scientists to join the network, before the network reached some stabilization. In fact, as the story will show, especially CCAEJ did not want the county supervisor to become interested in the network activities while they were going on; it was better to persuade him about the network's results – that warehouse development was causing health risks to the community.

Enrolment: Did the actants accept and play the roles they were assigned?
The USC scientists managed to create an alliance between them, their community outreach unit, the CSO and the A-team. The network further succeeded in upholding the obligatory passage point, since both the particles and the trucks behaved as the network assumed. Although it was the USC scientists who took the initial steps towards forming the network, CCAEJ was fully enrolled, performing the actions assigned to it by the network. The CSO even took independent initiatives (as the story goes on to illustrates), which indicates their full enrolment in the network.

Although the network had upheld the obligatory passage point at this point and the USC scientists had achieved their goal, the network continued, now focusing on achieving CCAEJ's goal – to *force the county supervisor to comply with his responsibilities to ensure a healthy environment for the residents in Riverside County*. The network needed to continue, even though the obligatory passage point was upheld, because the county supervisor rejected the network's results and formed his own network with the CE-CERT scientists to substantiate his arguments against the results of the USC scientists' research.

The A-team, which was established as part of the partnership agreement between the USC scientists and the CCAEJ, was also fully enrolled into the network. It played the role assigned to it by the network, because as one A-team member explained to the community liaison:

> *"She got [to a point, ed.] where she started to learn not just what the problems were, but what the sources were and then at that point she really wanted to take part in thinking about solutions on top of that […]. As part of the A-team, she has gained a lot of skills like doing the P-track monitoring and measuring the contamination in the air and doing traffic counting, but above all, taking that information and giving it back to the community, and educating her own community about what's happening in the area"* [A-team member B, translated from Spanish to English by the community liaison].

Furthermore:

> *"When she's going back to educate her community, she mentions how people don't or didn't know what was happening, or the impact that can be caused by all of this. Like building of warehouses and how, initially, she heard a lot of people talk about how great it is, because there is going to be more jobs and this and that, but they didn't know or think about or make the connection that it brings in diesel traffic that brings in other side effects and how those are in fact connected to their children being sick, and then she started to make the connection. It was part of her goal to educate the community about those connections"* [A-team member B, translated from Spanish to English by the community liaison].

This explanation indicates that the A-team members were fully enrolled into the network, and that through the network, they were capacitated to bring their knowledge back to the community.

Another action taken by the A-team members and the community liaison, which also indicates their enrolment in the network, was at the time the county supervisor argued that, the residents in Mira Loma should not be afraid of exposure to air pollution from the warehouse activities. They went to the county supervisor's house in the city of Riverside, to the county building and the high school in Mira Loma and took P-track measurements. One A-team member explained their motives for doing this:

> *"We want comparison about Mira Loma village community and Tavaglione's [the county supervisor, ed.] house and where he works in the county building. And we take the P-track machine, and these three points we combined them"* [A-team member A].

The community liaison supplemented the A-team member's explanation:

> *"So we wanted to demonstrate basically that the people who are making the decisions are people who don't live with the consequences of those decisions"* [CCAEJ community liaison].

This initiative was not included as a P-track measurement hot spot agreed upon with USC scientists; however, one of the USC scientists said:

> *"I thought that was very clever and apparently made the supervisor very mad and probably because it was quite effective"* [USC scientist B].

The USC community outreach manager also thought the A-team and the community liaison had taken a cleaver initiative, but she emphasized to them that they could not go public and state that this was done in co-operation with the USC scientists, because they were not interested in becoming too involved in local policy issues.

Again the P-track instrument was used as an interessement device, but this time to persuade the community to join the network.

Both the A-team and the community liaison said that the county supervisor became very angry with CCAEJ due to this action, and he tried to argue that the measurements were not true and that CCAEJ had manipulated with the results of the measurements.

Although the P-track measurements created even more tension between CCAEJ and the county supervisor, the county supervisor and CE-CERT invited CCAEJ and the community to a community meeting to discuss the CE-CERT results that had already been published. CCAEJ accepted to attend the community meeting and invited the USC scientists to join them. At this community meeting, the CE-CERT scientists presented their results. They also interpreted the results of the USC scientists' research findings, trying to argue against the health impact that the USC scientists had highlighted. One of the USC scientists explained that he had to correct the CE-CERT scientists several times during the meeting:

> *"It was, I mean it was a bit contentious, I have to say. You had David Cocker [the lead scientist from CE-CERT, ed.] on one side, trying to defend the work he had done and you had us talking about the work we had done and why the work that Cocker was doing wasn't that applicant to us. And yet, Tavaglione was clearly siding with the CE-CERT guys and trying to promote his case for the warehouse development"* [USC scientist A].

The USC scientist described further that finally, after opposing and yelling at each other, the CCAEJ chairperson stood up:

> *"She very calmly said: Well, everybody has an opinion. Let's basically just move on and get out of here tonight"* [The USC scientist A].

Since neither CCAEJ nor the USC scientists had succeeded in persuading the county supervisor to accept their results, CCAEJ realized that they needed to use other means to force the county supervisor to listen to them and stop new warehouse development. So

CCAEJ organized a happening in the community, hanging up hundreds of banners and posters stating that Riverside County had the poorest air quality in the country.

Figure 52: An example of the banners CCAEJ hung up in the city of Mira Loma in their battle to stop further warehouse development in the community (Picture: CCAEJ)

CCAEJ used the banners and posters as interessement devices to mobilize the community and cast a bad light on the county supervisor.

CCAEJ, the A-team and the community liaison also went to a meeting of the county board of supervisors and presented their results and their concern about health risks if more warehouses were to be developed in their community. They used the results as an interessement device to persuade the county board of supervisors to accept their concern. The media was also still playing an important role in discussing the lack of initiatives and the county supervisor's refusal to accept the fact that continuous warehouse development in the county was causing serious health risks. The CCAEJ campaign and the heavy media coverage finally succeeded; the county board of supervisors turned down approvals for new warehouses due to health concerns. CCAEJ and the network had thus succeeded in stopping further warehouse development.

The county board of supervisors had not been enrolled in the network of the USC scientists and the CCAEJ, although CCAEJ tried to persuade them to join through their campaign and by attending the county board of supervisors' meeting. However, the county board of supervisors had been persuaded to stop further warehouse development

through the actions taken by the network and because the media kept writing articles about the issue during the whole period. By persuading the county board of supervisors that further warehouse development in the community would cause even higher health risks to children, the network succeeded, to persuade the county board of supervisors to exert pressure on the county supervisor to listen to their concern.

For CCAEJ, it was important during the whole period when they were part of the network with the USC scientists, to keep the USC scientists enrolled, since the USC scientists' enrolment in the network gave the network and their claim legitimacy among the residents. When CCAEJ approached the community, they made sure to mention that the findings resulted from a co-operation between the CSO and the USC scientists; they thus used the USC scientists both to legitimize their claim and as an interessement device to persuade the residents to join the network.

Mobilization: Speaking on behalf of others?

The success in upholding the obligatory passage point and enrolling the actants in the network indicates that stabilization within the network was achieved. The question is, however, did the actants in the network also succeed in mobilizing the communities on whose behalf they spoke?

CCAEJ and the network took several initiatives to make sure that they did indeed speak on the behalf of the community. First, they formed the A-team, which consisted of ordinary community members, poor uneducated Latino women, and as part of the A-team's training, they emphasized the importance of communicating the knowledge gained through the A-team's community activities to the community. CCAEJ now[51] also offers an advanced SALTA class, since members of the regular SALTA classes were interested in more education. CCAEJ explained that the increased interest in the SALTA classes was due to the A-team's activities and the organization's reputation in the community due to their efforts to stop new warehouse development.

Teaching in the advanced SALTA class is carried out partly by A-team members and partly by one of CCAEJ's community officers. One A-team member explained:

> *"They have participated in the teaching of these classes, because the focus is a lot on air quality and goods movement issues, and they have been able to take the lead in teaching some of these classes"* [A-team member B, translated from Spanish to English by the community liaison].

[51] In June 2007, when I went to study the CSO's activities.

Another A-team member explained that in order to educate and mobilize the community, they just go to the community and speak with the residents, explaining the connection between air pollution and health risks.

Secondly, CCAEJ made sure that when they were campaigning against warehouse development, they were visible in the community by hanging up banners and posters throughout the community. CCAEJ also knocked on residents' doors to explain their concerns and USC's findings.

At the community meeting arranged by CE-CERT and the county supervisor, 300 residents turned up due to CCAEJ's ability to mobilize the community.

The USC scientists also succeeded in mobilizing their scientific community. They published several articles that included information from network activities (Gauderman et al., 2004; Gilliland et al., 2002; Gauderman et al., 2005; Kunzli et al., 2003; McConnell et al., 2003; McConnell et al., 2006; Gauderman et al., 2005; Gauderman et al., 2007; Gauderman, 2006). They also received requests from scientists all over the world, who wanted to know more about their research and its results. The conflict between the USC and CE-CERT scientists did not have an impact on the USC scientists' ability to mobilize their scientific community. The USC scientists are well known and recognized within the scientific community, whereas the legitimacy of the CE-CERT scientists is questioned by some in the scientific community.

Epilogue: Effects of the network alliance

This story is an example of an EEA in which the actants enrolled succeeded in upholding the obligatory passage point, and thus obtained scientific evidence of the health risks children are exposed due to warehouse activities in the community. This story also illustrates the importance of alliance and network building between human and non-human actants constructed as EEAs. Through a combination of scientific facts, the threat of legal action and persistence, the network succeeded in forcing the county supervisor to stop unplanned warehouse development in the community of Mira Loma and thus achieving a stable state in the network. As the story shows, several actions and actants contributed to the stability of the network, especially the success in upholding the obligatory passage point and the actions taken by both the USC scientists and CCAEJ when the county supervisor questioned their results.

Returning to the discussion started in chapter 2, *section 2.3: ANT as Inspiration for Studying Science-Society Relations – as Network Constructions*, about whether stabilization of networks equals effects, this case illustrates that network stabilization may in some cases equal effects. The case further illustrates that stabilization is never a fixed state; on the contrary, stabilization is continuously challenged by other networks. When the results of the

research where published, this contributed to stabilizing the actants within the network, since the obligatory passage point was successfully upheld. When the results were challenged by another network, however, this could have caused the network to become unstable; but in this case, the conflicting results contributed to making the network even more stable. The network's success in causing effects – i.e. by forcing the county supervisor to stop further warehouse development – may have been due to some of the enrolled actors' willingness to keep addressing the problem, in spite of the fact that the obligatory passage point was upheld. Based on this case, as well as the previous cases, it seems that the backgrounds and motives of the actors in EEAs created between CSOs and scientists play an important role in achieving network stabilization. In this case, CCAEJ was fighting for the health of the residents in the community, while the research group had a scientific interest in exploring the relationship between emissions from warehouse activities and children's health. When this scientific interest had been explored and the scientists had gained the scientific evidence they needed, and after they defended their scientific credibility, they could in principle have withdrawn from the network, as seen in cases A, E and G. The scientists chose to remain in the network, however, and help CCAEJ achieve their obstacle problem. Previously, I concluded that it seems that it is only possible to discuss stabilization of this type of EEA in relation to knowledge production processes. However, this case, as well as case C, seems to indicate that the motives of the actors may also play an important role for the network's success in achieving stabilization.

The activities of this EEA did not only impact the particular issue in question. Through the alliance, the research group helped the CSO to understand how to interpret scientific evidence and use scientific arguments in their struggle to impact their living conditions. The network also contributed to creating legitimacy around the CSO's concerns, in relation to the communities, the media and the local authorities. The network also impacted the lives of the A-team members remarkably. Since the network officially ended (i.e. when the grant for the partnership ended), they have all been offered positions with CCAEJ as community organizers, jobs that provide them with a fixed monthly salary. One CCAEJ member explained that the A-team members were offered these jobs, because of their engagement in A-team activities and in teaching the advanced SALTA classes. This indicates that not only did CCAEJ succeed in engaging ordinary members of the community in their work, they also succeeded in educating them to such an extent that they were able to work as community organizers, a job which they would not have been qualified for, if they had not become involved with CCAEJ.

By developing the land assessment map, the A-team and the community liaison made a valuable contribution to the USC scientists' understanding of the area, how the land had become developed, and where the warehouses were located. Through this mapping, the USC scientists gained a better understanding of where the air pollutants originated and who caused the air pollution.

After the network activities ended, the USC scientists have become even more engaged in community participatory research and have applied for another grant for a research project focusing on the health impact from the movement of goods. If the grant is approved, CCAEJ will be one of the partners in the project.

The USC scientists have been invited to present their results to the Los Angeles City Council. They have also been called on to testify at a hearing regarding legislation on how close to freeways daycare centers may be located, proposed by some state senators in California. The USC research group has also briefed the Senate in Washington DC about health impact from air pollution.

Finally, this EEA shows that alliance making between scientists and CSOs can play an important role as the voices of the citizens when legislation in an area is weak and local authorities give higher priority to economic interests than to citizens' interests and health.

The next and final case (case I) can be understood as an effect of case H, since the activities in case H forced the county supervisor to start addressing the impact of warehouse activities on the communities where they were located. I have chosen to present these cases as two separate cases; however, I wish to emphasize that case I cannot be fully understood without understanding the events and activities analysed in case H.

4.9 Case I: The Guideline Case

- The story about battles for buffer zones

This story is about an EEA in which the same CSO as in case H contributed to and impacted policy decisions concerning future land use by entering a network with governmental institutions. The network in this case was established by a county supervisor who succeeded in minimizing the CSO's resistance to recommended initiatives by inviting the CSO to join the network. This case distinguishes itself from the other cases in that it was initiated by the country supervisor and had no scientists directly involved in the network.

An interesting aspect in relation to this EEA is that although the network succeeded in upholding the obligatory passage point – which was to develop guidelines for future warehouse development – and thus seemed stable, the actors responsible for implementation of the guidelines argued that they did not have the legal means to enforce them. Therefore, the effect of the network was guidelines that developers could follow on a voluntary basis.

Problematization: Reducing air pollution through land use planning
The background for this story is related to the previous story (Mira Loma, case H) in which CCAEJ, through network constellations, succeeded in stopping further warehouse development in Mira Loma and in mobilizing the residents to oppose the county supervisor and demand clean air in their county. This story continues where the first story ended. Due to the growing concern among the residents in the county about continuing warehouse development, the county board of supervisors acknowledged that some general guidelines for warehouse development in housing areas were necessary. They wished to prevent the residents, and specifically CCAEJ, from campaigning against the warehouses and dragging the developers to court under the California Environmental Act. To ensure acceptance of general guidelines by the residents, the county board of supervisors decided to establish a Regional Air Quality Task Force (RAQTF).[52] The focus of this story is how a network was constructed, by whom and with whom, and how negotiations led to the development of the guidelines.

The representative from the Eastern Municipality Water District, which was one of the actors who became interested and enrolled in the network, explained the background for the RAQTF:

[52] The background of the story is based on the explanations of other actants than the county supervisor. The county supervisor was not interested in being interviewed. I succeeded in getting an interview with his deputy director, however, who did not remember why exactly or how the committee was initiated.

> *"Well originally […] the Riverside County board of supervisors was getting a lot of pressure from some community people. I think for the most part that in particular was in the Mira Loma area where there is a lot of warehouse development going on. They have some of the worst particulate matter pollution in the country there, and they have a lot of low and moderate income people there. They're seeing a significant increase in heavy duty diesel truck traffic due to warehouses and stuff. So they were becoming somewhat vocal, and I believe it was supervisor Tavaglione who's in here. He, I guess, passed a motion or measure to create a committee or taskforce to address air quality issues. And I think the reason it was called regional was in the original intentions was that it would be a Western San Bernardino and Western Riverside County coalition, that we would all be in a broader coalition"* [Eastern Municipality Water District representative].

The county supervisor's deputy director explained that the CE-CERT[53] research had made the county supervisor realize that children living in Mira Loma had lower lung capacity than children in other communities, and that this was due to the high levels of particulate matter in the air. Thus, the county supervisor became aware that the county needed to develop broader plans and guidelines for land use, rather than land being developed haphazardly as had previously been the case. The county supervisor's deputy director also explained that the whole region of Southern California experienced severe air pollution problems, and therefore all counties and cities in the area needed to address this issue. The county supervisor therefore decided to form a task force under the Western Riverside Council of Governments (WRCOG). The aim of the task force was to:

> *"Come up with a set of guidelines or policies that we could follow in order to make sure that as we update our general plan, land use elements and that sort of thing in the future. That we try to do everything we can to identify where these potential problems may exist and try to create the buffers that are necessary and idling limitations that may help […]. To try to do everything we can at the local planning level to reduce the impact of diesel particulate pollution on the local community"* [County supervisor's deputy director].

According to the final report developed by the RAQTF, *'Good Neighbor Guidelines for Siting New and/or Modified Warehouse/Distribution facilities'* (WRCOG, 2005), the aim of the task force was to *study air quality issues in the Western Riverside County*. The county supervisor and WRCOG framed the obligatory passage point, even though up to this moment they had not tried to persuade any other actants to join the network. The WRCOG and the county supervisor were not interested in involving other actants at this moment of translation; defining the overall aim of the task force was a governmental decision. WRCOG and the county supervisor knew however that they needed to involve other

[53] See the Mira Loma case (case H) for more details on the CE-CERT research and its results.

organizations than just governmental institutions, if the task force's work was to be accepted as legitimate by the communities affected by warehouse development. But these other actants were not invited to participate at this initial moment of translation. The network, which only consisted of the county supervisor and WRCOG up to this moment, can be illustrated like this:

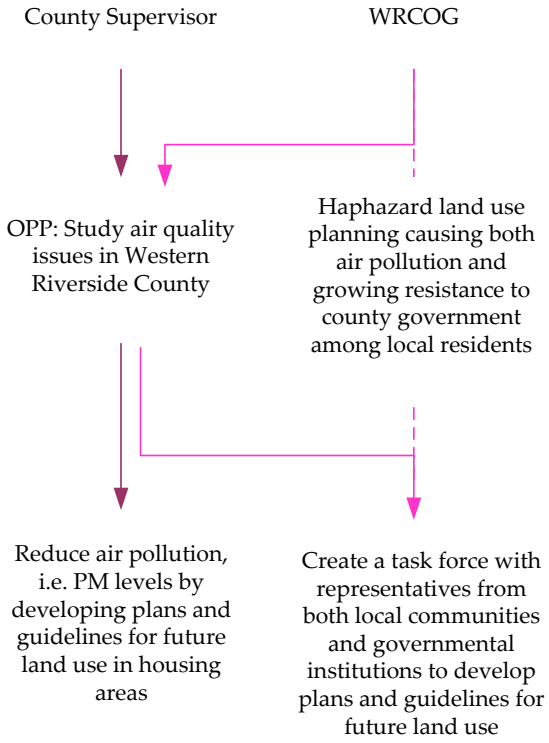


Figure 53: First alliances made – framing the obligatory passage point

By framing the obligatory passage point as 'study air quality issues in Western Riverside County', the network assumed that the emissions caused by warehouse activities caused health risks to the residents. This assumption was based on the results of the CE-CERT research. As the story illustrates, the behaviour of the emissions was never questioned or explored further, since the focus was on developing guidelines to prevent the emissions from damaging residents' health.

After having defined the purpose of the network, WRCOG's next step was to try to persuade other actants to join the network and interest them in working to uphold the obligatory passage point.

Interessement: Persuading other actants to accept the obligatory passage point
WRCOG's programme manager, who was in charge of establishing the RAQTF and keeping the task force working, explained that the way they tried to interest other actors in the network, was through letters of invitation:

> *"We sent out letters inviting all of our – we represent the 14 cities in the county in the western region. We sent out letters inviting those cities to participate. The planners, any air quality or environmental activist groups to participate"* [WRCOG programme manager].

WRCOG also sent an invitation to CCAEJ to join the task force, because as the programme manager explained:

> *"Basically because she's [the CCAEJ chairperson, ed.] everywhere. That group is, supervisor Tavaglione's area, is the Mira Loma area, so we know who the community groups are"* [WRCOG programme manager].

When CCAEJ received the invitation they were at first a little reluctant towards the task force. They were not sure they would have any say if they decided to join the network, but after discussions in the group, the chairperson and a staff member decided that they would join the task force. Their motive was that they would at least get an idea of the discussions taking place, and at best could also impact the decisions taken in relation to Mira Loma.[54] CCAEJ was thereby persuaded to join the network due to the possibilities of impacting the political decisions regarding land use plans in Mira Loma.

Other governmental institutions were also persuaded to join the network by WRCOG and the county supervisor, primarily due to their responsibility areas within the governmental structures. At this moment of translation, the following actors were persuaded to join the network by WRCOG and the county supervisor:

- The county supervisor's deputy director
- The mayor in the city of Beaumont
- The council member in the city of Norco
- The mayor in the city of Riverside
- A representative from the American Lung Association of the Inland Committee
- A representative from the County of Riverside Planning Department
- A representative from the Eastern Municipality Water District
- A representative from the City of Moreno Valley Planning Department
- A representative from the South Coast Air Quality Management District (AQMD)
- A representative from the private company, P.F. Ryan and Associations, Inc
- A representative from the organization Clean Energy
- The chairperson from CCAEJ
- A representative from CCAEJ

Figure 54: The members of the RAQTF (WRCOG, 2005)

[54] How and with which arguments WRCOG succeeded in persuading the CCAEJ into the network has not been possible for me to explain, since neither the representatives from CCAEJ nor the representative from WRCOG remembered this.

The Eastern Municipality Water District representative explained that originally WRCOG also tried to persuade San Bernardino County into the network, because WRCOG wanted the task force to address regional problems. San Bernardino County was however not interested and refused to be persuaded to join the network, because they could not see any purpose in joining the network. This meant that WRCOG only succeeded in interesting the cities within Western Riverside County and thereby failed to make the task force regional.

During the first meetings, task force members discussed and brainstormed ideas about the initiatives on which they should focus. The Eastern Municipality Water District representative explained that the problem with the task force was that it was a non-regulatory body, meaning that:

> *"Everybody is really sensitive about adopting regulations that require things – I mean it's very difficult to adopt broad-based kind of things. […] And how would you do something – you can't force cities to adopt ordinances"* [Eastern Municipality Water District representative].

The AQMD representative further explained that besides brainstorming ideas, the task force members also discussed priorities for the ideas. And the issue which all the members found most important to address was diesel emissions, particularly diesel emission problems in Mira Loma. The AQMD representative explained:

> *"I remember, in the discussions, that I had asked Penny Newman's group [CCAEJ, ed.] that, we really want to know, for your group and since you are the folks that are representing the people that live in Mira Loma, what are the issues that you – first and foremost are the most important to you? The first and foremost were the issues of trucks diverting through the neighbourhood, looking for an eating establishment, or couldn't find parking; working on their truck in front of residential areas, where there are kids playing. […]. This mix, you had this whole picture of people trying to establish a neighbourhood, and then you have these large trucks that come rumbling through"* [AQMD representative].

The concerns and problems experienced by CCAEJ and the Mira Loma residents inspired the AQMD and Eastern Municipality Water District representatives to suggest to the task force that they should develop guidelines containing aspects and considerations that new warehouse developers ought to consider as part of their planning of warehouse location.

By suggesting development of guidelines to be considered when planning new warehouses, the AQMD and Eastern Municipality Water District representatives succeeded in translating the obligatory passage point from '*study air quality issues in Western Riverside County'* to *'Provide local governments with specific strategies that can be considered and implemented to minimize potential diesel impacts from new warehouse and distribution centers'* (WRCOG, 2005: p. 3). This translation of the obligatory passage point

caused especially CCAEJ to become more interested in the network, since this framing included more of the concerns of the Mira Loma community than the obligatory passage point framed by WRCOG and the county supervisor. Even WRCOG's programme manager was persuaded to accept the translation of the obligatory passage point:

> *"We had South Coast Air Quality Management district as part, and they already had rules to establish for dust and various things, so they were able to tell us, well we already have a rule for that and maybe you can look at it this way. They did a lot of help with the strategies and they have the scientific background to guide us […]"* [WRCOG programme manager].

The network at this moment of translation can now be illustrated as follows.[55]

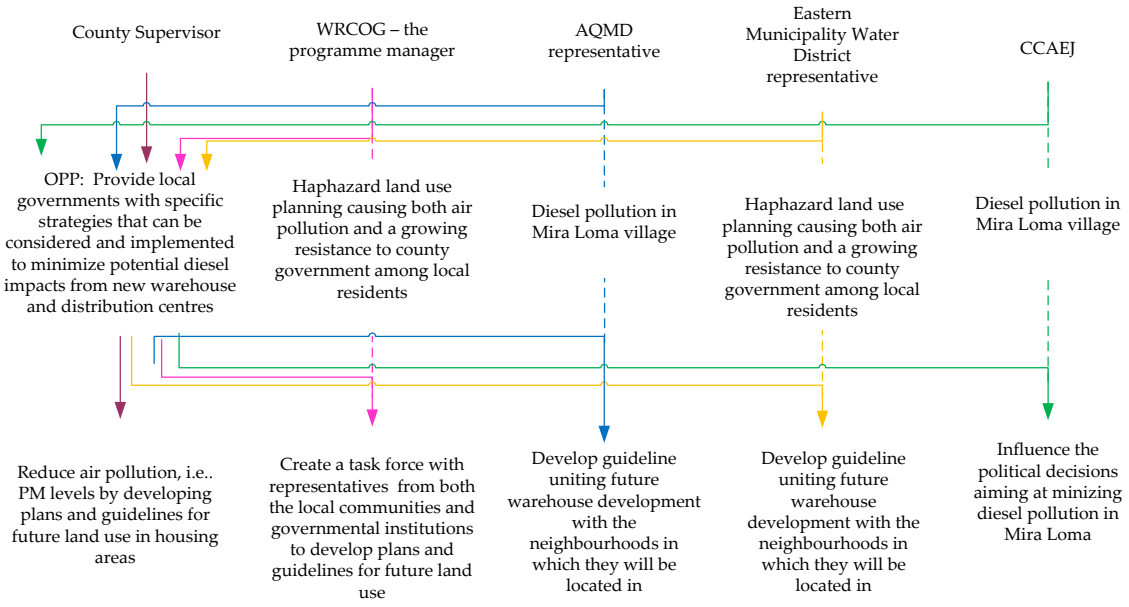


Figure 55: Illustration of problematization and obligatory passage point at the interessement moment of translation

Once all the actors WRCOG assumed relevant were persuaded to join the network and accept the new obligatory passage point, they could start to discuss the elements to be included in the guidelines. One aspect that was very important for CCAEJ was to recommend buffer zones by indicating the acceptable distance between warehouses and housing areas. The CE-CERT scientists had recommended a buffer zone of 1500 feet (approximate 450 m), whereas AQMD in one of their studies recommended a buffer zone of 1000 feet (approximate 300 m), since the studies showed that the health risk dropped significantly when people lived 1000 feet from the diesel source. The task force members

[55] The network illustration only includes the actants visible in the story. In spite of the fact that many institutions were represented, as illustrated in Figure 54, only a few of them took active part in the network.

decided that they would recommend 1000 feet, since this was AQMD's recommendation, an institution trusted by all members.

CCAEJ explained that although the task force agreed to a 1000-feet buffer zone, the county supervisor continued to argue that CCAEJ had to remember that he was not in a position to enforce this, since regulations about buffer zones had to be decided on the regional level and not the county level. By arguing that the regulation could only be made on regional level, the county supervisor tried to convince CCAEJ that implementation of the buffer zones was not his responsibility but that of others, and it was therefore not something the network should be addressing. In spite of this translation, CCAEJ stayed interested in the network and continued to participate in development of the guidelines. The task force also discussed other initiatives that would be easier to implement and which did not require regulation, such as informing truck drivers of truck routes, and motivating them to turn off the engine while waiting to unload or load their trucks.

The network's discussions resulted in a report with both local and regional goals and recommendations:

Goal	Benefits	Recommendation
Minimize exposure to diesel emissions in neighbourhoods that are situated in close proximity to the warehouse	1. Reduces exposure of diesel emissions to residents and other sensitive receptors 2. Reduces potential future health, odour and noise related issues	• Create buffer zones of at least 1000 feet between warehouses and sensitive receptors (housing, schools, playgrounds etc.) • Site design shall include check-in facilities for trucks to avoid idling of trucks outside the warehouse facility • Avoid locating residences and other new sensitive land uses near entry and exit points
Eliminate diesel trucks and unnecessary truck traffic through residential neighbourhoods	1. Reduces exposure of diesel emissions to residents and other sensitive receptors 2. Reduces or eliminate trucks in residential neighbourhoods 3. Reduces truckers' travel time if key destinations are clearly identified	• Require warehouses to establish specific truck routes and post signage between the warehouses and the freeway. • Provide food options, fuelling, truck repair and/or convenience store on-site or within the warehouse complex
Eliminate trucks using residential areas and repairing vehicles on streets	1. Reduces exposure of diesel emissions to residents and other sensitive receptors	• Allow homeowners in the trucking business to acquire permits to park vehicles on property, residential areas or streets • Establish overnight parking within the warehouse facilities

Continued on the next page

Goal	Benefits	Recommendation
Reduce and/or eliminate diesel idling within the warehouses	1. Reduces exposure of diesel emissions to residents and other sensitive receptors	• Train warehouse managers in efficient scheduling and load management to eliminate unnecessary queuing and idling of trucks • Restrict idling to under 10 minutes
Establish a diesel minimization plan for on- and off-road diesel mobile sources, to be implemented with new projects	1. Reduces exposure of diesel emissions to residents and sensitive receptors 2. Establishes long-term goal for facility to eliminate diesel emissions at the facility 3. Reduces on- and off-road diesel emissions that are associated with use of the facility	• Encourage warehouse owners to replace their existing diesel fleets with new model vehicles and/or cleaner technology • Encourage installation of clean fuel fuelling stations at facilities
Establish an educational programme to inform truck drivers of the health effects of diesel particulates and the importance of reducing their idling time	1. Educates truck drivers about health effects of diesel particulates to encourage them to implement diesel reduction measures	• Provide warehouse owners/managers with informational flyers and pamphlets for truck drivers about the health effects of diesel particulates and the importance of being a good neighbour. The following information should be included: health effects of diesel particulates; benefits of minimizing idling time; ARB idling regulation, and importance of not parking in residential areas
Establish a public outreach programme and conduct periodic community meetings to address issues from neighbours	1. Informs the community regarding proactive strategies that the warehouses have or are doing to reduce exposure to diesel particulate 2. Allows the warehouse to be more proactive 3. Encourages partnership to develop solutions for both parties	• Encourage facility owners/managers to conduct periodic community meetings • Encourage facility owners/managers to co-ordinate an outreach programme that will educate the public and encourage discussions related to the potential cumulative impacts from new warehouses

Figure 56: Goals and recommendations for warehouses owners/managers in the local communities (WRCOG, 2005: p. 7-10)

The network's recommendations for implementation at the regional level were:

- Develop, adopt and enforce truck routes in and out of a jurisdiction and in and out of facilities
- Have truck routes clearly marked with trailblazer signs, so trucks will not enter residential areas
- Promote cleaner technology
- Adopt and implement the regional idling ordinance to minimize idling at delivery locations
- Educate the local enforcement agencies (including law enforcement) on diesel emission minimization strategies
- Educate local governments of potential air quality impacts
- Provide food options, fuelling, truck repair and/or convenience store on-site.

Figure 57: Recommendations for decision-making at regional level (WRCOG, 2005: p. 11)

By succeeding in developing the guidelines, the network succeeded in upholding the obligatory passage point. The AQMD representative explained that the recommendations were developed with the participation of all members in the task force:

> *"Everybody participated based on what their interests and what their need were. […]. Everyone had sort of a different role. Obviously our role was strong because we're the Air Quality Agency; our concern is for air quality, health effects from diesel particulates"* [AQMD Representative].

The discussions among the members in the network were however not always without conflicts. The CCAEJ representative explained that CCAEJ chose to send another representative to the last meetings after the recommendations had been developed, because as she explained:

> *"During the last two meetings, Rachel [one of the staff members of CCAEJ, ed.] went, because they [the WRCOG programme manager and the county supervisor, ed.] are now totally disregarding my presence in the room"* [A staff member of CCAEJ].

By ignoring the CCAEJ representative, WRCOG tried to neglect their existence and importance, but CCAEJ remained interested in the network. It was important for them to keep pressuring the county supervisor to implement the guidelines, in order to ensure that he was not only using CCAEJ to legitimatize that he was addressing the issue.

When the guidelines were developed, WRCOG produced a report addressed especially to planners, architects, developers, elected officials, school districts, community advisory councils and community organizations. The WRCOG programme manager explained that although the recommendations were developed in co-operation between county and city officials, neither the task force nor the WRCOG had the authority to enforce the guidelines or force the cities and counties to comply with them:

> *"We make recommendations for the cities, and we hope that the cities will take our recommendations and implement them, but we have no authority to make them"* [WRCOG programme manager].

The Riverside County Planning Department representative also explained that the planning department, as well as WRCOG, did not have the authority to enforce the guidelines. He explained that all the Riverside County Planning Department could do was to send the guidelines to the cities and counties and hope that they would follow them when they were planning future warehouse development.

Enrolment: Did the actants accept and play the roles they were assigned?
WRCOG and the county supervisor managed to create alliances between different governmental institutions and CCAEJ around upholding the obligatory passage point. By translating the first initial obligatory passage point, the AQMD and Eastern Municipality Water District representatives succeeded in persuading the other actors that what the network needed to do was to develop guidelines for warehouse development in housing areas. The translation of the obligatory passage point motivated CCAEJ to become even more interested in the network, because developing guidelines seemed more useful to the CSO. Upholding the re-framed obligatory passage point caused some degree of stabilization within the network. However, the fact that the task force and its members lacked enforcement authority meant that some of the actors tried to deny their responsibility to implement the guidelines, and this impacted their enrolment in the network.

WRCOG, which can be viewed as the network moderator, was enrolled in the network as long as the network was only concerned with developing the guidelines. When the guidelines and the recommendations had been developed, WRCOG published a report and sent it to cities and counties within the region. They also published the report on their website. The report containing the guidelines was used as an interessement device by WRCOG in its attempts to interest and enrol other actors to comply with the guidelines. It seems, however, that WRCOG was not fully enrolled in the network, since the programme manager did not try to convince actors within the county's governmental structures to implement the recommendations, or exert pressure on the right authorities to implement them:

> *"What we are, is basically a facilitator between our cities and the county, and we bring them together and they can talk about regional issues and come up with regional solutions for the area. So we make recommendations for the cities and we hope that the cities will take our recommendations and implement them, but we have no authority to make them"* [WRCOG programme manager].

In spite of the fact that the regional planning department also has no enforcement authority to implement or pressure warehouse developers to comply with the recommendations, the representative did use the recommendation. He explained that he informed his colleagues about the recommendations, and when new planners are hired,

they attend training sessions in which the recommendations are included as part of the information given:

> *"I am committed to putting on a little training session that relates to this new neighbour policy. So that our planners are at least aware of what are issues […] when a warehouse proposal ends up on their desk and they have to process it. So at least they are sort of thinking about what the impact of a warehouse might be on the neighbourhood and that sort of thing"* [Riverside County Planning Department representative].

Introducing the guidelines and recommendations as an element in training new planners is an indication that the representative was enrolled in the network. Although he was not in a position to enforce the guidelines, he tried to use them when possible.

The AQMD representative explained that when they receive Environmental Impact Reports for approval from warehouse developers, they can see that the warehouse developers do not in all cases use the guidelines. In each case, AQMD specifies for the developers that these guidelines should be followed, or at least considered, in order for them to ensure minimization of air pollution in the communities where they are going to develop the warehouses. By specifying for the warehouse developers that they should follow the guidelines, AQMD uses the guidelines and the recommendations as interessement devices to persuade the warehouse developers to comply and accept that they have the responsibility to ensure a healthy environment in the neighbourhoods where they are to be located. AQMD attempts to have developers comply with the guidelines indicates that they were enrolled in the network and that they did utilize the means available to them to promote the guidelines.

After the guidelines were developed, CCAEJ promoted them through their website and whenever they talked to people, both in the communities and with county authorities. The CCAEJ chairperson explained:

> *"It [development of the guidelines, ed.] gives you something to point to; here are the recommendations. You have AQMD and the agencies with expertise recommending this; this is what you should do. And for some of the cities, they didn't have the slightest idea that it's a problem when placing the buildings [the warehouses, ed.]. So this has been helpful"* [CCAEJ chairperson].

CCAEJ's use of the guidelines indicates that the organization was enrolled in the network, and that they played the role they were assigned, that of being the voice of their community. CCAEJ stayed in the network, even after the CCAEJ staff member experienced that her presence was being ignored, which again indicates their enrolment. CCAEJ wanted these guidelines to be developed and wanted to be part of the network, because it gave them an opportunity to impact policy decisions – maybe not directly since

the task force did not have the authority to enforce the guidelines, but indirectly since the guidelines were developed with county authorities. Therefore, CCAEJ argued, the guidelines had more legitimacy than if the CSO had developed them themselves.

Mobilization: Speaking on behalf of others?
The success in upholding the obligatory passage point and the actors' enrolment in the network do indicate that stabilization within the network was achieved. The actors have attempted to some degree to mobilize their institutions to use the guidelines, although none of the actors was in a position to enforce the guidelines.

CCAEJ still represents the community; none of the other actors questioned this at any moment.

The AQMD representative explained that she has experienced that some cities and counties do refer to the guidelines when they process warehouse approvals, which indicates that some cities and counties have accepted the guidelines.

Epilogue: Effects of the network alliance
This story is an example of an EEA in which the network succeeded in developing guidelines for future warehouse planning. Compared to my other cases, this case differs in one central point: the network was established without interesting or enrolling scientists in the network. Rather, the network made the scientifically based assumption about the existence of certain relations: emissions from warehouse activities were causing health risks to the communities. Based on this assumption, the guidelines were developed with input from different governmental institutions and CSOs.

This EEA illustrates how a CSO, by entering a network with governmental institutions, can contribute to policy decisions concerning future land use planning. On the other hand, this case also shows the complexity of stabilization, as I have discussed earlier in relation to the other cases. The complexity as it is reflected here is that in spite of the fact that the guidelines were developed and the obligatory passage point was upheld, the network – or at least the CSO – did not necessarily cause the effect it had hoped for. As discussed in the previous cases, Latour and Callon argue that upholding the obligatory passage point would indicate some kind of stabilization of the network. But this is questionable in this case, since it seems that the actors that could influence the enforcing bodies refused to do so, or they claimed they did not have the influence to impact others to enforce the guidelines. Despite the network's lack of means of enforcement, the guidelines have been used by the warehouse developers to some extent. And the county planning department has included the guidelines in their training programme for new planners.

CCAEJ has also used the guidelines, primarily to put pressure on the county and the developers. CCAEJ argues that especially buffer zones need to be implemented when new warehouses are developed, since it is scientifically proven that implementing a buffer zone of 1000 feet significantly reduces health risks for the residents. When arguing for buffer zones and the guidelines, CCAEJ emphasizes that the guidelines were developed in co-operation with governmental institutions; this gives them more legitimacy than if the guidelines had been developed by the CSO.

Finally, some sort of stabilization of the network is indicated by the fact that after the development of the guidelines, the task force decided to start developing guidelines for truck drivers to specify truck routes, parking regulations, and the importance of reducing idling time. Through their work on the guidelines for land use, the network identified a need for guidelines for the truck drivers.

CHAPTER 5: DISCUSSION OF EFFECTS OF THE NETWORK ALLIANCES

In the previous chapter (chapter 4) I explained and analysed nine cases inspired by Callon's (1986a) sociology of translation where **CSOs in order to impact an air pollution agenda engaged with scientists through alliance building and network constructions with Science Shops.** According to Yin (2003: p. 116-118 & p. 133-137), when conducting multiple case studies, the individual case studies provide the first step in the analysis. The next step is to compare the cases in relation to different characteristics identified in the case studies. The challenge, however, is how to combine Yin's ideas about comparing the cases in relation to different characteristics without ending up giving sociological explanations that strive to **predict** social changes in society. The aim here is rather to explain how different types of network alliances between CSOs, Science Shops and scientists are created around air pollution controversies, how they contribute to success or failure in causing effects on the air pollution issue in question, and whether the networks succeed in affecting other issues than the issue in question. Akrich et al. (2002) acknowledge the dilemma confronting a researcher who needs to understand why some innovation processes fail while others are successful. In the article, *The key to success in innovation Part I: The art of interessement* (Akrich et al., 2002), the authors argue that in the search for what guides actions: *"[...] we must not believe for a moment those edifying stories which retrospectively invoke the absence of demand, technical difficulties or inhibitory costs. These questions are controversial when innovation is in the making"* (p. 190). The authors continue: *"Since the outcome of a project depends on the alliances which it allows for and the interests which it mobilizes, no criteria, no algorithm, can ensure success a priori. Rather than speak of the rationality of decisions, we need to speak of the aggregation of interests which decisions are capable or incapable of producing. Innovation is the art of interesting an increasing number of allies who will make you stronger and stronger"* (p. 205). Therefore, I need to explore and seek patterns in the cases that can explain how the problems were sought to be solved, while maintaining an open mind to the fact that no single mechanism can explain why some networks fail and other succeed in causing effects.

Thus, in this chapter, I analyse across the cases in an attempt to understand the effects of the network alliances, why the networks succeeded in obtaining these effects, and what contributed to or jeopardized successful effects of the network alliances. Thus, focus in this chapter is on the *effects* of the networks. I discuss *effects of the network alliances* in an explorative manner compared to the traditional approach of ANT, which characterizes

effects as 'stabilization' and 'black-boxing'. I discuss this next. After this discussion, I discuss the knowledge needs of the CSOs and the effects observed in the case studies. Then, I move on to discuss the mechanisms that seem to contribute to the networks' success in causing influence, followed by a discussion of the cases that succeeded in impacting the initial problem of the CSOs, exploring the mechanisms contributing to the networks' success. Since understanding how CSOs, through their network alliances with Science Shops and air pollution scientists, succeed in impacting the issues with which they are concerned also implies understanding when and why they do not succeed, a discussion of this follows. Finally, the mechanisms that seem to contribute to successful network alliances are summarized.

5.1 Characterization of Effects

Through my work analysing the individual case studies, I have realized that ANT's characterization of 'stabilization' seems to lack possibilities to explain the effects of the networks that I have observed. Thus, before analysing across the cases, it is necessary to discuss what characterizes network stabilization and how this differs from the effects caused by the networks. Latour (1987) suggests that only a network that produces a black-box reaches a stable state; i.e. impacts or affects the original problem that caused the network to be created. This characterization may seem appropriate for minor well-defined problems, as illustrated by his examples of the Kodak camera and the hotel key (Latour, 1991). In the hotel key example, the problem is that hotel keys disappear; the hotel guests do not comply with the hotel's signs requesting them to deliver the keys when they leave the hotel room. The solution to this problem was to invent a large metal weight to attach to the keys (Latour, 1991). A nice well-defined problem, which through several translations ended as a black-box; the problem was solved and the metal weight attached to the key became *taken-for-granted*. Based on this logic, it could be argued that to understand whether a network has effects, i.e. reaches a stable state, the researcher has to examine *what the initial problem was* and then move to the final situation: *what did the network achieve*. What lies between these two situations can be explained by analysing translation processes.

Applying this logic to Callon's (1986a) scallop case, it is obvious that the network did not end with a black-boxed situation. Since the mobilization of both the scallops and the fishermen failed, the conclusion in this case must be that the network failed. But analyses of this particular case seem to show that the scientists' did, nevertheless, have some success in interesting and enrolling the actants in their network. So how are we to account for this, if effects (i.e. stabilization) require a black-boxed situation? Furthermore, it seems that merely understanding effects as a black-box leaves out 'room' for explaining *other forms of effects* of the network, since in explaining what the network achieved (as a black-

box), it may be difficult to judge in situations that do not involve such well-defined problems as the disappearance of hotel keys. When dealing with complex problems (problems that are not well-defined and/or problems that require more than such a simple solution as a metal weight), such as those addressed in my cases as well as in Callon's scallops case, it may be insufficient to understand effect as merely a black-box. My proposal, therefore, and the approach I have chosen to explore effects (i.e. in ANT terms, 'stabilization'), is to keep an open mind and explore all the effects caused by the networks.

Another issue related to the stabilization and black-boxing of networks that seems essential to discuss, before continuing to analyse the effects of networks in the cases, is that ANT's focus on black-boxes seem to ignore the situation in which a network may become stable (i.e. uphold the obligatory passage point without any enrolled actants refuse or deny it) even though it does not affect other networks or the network's issue of concern. Again, this may be explained by the character of the problems; for well-defined problems related to maybe only one company, such considerations as these would not be relevant. However, when dealing with complex problems that are not well-defined, or at least cannot be solved through the implementation of such a simple solution as a metal weight, we need to distinguish analytically between the network's stability and the network's stability towards other networks, if we want to understand why networks succeed or fail.

This criticism has also been raised by Star (1991), who raises the concern that STS scholars seem to lack an interest in *"[...] understanding the nature of stabilization of large scale networks [...]"* (p. 26). Star (1991) is thus also concerned with problems that are not well-defined. Through a McDonald example, she enlightens us about the chaos that one simple request – *a hamburger without onions* – may cause because this request differs from McDonald's standardized menus, which are produced through assembly-line production where every burger is identical. Star (1991) thus concludes: *"There is thus a critical difference between stabilization within a network or community of practice, and stabilization between networks, and again critical differences between those for whom networks are stable and those for whom they are not […]"* (p. 43). In her McDonald example, the chaos happened within the boundaries of the kitchen as well as inside herself, however; reflecting on this, we could say that my cases represent the chaos outside the kitchen – i.e. outside the formed networks. Star's point is that buying a hamburger at McDonalds may be simple for some, and in these cases the network would seem stable. For others, who require special requests however, the black-boxing cannot be upheld, and the network dissolves and appears destabilized. The question thus becomes: how are we to zoom in or out of the network? My suggestion is that analysing network effects includes analytical considerations in which we zoom both in and out of the network.

Due to these considerations, I have followed Callon's (1986a) interest in effects, i.e. that something is strengthened and becomes stable and is not merely black-boxed; however, I

suggest keeping an open mind in situations where what ANT terms network stabilization fails – when zooming out of the network. Instead of concluding that the networks fail, I explore whether effects can be observed. Thus, in this chapter, my interest is on the effects caused by the networks.

Since I also have found inspiration in Irwin & Michael's (2003) ideas about production of knowledge, understood as EEAs, I need to consider how Irwin & Michael (2003) relate to such discussions of stabilization and effects. It seems, however, that the authors put little emphasis on how the produced knowledge is sought to be used and by whom. The concept focuses only on how knowledge is produced, whereas the effects of the produced knowledge seem to be of less importance. In their book *Science, Social Theory and Public Knowledge* (Irwin & Michael, 2003), the two authors' errand is to break with a previously dominating tradition within Science and Technology Studies, which seems to acknowledge scientists as the main knowledge producers. Instead, Irwin & Michael suggest that we understand knowledge as constituted by heterogeneous networks in which distinctions between what is termed lay-knowledge and expert-knowledge are abandoned. Although this is a praiseworthy attempt to understand knowledge production with a new pair of glasses, it seems that in their striving to erase the old tradition of elevating scientists on a pedestal, they do not focus on how the knowledge produced in these EEAs are sought to be used and by whom. Let me elaborate on this: as their key example for their analytical considerations of EEAs, Irwin & Michael use a conference in which scientists, CSOs, regulators and politicians participated. As already discussed in the *Introduction* chapter (chapter 1), Irwin & Michael describe one of the plenary sessions as a 'discursive mosaic'. This mosaic consisted of many different types of knowledge constructed by both the 'natures' and the 'socials', and arguments from what can be termed 'lay' knowledge were blurred with 'scientific' knowledge, making it meaningless to distinguish between these two types of knowledge. By introducing us to the concept of EEAs, Irwin & Michael urge us to understand such networks, and the knowledge produced in such networks, as groupings where the individual actor's knowledge contribution is blurred and mixed into relevant coherent assemblages. However, Irwin & Michael do not focus on how this produced knowledge is sought to be used by the assemblage. The authors choose to end their story after the plenary session, which leaves us in a position where it is unclear what happens with the assemblages and the produced knowledge after the conference. Their point about heterogeneity is a valuable contribution to understanding how knowledge is produced, as is their suggestion regarding the situations where this blurring of expert and lay knowledge distinctly appears (see chapter 2.2: Ethno-Epistemic Assemblages). The concept, however, appears to remain unexplored in relation to how we should understand the effects of the assemblage. I will return to a discussion of this, as well as my suggestions for how to understand the effects of EEAs in the next chapter (chapter 6: Discussion and Concluding remarks)

Thus, since Irwin & Michael's EEA concept does not seem to contribute to an understanding of how these EEAs gain impact or effects on the issues of concern, I must rely on ANT's ideas of effects.

In the following, I analyse across the cases in order to understand which effects the network alliances caused, why the networks succeeded in obtaining these effects, and what contributed to or obstructed successful effects of the network alliances. All these reflections will contribute to my understanding of how **CSOs, through alliance building and network constructions with Science Shops, had engaged with scientists in order to influence an air pollution agenda.** Thus, next I start with a discussion of the CSOs' knowledge needs and the effects observed in the case studies.

5.2 Knowledge Needs and Effects

Since my specific interest in this dissertation is on alliances between CSOs, Science Shops and scientists working with air pollution issues, all the cases naturally focus on this issue, but in different ways as I will summarise in this section. The cases are covering different types of sources of air pollution. Five of them are related to air pollution from transportation (traffic), two are related to industrial pollution, one to pollution from agriculture and one from local energy production (wood burning stoves). Most of the cases focus on health related problems from air pollution. One case focuses on air pollution in general from air traffic. The relations that the CSOs (members) have to the addressed air pollution problems are in most cases as neighbours exposed to current or future pollution. One case is focused on a user CSO (the bicycle apparatus case) and in one case, the board game case, it is a more overall citizen concern (board game in relation to pollution from air traffic), which is the CSO relation to the problem.

Based on the case studies, I find two forms of effects caused by the networks: 1) effects on the CSOs' problems, and 2) other effects resulting from the networks' activities. When effects on the CSOs' problems were observed, this meant that the problems that the CSOs experienced prior to the networks' activities were either solved as a result of the networks' activities or due to other circumstances. Interestingly, I also observed other forms of effects, both in cases that affected the CSOs' problems and also in cases that failed to affect these problems. Among the other forms of effects I observed were an emerging interest among the scientists, which lead to the initiation of a PhD project (the pesticide case); and interest by the carpet factories in further co-operation with both the community and with the Science Shop (the carpet factory case). My argument for drawing attention to these two cases is that in the pesticide case, the network failed to solve the CSO's problem, whereas in the carpet factory case, the network succeeded. These two cases thus seem to indicate that other forms of effects than only those directly affecting the CSO's problem might

result from alliances between CSOs, Science Shops and scientists. In the figure below, I illustrate which forms of effects I have observed in each of the cases.

	The CSO's problem	**CSO type**	**Effect on the CSO's problem**	**Other effects due to network activities**
The parent group case (case A)	Avoid school building construction due to concern that the children would be exposed to traffic emissions.	Single issue based.	School not constructed, though it is unclear whether this was due to the network's activities.	Scientists obtained new updated data indicating a relationship between traffic emissions and children's health.
The pesticide case (case B)	Concerns about health impact on humans from airborne pesticides.	Single issue based.	None.	Emerging interest among scientists; a PhD project was initiated.
The Scania case (case C)	Concerns about odour pollution from planned industrial activities in the community.	Single issue based.	Odour emissions avoided through instalment of a burning unit. Odour emissions reduced to within permitted limits.	Local experiences with odour pollution disseminated on a national odour platform.
The carpet factory case (case D)	Concerns that toxicity from industrial activities in the community cause risks of cancer, odour pollution and water pollution.	Single issue based.	Implementation of a complaint telephone to be used to report peaks in odour pollution from carpet factory activities. Toxicity and water pollution not researched.	Carpet factories are interested in further co-operation with both the community and the Science Shop.
The board game case (case E)	Need for scientific documentation indicating sustainable transition possibilities for the aviation sector.	Part of the CSO's existing agenda.	None.	Emerging interest within the scientific community about using board games as simulation models.
The bicycle apparatus case (case F)	Develop an apparatus to measure road and air quality on bicycle paths.	Part of the CSO's existing agenda.	An apparatus developed and used by the CSO in their activities.	Measurements in 5 major cities in EU (as part of an EU-funded research project).
The stove case (case G)	Concerns about whether residents in the community were exposed to air pollution from their stove use.	Part of the CSO's existing agenda.	None.	Science Shop tried to include the community case in a research project.

Continued on the next page

	The CSO's problem	CSO type	Effect on the CSO's problem	Other effects due to network activities
The Mira Loma case (case H)	Wanted to stop air pollution in Mira Loma caused by warehouse activities.	Part of the CSO's existing agenda.	Further warehouse development in Mira Loma was stopped.	Scientific evidence regarding the relationship between truck traffic and children's health. Guidelines developed for future warehouse activities (case I). Citizens employed by the CSO as community organizers. Education programmes initiated in communities with impoverished residents focusing on civil rights and environmental rights. Agreement between the CSO and the scientists about a new co-operation partnerships dealing with goods distribution.
The guideline case (case I)	Develop guidelines for future warehouse planning.	Part of the CSO's existing agenda.	The guidelines were developed. No enforcement or means to enforce the guidelines.	

Figure 58: Overview of the effects of network activities

I argue that effects on the CSOs' original problems were seen in the parent group case, the Scania case and the Mira Loma case. Furthermore, effects were partly observed in the carpet factory case, the bicycle case and the guideline case. Questions emerging from this are: Do I see any relations between the types of problems and effects on the CSOs' original

problems? Or is there a relation between the way the CSOs are created and the networks' success in affecting the CSOs' original problems? I discuss these questions next.

Based on the case studies, I see two types of CSOs; single-issue based CSOs and already existing CSOs where the issues of concern are included in ongoing activities related to creating a healthier and more sustainable environment. Interestingly, I see successful effects of the network alliances on the CSOs' original problems in both types of CSOs (see figure 58), which seems to indicate that network alliances between CSOs, Science Shops and scientists can contribute to affecting both issues raised by CSOs as single issues, and issues raised as part of the CSOs' existing activities and campaigns. Another interesting observation in relation to the cases that succeeded in affecting the CSOs' original problems indicates that it is possible for network alliances between CSOs, Science Shops and scientists to influence problems which the networks wanted to change here-and-now – such as avoiding local pollution from industrial activities (as seen in the parent group case, the Scania case, the carpet factory case and the Mira Loma case) – despite the fact that these cases involved trying to change the practices of such strong actors as local authorities and international and national companies. Further, the case studies also seem to indicate that it is possible for network alliances between Science Shops, CSOs and scientists to contribute to ongoing societal debates about air pollution. This was specifically seen in the bicycle apparatus case, where the CSO, rather than needing assistance to change a specific problem here-and-now, needed assistance to develop an extension to an already working apparatus to measure road quality in order to develop CSO capacity to document exposure to air pollution caused by traffic. And through the use of this apparatus, the CSO intended to obtain scientific documentation of the conditions for bicycling in major cities in the Netherlands – documentation they wanted to use to put pressure on national politicians.

The types of pollution dealt with in the cases that succeeded in affecting the CSOs' original problems were odour pollution caused by industry or traffic pollution caused by existing infrastructure. The sources of pollution were caused either by industrial activity or traffic behaviour. The cases also reflect different actor constellations; in the Mira Loma case and the Scania case, the CSOs did not only fight against the warehouse developers and Scania, but also the local authorities. In both cases, the local authorities stressed the economic interests of the local community in continuing or allowing new industrial activities despite the (potential) pollution. In the parent group case, the network fought against the local authorities and their decision about the location of a proposed school building. In this case, as well as in the Mira Loma case, any changes that would affect the CSOs' problems would require some sort of reorganization of city planning, whereas the changes required in the Scania case and the carpet factory case required reorganization of industrial activities. This meant that these networks addressed problems to which the solutions would constitute a threat to the existence of other networks; but despite this, the network

alliances between the CSOs, the Science Shops and the scientists succeeded in affecting the CSOs' original problems.

Comparing the types and sources of problems in the successful cases to the cases that failed to affect the CSOs' original problems (the pesticide case, the board game case and the stove case), the same complexity is found. In these cases, the problems reflected were pollution from airborne pesticides, traffic pollution from existing infrastructure (i.e. the aviation sector), and particle pollution caused by stove use. Thus, in two of the cases (the pesticide case and the board game case), the sources causing the pollution also reflected situations caused by industrial activities or traffic (aviation) behaviour, as did the successful cases. This seems to indicate that the types and sources of problems differ across the cases, both in the successful cases and in the cases that failed.

In Jørgensen et al. (2004), three types of knowledge needs CSOs had when they approached Science Shops were identified; they were defined as: 1) documentation of a problem experienced in local communities; 2) new knowledge about technological changes or assessment of policy decisions; or 3) alternative solutions or new perspectives to improve a social or environmental situation. Comparing these three types of knowledge needs with the CSOs' knowledge needs in the case studies, an interesting relation emerges. For example, documentation of a problem (knowledge need 1) is observed in the Scania case, the carpet factory case, the Mira Loma case, the stove case and the pesticide case, where the types of problems were odour pollution caused by industry, traffic pollution caused by existing infrastructure, exposure to airborne pesticides from agricultural activities, and exposure from stove use caused by fellow residents. The CSO in the parent group case also addressed a problem related to traffic pollution caused by existing infrastructure; however, in this case, the CSO needed an assessment of a policy decision (knowledge need 2). In the bicycle apparatus case, the CSO also addressed pollution from traffic, but in this case the CSO needed the development of an alternative solution (knowledge need 3) to document air pollution from traffic. Thus, the successful cases seem to indicate that the type of problem does not necessarily determine the CSOs knowledge needs, in that pollution caused by existing traffic infrastructure may cause the CSOs to have knowledge needs in all three categories.

5.3 Mechanisms in Influence

As the case study analyses have shown, some of the networks succeeded in affecting the problems of the CSOs and others did not; the question is therefore why did some networks succeed and others fail? In this section, I strive to identify the mechanisms that seem to have contributed to the network alliances success or failure in affecting the CSOs' original problems, with Akrich et al.'s (2002) recommendations in mind. That is to say that

the explanations are not to be found in the rationality of the decisions, but must be understood as a complex set of relations in the networks. As the first step I summarize the mechanisms observed in my case studies from *Chapter 4: Translation Analysis of the Network Alliances*, inspired by Latour's (1991) key example, explaining what the original problem was at the beginning of each case and what the networks achieved at the end. As discussed in the previous section, I do not perceive this way of describing the results of a network to be sufficient, since it does not allow, for example, an explanation of other effects or of the mechanisms contributing to or jeopardizing the network's effects. Nevertheless, I find it sufficient as an overall summary aiming to help the reader remember the cases. I have, however, added at the end the mechanisms that seem to have influenced the networks' achievements or lack of achievements.

5.3.1 Summary of the Case Studies

Case A: In the **parent group case,** the network was created around the CSO's concerns about a local school's plans of constructing a new building close to a motorway. Despite the network being translated into scientific documentation that supported the CSOs worries, the network finally failed to persuade the local school board and authorities about the claim because these actors questioned the methodologies behind the scientific results. Later, after the network was dissolved, it was decided not to construct the school building right next to the motorway.[56]

Case B: In the **pesticide case,** the network was created around the CSO's concerns about the possible health risks from airborne pesticides. Finally, the network was translated into a scientific report with inconclusive results; it could not be concluded that airborne pesticides did not cause health risks, nor could it be concluded that airborne pesticides caused health risks. Due to the inconclusive results, and maybe also because it would cause a tremendous change of practise for the farmers, the network failed to create an alliance with the local farmers and thereby cause local effects.

Case C: In the **Scania case,** the reopening of the factory raised concerns among the citizens in the area regarding whether the painting procedures would cause odours. Finally, Scania agreed to reduce odour emissions from the factory. The means used to force Scania to agree to reduce their odour emissions seemed to be independent scientific documentation combined with threats of legal action.

[56] It should be noted that it has not been possible to gain information about why this decision was made, but one explanation could be that the network succeeded in creating public awareness about the problem and that this contributed to the decision not to construct the school building at the proposed location.

Case D: In the **carpet factory case,** the CSO's original problem was related to health risks caused by two carpet factories in the community. Despite the fact that the network only succeeded in producing weak scientific evidence of odour pollution, it finally succeeded in persuading the local authorities to establish a complaint telephone through independent negotiations.

Case E: In the **board game case,** the network was created around the CSO's original problem of lacking knowledge about transition possibilities in the aviation industry. Finally, the network was translated into a board game, which did not meet the wishes of the CSO or succeed in convincing the actors that it could be used as a communication tool for debating transition possibilities.

Case F: In the **bicycle apparatus case,** the network was created around the CSO's problem of extending an already existing bicycle apparatus for measuring road quality to also measure air quality. Finally, the network was translated into a functioning apparatus that could measure both road and air quality.

Case G: In the **stove case,** the original problem of the CSO concerned whether or not particles from residents' stove use caused a health risk to their own community. Finally, the network was translated into a literature study. However, the study's conclusions: that the residents' stove use did not cause health risks to their community were not what the CSO had expected. The weak conclusions caused a conflict, between the CSO on one side and the scientists (including the Science Shop representative) on the other, concerning the credibility of the results and what could be concluded on the basis of a minor literature study. The weak conclusions also allowed the majority of the residents to conclude that their behaviour did not cause health risks to themselves or their fellow residents.

Case H: In the **Mira Loma case,** the original problem of the CSO was that their community was exposed to heavy truck traffic from warehouse activities and therefore to air pollution. Finally, the network succeeded in avoiding new warehouse development in the area, and the county board of supervisors recognised to some extent the health risks to humans that truck emissions can cause. The means used by the network were direct dialogue with the county board of supervisors. The network succeeded in establishing this dialogue due to independent scientific documentation of the problem, combined with community support through door-to-door campaigns in the community.

Case I: In the **guideline case,** the original problem of the CSO was air pollution from warehouse activities. Finally, the network was translated into non-enforced guidelines for new warehouse development. Furthermore, the network agreed to continue their activities by developing truck driver guidelines.

These short summaries of the case studies, together with the observations made in section *5.2: Knowledge Needs and Effects*, seem to indicate that understanding the mechanisms contributing to or jeopardizing successful effects of network alliances between CSOs, Science Shops and scientists is complex. In some situations, scientific documentation was used as a means to gain impact, whereas in other situations scientific documentation in itself was not enough; it had to be combined with active involvement of the CSOs as negotiators or mobilizers of the community, or the Science Shops had to take active part in negotiations and dialogue with the opposing actors. In other situations, it seems that the fact that scientists and not students conducted the research contributed to the networks' success. Thus, the case studies seem to reflect different types of actor constellations, where the CSOs, the Science Shops and the scientists assume different roles. Also the role assigned to the scientific documentation of the problem seems to reflect differences and similarities; one interesting observation made is that in most of the cases, the mechanisms contributing to or jeopardizing successful effects of the network alliances involved scientific documentation of some kind. Let me elaborate on this.

As discussed previously in this chapter, the case studies seem to indicate that it is not the specific type of problem or the sources of the pollution that contribute as single mechanisms to success or failure. Rather, the case studies seem to indicate that also the way in which the Science Shops and the other actors in the networks approached the role of scientific documentation of environmental problems and their health impacts seems to contribute to the network alliances' success. In relation to this, it is interesting to observe, that network alliances between CSOs, Science Shops and scientists may succeed in affecting the CSOs' original problem, even though the network does not succeed in documenting the problem scientifically, as seen in the carpet factory case. This required, however, that the Science Shop itself assumed the role of negotiator between the CSOs and their concerns and the actors rejecting the CSOs' concerns. The case studies also show that in other situations (like the Scania and Mira Loma cases), it was the scientific documentation of the problem combined with the threat of legal action, or other actions taken to gain the support of the community, that eventually forced change.

Further, in as much as student projects are sometimes cited as the reason for a limited amount research and inconclusive projects, it is interesting to see that student projects can be part of successful network alliances between CSOs, Science Shops and scientists. I elaborate on this as well as considerations about the role of scientific documentation in section 5.4: *Analyses of Cases with Effect on CSOs' Problems*.

5.3.2 Mechanisms Contributing to the Networks Success or Failure

I argue that the case studies reflect different types of actor constellations and as well as different ways in which the network alliances approached the CSOs' problems, meaning that the process of seeking influence differed across the case studies. Interestingly, the case studies used three different approaches to how the networks should impact the CSOs' problems. Also, the way the network alliances approached the CSOs problems and solutions seems to be shaped especially by the roles assumed by the Science Shops in their interaction with the CSOs and the scientists. Since these approaches are shaped by the role of the Science Shop, I call them 'Science Shop approaches'. It should be noted, however, that the approaches are to be understood in a broader sense, meaning that the way the network alliances approached the problems and tried to gain influence is of course to be understood as interaction among all the involved actors. The three approaches reflected by the case studies are: *dissemination of 'science'*; *mediation between CSOs and scientists;* and an *impact-seeking approach*. The *dissemination of 'science'* approach was the way the network in the Mira Loma case initially approached the problem. Here, the Community Outreach Unit involved in the case approached interaction with the CSO as a question of communicating 'science' to the CSO, thus making 'science' produced by the scientists available to the public. The knowledge transfer can be understood as a one-way street – from the scientists to the CSO. This way of disseminating knowledge to the public, seems close to the 'deficit model'; hence, the underlying assumption might be that when the public is made aware of the value of 'science', they know what to do with it. Although the university's Community Outreach Unit initially approached interaction with the CSO in the Mira Loma case as merely a question of disseminating the produced 'science', the case shows that as the relationship developed, the scientists became more involved and ended up applying a more impact-seeking approach. This indicates that in some situations interaction with CSOs can contribute to scientists becoming more engaged in societal problems rather than merely disseminating their knowledge.

The second approach identified in the case studies I call *mediation between CSOs and scientists*. Characteristic for this approach is that the Science Shops facilitate and mediate the interaction between the CSOs and the scientists (including student researchers) involved in the projects. Another characteristic of this approach, as exemplified in the cases originating from the Science Shop for Biology, Utrecht University, the Science Shop for Economics, Groningen University, and the Science Shop DTU, is the way the networks provided the CSOs with the necessary scientific knowledge (or apparatus as in the bicycle apparatus case) without becoming directly engaged in discussions with the CSO or other relevant actors about how to solve the problems. The case studies also indicate that when Science Shops apply a mediation approach, the mediation role may only be to ease the process when conflicts arise between the CSO and the scientists. This is illustrated by the pesticide case from the Science Shop for Biology, Utrecht University, where the Science Shop had to explain to the CSO how to interpret scientific data in a scientific manner. The

mediating role may also require the Science Shops to assume the role of process supervisors, as observed in the stove case from the Science Shop DTU. In this case, I not only assumed the role of scientific supervisor but also the role of mediating between the CSOs and the student researchers throughout the whole project period, and not only when conflicts occurred.

The third Science Shop approach observed in the case studies is what I call *an impact-seeking approach*. This approach is particularly seen in cases from Science Shop Chemistry, Groningen University. In these cases, it is not only a question of the Science Shop documenting the problem; the Science Shop is also trying to make a direct impact on the problem. This means that when interacting with the CSOs in the Scania and carpet factory cases, the Science Shop tried directly to assist the CSOs in the processes of impacting the problem in. The approached applied by the scientists in the Mira Loma case also reflects this - although the scientists' first approach was to disseminate results to the CSO, later, after having formed the formal partnership, they changed their practice to a more impact-seeking approach, assisting the CSO by both building capacity among the CSO's staff members and supporting them in their dialogue with the county board of supervisors and the residents in the community.

Emerging from this is the question of whether one Science Shop approach is more successful than the others in relation to affecting the original problems of the CSOs. It seems that in the cases in which the Science Shop applied an impact-seeking approach (see figure 59 for an overview of this), the network alliances succeeded in affecting the CSO's problem. However, effects on the original problem of the CSO were also seen in some other cases where the Science Shop approach was more to mediate between the CSO and the scientists (see figure 59 for an overview of this). Thus, the case studies do not seem to point to any simple unique conclusion regarding which Science Shop approach is most successful, but they do seem to indicate that when the Science Shop applies this impact-seeking approach, the network is likely to succeed in affecting the CSO's problem, as seen in cases C, D and H.

To summarize the discussions about mechanisms contributing to influence, I have constructed the figure below. The figure is to be understood as summarizing the knowledge needs of the CSOs, the agenda of the CSOs, the way the networks approached the problem, and the mechanisms used by the networks to influence the CSOs' original problems.

	The CSO's problem	The CSO's knowledge need	The CSO's agenda	Science Shop approach	Mechanisms contributing to or jeopardizing effects of the network alliances on the CSO's original problem
The parent group case (case A)	Avoid school building construction due to concern that the children would be exposed to traffic emissions.	Scientific documentation of the assumed problem.	Avoid school construction.	Mediation. Project carried out by a student.	Although the network succeeded in documenting the problem scientifically, the network finally failed to persuade the local school board and authorities about the claim, because they questioned the methodologies behind the scientific results. Later, when the network was dissolved, it was decided not to construct the school building right next to the motorway.
The pesticide case (case B)	Concerns about health impact on humans from airborne pesticides.	Scientific documentation of the assumed problem.	Avoid the use of pesticides in bulb farming.	Mediation Project carried out by a student.	The network failed to document the CSO's concerns scientifically – the conclusions were inconclusive. To seek opportunities for further research, the network tried to convince a parliament member about the seriousness of the problem. This failed however, and further funding was rejected. Thus, due to the inconclusive results, and maybe also because it would demand a tremendous change in the farmers' practice, the network failed to create an alliance with the local farmers and thereby cause local effects.
The Scania case (case C)	Concerns about odour pollution from planned industrial activities in the community.	Scientific documentation of the assumed problem.	Avoid odour pollution from a planned factory.	Impact-seeking. Project carried out by the Science Shop.	The network succeeded in documenting the CSO's problem scientifically through independent research carried out by the Science Shop. By combining the scientific documentation of the problem with a threat of legal action, the network succeeded in persuading Scania to agree to reduce their odour emissions.
The carpet factory case (case D)	Concerns about toxicity from industrial activities in community, causing risks of cancer and odour and water pollution.	Scientific documentation of the assumed problem.	Avoid odour pollution from existing industrial activities.	Impact-seeking. Project carried out by the Science Shop.	When the network failed to document the CSO's original problem scientifically, the Science Shop assumed the role of negotiator between the CSO and the local authority and the carpet factories. Through this dialogue, the network succeeded in persuading the authority to implement a solution satisfying both the CSO and the carpet factories.

Continued on the next page

	The CSO's problem	The CSO's knowledge need	The CSO's agenda	Science Shop approach	Mechanisms contributing to or jeopardizing effects of the network alliances on the CSO's original problem
The board game case (case E)	Need for scientific documentation indicating sustainable transition possibilities for the aviation sector.	Scientific considerations about transition possibilities for the aviation industry.	Contribute to societal discussions about the possibilities of transition in the aviation industry.	Mediation. Project carried out by a student.	The CSO's problem was translated into a board game, which did not meet the wishes of the CSO or succeed in convincing the actors that it could be used as a communication tool for debating transition possibilities.
The bicycle apparatus case (case F)	Develop the CSO's capacity by developing an apparatus to measure road and air quality on bicycle paths.	Assistance to construct the needed apparatus.	Contribute to an ongoing societal debate about air pollution from cars.	Mediation. Project carried out by a student.	The network succeeded in producing a functioning apparatus that could measure both road and air quality. Use of the apparatus was not within the scope of the network.
The stove case (case G)	Concerns about whether community residents were being exposed to air pollution from their stove use.	Scientific documentation of the assumed problem.	Avoid air pollution caused by residents' own practices.	Mediation. Project carried out by a student.	The scientific report produced by the network concluded that the residents were not exposed to health risks due to their stove use. This did not comply with the result expected by the CSO. Therefore, the CSO contrasted the results with the credibility of the research. The weak conclusion also allowed the majority of the residents to conclude that their behaviour did not cause health risks to themselves or their fellow residents.
The Mira Loma (case H)	Wanted to stop air pollution in Mira Loma caused by warehouse activities.	Scientific documentation of the assumed problem.	Avoid air pollution from existing industrial activities.	Initially: dissemination of knowledge. Later, after developing the co-operation with the CSO: Impact-seeking. Research carried out by both the scientists and members of the CSO.	The network succeeded in scientifically documenting the problem, but opposing actors rejected the scientific documentation and questioned some of the assumptions made. Although the scientific documentation was questioned, the network succeeded by combining it with support from the community through door-to-door campaigns. These resulted in dialogue with the county board of supervisors and convinced them to stop further warehouse development in the community.
The guideline case (case I)	Develop guidelines for future planning of warehouses.	Develop guidelines for future warehouse planning with support from governmental institutions.	Contribute to regulation of future warehouse development.		The network was translated into non-enforced guidelines for new warehouse development.

Figure 59: The conclusions from the individual case studies in relation to parameters contributing to a network's success or failure

So what does the overview in figure 59 tell us in relation to the mechanisms contributing or jeopardizing successful effects of network alliances? One observation is that when scientists (and not students) carry out the research, the networks are more likely to affect the CSOs' problems. This is however not the same as concluding that when students carry out the research the networks will fail, since effects are also seen in cases where students were involved (as in the parent group case and the bicycle apparatus case). Thus, the case studies do not point to any clear conclusions in regards to the relationship between who carries out the research and the success of the networks.

Interestingly, the case studies also seem to indicate that it is possible to cause effects even though this involves changes in the practice of actors such as international companies or local authorities, as seen in the Scania case and the Mira Loma case. Finally, the parent group case reflects that it is not always possible to trace the causes to the effects, and that in some situations effects are first observed long after the network's activities are finished, making it difficult for the actors to judge whether these activities have caused the effects.

In the following, I discuss the mechanisms that seem to have either contributed to or jeopardized the networks' success in causing effects. First, I discuss the cases that I conclude affected the CSOs' original problems. Then, I discuss the cases where the network failed to cause effects on the CSOs' original problems. From here, the discussion continues with regard to other effects caused by the network alliances. And finally, to round off this section, I summarize the conclusions drawn from all the discussions in section 5.7.

5.4 Analyses of Cases with Effect on CSOs' Problems

I argue that effects on the CSOs' original problems were seen in the parent group case, the Scania case and the Mira Loma case. Furthermore, effects were partly observed in the carpet factory case, the bicycle case and the guideline case. This section explores the aspects that led to these successes in causing effect. I do recognize that the effects observed in the parent group case may have been due to other activities than those of the network. But the fact that the effect – i.e. the decision not to locate the school building at the proposed location – occurred a while after the network was dissolved may also indicate that effect can in some situations occur after a period of time and is not directly observable as soon as the network alliances end or are dissolved. However, since the case has not provided me with a clear understanding of the mechanisms that led to the decision not to construct the school at the proposed location, I am not able go into the same level of detail in this case as in the others. The same applies to the bicycle apparatus case, since in this case I only succeeded in obtaining information about the network activities from the Science Shop representative and from written material. The next discussions, therefore,

mainly concern effects caused by the Scania case, the carpet factory case and the Mira Loma case. Since I consider the guideline case to be one effect of the Mira Loma case, these two cases are discussed together.

5.4.1 Two Situations Motivating Scientific Documentation of Problems

In the Scania case, the carpet case, the parent group case and the Mira Loma case, the CSOs assumed that scientific documentation would contribute to impacting the problem in question. This scientific documentation was intended for legal actions against the industry and local authorities or for initiating dialogue in order to persuade local authorities to change plans. These case studies seem to reflect two different situations that motivated the CSOs to document the issue of concern: either because they had an opportunity to raise their concern through spaces for invited participation, or because they wished to convince the actors causing the pollution, through scientific documentation, that they were causing a health risk to the community. The Scania case illustrates the first situation: a CSO, through spaces for invited participation, strove to avoid future pollution. In this case, the CSO sought to influence the problem through existing channels of influence and participation. In spite of the provision by law ensuring citizens the right to influence future planning of infrastructure and industrial activities in their communities, the local authorities rejected the CSO's concern, arguing that it was ungrounded. This left the CSO in a situation where they saw scientific documentation of their concern as the only means to convince the local authorities and Scania that the proposed activities would cause health risks to the residents.

In other cases, the CSOs needed scientific documentation to support their concerns about being exposed to health risks and thus convince other actors about the risks connected with the industrial activities. This was exemplified by the Mira Loma case and the carpet factory case. In these cases, the CSOs had no possibility to act within the official channels of influence or participation; therefore, they assumed in the carpet factory case that scientifically documenting their concern would convince the local authorities and the carpet factories that their claims were legitimate. This indicates that it may be difficult in some situations for the CSOs to affect concerns that are based on people's experiences or assumptions; what seems necessary in order for the CSOs to succeed in affecting their concerns is that they are supported by scientific documentation.

5.4.2 Effects on Here-and-Now Problems without Sound Scientific Documentation of the Problem

One of the case studies – the carpet factory case – has shown that in some situations it may be possible to cause effects on here-and-now problems without having been able to document the problem scientifically. But as observed in the case, this required the Science Shop applied the impact-seeking approach that opened the possibility for the Science Shop coordinator to become engaged not only in the process of producing scientific data but also in a dialogue about how to meet the CSO's concern. In this specific case, the network failed to scientifically document the problem, and therefore it did not perceive the CSO's initial intention of filing a lawsuit against the carpet factories for causing odour pollution as a solution. Thus, other means of solving the problem had to be found, such as dialogue and negotiations with the counterpart, in order to try to seek a solution to the problem experienced by the CSO. The way the Science Shop approached this was to acknowledge the technical data provided by the two carpet factories as correct, while arguing and working to convince the local authorities and the two carpet factories that despite the lack of clear scientific evidence, the problem still occurred in specific situations. The Science Shop's arguments were so convincing that the local authorities agreed to set up a complaint telephone line, which provided the community with the opportunity to report odour pollution when it was experienced.

5.4.3 Scientific Documentation Combined with other Means Caused Effects

The case studies also indicate that scientific documentation of a problem may not be enough in itself to cause effects, but that other means can be combined with the scientific documentation to contribute to an effect on the CSOs' original problems. This was seen in the Scania case and the Mira Loma case. In the Scania case, the network's first approach was to document the problem scientifically, and on the basis of this documentation, enter negotiations with the Scania management and the local authority. When this failed and Scania and the local authority refused to accept the documentation of the odour particles, the network decided to file a lawsuit. Thus, in this case, the network initially perceived 'scientific documentation' as the solution, but when this failed, the network had to combine the scientific documentation with a threat of lawsuit. Through these means the network succeeded in forcing Scania to set up an agreement with the network.

The Mira Loma case also reflects a situation where the produced scientific documentation of the air pollution caused by warehouse activities was not sufficient to affect the CSO's original problem. In this case, an opponent network contested the results of the scientists supporting the CSO, arguing that it was the particles blowing in from port activities in Los Angeles that were the source of the pollution and not warehouse activities in the village. This led the university scientists to defend their results publicly, although until that moment they had assumed the role of supporting the CSO behind the scenes. Publicly

defending the results was not sufficient to convince the opponent network, it was necessary for the network to combine the scientific documentation with other means. The way the network approached this was to engage the CSO directly in gathering more evidence of the pollution levels, which the CSO then presented to the community through banners and door-to-door campaigns. In this way, the network succeeded in persuading the residents to support the network in their claim for a healthier environment. With the support of the whole community together with P-track measurements made at the county supervisor's home, the county building, and at an intersection in the community, the network succeeded in gaining access to a county board of supervisors meeting. At this meeting, the CSO presented the evidence collected and argued that warehouse activities were in fact the main source of the pollution experienced in the community. Thus, they succeeded in convincing the county board of supervisors that the community was facing severe health risks caused by air pollution from warehouse activities. This case shows that even though this network had sound scientific documentation of the source of the pollution, it was necessary to combine this documentation with evidence that was not scientifically sound (i.e. the P-track measurements made by the CSO) together with massive community support before it could succeed in affecting the experienced problem.

5.4.4 The Role of Independent Scientific Research: The Roles Assigned to the Scientists and CSOs

The network alliances that succeeded in affecting the CSOs' original problems also present another interesting element that contributed to the networks' success: the role assigned to independent scientific research and thereby to the scientists and CSOs. In the carpet factory and parent group cases, the process of documenting the problem – and in the carpet factory case, also the process of negotiating with the local authority – was delegated to the scientists and Science Shops, while the CSOs assumed a more invisible role (even though the CSO in the carpet factory case also participated in the steering committee). These two cases led to an important observation that is also reflected in some of the cases that failed to affect the CSOs' original problems (the pesticide case and partly the stove case) – that some CSOs and scientists consider scientific documentation to be independent and objective, which means that it is produced with no interference from the CSOs. Claiming independence in relation to scientific documentation seems to be perceived as important for creating legitimacy for the network's activities.

Interestingly, the Mira Loma and Scania cases seem to reflect other roles, assigned especially to CSOs, than only that of invisible partners in the network. In the Mira Loma case, the CSO was assigned the roles of research partner (gathering data and carrying out measurements) and network spokesman in relation to the community, the media and the politicians. This seems to have contributed to the network's success, since by assigning the CSO this role, the network succeeded in mobilizing the community which the CSO use to

put pressure on the county board of supervisors. And even though the county supervisor of Riverside questioned the scientific legitimacy of the P-track measurements, and the scientists (co-operating with the CSO) emphasized that the measurements were ad hoc measurements, it seems that the politicians accepted these data as reflecting the actual situation in the community. In other situations, assigning the CSO the role of negotiator contributed to the network's success in impacting the CSO's original problem. This was seen in the Scania case, where the CSO was assigned the role as negotiator with the Scania management and the local authorities supported by both the Science Shop and the Bureau of Legal Aid and the prospective of winning the lawsuit.

5.4.5 Student Projects can be Part of Successful Network Alliances between CSOs, Science Shops and Scientists

The successful cases also seem to indicate that network alliances based on project strategies that include student scientists can affect the CSOs' original problems, even though such projects may be limited in time and resources, and may even be questioned for their credibility. The cases on which the networks based their research activities on students as scientists were the parent group case, the carpet factory case, and the bicycle apparatus case. It is important when approaching research activities as student projects that the scientists supervising the research follow the process carefully and that they are willing to defend the research and the results, if the results or methodologies subsequently are contested by other actors. This was for example observed in the parent group case, where the scientific results produced by the network, as well as their legitimacy, were questioned by the local authority and the hired consultant firm. By questioning the legitimacy of the results, the opponent also indirectly questioned the involved research group professor's scientific credibility. He therefore felt obligated to defend the results and the methodology.

In this sub-section I have explored and sought to explain how effects were caused as network alliances between human actors and their interrelation with such non-human actants as measurements and scientific documentation. Next I continue this discussion by exploring the mechanisms that lead other cases to fail in affecting the CSOs' original problem.

5.5 Analyses of Cases without Effect on CSOs' Problems

I argue that neither the pesticide case nor the stove case and the board game case succeeded in affecting the CSOs' initial problems. The question is why? And do these case studies reveal aspects not observed in the cases that succeeded in affecting the original problem of the CSOs?

The cases that failed to affect the CSOs' original problems seem to indicate the same types of problems – i.e. problems the CSOs wanted to change here-and-now (the pesticide and stove cases) and problems dealt with as part of the CSO's existing agenda (the board game case) – as in the cases that succeeded in causing effects to the original problem of the CSOs. I find the same types of CSOs as in the cases that succeeded in affecting the CSOs original problems. Thus, the CSOs involved in the networks that failed were also created due either to a specific air pollution problem (the pesticide case), or to an issue that was part of CSOs' already existing attempts to address issues related to creating a healthy and more sustainable environment (the stove case and the board game case).

Further, the case studies seem to reflect the same kind of Science Shop approach (the mediation approach) both in the cases that failed and one of the cases that succeeded in affecting the CSOs' original problems. Also the ways the CSOs approached the problem seem to reflect similarities between the successful and unsuccessful cases. In these three cases, as in the successful cases, the CSOs chose a strategy of documenting the problem scientifically.

These cases reflect the same types of CSO knowledge needs as in the cases that succeeding in affecting the CSOs' original problems: Knowledge type 1) documentation of a problem experienced in local communities, was reflected in the pesticide case and the stove case, while knowledge type 3) alternative solutions or new perspectives to improve a social or environmental situation, was observed in the board game case, where the CSO needed knowledge about the possibility of more sustainable strategies in the airline sector.

Thus, the explanation of why these three networks failed to affect the original problems must lie in the specific ways the networks approached the problems. Based on the cases that failed to affect the CSOs' original problems, one conclusion to be drawn is the significant role that translations of the original problem played in the networks' success or failure. The cases also seem to indicate the importance of acceptance of the translations and the return from the translations to the CSOs' original problems. The consequences for the networks' success can be fatal, if the translations do not return to the original problem. Let me elaborate on this.

5.5.1 Fatal Translations

My argument is that in the board game case and the stove case, translations were made that were not returned or fully accepted by the CSOs, and this might be the explanation as to why the networks failed. The fatal translation in the board game case was when the Science Shop translated the CSO's original problem into the need to develop a board game. Through this translation, the Science Shop not only neglected the CSO's original

problem or idea, it also neglected the knowledge possessed by the CSO. This had the effect that the CSO lost interest in the network and finally because the board game did not convince the CSO that it could contribute with new information or perspective, the CSO denied including the board game in their strategy for debating transition possibilities in the aviation sector.

In the stove case, the fatal translation occurred when the scientist argued that measurements were not possible due to the limited resources available for an introductory student project. Interestingly, the CSO seemed to accept this translation in the beginning, maybe because it was clear that this was their only opportunity to have the problem researched and scientifically documented. In this case, the CSO's intention from the beginning was to initiate debate among the residents about their behaviour regarding the use of their stoves. In order to motivate such a debate, the CSO felt they needed scientific documentation that showed that some residents' stove use caused health risks to their fellow residents. When the results of the network's activities turned out not to support the CSO's concerns, the CSO representative argued that conclusions could not be based entirely on a literature study and answers from a questionnaire, in spite of the fact that the scientist seemed to support the student's conclusions. This seems to reflect an interesting aspect – that although translations seem to be accepted at one point in time by an actor, the same actor can later reject the translation. It further reflects a situation where despite failing to document the problem, the CSO still experienced that the problem existed and therefore could not accept that the other actors in the network denied the problem.

5.5.2 Too Little Involvement of the Science Shops

Another interesting issue which the cases that failed to affect the CSOs' original problems seems to bring forth is that it might be difficult to cause effects if the Science Shops involved are not willing to engage themselves further in the issues than to provide the necessary scientific knowledge - also in situations where the networks' results may be inconclusive. For example, both the pesticide case and the carpet factory case failed to provide clear scientific evidence of the expected pollution, but the two networks, respectively, failed and succeeded in affecting the CSOs' original problems. One explanation to this difference is the Science Shop approach; in the carpet factory case, the Science Shop succeeded in convincing the carpet factories and the local authorities to accept the problem through negotiations, whereas in the pesticide case, although the Science Shop attended the meeting with the parliament member, it chose not to become involved in discussions with the bulb farmers or the local authorities.
This could point to one important conclusion – that network alliances such as these are more likely to succeed when the Science Shops apply a more impact-seeking approach – also in situations where the networks' results may be inconclusive.

The stove case also reflects an interesting aspect observed in the pesticide case – that community members may interpret the scientific results differently than the CSO itself. As seen in the stove case, the CSO contested the results, which indicated that the methodology in the research raised questions about how conclusive the results were. When the results were presented to the residents, however, they interpreted them to mean that their behaviour regarding stove use did not cause health risks to their fellow residents. This dilemma was also reflected in the pesticide case, where instead of being concerned about their own or their children's health due to their use of airborne pesticides, the farmers interpreted the network's results as meaning that their use of airborne pesticides did not cause any health risks.

Thus, the discussion in this sub-section seem to point towards that it is not the specific type of problem or the specific actors the networks fight against that determine whether the networks fail. Rather, what seems to contribute to the network alliances' success or failure is the way the networks approach the problems. The engagement of both the Science Shops and the scientists and their motives for becoming involved in the process to affect the problem also contributes to the process of making networks successful. Furthermore, it seems that some translations of the network's focus may be accepted at a certain time, maybe because this is the possibility for research the CSO sees at that time, but if the results do not support the CSOs' assumptions, they may be questioned. Relating this to the board game case and the stove case, I observed that the CSO in the board game case may at first have accepted the translation because of considerations that a board game could be an interesting way to open up for dialogue. And the CSO in the stove case may have expected that a well-argued scientific student report could support their concerns and fears concerning smoke from neighbours' stoves.

5.6 Analyses of Other Effects in Cases

In section 5.2, I argued that I have observed two forms of effects in the case studies: effects on the CSOs' original problems and what I formulate as other types of effects. I have now discussed the first kind of effects and turn here to the other forms of effects that I have observed in the case studies. What is interesting is that other forms of effects were observed both in all the cases, meaning both in cases that affected the CSOs' problems as well as in cases that failed to affect the CSOs' problems. Figure 60 illustrates the other forms of effects I have observed in the case studies (see next page).

	The CSO's problem	Other effects due to network activities	Effects on the CSO's original problem
The parent group case (case A)	Avoid school building construction because they were concerned that their children would be exposed to traffic emissions.	Scientists obtained new and updated data indicating a relationship between traffic emissions and children's health.	+
The pesticide case (case B)	Concerns about health impact on humans from airborne pesticides.	Emerging interest among scientists, and a PhD project initiated.	÷
The Scania case (case C)	Concerns about odour pollution from planned industrial activities in community.	Local experiences with odour pollution disseminated in a national odour platform.	+
The carpet factory case (case D)	Concerns that toxicity from industrial activities in community could cause risks of cancer, odour pollution and water pollution.	Carpet factories interested in further co-operation with both the community and the Science Shop.	(+)
The board game case (case E)	Need for scientific documentation indicating sustainable transition possibilities for the aviation sector	Emerging interests within the scientific community about the board game idea	÷
The bicycle apparatus case (case F)	Develop an apparatus to measure road and air quality on bicycle paths	Measurements in 5 major cities in EU (as part of an EU funded research project)	(+)
The stove case (case G)	Concerns about whether residents in the community were exposed to air pollution from their stove use.	Science Shop tried to include the community case into a research project.	÷
The Mira Loma (case H)	Wish to stop air pollution in Mira Loma caused by warehouse activities.	Scientific evidence of the relationship between truck traffic and children's health. Case I: development of guidelines for future warehouse activities. Citizens employed in the CSO as community organisers. Education programmes initiated focusing on civil and environmental rights in communities with impoverished residents. Agreement between the CSO and the scientists about a new co-operation partnership dealing with goods distribution.	+
Case I: The guideline case	Develop guidelines for future planning of warehouse activities	Agreement to develop guidelines for truck drivers to specify truck routes, parking regulations and the importance of reducing idling time.	(+)

Figure 60: Comparison between other forms of effects and the networks' success in affecting the CSOs' original problems

So why are these other forms of effects interesting? I find them interesting because they show that network alliances between CSOs, Science Shops and air pollution scientists can lead to other effects than expected; effects that can contribute to raising awareness about the issue in question both among politicians, industries and scientists as seen in almost all the cases. For example, the pesticide case, the board game case (networks that failed to affect the CSOs' original problems) and the Mira Loma case reflect effects that influenced scientists' research interests. In the pesticide case, I observed an emerging interest among the scientists that led to the initiation of a PhD project. This interest arose among the scientists involved in the network alliance, when they became aware of how little knowledge they had about the relationship between airborne pesticides and their impact on human health. Also the board game case gave rise to an emerging interest among the scientists concerning using board games. In this case, however, the interest concerned another area than that of the CSO, i.e. the use of board games in simulation models. The network activities also contributed to the scientists' research interests in the Mira Loma case, where they contributed to the scientists' knowledge base (by providing them with a clear understanding of the warehouse location in the community and by providing them with an understanding of the pollution hot spots in the community). And maybe more important, the network activities caused the scientists to understand the importance of co-operating with CSOs and that such co-operation can contribute new types of knowledge previously unknown to the scientists.

The case studies also seem to show that other effects of the network alliances can contribute to changing the Science Shops' position, both within the scientific structures and in relation to industry. For example the carpet factory case seems to indicate that the factories became interested in further co-operation with both the community and with the Science Shop, when they became aware of the Science Shop's expertise within the field of odour pollution and its ability to mediate dialogue between them and the community. And in the Scania case, the Science Shop researcher shared his experiences with fellow colleagues in a network he belonged to, which both contributed to the Science Shop's position among the network members, and also made the CSO's fight visible to others.

Finally, these other effects seem to contribute to building CSO capacity. This was particularly seen in the Mira Loma case, which in addition to contributing to the scientists' knowledge base also succeeded in capacitating the CSO to set up an education programme focusing on civil and environmental rights in communities with impoverished residents. Furthermore, the A-team members that consisted of poor uneducated Latino women became capacitated through the network's activities to such an extent that they were offered employment in the CSO as community organizers. Finally, the guideline case can also be viewed as an effect of the network's activities, which finally contributed to acknowledgement of the need for guidelines for future warehouse planning as well as instructions for the truck drivers.

From this it can be concluded that other forms of effects than just direct effects on the CSOs' problems can result from alliances between CSOs, Science Shops and scientists. An important methodological lesson to be learnt from this discussion is that had I only focused on the effects of the stabilized network, I would not have gained an understanding of these other effects caused by the networks, and this understanding is just as important as understanding how the network sought to solve the CSOs' initial problems. The importance of this lies in the understanding that problems experienced by CSOs can contribute to the opening up of new research areas, and also that such alliances can influence more permanently the relationship between industry, community and university (as seen in the carpet factory case).

5.7 Summarizing Mechanisms in Network Alliances between CSOs, Science Shops and Scientists

So what are we to learn from the discussion of effects of the case network alliances? I suggest that the lessons learnt are that network alliances such as these can cause two types of effects: effects on the CSO's original problem, and other forms of effect. And that it is interesting to note that these other forms of effects can result both in cases that affected the CSOs' original problems as well as in cases that failed to affect the CSOs original problems.

An important lesson learnt from the case studies is that it is possible for both network alliances that strive to affect problems here-and-now and networks that work to affect problems that are part of the CSOs' ongoing agenda to cause effects. This despite the fact that such network alliances may be fighting against actors such as industry or local authorities (as in the Scania case, the Mira Loma case and the parent group case).

My discussion of the case studies also indicates that understanding the mechanisms contributing to or jeopardizing the successful effects of network alliances between CSOs, Science Shops and scientists is complex, and that no single mechanism can explain the network alliances' success or failure. Through the discussion, we have also learnt that in some situations, scientific documentation was used as a means to gain impact, whereas in others, scientific documentation in itself was not enough; it had to be combined with active involvement of the CSOs as negotiators or mobilizers of the community, or the Science Shops had to take active part in negotiations and dialogue with the opposing actors. In still other cases, the fact that scientists rather than students conducted the research seemed to contribute to the networks' success. Thus, the case studies reflect different types of actor constellations, where the CSOs, the Science Shops and the scientists assume different roles and approach the problem and its solutions in different ways. Related to this, it appears that when the Science Shops apply an impact-seeking approach,

the networks are more likely to succeed in affecting the CSOs' original problems than when the Science Shops apply the mediation approach. In only two of the cases (the parent group case and the bicycle apparatus case) where the Science Shop applied a mediation approach did the networks succeed in affecting the original problems. And as previously discussed, these two cases contain limitations, since the available information leaves me with no clear understanding of the mechanisms contributing to their success.

Appearing from the discussions in this chapter seems to be that the Science Shop approach and the engagement of both the Science Shops and the scientists and their motives for becoming involved in the process of affecting the problem all contribute to the process of making networks successful. In the next chapter I discuss this further.

CHAPTER 6: CONCLUSION AND RECOMMENDATIONS

In this final chapter, I reflect on the theoretical approaches I have chosen as inspiration for my analyses and discussions. These reflections include considerations about how my research can contribute to ANT scholarship as well as to an elaboration of the concept of EEA developed by Irwin & Michael (2003). I then reflect on the methodology, and I have sought to account for the criticism that arose concerning the managerial tendency in Callon's (1986a) sociology of translation. In the third section, I reflect on the possibilities for networks of CSOs, Science Shops and scientists to obtain influence, with regard to the challenges facing both the Science Shops and the countries in which they are situated, due to a political shift towards right-wing parties. In section 4, I discuss the lessons learnt from the case studies in relation to understanding how CSOs, through co-operation with Science Shops, seek to gain influence on the issues they find problematic and what seems to influence whether they obtain influence. Rounding off the chapter (section 5), I reflect on the future perspectives for Science Shops.

6.1 Theoretical Considerations

I have found theoretical inspiration for this dissertation in both ANT and in Irwin & Michael's concept of EEAs. I believe that inspiration from both of these ideas has contributed to the identification of new perspectives in facing the analytical challenge of seeking to understand the network alliances between Science Shops, CSOs and scientists. These perspectives concern how we understand the analytical term 'stabilization' in ANT, how in the analytical phase we should navigate between zooming in to and out of the network alliances, as well as how we can understand the knowledge produced in EEAs through the sociology of translation analysis. Thus, the aim in this section is to elaborate on the contribution of this research to both the ANT scholars and scholars interested in the blurring of knowledge between what has previously been discussed as lay knowledge and expert knowledge.

6.1.1 This Research's Contribution to ANT Scholars

Inspiration from ANT as the analytical guide for analysing and understanding the effects of network alliances between Science Shops, CSOs and scientists has lead me to challenge one of the central analytical concepts in ANT, stabilization. I challenge this analytical term both with regard to how it is defined and characterized, and also with regard to how,

when we zoom in to and out of the network, we can better understand the knowledge produced and the effects caused by the network. I elaborate on this in the following.

6.1.1.1 Opening Up the Analytical Term of 'Stabilization'

In my discussion (in chapter 5.1: *Characterization of Effects*) about the characterization of stabilization and effects, I suggested opening up the term stabilization to consider it more than a question of characterizing a black-boxed and taken-for-granted situation, as suggested by Latour (1987). My basis for this is that this characterization of stabilization seems to lack possibilities to explain the different effects of network alliances between CSOs, Science Shops and scientists that are dealt with in my case studies.

I have argued that Latour's (1987) characterization of stabilization as a black-box seems suitable for well-defined problems such as his example of the hotel key, but when dealing with issues that are not this well-defined, issues such as those in my case studies that are part of larger societal discourses concerning problems caused by air pollution, then I suggest that we need to open up the analytical term of stabilization, so that it allows us to explain the effects of the network activities. Through my discussion of effects (see chapter 5), I show that network alliances such as these can affect the problems experienced by CSOs before the networks were created, but that these outcomes cannot be characterized as black-boxed or taken-for-granted. For example, I argue that the network created in the Mira Loma case was a success; due to the role of the network in stopping further development of warehouses in the community. Were we to judge the success of the network according to Latour – i.e. according to whether the network caused a taken-for-granted situation – then success would be questionable, since the case does not convincingly indicate that all networks (and especially not the network in which the county supervisor of Riverside was enrolled) assigned the same meaning to the problem as the network created around the CSO's original problem. In the case, it was another network that questioned whether the source of pollution could be exclusively assigned to warehouse activities. This indicates that the source to the problem was not taken for granted. The guideline case also seems to support this argument, since the network in this case did not succeed in producing a taken-for-granted situation. There was no set up of regulations specifying how to tackle minimization of pollution from already existing sources to pollution. Accepting Latour's characterization of stabilization would lead me to conclude that this case (the Mira Loma case and the related guideline case) was not a success, since the network did not produce a black-box; but I argue that the case is a success, since the network succeeded in avoiding further warehouse development in the community. Thus, my suggestion and contribution to the discussions of stabilization in ANT analysis is that we need to analyse network effects more openly than just regarding this as a question of a black-boxed situation. In practice, this implies that as researchers we

explore all the effects caused by network activities by considering both the enrolled actors' own words as well as all the activities of the enrolled and non-enrolled actants.

6.1.1.2 Stabilization – Zooming In to and Out of the Network

Another consideration raised through my analysis of network effects also relates to the analytical term of stabilization in ANT. It concerns the relation between assessment of network stability and the zoom we apply to the network.

Some of my case studies seem to indicate that a network may uphold its obligatory passage point without it necessarily affecting the problem for which it was created. This observation has caused me to reflect on when a network is stable – is it when the obligatory passage point is upheld? When something is taken-for-granted? Or when it can be direct observed that the problem is affected? The individual case study analyses also made me reflect about how to delineate the network – are we to focus on the network created around upholding the obligatory passage point? Or are we to focus on the network that having upheld the obligatory passage point is now striving to affect the CSO's original problem? Let me elaborate on this by using the parent group case as an example. In this case, the network was created around the actants' wish to uphold an obligatory passage point concerning acquiring '*new research data on the relationship between motorway emissions and children's health'*. Thus, the obligatory passage point in this case differed from the CSO's original problem, which was to avoid construction of a school building close to a motorway. The dilemma here is which situation should form the basis for discussing whether the network became stable? Since the Science Shop and the scientists clearly argued that they were not willing to enter into discussions of political character, it must be assumed that the network was delineated around upholding the obligatory passage point. But then how are we to understand the effects of networks where the obligatory passage points do not correlate with the CSOs' original problems?

I suggest that when we analyse issues that cannot be characterized as well-defined or where simple solutions are not to be found, that we apply a zoom on the network that implies a discussion of both the stability of the network internally isolated from the surroundings, and the stability of the network when some of the actants seek to enrol new actants, which entails the network's relation to other networks. Critics of ANT's sometimes simple characterization of stability as something that can be measured and is well-defined include Star (1991), as discussed in chapter 5.1: *Characterization of Effects*, and Singleton & Michael (1993), and I tend to agree with them on this issue. Therefore, I suggest analysing such effects of network alliances as a result of something that has been strengthened. I further suggest that in situations where ANT would conclude that the network did not become stable, we nevertheless explore whether the network caused other effects.

6.1.2 This Research's Contribution to Understanding EEAs

In this dissertation I have found some inspiration from the ideas of Irwin & Michael (2003). They find that the interactions between the actors from society and science, as well as the knowledge produced in network alliances between actors from science and society, is a blur of expert and lay knowledge, thereby constituting what Irwin & Michael (2003) call a mixture of science and society. The challenge, as I see it, with regard to their ideas about studying network alliances as Ethno-Epistemic Assemblages (EEAs), is two- fold. It seems that Irwin & Michael (2003) do not provide methods or guidelines for studying these network alliances, nor do they reflect on how the produced knowledge is sought used and by whom. Thus, I suggest that one way to study and gain understanding of how this interaction takes place, how knowledge is produced, and how the EEAs seek to use the produced knowledge in order to cause effects, is to study these processes as translation processes, which I have done with the inspiration of Callon's sociology of translations.

6.1.2.1 EEAs as Descriptions of Interaction and Knowledge Production

Often when CSOs strive to affect a problem or controversy that they experience as problematic, some sort of production of new knowledge is required, as my case studies show. This means that knowledge production can be viewed as one means to cause effects. The question is, though, how should we understand how knowledge production takes place?

Irwin & Michael's ideas of EEAs are one of several contributions within the sociological studies of Science-Public relations to understanding the interactions and relations between what they call society and science and how knowledge is produced through this interaction. What makes their ideas of EEAs unique compared to other contributions is that they are motivated by a wish to break with an earlier dominant tradition within Science and Technology Studies that scientists are the main source and producer of knowledge. Instead, the authors emphasize that citizens and thereby also CSOs, in their interaction with scientists, play an important role in contributing to the production of knowledge. Acknowledging interaction and knowledge production as blurring the differences between lay people's and experts' contributions seems to address the criticism of some of the most dominant contributions to understanding knowledge production. Due to my interest in understanding the concept of EEAs and its considerations about knowledge production, I need to understand the context that it strives to break with. Thus, one plausible place to start is with Kuhn and his thinking about knowledge production. The focus of this next discussion is why these dominant views have failed to acknowledge the role of civil society in knowledge production.

6.1.2.2 Dominant Views on Knowledge Production

Discussions of how knowledge production takes place originate from Thomas Kuhn's ideas that scientific knowledge production is not to be understood as a linear process; instead, he argues, knowledge production takes place through scientific revolutions and phases of normal science (Kuhn, 1970). Kuhn's ideas of the scientific paradigms seem to describe nicely how scientific knowledge is produced, but they failed to explain how knowledge production that addresses societal issues or interdisciplinary sciences evolved. One of the most important attempts to tackle this need to explain knowledge production as transdisciplinary was brought forward by Gibbons and some of his colleagues in their book, *The New Production of Knowledge* (Gibbons et al., 1994), where they argue that knowledge is to be understood as a hybrid, and that knowledge production in the mid-20th century had moved into a new phase called Mode 2, characterized by being context-driven, problem-focused and transdisciplinary. Their main argument is that in contrast to the phase which they characterize as Mode 1 – i.e. traditional scientific knowledge production – knowledge production is now produced in networks where different actors who are not only scientists contribute with their knowledge and expertise. Although many actors and commentators, not least within science policy circles, find the notion of Mode 2 very appealing, some severe criticisms have been raised. First, scholars within Science and Policy studies and within Sociology studies of Science-Public relations have criticized Gibbons and his colleagues for their ideas about understanding knowledge production in terms of Mode 1 and Mode 2, due to their historical considerations and lack of descriptive theory. Their idea that before the 20th century, scientists were the only producers of knowledge, with interests isolated from society, have been criticized by Etzkowitz & Leydesdorff (2000), who argue that this assumption is wrong and that Gibbons et al. lack empirical data to back up their claim. Fuller (1999) has also criticized the historical assumptions of the notion of Mode 1 and Mode 2; he argues that it is wrong to assume that Mode 1 originates from the 17th century and Mode 2 first develops after World War II. Secondly, the Mode 2 notion has been criticized for its lack of descriptive validity. Godin (1998) and Shinn (2002) argue that Mode 2 seems to be more of a normative political ideology than a theory.

These criticisms raise serious doubt that Gibbons et al.'s Mode 2 notion can provide a satisfactory or adequate explanation about how to understand knowledge production. Etzkowitz & Leydesdorff (2000) propose their notion of Triple Helix, arguing that knowledge production is developed when actors from university, industry and governmental institutions jointly seek to address new problems. The problem with this way of perceiving knowledge production is that it totally neglects civil society organizations and their contributions to knowledge production.

Summing up, it can be concluded that what is needed is a notion to explain how to understand knowledge production that 1) does not assume historical distinctions in

knowledge production; 2) provides both a normative and descriptive framework; and 3) enables us to understand all societal actors' contribution to knowledge production. One such concept is presented by Irwin & Michael (2003), who suggest that by viewing interactions between 'science and society' and the knowledge produced in these interactions through their concept of EEAs, we will conclude that interaction and knowledge production are to be understood as a blurring of all the societal actors knowledge and contributions. Irwin & Michael's concept of EEA is to some extent inspired by ANT's idea that knowledge is to be understood as a social production and is the effect of a network of heterogeneous materials (Law, 1992). By introducing the concept of EEA, Irwin & Michael argue that 'the public' or 'citizens' are highly knowledgeable when engaging in science through different network alliances. Irwin & Michael thus deny that knowledge is either lay knowledge or scientific knowledge; instead, they suggest understanding knowledge as formed and produced in hybrid groupings.

The concept of EEA still needs to be further elaborated. Horst (2007), for instance, argues that the concept makes its contribution by pointing towards analytical elements when studying relations between 'science and citizens'; however, she points towards a challenge for researchers, when they try to use this concept in their work: how should they determine the assemblage. Despite this challenge, Irwin & Michael's idea of EEAs seems to be one of the best suggestions for how to study interactions between 'science and society' and the knowledge produced through these interactions. With the introduction of the concept of EEAs, Irwin & Michael have launched both a descriptive framework contributing to an understanding of the relations between 'science and society', and a normative framework, initiating a new trend for how knowledge production should take place in the future.

6.1.2.3 The Contribution of the Project

The critical reader might ask: Is she right in her assumption that network alliances between CSOs, Science Shops and scientists can be characterized as EEAs (an assumption I made at the beginning of this dissertation; see chapter 2.2: *Ethno-Epistemic Assemblages*)? If I am right in this assumption, then how have my analyses contributed to an elaboration of the concept? In the following, I reflect on these questions.

My point of departure has been that network alliances between CSOs, Science Shops and scientists can be characterized as EEAs, meaning that the interaction and the knowledge produced as part of network activities are to be interpreted as a mixture of the knowledge all the network actors possess and bring into the network. My argument for making this assumption is based on Irwin & Michael's (2003) reflections concerning how to observe this blurring of different forms of knowledge. The authors mention three situations (see chapter 2.2: *Ethno-Epistemic Assemblages*), where one is that this blurring can be observed in

situations where citizens and CSOs are enrolled in various networks or alliances with other CSOs, the media, scientists, and industries. In this situation, they argue, it is not possible to distinguish between citizen/CSO knowledge and expert knowledge (Irwin & Michael, 2003: p. 111), a situation reflected in the network alliances between the CSOs, Science Shops and scientists I have analysed. In all the cases, the networks were initiated by the CSOs due to a concern experienced in their local or national settings. Irwin & Michael (2003: p. 124) they call these 'suffering' scientific citizens. This means that the networks' and thereby the scientists' enrolment in the networks was initiated due to the CSOs knowledge about the problem. Thus, already here we can observe a blurring, since knowledge concerning the problem did not only come from the scientists.

The network alliances also show other aspects of this blurring: in the carpet factory case, we observed that the network failed to produce sound scientific documentation of an odour problem; nevertheless, the network succeeded in enrolling the carpet factories and local authorities to set up a complaint telephone line. That the network succeeded, in spite of no clear scientific documentation of the problem, shows that the actors accepted the knowledge contributed by the CSO – that odour pollution actually did occur even though it could not be documented scientifically. Another example of this blurring is observed in the Mira Loma case. The CSO in this case contributed through mapping their community, with new knowledge about warehouse locations. This was knowledge the scientists did not possess and which they would have had difficulties in gathering themselves, since it would have required in-depth knowledge of the community. I would also like to draw attention to the guideline case, since in this case, the CSO possessed knowledge about idling and parking in the community, knowledge that contributed to the development of the guidelines as well as to the scientists' and authorities' understanding of the problems related to warehouse activities. Thus, my argument, supported by this discussion, is that this confirms that the network alliances between CSOs, Science Shops and scientists can be characterized as EEAs – as I assumed from the beginning.

The next question I address is how my analyses might contribute to an elaboration of the concept of EEAs. My argument is that through the case studies I contribute by proposing a method to analyse such EEAs by showing that such network alliances can be analysed with inspiration from Callon's (1998a) sociology of translation. Since my interest has been to understand how these networks gain impact, my contribution to an elaboration of the concept also lies in the analyses of how the produced knowledge in the EEAs have been sought used. Thus, this research's contribution to the elaboration of the concept is an understanding of 1) *how knowledge is comprised of a mixture of both 'lay and expert' knowledge*; 2) *how this blurring of knowledge may take place*; and 3) *how CSOs and scientists through this mixture of knowledge try to cause effects like political influence and/or new research interest*.

6.2 Methodological Considerations

In this section, I reflect on some of the methodological considerations that I have faced both during the process of analysing the cases and afterwards, when reflecting on my findings. My first reflections are related to my approach of analysing the network alliances as socio-technical networks. I also reflect on the fact that in some of the cases I failed in establishing contact to the CSOs, since it could be assumed that this would lead me to fail in giving them a voice in my analysis. I relate these reflections to the criticisms raised by Star (1991) that ANT and especially Callon seem to favour the strong actors. Although I have related to this discussion previously (see chapter 2.4: *The Nature and State of Explanation in ANT*), I find it important for the legitimacy of my analysis of the case studies to address this discussion here.

6.2.1 The Case Study Analyse as Analyses of Socio-Technical Networks

As mentioned several times I have been inspired by Callon and his sociology of translation in the process of trying to understand the effects caused by network alliances between CSOs, Science Shops and scientists. Thus, I have analysed the network alliances as socio-technical networks that organize various elements in order to achieve success, for example, assigning particles specific behaviour, or CSOs assuming a specific role etc. Critics of ANT and Callon might argue that instead of studying the effects of these network alliances as translations processes, a more appropriate approach would be to study these networks as social processes constructed around the Science Shops. I reject such a criticism, since studying the networks merely as social processes would have resulted in neglecting the relations between human and non-human actants - for example, in the Mira Loma case, the CSO's use of the P-track measurements to legitimize their concern. It is also my impression that studying the networks merely as social processes would have lacked gaining an understanding of what contributes to establishing these relations, which in ANT terminology is called interessement devices. As the case studies show, these interessement devices play an important role in the networks' attempts to keep actants enrolled, or in its attempts to persuade actants to accept the networks' activities. An example of the importance of these interessement devices is shown by the pesticide case, where the letter written by the students to the farmers was an important element contributing to the farmers allowing the students to enter their homes in order to take dust samples. Another example is the Mira Loma case, where the P-track measurements were a crucial element contributing to persuading both the community and media, and finally also the county board of supervisors to do something about the air pollution levels in the community. Interestingly, this case also illustrates that not all interessement devices succeed in creating a relation between actants. For example, the scientists in this case had already presented arguments for concern, both at a community meeting and in scientific reports about the air pollution levels, but they had not succeeded

in persuading the county board of supervisors about the legitimacy of their case. It can be concluded from this discussion that if we want to understand network alliances such as these, then we have to understand the networks as socio-technical networks and not only as networks consisting of social processes.

6.2.2 Access to Empirical Material

As already discussed I did not succeed in establishing contact to all relevant actors in some of the cases, more specifically some of the CSOs. Despite this, it is my conviction that through the diversity in the empirical material collected from the interviews, interviewees and written material across the nine case studies, I have been able to find patterns and formations of effects caused by the networks. I am further convinced that through the material collected I have been able to give the CSOs a voice and trace their interactions through reports and other written materials as well as through other actors' descriptions.

Although it is my impression that I have succeeded in analysing the roles of the CSOs – even in the cases where I did not succeed in establishing contacts with the CSOs – it could be asked whether there is a relationship between my analysis of the success of the networks and the accessibility of actors (I am here thinking about the accessibility of the CSOs). Therefore, I should reflect on this. Considering all the networks, I do not find any coherency that indicates that lack of access to the CSOs has caused me to conclude that the networks either succeeded or failed in affecting the CSOs' original problems. Let me start by discussing this in relation to the cases where I failed to establish contact to the CSOs. In both the parent group case, the carpet factory case and the bicycle apparatus case, I conclude that the networks succeeded in affecting the CSOs' original problems, despite the fact that I failed in establishing contact to the CSOs. The only case that might indicate a relation between lack of effects on the CSO's original problem and direct contact with the CSO is the pesticide case, but in this case, my conclusion about lack of any effect on the original problem cannot be connected with lack of accessibility to the CSO, but more due to other circumstances, such as inconclusiveness in the results of the network activities, and the Science Shop and scientists' unwillingness to enter into dialogue with the local authority and bulb farmers of how to address the problem. A last comment to be added in relation to this discussion is that in the two other cases that I conclude did not affect the original problem – the board game case and the stove case – I succeeded in gathering empirical material through interviews with the CSOs, the scientists and the Science Shops. I can therefore conclude from this discussion that I do not see any coherency between the accessibility of the CSOs and my conclusions about networks' success in affecting the CSOs' original problems.

Another discussion that is in line with my failure to establish contacts with some of the CSOs is the question about whether this has caused me to weaken the focus on the role of CSOs in my case study analyses. This is discussed in the following section.

6.2.3 Reflections on the Criticism of ANT concerning little emphasis on Weak Actors

One point of criticism raised by opponents of ANT is that ANT analysis, especially sociology of translation analysis, has a tendency to favour strong actors and marginalize weak actors, which in my case would be the Science Shops/scientists and the CSOs, respectively. One of the critics who have raised this issue is Star (1991), who argues that especially sociology of translation analysis seems to focus too much on one actor as the focal point for the analysis. I tend to agree with Star to some extent in her argument that one actor is chosen as the focal actor; it can also be argued that Callon in his analysis of the scallops tends to make the scientists stronger and the fishermen weaker. Relating this discussion to how I have approached the case study analysis, I argue that by studying the effects of the network alliance, I have opened up for a broader discussion than merely whether the networks succeeded in upholding the obligatory passage points. And by opening up the discussion, I argue, the case studies respect the CSOs rather than making them weak actors.

Another point of criticism that might be raised is whether I have made the CSOs weak in the cases in which I did not succeed in establishing contact with them. In reflecting on this, the focus is again on the parent group case, the pesticide case, the carpet factory case and the bicycle apparatus case. My immediate answer to such criticism is that I do not believe that the CSOs in these four cases are presented as either weaker or stronger than in the other cases. My intention has not been – as we may be tempted to think in Callon's scallops case – to give one actor more importance than other actants. On the contrary, my intention has been, and is, to understand the effects such networks can cause and the mechanisms that contribute to causing these effects. Thus, I have not been driven by a motive of making the Science Shops stronger or giving them sole credit when effects were observed. I believe I have shown that this has not been my motive, for example the pesticide case, where I strongly emphasize that when the network realized there was a need for funding for more research, then it was the CSO that took over the role as the network's spokesperson by establishing contact with the parliament member. Had my focus been only on the Science Shop, or only on the CSOs that I succeeded in establishing contact with, I would not have been able to understand this shift in the network.

6.3 Opportunities for Influence

Having discussed my theoretical and methodological considerations, I discuss now civil society's opportunities for influence in the three countries represented by the case studies. I discuss the recent development in the framework for co-operation between CSOs, scientists and Science Shops in the three countries, as well as how the Science Shops have sought to adapt to change, especially in the European political discourse, which seems to imply that universities prioritize profit-making activities over democratization of science and technology. The aim of this discussion is to provide a frame of reference for the conclusions in sections 6.4 and 6.5 about the opportunities for CSO influence through Science Shops.

6.3.1 The Structures for Citizen Science in Europe and USA

The transition to the 21st century has not only meant a shift in numbers; we also experience a shift in the political discourse in Europe and to some extent USA; a shift that has meant that right-wing political parties have won the majority in many European parliaments. This shift has led to a political focus that emphasizes commercialization of science and competitiveness (Jamison, 2008: p. 120). Some universities have even been turned into independent companies, and their main purpose is to serve industry (Wachelder, 2003). According to Jamison (2008: p. 119), this is causing a significant deterioration in scientists' academic freedom and universities' autonomy. The political shift towards the right has not only influenced the universities' autonomy, but also caused countries such as Denmark and the Netherlands, which were previously at the forefront with regard to participatory science and technology, to see themselves now being outdistanced by countries such as the UK (Irwin, 2007: p. 304; Joss, 1999: p. 291). While since the 1990s, the UK is placing more and more emphasis on "*two-way dialogue, transparency and 'taking citizens' concerns seriously'*" (Irwin 2007: p. 304), the tendency in Denmark and the Netherlands seems to be the opposite. One consequence of this is reflected for example in the reorganization or closure of the Science Shops in these two countries (I return to this discussion later in this section). Thus, while the UK seems to be moving more towards a democratization of the relationship between policy, science and citizens, Denmark and the Netherlands seem to be moving in the opposite direction. As Irwin (2007: p. 304) puts it: *"Denmark [...] may even be moving away from it following a change of government thinking and also a certain skepticism about the operation and impact of exercises such as consensus conferences"*. Thus, while the UK and the European Commission move towards more public engagement in science, Denmark and the Netherlands seem to be returning to a deficit model. The question is then, what are the consequences of this shift towards the ideology of the right-wing parties and the possible return of the deficit model for CSOs' opportunities for influence? Let me dwell on this.

Denmark and the Netherlands have a long tradition for debate and participatory democracy (Baark, 1997; Andringa & Schot, 1997), especially within environmental regulation and management. The tradition has been that all actors (CSOs, the industry and scientists) have had a voice in the debate: *"All interested parties are assumed to have a legitimate right to negotiation, and to take part in decision-making, and this has been used both for raising issues, as well as for restructuring institutions and administration procedures*" (Baark, 1997: p. 47). One example of this tradition is that in the Netherlands in 1994 national laws on odour pollution were not made in order to leave legislation up to the local authorities. The philosophy behind this political decision is that odour pollution is a local problem and decisions related to local problems should be taken in local settings in close dialogue with the citizens and the involved companies (Mulder, 2006). Another example of participatory democracy is the Science Shops that developed in the Netherlands in the 1970s and later spread to a number of European countries (in Denmark, the first Science Shop was established at DTU in 1985). Later, they also spread to countries outside Europe, such as Israel in 1997 and South Africa in 1995 (Mulder et al, 2001). As discussed in chapter 1.2: *Science Shops - from Protest Organizations to Formalized Organizations*, the Science Shops developed due to a wish from left-wing students and scientists to democratize science and technology and to give citizens and CSOs a voice and access to and impact on scientific and technological knowledge (Wachelder, 2003; Dickson, 1984; Farkas, 2002). The democratization of science and technology in Denmark was initiated by the nuclear power and energy discussions in 1970s. A debate that *"led to the creation of state-supported research programs in technology assessment, and new methods of interaction between citizens and experts in relation to science and technology*" (Jamison, 2010: p. 75). Despite the long tradition for citizen involvement and democracy in science and technology in the two countries, it seems that both Denmark and the Netherlands have reached a turning point; a turning point that has meant a reorganization of the Dutch Science Shops, the closure of all the Science Shops in Amsterdam (starting in 1991 and ending in 2005) and a reorganization of the Danish Science Shops, including the closure of the Science Shop DTU. I elaborate on this in section 6.3.2: *Status for the Dutch and Danish Science Shops*).

USA seems to reflect a different picture than Europe concerning the recent development in the possibilities for Community-Based-Research (CBR). According to Strand et al. (2003), higher education institutions in USA have begun a process, starting two decades ago, of rethinking its relationship with civil society. This despite the fact that the political majority has shifted between left-wing and right-wing parties. This process was initiated due to criticisms from students, some scientists and civil society that 1) education institutions were disconnected from civil society; 2) research seemed too narrowly defined; and 3) students lacked the competences that would make them capable to be democratic citizens (Strand et al., 2003: p. 1). Thus, some students and scientists demanded a more active role in engaging with civil society to meet a growing need from CSOs for access to science. In a way, this process is similar to the democratization of science and technology in Denmark

and the Netherlands; however, the difference is that while Denmark and the Netherlands seem to be returning to more elite science, USA seems to be continuing the process of democratizing science and technology with more public participation. It is not merely within higher education that democratization of science is being acknowledged in USA; the US Environmental Protection Agency, for example, supported in 2005 a conference for community-based participatory research and environmental justice (Hess, 2007: p. 54).

One of the initiatives that developed out of the increased criticisms of undemocratic structures in the 1960s in the USA was what has come to be known as Community-Based-Research. The idea behind these initiatives is two-fold: to prepare students for a more active role in society; and to encourage research relations with CSOs and citizens as active partners in conducting the research. CBR projects are therefore based on problems or issues identified by the CSOs (Strand et al., 2003: p. xiii-xx; Chopyak & Levesque, 2002: p. 159). The CBR idea has become quite widespread in USA, meaning that many universities now have some sort of Community Outreach Unit. The aims of these units may vary, however, from strengthening university relations with society to communicating and translating science for communities so they understand how they can use scientific results in their own context (Hricko, 2007; HYDRA, 2010; NIEHS, 2010). That the ideas of CBR have been accepted and have developed into a legitimate activity for scientists is also reflected in the Mira Loma case, where co-operation between the CSO and the scientists was made possible, because the university had set up a Community Outreach Unit with the aim: *"To have a two-way street and get community input and community concerns, so that the scientists understand what's going on in the community"* (Hricko, 2007). This quote also makes it clear that these Community Outreach Units may in some situations be more interested in disseminating or communicating 'science' to the public or to CSOs than in carrying out research with them. In other situations, this approach may be expanded, as in the Mira Loma case, where the co-operation between the scientists and the CSO was at first based on disseminating 'science', but it developed to become more participatory and engaged both the scientists and the CSO.

It is clear from this short overview of the structures and possibilities of citizen science in Europe and USA that dramatic changes are occurring in Denmark and the Netherlands, whereas the possibilities for CSOs in US seem more promising – or at least there is no indication that these initiatives are being threatened due to shifts in the political discourse. The dramatic changes in the Netherlands and Denmark, however, are changes that will delimit citizens' access to scientific structures. Thus, in the following, I discuss the consequences of these changes for the Science Shops in the Netherlands and Denmark.

6.3.2 Status for the Dutch and Danish Science Shops

The emphasis on profit-making research has meant a reorganization of the universities in the Netherlands. This has caused several universities to decide to close Science Shops, since this type of co-operation relationships (i.e. co-operation with citizens and CSOs) normally does not provide opportunities for funding (Wachelder, 2003). More specifically, this reorganization has implied that the department Science Shops at the universities at Utrecht and Groningen have been merged into faculty Science Shops, with a reduction in staff as well as in their freedom to work. But let me start this discuss by exploring how the Science Shops in my case studies have sought to adapt to these challenges, and what consequences this has had, especially for the Science Shops that I conclude are the most successful in affecting the CSOs problems – i.e. the impact-seeking Science Shops.

The present status of the former Science Shop Chemistry at Groningen University is that it has been reorganized together with other former departmental Science Shops into a faculty Science Shop for Mathematics and Natural Science. Its former resources for 3.2 fulltime jobs have been cut back to one fulltime job. A cut-back that Henk Mulder, program leader of the faculty Science Shop, considers to be a significant deterioration of their options. One consequence has been that the Science Shop now only focuses on the research areas existing within the faculty. This means that requests from CSOs concerning noise or odour problems are no longer accepted, since these were areas in which the Science Shop scientist had expertise; they are not areas of general faculty expertise. Another consequence of the reorganization – a consequence that I perceive to be critical in the light of the indications from my analyses – is that the Science Shop has been 'forced' to apply a mediation approach rather than the successful impact-seeking approach. According to Henk Mulder (who is the Science Shop representative in the Scania and the carpet factory cases), his role has now changed from seeking impact to being more a matter of mediating and producing knowledge. The Science Shop does however seek to maintain the procedure of organizing a final meeting, where the student(s) presents the results for the CSO, and they discuss the need for any follow-up projects. But as Henk Mulder mentions,[57] the process of *"working with the client to implement the research findings may have suffered most from our lack of time"*. Henk Mulder further comments that *"basically we have to choose between number of projects and in-depth engagement"*. In relationship to what my case discussions indicate, I find this very critical, since the Science Shops' engagement in the issues seems to be crucial for the CSOs' influence on the issues. This shift from impact-seeking to mediation may also have a consequence in relation to the basic aims of the Science Shops and our own self-understanding. We are left in a situation where we have to consider whether our purpose is to give the CSOs access to the universities and assist them in drawing attention to the problems they face, or if our purpose is to position ourselves at the universities as project mediators for students – which the quotation from

[57] In email correspondence 5 March 2010.

Henk Mulder seems to indicate. Thus, with regard to the future existence of the Science Shops, we need to consider our purpose and the role we want to assume. And one way to reframe our role could be to learn from the experiences of Community-Based-Research from the USA, meaning that we in the Science Shops could consider applying a more research-based strategy, where CSOs play an important role as research assistants. Or we could consider involving the scientists more in discussions of results and how they can be used by the CSOs.

The reorganization of the former Science Shop Chemistry into the faculty Science Shop for Mathematics and Natural Science has also caused positive effects in relation to enrolling students who had otherwise been difficult to enroll into Science Shop projects. Henk Mulder mentions that they have succeeded in initiating a project with a physics student, supervised by a professor from applied mathematics. The aim is to describe possible ways of modeling the erosion of the seabed of the Waddensea (a request from the Waddensea Protection Foundation). A project like this would have been difficult to initiate when the Science Shops were affiliated to the different departments, since it requires co-operation between two departments.

The tendency for the other Dutch Science Shops is that they no longer have research capacity – with the exception of the Eindhoven Science Shop, which still has the capacity to carry out research itself. The other Science Shops have become centralized or reorganized into larger units, and they accept requests from SMEs (Small and Medium-sized Enterprises) and local authorities.

Turning towards my own Science Shop, which in most cases also applies an impact-seeking approach, we also suffer under this right-wing political shift – in fact, we suffer so much that in principle the Science Shop DTU no longer exists. At the moment (Spring 2010), we are negotiating, however, with DTU's section for match-making as to whether and how requests from citizens and CSOs can also be met with the same type of dialogue in the future as in the past through the Science Shop. The status of the other two Danish Science Shops is that for several years the Science Shops at Roskilde University Center and Copenhagen University, in order to secure their existence at the universities, have accepted requests from public authorities and small and medium-sized companies. Thus, the role of these Science Shops has developed into a project mediator between university and society in general, rather than remaining a mediator between citizens and science.

One may wonder why the Dutch and Danish Science Shops face such challenges, when several research projects (Jørgensen et al., 2004; Farkas, 2002; and my own) clearly indicate that especially the Science Shops with capacity to enter into dialogue and negotiations with the CSOs and industry or the authorities are the most successful with regard to affecting the CSOs' problems. Some might even argue that the time has passed for the

Science Shops that wish to stick to their ideological basis; Science Shops should to a greater extent seek to adapt to this right-wing shift, for example by adopting a more consultancy based strategy and thus expand their clientele to include SMEs as many of the Dutch Science Shops have done, or by accepting the role of public relations tool for the universities (Wachelder, 2003; p. 250-261).

Despite the challenges facing the Science Shops, the problems raised by CSOs do not seem to have become less important or are of such character that the CSOs themselves are able to tackle or address them. Thus, issues of climate change, the disabled 's rights to the same living conditions as non-disabled persons etc. may even prove to be new areas in which CSOs need scientific assistance in order to raise their voices. Given these new challenges, it is my opinion that there still seems to be a need for Science Shops to contribute to the capacity building of CSOs, and that it is as important now as it was 30 years ago, when the Science Shops were first established to open the universities to civil society.

Given this assumption that CSOs and Science Shops make valuable contributions to democratizing science and technology and to the process of making the knowledge produced useable for the CSOs – and despite the challenges facing the Science Shops in Denmark and the Netherlands – I discuss in the following what can be learnt from the case study analyses in relation to understanding how CSOs, through co-operation with Science Shops, seek to gain influence on the issues they find problematic.

6.4 The Lessons Learnt

The aim in this section is to discuss the lessons learnt from the case studies. My motive was my wish to **understand the process under which CSOs engage with scientists in order to impact the air pollution agenda through alliance building and network constructions with Science Shops.** Thus, in this section, I sum up the conclusions from the case study analyses regarding *how and why network constellations are created between CSOs, Science Shops and scientists concerning air pollution controversies*; as well as *which effects these network alliances cause*.

This discussion includes three complexities concerning scientific documentation that emerged from the case studies, which suggest that is it not enough to rely on scientific documentation as the only means to achieve impact on the issue of concern; it is also necessary that scientists and the Science Shops are willing to engage themselves in other ways than just producing knowledge. Finally, I discuss other elements that seem to contribute to successful network alliances between CSOs, Science Shops and scientists.

6.4.1 Background and Impact of the Network Alliances between CSOs, Science Shops and Scientists

Through the case studies, we learnt that the network alliances were primarily based on problems people experienced as being caused locally, although they might be linked to national decisions concerning infrastructure or to industrial activities, for example. We also learnt that different types of pollution sources cause CSOs to engage with Science Shops and scientists. These sources of pollution were related to infrastructure (car, truck and aviation traffic), industrial activities, and fellow residents' own behaviour. The various pollution problems and sources of the pollution also involved different actor constellations, including industry, local authorities, farmers and citizens, represented through different roles. In some cases, the citizens represented in the CSOs were neighbours experiencing the problems (as seen in the pesticide case, Scania case, carpet factory case, and Mira Loma case), whereas in other cases the CSOs represented users (seen in the stove case) or citizens in general (seen in the board game case). Through the case studies we also learnt that in one of the cases (in the Scania case), the CSO used official channels through invited spaces for participation, in attempts to influence future planning and thus avoid possible exposure to air pollution. In the other cases, the CSOs were concerned with problems that already existed. The case studies also indicate that although the problems are experienced locally and are caused by local activities, it may be difficult to impact the problem, since it may be connected to financial or employment factors affecting the community as a whole, like bulb farming in the pesticide case or Scania's threat of moving their operation away from the city. On the other hand, it is not impossible, even though it involves changing the practices of such actors as industry or local authorities. What seems contribute to effects are a combination of scientifically documenting the problem combined with a willingness among the scientists (in the Science Shop or a department involved in the research) to engage in discussions of the premises for the produced knowledge.

We also learnt from the case studies that some network alliances between CSOs, Science Shops and scientists succeeded to affect problems here-and-now, while others work to affect problems that are part of the CSOs' ongoing efforts to influence societal agendas, like the car traffic's impacts on bicyclists. The effects observed to be directly linked to the CSOs' original problems were that the networks succeeded in:

- Avoiding the construction of a public building close to a motorway;
- Reducing pollution from industrial activities;
- Developing an artifact to be used for cleaner air in cities;
- Avoiding an increase in exposure to air pollution from transport activities.

It was also learnt through the case studies that network alliances between CSOs, Science Shops and scientists can cause other forms of effects than direct effects on the CSOs' original problems. The other effects observed were for example increased awareness about

the issue in question among politicians, scientists and industry, and influence on research agendas, sometimes leading to change. It is also interesting to note that these other effects were observed, both in cases that succeeded in affecting the CSOs' original problems as well as in cases that failed to do so.

6.4.2 Three Complexities in relation to Scientific Documentation

The case studies have shown that CSOs in several cases have the perception that in order to give their problem legitimacy, they need independent scientific evidence to support their claim. This perception may be based on another perception, that for politicians and scientists scientific documentation reflects 'reality', free of the influence of subjective assumptions, and that scientific documentation simply cannot be questioned or contested. This perception seems to be widely accepted even though history presents many examples showing that science does not produce ultimate answers. One such example is the discussion in the 1970s about nuclear power and its possible risks, an issue that still divides scientists. The same can be said about the scientific discussions concerning biotechnology and genetically modified crops, where we see scientists disagreeing, for example, about the risks from spreading genetic material that is coded for pesticide resistance or other properties. Thus, scientific knowledge in itself does not provide us with the one and only truth, since it can be contested; nevertheless, it is clear from the case studies that scientific documentation is a central factor, when CSOs engage in network alliances with Science Shops and scientists. Based on experience from the case studies, there appears to be three problems connected with scientific documentation and its use as a means to legitimize problems. These three problems or complexities are: 1) a concern is raised about health risks, but the methods applied to document the concern fails to provide documentation; 2) the CSOs are concerned about potential pollution and its health impacts, but the methods applied – due to limited resources – do not support the concerns; and 3) the concerns of the CSOs are documented, but the results are contested, because they are perceived as threats to ongoing or planned activities by other actors, who thus use resources to contest the methodologies and assumptions. These three complexities are interesting, since they indicate that scientific documentation is not enough to strengthen the influence of the CSOs; something more is necessary. Let me elaborate on this.

The *first complexity* is related to a concern raised about health risks, but the methods applied to document the concern fail to provide the documentation. This was seen in the carpet factory case, where the network failed to provide scientific evidence of odour pollution, despite applying normal assessment models – an acknowledged method. The Science Shop representative succeeded, however, in persuading the authorities that the CSO actually did experience the problem and that it was a health risk. This led to an agreement to set up a complaint telephone line that the community could use to report peak hours to the authorities and the two carpet factories. The experience from this case

shows that a problem can be acknowledged despite the failure to document it in scientific terms. The role of the Science Shop in this case was not only that of scientist conducting a scientific assessment; it was also the role of negotiator and mediator between the CSO and the companies/the local authority, thereby legitimizing the knowledge of the CSOs, knowledge they pursued due to their daily experience. The perspective of the Science Shop here was to seek impact on the CSO's problems; therefore, the network succeeded in affecting the CSO's problem, despite the fact that it failed to document the pollution using the normally applied assessment models.

The *second complexity* involves CSOs' concerns about potential pollution and its health impacts, but the methods applied - due to limited resources - do not support the concerns. This complexity raises the question of who should get the benefit of the doubt: the polluters or those who are being exposed to the pollution? This complexity is reflected in the stove and pesticide cases. In both these cases, the networks failed to document the concerns of the CSOs; or rather, the methods applied were not complex enough to enable an in-depth assessment of the problems. In these two cases, the situations were handled differently than in the carpet factory case. In the pesticide case, the argument of the scientists and the Science Shop was that they needed more funding to investigate the CSO's concern further – funding that was denied. In the stove case, the CSO questioned the results due to the methodology applied (i.e. assessments based on a literature study rather than measurements), and maybe also because the assessment based on the literature study did not support their claim. Interestingly, the scientist acting as supervisor supported the research results, arguing that the CSO should not be concerned about health risks from other residents' inadequate stove use. As Science Shop representative in this case, I sought to accommodate the CSO's concerns by trying to persuade a research group from NERI to include the community as research object in a research project which I was intended to follow as observer, but I failed in this attempt (see case G). Therefore, in this case as well as in the pesticide case, neither the Science Shop (in the pesticide case) nor the scientists engaged themselves further in striving to meet the CSOs' concerns; as a result, the networks had no affect on the CSOs' problems. The question is, though: could the scientists and Science Shops have approached this differently? Or should the Science Shops have become engaged in seeking to persuade the polluters to change their practice, as in the carpet factory case. This would imply that I together with the CSO should have become engaged in attempting to persuade the Raadvad residents that changing their stove use practice could mean less exposure to air pollution; and in the pesticide case, that the Science Shop should have tried to convince the farmers that they might be exposing people living close to the bulb fields to health risks, and that they themselves were maybe being exposed, or causing their children to be exposed, to health risks from their use of pesticides. Such cases raise the question: should limited resources for carrying out investigations acquit problems like these? Would it not be more correct to try to apply a more precautionary approach and seek to explore the issue in detail before concluding

that it does not cause health risks to humans? And is this not an important role that the Science Shops could assume?

The *third complexity*: the CSOs concerns are documented, but the results are contested, because they are perceived as threats to ongoing or planned activities by other networks, who thus use resources to contest the methodologies and assumptions. This complexity is reflected by the parent group case and the Mira Loma case, which both succeeded in affecting the CSOs' problems, but due to different circumstances. In both cases, the network succeeded in documenting the problem, but in both cases, the documentation and methodologies applied were questioned. In the Mira Loma case, consultants hired by the local government contested the scientists' results; the consultants did not agree about the proportion of air pollution originating from other sources than warehouse activities. But the scientists were willing to become engaged in more than discussions about the credibility of the results. By supporting the CSO in its concern and providing them with scientific arguments and instruments, the network succeeded in persuading the board of county supervisors to stop further warehouse development. In the parent group[58] case, the local authorities and a consultant firm also questioned the results, presenting the counter-argument that the methodologies applied were invalid. This forced the scientists into a dialogue about the applied methodology and the credibility of the method, and thereby, indirectly, the validity of the results, even though they had indicated from the beginning that they would not become involved in discussions about the validity of the results. This complexity indicates that if a problem – although scientifically documented – may appear as a threat to others and their activities, the CSOs and scientists must use other means to persuade the actors contesting their scientific documentation. These other means can for example be mobilizing the communities where the problems occur, thus exerting pressure on the opposing actors.

The lessons learnt from this discussion is that it is not enough just to rely on scientific documentation as the only means to gain impact on the issue of concern, since lack of agreement with the results can lead to questioning of both the methodology and assumptions. On the other hand, scientific documentation can contribute to opening discussions that otherwise may seem black-boxed, as we have seen in the Mira Loma case, and also in the Scania case. This possibility, however, seems to require that the scientists and Science Shops are willing to become further engaged than just acting as producers of knowledge, which is the subject of the next discussion.

[58] Here, I wish to add that due to limited access to empirical material, the mechanisms contributing to the effect that the school building was not constructed at the proposed location are not clear to me,

6.4.3 Requirements to the Science Shop Scientists and CBR Scientists

One important conclusion drawn from my discussions is that when focus is on network alliances, such as those I have analysed, and the question of how they achieve impact, it is not merely a matter of supplying the CSOs with scientific analyses that they can use. It is essential that Science Shop scientists and the other involved scientists (such as supervisors and/or researchers) are willing to become engaged in the issue of CSO influence and not only rely on a scientific report alone (whether the report is produced by scientists or students) will enable the CSO to open a discussion on the issue. This also implies that the CSOs' aim to just document a problem scientifically may not be a sufficient strategy for obtaining influence (as discussed in the previous section). It is therefore necessary for the Science Shops and scientists to allow themselves to become involved in the issue beyond the production of scientific documentation. This implies that the Science Shop scientists and other scientists should become involved in discussions about the assumptions behind scientific documentation as well as in strategic discussions of the usefulness of the research and how CSOs can use the results when trying to influence the decisions of government, industry etc. For this process to succeed, the model or approach the Science Shops should apply is the approach I call *impact-seeking*. This conclusion raises a dilemma, since, as I discussed earlier in this chapter (section 3.2: *Status for the Dutch and Danish Science Shops*), the prospective for these impact-seeking Science Shops (Science Shop Chemistry and Science Shop DTU) do not seem good. Despite this dilemma, I argue that this approach provides the best opportunities, if we want to contribute to the CSOs' capabilities and make science and technology more democratic and usable for the CSOs. To apply this approach requires that the Science Shop act as mediator as well involving itself in the interpretation of the data and facilitating the dialogue process. Depending on the type of Science Shop, this role may also imply assuming responsibility for the research, as either researcher or supervisor. Given the challenges facing the impact-seeking Science Shops, another option could be to develop the Science Shop's mediation approach so that the Science Shop's role also becomes to engage scientists and supervisors in discussions of research assumptions and methodologies, as well as the usability of the results.

That the Science Shops and scientists should reconsider their role and their willingness to become involved in the CSOs' issues of concern, beyond the production of scientific documentation - this is an interesting conclusion, since other studies with focus on 'regulatory science', or rather science-for-policy, seem to indicate the same. Jasanoff (1995), for example, concludes an analysis of science and policy by emphasizing: *"Both scientists and policy-makers, therefore, must participate in the process of resolving disputes over regulatory science"* (Jasanoff, 1995; p. 292). Although Jasanoff has her focus on the relation between science and governmental policy, whereas my focus is on CSOs' opportunities for influence, the point is the same in relation to the role of the scientists: scientists need to cross the line between producing the knowledge as black-boxed results and contributing to negotiations of the interpretation of the results. Jasanoff (1995) further argues that

scientific results may not be used or agreed upon, because the basis for the scientific results are questioned by others; and if the scientists are not willing to enter into negotiations about the basis for the results, one effect can be that the results are useless.

6.4.4 Other Elements Contributing to Successful Alliances between CSOs, Science Shops and Scientists

In the sub-section above, I conclude that Science Shops and scientists need to engage in discussions about the usability of the produced knowledge as well as in discussions of how CSOs can use the scientific results in their efforts to impact the issues of concern. I also conclude that the approach the Science Shop should apply in this process is the impact-seeking approach. In this sub-section, I discuss other mechanisms that the case studies indicate contribute to successful alliances between CSOs, Science Shops and scientists.

The case studies show that the framing and translation of the research question may be decisive for the success of the network co-operation. The challenge lies in framing research questions in such a way that they become interesting for scientists. This requires suiting requests to curricular activities or to research agendas without distorting them so that they are no longer recognizable to the CSOs. The case studies indicate the Science Shops play an important role in this framing and translation of research requests to ensure that the framing suits both parts.

The case studies also show that these network alliances can contribute to opening new data opportunities, as seen in the parent group case, where the scientists' accepted being enrolled in the network due to the opportunity to gather new data about a subject researched years before. Another aspect revealed by the case studies is that alliances with CSOs can also contribute to publication opportunities, as observed in six of the cases. The reason for emphasizing this is that publication opportunities seem to be an important motivating factor for scientists to become involved in co-operations with CSOs as shown in the analysis in the INTERACTS project (Jørgensen et al., 2004). Here, the scientists emphasized that for them to become involved in such co-operation, the issue has to be of such character that afterwards they can use the knowledge produced in scientific publications, since it is on this basis that universities evaluate the work of their scientists.

Having discussed the lessons learnt from the case studies, I move on to discuss the future perspectives, given the challenges presently facing the Science Shops.

6.5 Future Perspectives for Science Shops

Section 6.3: *Opportunities for Influence* discusses how a shift in the political discourse in Denmark and the Netherlands caused a situation in which Science Shops must struggle to survive and to be able to work in such a way that they can actually help CSOs achieve impact. Today, these political shifts require universities to give priority to co-operation with industry. Despite these challenges, faced especially by the Dutch and Danish Science Shops, there seem to be opportunities for development of Science Shops in other countries as well as for resources (through the European Union) to take new initiatives related to democratizing science and technology. In this section, I therefore discuss these opportunities in the light of my research.

6.5.1 New Science Shops on the Way

Despite the gloomy perspectives for the 'old' Science Shops, there may be openings in relation to establishing new Science Shops in other countries. We see in other European countries than the Netherlands and Denmark, not least the Eastern and Southern European countries, an increasing interest in establishing Science Shops that aim to mediate between scientific communities and civil society. This is one conclusion of the recently completed EU-financed project TRAMS (Training and Mentoring of Science Shops) that aimed to establish new Science Shops and support young Science Shops in countries like Spain and Estonia (de Bok, 2008). The TRAMS research project was driven by a wish to set-up structures that would assist new Science Shops, including development of a Science Shop toolbox. The background for the TRAMS project was needs identified in the ISSNET project (Improving Science Shop Networking) conducted by the Science Shop community in the period 2003-2005 (Teodosiu et al., 2005). This project concluded that support and toolboxes were needed to motivate thematic and international co-operation between CSOs and Science Shops. Thus, recent experiences seem to indicate some openings in relation to establishing new Science Shops. The question is, however, which concepts these countries will apply. Will it be the mediation approach, which several Dutch Science Shops seem to have chosen in order to survive; or will they apply a more impact-seeking approach, with emphasis on assisting the CSOs in their efforts to impact the issues they find problematic and not only provide support with a scientific report? And on which actor groups will these new Science Shops focus their co-operation? Will it be citizens and CSOs, or will it be a broader mix of societal actors, including for example SMEs? My suggestion to these new Science Shops is that they should consider the impact-seeking approach, or consider strengthening the mediation approach by engaging and involving scientists and supervisors in discussions of research assumptions and methodologies as well as the usability of the results; the question however is whether they have the competences or financial resources necessary for this approach.

My contribution to these new Science Shops is that when they reflect on their role and their contribution in relation to assisting CSOs impact the issues they address, they could be inspired by the way I have approached understanding the interaction between CSOs, Science Shops and scientists: i.e. applying a systematic and theoretically based analysis of the interaction in order to understand the translations. I believe this can contribute to bringing them closer to the processes and controversies shaping the interaction in the daily work. Focusing on the translations the network's actants perform is valuable when seeking to understand why some alliances fail and others succeed. To understand how and why CSOs are able to impact the issues they address by forming alliances with Science Shops, we need to understand the mechanisms that can lead to effects. These mechanisms comprise both the translations made in the networks and the actors (which can include scientists, local authorities, industry, and artifacts such as measuring apparatus, scientific data etc.) that the network seeks to interest and enrol, as well as the mechanisms leading to effects in spite of controversies with ministries, authorities or fellow residents.

Given the challenges faced by the Science Shops, there could also be a need for further investigations to explore in detail whether the existing and newly established Science Shops have the competences to apply an impact-seeking approach, and whether the reorganization of the old Science Shops has implied better or worse opportunities to apply the impact-seeking approach, which seems to be the best approach for supporting CSOs in developing influence.

6.5.2 Future Research Opportunities Involving Science Shops

One of the future opportunities and activities of relevance in relation to Science Shops, is the coming (starting Spring 2010) EU-financed project PERARES (Public Engagement with Research and Research Engagement with Society), in which several Science Shops are partners (including Science Shop for Mathematics and Natural Science at Groningen University and my Department of Management Engineering at DTU, where the Science Shop was located). The aim of this research project is to *"…get a deeper and more systematic engagement of research bodies with civil society groups and advance this by transnational exchanges of experience and mutual learning"* (PERARES Approved project proposal, 2009). This means that the PERARES project has a broader perspective than merely focusing on Science Shops and their relations with CSOs and scientists. What makes the PERARES project interesting is the intention to broaden the CSOs' possibilities so that they contribute to setting research agendas. Thus, CSOs become suppliers to research and not merely receivers of scientific results. This indicates that the networks to be constructed as part of the PERARES project can be characterized (in analytical terms) as EEAs. A need for engaging CSOs in research agendas was identified in the SCIPAS project (Hende & Jørgensen, 2001) as one important element for democratizing science and technology. My

case studies also indicate that although these network alliances are often created due to here-and-now problems, the CSOs' problems and knowledge can also contribute to research agendas.

The partners in the PERARES project include both research institutions and Science Shops. This indicates an interest among some research institutions to become engaged in network alliances aiming to strengthen their engagement with CSOs and thus open opportunities for CSOs to contribute to science and research by both identifying problems as well as producing knowledge. It is also interesting to observe that it is not only current projects that provide opportunities for establishing new Science Shops; future projects may also open up for such opportunities. For example, one of the WP's in the PERARES project opens opportunities for establishing new Science Shops. Thus, in relation to this, it is relevant to consider which concepts and which resources will form the basis for these new Science Shops – will it be the impact-seeking approach or the mediation approach? If the tendency is that these new Science Shops should apply a mediation approach, it could be interesting to further consider my thoughts concerning expansion of the role of Science Shops to include engaging scientists and supervisors in discussions of the assumptions and methodologies of the research as well as the usability of the results.

Finally, I hope that my research can inspire other Science Shops in planning and evaluating their ongoing interaction with CSOs and scientists. It has served as inspiration to me in my work as Science Shop representative in several network alliances with CSOs, scientists and students; it has made me aware of which types of translations I and other actors make in the network alliances as well as the consequences of these translations.

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APPENDIX I

INTENTIONS OF ACTION RESEARCH IN CO-OPERATION WITH THE ACCENT RESEARCH COMMUNITY

During the initial discussions aimed at framing the research activities, the ACCENT WP17 leader wished me to follow one specific research project connected to the ACCENT network. One project was identified which concerned emissions from stove use in Denmark. An initial meeting with the project leader was held, and he found the idea that I participate as observer interesting. The aim of the research project was to explore the emissions from stove use and analyse the health impact on humans using the stoves. The research project started about one year before I entered the scene, and during that year, several of the scientists, including the first project leader, had been replaced due to new job offers. A couple of months after it had been agreed that I would participate in the research project as observer, the project leader was changed again. One project meeting was held at the beginning of 2007, where the scientists presented the results up to that moment. It was agreed to organise a stakeholder board meeting to discuss the same results with the stakeholders and receive their feedback. But by the end of 2007, the stakeholder meeting had still not been held, despite several attempts by me to have it arranged. I chose then to withdraw from the research project, since my objective in participating as observer was to study the interaction between the scientists and the CSO, which belonged to the stakeholder board. If I had continued to put pressure on the project leader to arrange the meeting, I would have influenced the process too much for it to reflect their interactions, i.e. I would have forced a process that would not have been initiated without my intervention.

The ACCENT WP 17 leader also wanted to organize a joint event between the ACCENT WP16*: Young Scientists and Education* and the ACCENT WP 17, and he asked me how such an event could be formed. The ACCENT WP16 had already decided that they wanted to organize Science Cafés in several countries, the next in Latvia in June 2007. Since I am not in favour of traditional Science Cafés, as they are mainly based on the concept of disseminating knowledge determined by the scientists to the public attending the Science Cafés, I had a dialogue with the ACCENT WP16 committee about how to design Science Cafés in a more participatory manner. I drafted an idea meant to be applied in Latvia; however, the ACCENT WP16 committee chose to organize a traditional Science Café as an ACCENT WP16 event and not as a joint event between ACCENT WP16 and ACCENT

WP17 (see appendix II for my thoughts about developing and organizing a Participatory Science Café).

Thus, I did not succeed in carrying out action research as I intended, not because I did not try, but due to the fact that other involved actors gave priority to other activities.

APPENDIX II

IDEAS FOR A PARTICIPATORY SCIENCE CAFÉ

Ideas for a Science Café – a bottom-up initiative

Aim: To plan and organize a Science Café in Riga, June 2007, in co-operation with national and local CSOs (Civil Society Organizations) and ACCENT scientists, aiming to develop co-operation between CSOs and air pollution scientists.

The idea behind the Science Café:
Traditionally, Science Cafés are based on the approach of disseminating knowledge to citizens about a specific area of interest, defined by the organizers. A traditional Science Café is built on the assumption that citizens have no knowledge about the environmental issue for discussion. Furthermore, it does not involve any considerations about how the disseminated knowledge can be used by the participants after the Science Café has ended. The idea behind this proposal for a Science Café differs very much from this approach, since the idea is not only to disseminate knowledge, but also to take as the starting point activities already addressed by CSOs, and to help develop environmental competences among CSOs working within the field of air pollution issues. This means that the Science Café should be based on local research and how this research can be related to local CSO activities.

By only disseminating knowledge, one risks putting the participants of the Science Café in a situation where they do not know how to act upon the information they are given; they are made aware of problems, but the societal backgrounds to the problems and possible solutions are not discussed. This can lead to fear, anxiety and inability to act. Instead, this kind of knowledge should be connected to the societal context of the problems and to strategies for how to change a given situation. This proposal for planning and organizing a Science Café is based on this way of understanding knowledge – we can call it *action-oriented knowledge*. The aim is to contribute to the development of action-oriented knowledge among CSOs and air pollution scientists, and in this way enable participants to take action in relation to the issues/problems discussed at the café event.

Environmental competences

Environmental competences are to be understood as the ability to address and improve environmental problems. This ability is based on four major and equally important factors:

- Knowledge and enlightenment (action-oriented knowledge)
- Engagement, desire, and drive
- Visionary and reflective thinking
- Ability to interact

These four factors are described briefly below. Because, if we agree to plan and organize the Science Café with the aim to develop environmental competences among CSOs working within the field of air pollution and with air pollution scientists, we need to have the same understanding of what environmental competences mean and involve.

Action-oriented knowledge consists of several dimensions, whereas knowledge about problems is only one of the dimensions. The following figure shows an example of the four dimensions of knowledge.

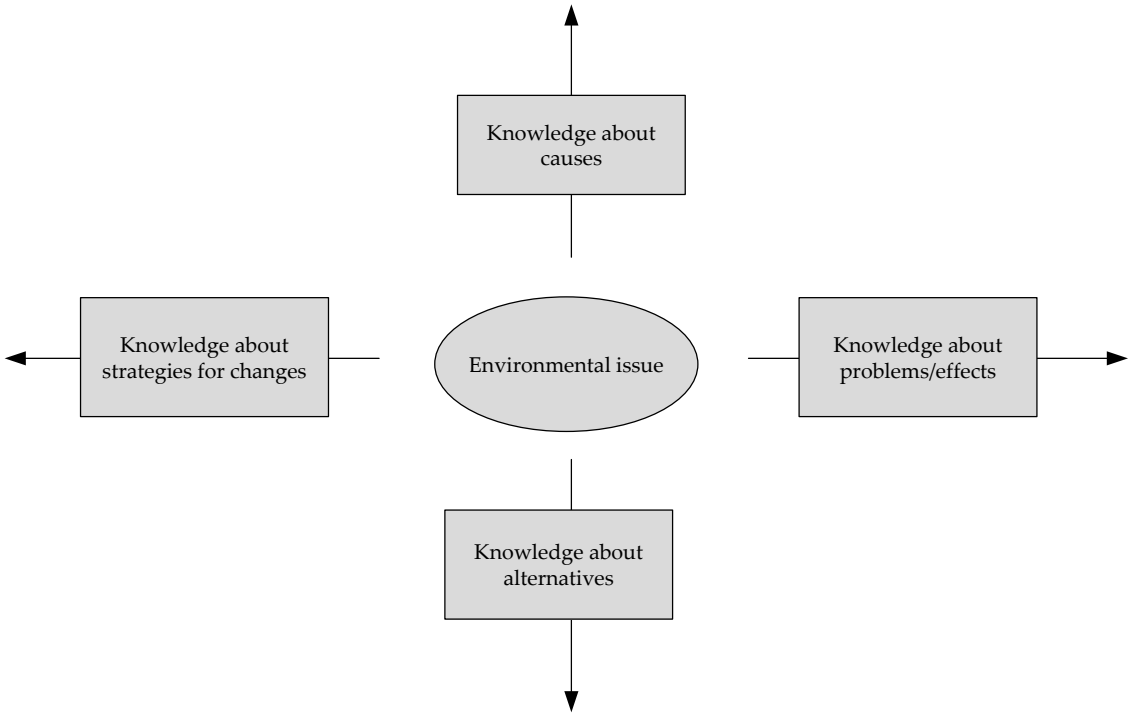

Figure 1: The dimensions of action-oriented environmental knowledge (Jensen and Jørgensen (2002)).

The first dimension, *Knowledge about problems/effects*, often contributes to raising concerns and attention; however, the knowledge does not include an understanding of the problem or how the participants can contribute to solving the problem.

Knowledge about causes includes the cause-effect dimension and gives some answers to why the problem has occurred.

Knowledge about strategies for changes includes how to change routines and practices and knowledge about how to structure co-operation relations, how organize and develop strategies, and how power relations can be interpreted and analysed.

The last dimension covered in the definition of action-oriented environmental knowledge is *Knowledge about alternatives*. This dimension includes development and qualification of own visions, and knowledge about other cultures and organizations and how they handle environmental problems.

In order to fully develop environmental competences, other elements have to supplement the knowledge element. Engagement, desire and drive are important elements if actions are to take place, and they need to be active among the CSOs; otherwise, it is unlikely that any actions will take place in relation to the problem under discussion. Engagement, desire and drive do not just develop out of the blue or just from an interest among the CSOs; they are linked to the development of knowledge that points towards the necessary and wished for changes and to previous experiences with the possibilities to reduce environmental problems.

Visionary and reflective thinking is an also important component in developing environmental competences. This means that the CSOs and air pollution scientists have to develop the capacity through the planning and organizing phases of the Science Café to think in visions and be able to argue for their visions, which at the same time enables them to critically reflect upon the existing situation (including understanding and reflecting on deep-rooted routines and practices).

Ability to interact is the last component contributing to the development of environmental competences. This is understood as the ability of the individuals in the organizations to shape and interact in social relationships.

How to start the planning process?
The following is an outline of the steps necessary in order to explore the interest of such a Science Café and thereafter plan the café co-operation:

Step 1: Conduct an initial 'investigation' in Riga and Latvia exploring which national and/or local CSOs are working with air pollution issues (2 weeks).

Step 2: Contact the identified CSOs to find out if they are interested in participating in planning and conducting the Science Café (2 weeks).

Step 3: Arrange an initial meeting with the interested CSOs to discuss interests, concerns and ideas

Step 4: Planning phase (6 months).

Step 5: Organize/conduct the Science Café (June 2007).

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APPENDIX III

INTERVIEW GUIDE FOR SCIENCE SHOP, CSO, SCIENTIST AND STUDENT REPRESENTATIVES

Interview person:
Organization:

Organizations involved in the co-operation

- Which organizations? (research institutions, NGOs, CSOs, Science Shops, local government met)
- Details of the organizations

Project initiation

- How was the project initiated?
    - By whom
    - Why (knowledge need of the request group)
    - Scientific contribution to the request need
    - Why a Science Shop project
    - Theme on the agenda of society or local government
    - Why did your organization get involved?
    - Which perspectives did your organization see in the project (in relation to setting research agendas, influencing policy strategies…)
    - The shaping of the request – how was it transferred into a scientific problem

Project aim / activities

- The aim of the project (focus on local, regional, national or international)
- Project activities
- Time frame

The co-operation process

- The role of the different involved organizations/actors
- Knowledge production /sharing

The results/outcome of the project

- Results, outcome
- What could the results be used for

Impact of the project

- Dissemination
- How were the results / scientific knowledge used by the involved actors
- Which kind of knowledge production /knowledge building took place between the involved actors
- Capacity development
- Impact on research agendas
- Impacts on policy strategies

Air pollution research needs – to the NGOs/CSOs only

- Suggestions or needs for new research
- Need for access to more knowledge/information
    - Which kind of knowledge (measurements, models or analysis of model predictions

This dissertation is the result of a PhD project entitled *The Making of Citizen Science – Network Alliances between Science Shops and CSOs Engaging in Science and Air Pollution*. The PhD project was carried out at Department of Management Engineering, Section for Innovation and Sustainability, at the Technical University of Denmark.

The project's aim is to understand how Civil Society Organizations (CSOs), through alliance building and network constructions with Science Shops and similar community-based research units, engage with scientists in order to impact air pollution problems. The analytical approach of this PhD project is inspired by Science and Technology Studies (STS) in general, more specifically by Irwin & Michael's (2003) concept of Ethno-Epistemic Assemblages, and by the Actor-Network Theory and Callon's (1986a) sociology of translations. A version of these approaches is used to study nine cases of network alliances between Science Shops and similar organizations and CSOs. The application of Callon's sociology of translation to the case studies contributes to understanding why and how the actors sought to stabilize controversies, as well as the mechanisms contributing to the networks' success in affecting the problems experienced by the CSOs.

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